Bridging Theories, Concepts, Organisations, and Collective Knowledge for Health and Sustainability Integration

by

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Author's declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Complex environmental health issues are examples of 'wicked problems' that require cross-sectoral collaboration of the public, private, not-for-profit, and academic sectors together with the communities in which they function. Although the linkages between health and sustainability have been widely acknowledged in theory, stakeholders engaged in sustainable development and health seldom collaborate in practice. Promoting environmental health has remained strongly in the domain of the health sector, despite the ambitious rhetoric of international agreements.

This dissertation focuses on cross-sectoral integration of health and sustainable development practices by exploring the bridging of 'siloed' knowledge. The emphasis is on collective knowledge and the three characteristics of cross-sectoral partnerships that have been identified as valuable for improving decision-making processes: bridging key discourses, bringing together key groups, and generating new knowledge. Aristotle's three intellectual virtues, *epistemé, techn*é and *phronesis*, were modified to help describe these aspects of collective intelligence that could enhance the integration of approaches to health and sustainability.

The theoretical foundation for this transdisciplinary research was built primarily on health promotion and sustainability governance literatures, which were examined for their overlapping and complementary aspects. Children's environmental health was studied as a useful bridging concept and UNESCO-mandated biosphere reserves as bridging organisations for integrating health and sustainability. Activities in all Canadian and British biosphere reserves were assessed for the extent of their focus on health. In addition, by

investigating four biosphere reserves as case studies, this research identified barriers to and drivers for integrating health goals into biosphere reserve activities. At the same time, the organisational understanding of matters relevant to children's environmental health was studied to assess the potential of biosphere reserves as bridging organisations for gathering and mobilising local knowledge on these issues.

The findings centre on three new perspectives for mobilising knowledge as it relates to the cross-sectoral integration of health and sustainability: (1) the bridging of health promotion and sustainability governance theories, using children's environmental health as a bridging concept and area of application, which brings together the key discourses in a transdisciplinary manner (*epistemé*); (2) the value of bridging organisations offering their skills and functional platforms as mechanisms to facilitate bridging of health and sustainability in practice, by bringing together main stakeholders (*techné*); and (3) the importance of bridging collective knowledge and combining the theoretical, practical, and ethical aspects of the integration process, to increase the level of understanding of specific problems, in this case children's environmental health (*phronesis*).

Other contributions offered by this research include the discovery of similarities in health promotion and sustainability governance theories; development of a transdisciplinary ecohealth framework; recognition of biosphere reserves as bridging organisations that function as innovative community-based forums for the integration of sustainable development and public health; and findings that reveal an insufficiency of local data collection on children's environmental health threats. All in all, the findings in this research offer a conceptual and practical frame for integrating health and sustainability by facilitating cross-sectoral collaboration.

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List of acronyms and abbreviations

BPA	Bisphenol A
BR	Biosphere reserve
CBRA	Canadian Biosphere Reserves Association
CEH	Children's environmental health
CESAPE	Children's Environmental Health Action Plan for Europe
EDC	Endocrine disrupting compound
EPA	Environmental Protection Agency of the United States
IDRC	International Development Research Centre of Canada
LA21	Local Agenda 21
MAB	Man and the Biosphere programme
MEA	Millennium Ecosystem Assessment
OECD	Organisation for Economic Co-operation and Development
SDOH	Social determinants of health
UK	United Kingdom
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization

Definitions for cross-sectoral audiences

Environmental health	**"**In its broadest sense, environmental health comprises those aspects of human health, disease, and injury that are determined or influenced by factors in the environment. This includes not only the study of the direct pathological effects of various chemical, physical, and biological agents but also the effects on health of the broad physical and social environment, which includes housing, urban development, land-use and transportation, industry, and agriculture." (U.S. Department of Health and Human Services 2000: 8-3),
Health Promotion	"The process of enabling people to increase control over, and to improve, their health" (WHO 1986) "Any planned combination of educational, political, environmental, regulatory, organisational mechanisms that support actions and conditions of living conducive to the health of individuals, groups, or communities" (*Joint Committee on Health Education and Promotion Terminology* 2001 as cited in McKenzie *et al*. 2004:4).
SDOH	*Social determinants of health;* "the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels." (WHO 2012)
Sustainability governance	Reforming socio-political practices that govern individual and collective action towards the biosphere and prospects for a more sustainable and equitable future (Kemp et al. 2005; Bosselmann et al. 2008; Adger & Jordan 2009a; Meadowcroft 2009).
Collective knowledge	Collaboratively collectable knowledge of experts, practitioners, and general public that is relevant to a particular context-specific issue at the community level.

Preface

This dissertation is structured as a hybrid of two dissertation forms (monograph and manuscript), in which the three manuscript chapters are simultaneously independent entities and part of a larger argument, which is introduced in Chapter 1 and further discussed in Chapters 7 and 8. Each of the manuscript chapters introduces a new facet to integrated knowledge in connection with cross-sectoral bridging of health and sustainability and provides examples to illustrate the argument. All papers are single-author manuscripts. The structure of the dissertation and its components are explained in detail in Chapter 1, Section 1.4.

1 Introduction

> "*It's the environment, stupid! Declining ecosystem health is THE threat to health in the 21st century*" – title of Trevor Hancock's editorial in the 25th anniversary volume of the Ottawa Charter for Health Promotion in *Health Promotion International* (Hancock 2011a).

There is nothing radical or surprising about this observation that a healthy environment is essential for human well-being. In 1997, the World Health Organization (WHO 1997) recommended that the protection of health and the environment be integrated into all economic growth considerations, as well as decision-making and policy development, in general. While economic, environmental, and other social conditions have been acknowledged as vital determinants of human health (e.g. WHO 1986; Raphael 2004), it is worth emphasising the interdependency of the relationship. Economic prosperity and sustainable livelihoods would be hard to achieve with a population whose working capacity is severely compromised by health-related challenges (Barouki et al. 2012) and with ecosystem services that are reduced by disease-prone flora and fauna (McMichael and Scholes 2005; Charron 2012). These linkages have been widely acknowledged (Corvalan et al. 1999). Health was also placed centrally on the agenda of Johannesburg World Summit on Sustainable Development in 2002 (von Schirnding 2005). In practice and particularly at the local level, however, decision-making and action related to health and sustainable development still take place primarily in administrative silos.

At least two fundamental knowledge-related challenges persist within the current institutional system of departmental and functional silos:

1. Disciplinary knowledge, limited by compartmentalised administrative structures is not yet merged with other knowledge frameworks. Thus the development of a more system-wide collective understanding for problem solving is impeded;
2. There are no embedded mechanisms in place at the local level to facilitate cross-sectoral information exchange and the co-creation of new systemic knowledge.

Bridging the gap between existing bodies of knowledge has been widely identified as one of the key challenges in current attempts to address issues relevant to sustainable development (e.g. Berkes et al. 2006; Berkes 2009; Glaeser et al. 2009; Silvano et al. 2009; Mauser et al. 2013) or public health (e.g. Mitton et al. 2007; Cargo and Mercer 2008; Minkler 2010). *Knowledge-to-Action* efforts in health research (e.g. Graham et al. 2006; Pentland et al. 2011), social learning studies in environmental governance (e.g. Armitage et al. 2008; Cundill 2010), and community-based participatory research approaches (e.g. Cargo and Mercer 2009; Minkler 2010) are good examples of attempts to bridge the knowledge gaps. Disseminating knowledge on its own, however, does not change behaviours (Wilcox 2008) and relying on the input of conventionally-selected stakeholders tends to limit the expertise at the decision-making table (Fischer 2006; Cargo and Mercer 2008; Raymond et al. 2010). Moreover, if stakeholders do not see a given issue as a priority or meaningful part of their mandate, they may not be willing[1] to engage in addressing the problem (Flaman et al. 2010).

In response, the doctoral research reported in this dissertation investigated alternative mechanisms to facilitate cross-sectoral collaborative bridging of health and

[1] 'Willingness' in this context refers to matters of prioritisation within existing budgets or motivation to join collaborative funding applications.

sustainable development that would benefit both ecosystem and human well-being, particularly children's environmental health. Children's environmental health was used as an example of a bridging concept and potential shared outcome that highlights the interconnectedness of health and sustainability in general (Illig and Haldeos 2004; WHO 2004; 2009). Although this work emphasises public health, the broader ranging consequences of linkages between health and sustainable development are implicit. The approach to knowledge in this research is deliberative and participatory because the knowledge needed to understand and govern dynamic complex social-ecological systems is too diverse to be managed by one single entity (Folke et al. 2005; Ansell and Gash 2008; Adger and Jordan 2009b; Berkes 2010). This is also the case with children's environmental health threats, the bridging concept in this dissertation. The project identifies ways to develop a common, cross-sectoral understanding about local, context-specific situations concerning children's environmental health. This work, in turn, has the potential to improve problem solving and policy development related to this type of complex socio-ecological challenges.

The connection between child health and the environment was chosen as an example to illustrate knowledge-related issues in decision-making for multiple reasons. Children, identified as the priority outcome in Brundtland Commission's definition on sustainable development (WCED 1987), are key to the well-being of future generations. At the same time, children's on-going physiological development makes them significantly more susceptible to both social and biophysical environmental influences than adults (Schettler 2001). Moreover, in both developed and developing countries, children carry a disproportionate burden of the environmental health risks, which are often associated with

inadequacies of economic development (Illig and Haldeos 2004). Threats to children's environmental health have been widely documented (Colborn et al. 1993; Guillette et al. 1998; Faustman et al. 2000; Chance 2001; Schettler 2001; Garg and Landrigan 2002; Koller et al. 2004; Davies 2006; Kyle et al. 2006; Lundquist et al. 2006; Guidotti 2007; Grandjean et al. 2008; Kalia 2008; Neira et al. 2008; Gavidia et al. 2009; WHO 2009; Gilbert et al. 2010; Miodovnik 2011; Simeonov et al. 2011; Barouki et al. 2012; Fucic et al. 2012; WHO 2012). Extensive attempts have been continuously made to disseminate information about these threats and possible solutions (e.g. EPA 1996; WHO 2004; CPCHE 2005; Royal College of Obstetricians and Gynaecologists 2013), but awareness of existing issues has not yet reached wider audiences (e.g. Goldman et al. 2004; Ortega Garcia et al. 2007). Furthermore, there are very few systemic attempts to assess the current situation by monitoring indicators relevant to children's environmental health at the local level. For instance, existing biological or epidemiological findings of expert scientific studies are seldom validated or repudiated in various practical contexts.

Threats to children's environmental health are good examples of 'wicked problems' that cannot be resolved by one sector alone (Caron and Serrell 2009). They also often involve complex political, cultural, and socioeconomic issues (Briggs 2008). In addition to the knowledge produced by academic research, broad cross-sectoral collaboration is required to gain the spatially specific, meaningful data that are needed to assess specific situations related to children's environmental health. Environmental pollution varies geographically and is influenced by the local industry, population, infrastructure, waste management processes, biophysical landscape, and a number of other factors. As such, environmental health issues often involve convoluted situations and a range of diverse

stakeholders who may have contradicting perceptions of the problems at hand. Furthermore, these issues are frequently exacerbated by poorly coordinated sector-specific problem-solving attempts within administrative disciplinary silos (Brown et al. 2010).

Originally defined by Rittel and Webber (1973), 'wicked problems' are understood to be complex social-ecological challenges that are hard to pin down, because they are dynamic by nature and may be perceived in very different ways by different stakeholders (Kreuter et al. 2004). Wicked problems always take place in social context and tend to require heuristic, adaptive approaches to problem solving (Lach et al. 2005). Typically, wicked problems involve too many interacting factors to permit full analysis or to allow design of fully reliable responses.

While some wicked problems may be addressed well enough to eliminate the most serious associated concerns, scholars generally do not see wicked problems as problems that can be solved. Caron and Serrel (2009), for instance, emphasised the role of academic–community partnerships and practitioners' understanding of context-specific social dynamics in managing wicked problems. In their study of childhood lead poisoning in Manchester, NH, the number of incidences was reduced but some of the issues remained unsolved. Others scholars object to the term 'manage' insofar it implies effective control and prefer more descriptive expressions, such as 'governability', because they see wicked problems as on-going challenges. Jentoft and Chuenpagdee (2009:553), for instance, pointed out that it can be hard to distinguish when, and if, a wicked problem is solved and thus "there are limits to how systematic, effective and rational a governing system can be in solving them". However, in the case of children's environmental health, determining

whether the problems can be solved or merely managed or governed is not the immediate concern. Limited public awareness of the existing children's environmental health issues and minimal professional acknowledgement of the complex causal relationships underlying them have left many issues unaddressed.

The complexity of the practical issues related to cross-sectoral bridging, public health, sustainability, and children's environmental health made this a good candidate for transdisciplinary research. Transdisciplinary research has been identified as a useful method to explore "problems that are complex and multidimensional, particularly problems (…) that involve an interface of human and natural systems" (Wickson et al. 2006:1048). It often focuses on practical real world issues, instead of theoretical or intellectual challenges. Furthermore, transdisciplinarity has been identified as a useful approach for studying complex issues related to both sustainable development (Steiner and Posch 2006) and public health (Kessel and Rosenfield 2008). Typically, when a transdisciplinary approach is used, the system or case studied cannot be described precisely. Moreover, outcome expectations are not specified, dynamic processes are involved, and purely analytical solutions are not achievable (Steiner and Posch 2006). Transdisciplinarity refers to a 'fusion' of methods and, ideally, epistemologies, which aims to create new types of knowledge. Instead of adapting information from other disciplines into one primary knowledge framework, transdisciplinary research treats all disciplinary knowledge as equals (Stein 2007).

Local cross-sectoral partnerships were identified as a potential key venue for meaningful bridging of health and sustainability, because of the emphasis on partnerships

in both health (e.g. WHO 1986,;2005) and governance literatures (e.g. Meadowcroft 2007). They can facilitate shared activities, such as collaborative knowledge mobilisation, collective learning, and project development processes. The need for better understanding

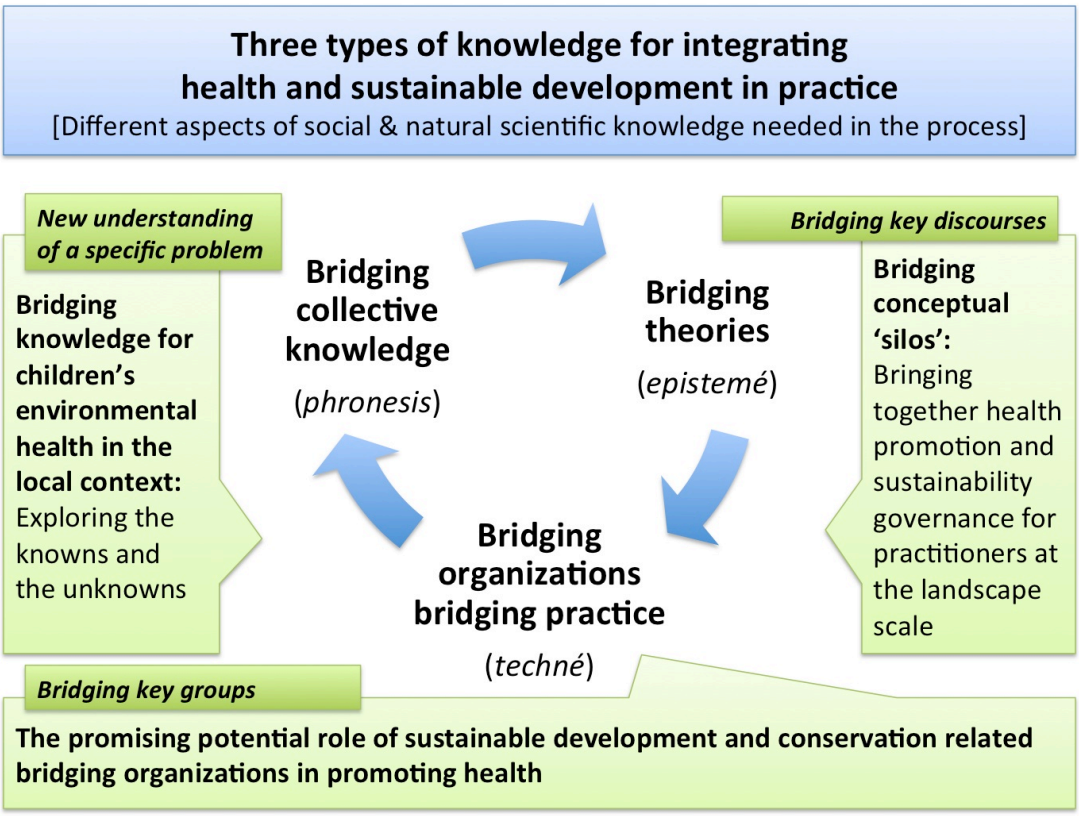

Figure 1.1: Overview of this doctoral research

of various types of bridging in cross-sectoral work for governance has been highlighted by a number of scholars (e.g. Folke et al. 2005; Cash et al. 2006; Meadowcroft 2007; Schultz 2009). Meadowcroft (2007:204) suggests that cross-sectoral partnerships can play a role in enhancing deliberation of the political system and, consequently, decision-making by "increasing the level of understanding of specific problems, building links among important groups, [and] bridging key discourses (science, law, the popular press)". The three

components listed by Meadowcroft also parallel the agendas of each of the three articles in this dissertation (See Sector 1.4 for details).

The dissertation investigates three aspects of bridging health and sustainability, which have been hitherto unexplored in the academic literature: (1) bridging theories and concepts; (2) bridging organisations (bridging practice); and (3) bridging collective knowledge (See *Figure 1.1*). These categories also reflect the twofold critique of the current situation, the compartmentalised knowledge and paucity of mechanisms to bridge across disciplinary divides in practice. This shortcoming is clearly demonstrated by the fragmented manner in which health and sustainability are currently addressed. Transdisciplinary research, which builds on inclusive and reflexive practice, is a new, emerging, exploratory approach to academic research. The iterative process, used in this research to investigate the current situation, revealed early on findings that lead to the following question: if the way in which knowledge is generated and shared in practice is not appropriate, how should it be tackled? This query led to Flyvbjerg's (2001) *Making Social Science Matter: Why social inquiry fails and how it can succeed again* and his critique (2001; Flyvbjerg et al. 2012) of social scientific research that builds on Aristotle's three intellectual virtues.

The three aspects of bridging selected for this research reflect three different but complementary types of knowing, which are loosely associated with Aristotle's three intellectual virtues (*epistemé*, *techné*, and *phronesis*), as interpreted by Flyvbjerg (2001: 53-65). *Epistemé* refers to broadly applicable context-independent knowledge; *techné* to practical, applied and context-specific knowledge; and *phronesis* to pragmatic, action

oriented and context-dependent knowledge, based on value-rationality[2]. While Flyvbjerg (2001; Flyvbjerg et al. 2012) has chosen to focus primarily on *phronesis* because of its importance for conventional social sciences research, the transdisciplinary approach, which integrates social and natural scientific research, requires a broader perspective of knowledge. Furthermore, neither Aristotle nor Flyvbjerg makes a distinction between individual and social level of knowledge. This doctoral research explored various aspects of cross-sectoral bridging of knowledge explicitly at the collective level. For this reason, Flyvbjerg's (2001) Aristotelian interpretation was adapted to illustrate the three aspects of knowledge useful for cross-sectoral bridging of health and sustainability.

Overall, this research explored whether these various approaches to bridging could help address the existing gap between health and sustainable development practices both of which embrace intentional social change for a better society. To address the gap between sectoral knowledge using the three types of knowledge, three venues were chosen, one for each intellectual virtue studied, respectively (Figure 1.1): (1) how bridging theoretical concepts that advance health and sustainability can be used to help bring practitioners together for children's environmental health (bridging key theoretical discourses; *epistemé*); (2) the extent to which existing bridging organisations that focus on sustainable development have addressed public health issues, bridging health and sustainability in practice (bridging key stakeholders; *techné*); and (3) whether these bridging organisations have the potential to mobilize local knowledge to address children's environmental health (increasing the level of understanding of a specific problem; *phronesis*). Furthermore, each

[2] Discussion of social influences in all types of knowledge (e.g. Latour 1987; 2004) is beyond the scope of this dissertation, but the way in which *phronesis* most significantly differentiates from *epistemé* and *techné* is the explicit inclusion of the value perspective (ethics).

of these aims translates to an overall objective, which can be found in *Table 1.1*. The specific research questions addressing the overall objectives are in turn described in *Table 2.1*. Health promotion and sustainability governance were chosen as the key discourses and the conceptual foundation for the research. United Nations Educational, Scientific and Cultural Organization (UNESCO)-mandated biosphere reserves were investigated, as examples of bridging organisations, to see how well they have integrated health and sustainability in practice. Furthermore, practitioners' perceptions and knowledge around issues relevant to environmental paediatrics were studied in order to explore the potential capacity of these organisations to help mobilise local knowledge related to children's environmental health.

Both health promotion and sustainability governance rely on quantitative measures and natural sciences to study causalities. Yet equally important are the social scientific theories related to promoting health and governing for sustainability, which reflect the focus on intentional change. Indeed, both fields use qualitative methods to investigate approaches to achieving outcomes. The complementary nature of the fields makes them ideal candidates for transdisciplinary research.

1.1 Connections between health and sustainable development

In 1974, the internationally-renowned Lalonde Report (Health Canada 1974), drew attention to the fact that human health is intertwined with the environment. Since the 1980s, a number of academic discussions and strategic international documents (e.g. WHO 1986; Hancock 2000; Corvalan et al. (MEA) 2005) have acknowledged the importance of integrating health and sustainable development. The field of health promotion, for instance, recognises the physical environment as one of the social determinants of health (SDOH)

(WHO 1986). The literature on governance towards sustainable development, in turn, has incorporated health and well-being considerations into sustainability criteria (Parris and Kates 2003; Pope and Morrison-Saunders, 2004; Gibson et al. 2005). A growing body of literature suggests health should be a driver for social and economic development and goals should be built around determinants for improved health and wealth (Hancock 2000; Lebel 2003; Corvalan et al. (MEA) 2005; McMichael 2006; Dakubo 2010; Hancock 2011a; Hogstedt and Pettersson 2011). Yet, attempts to integrate health and sustainability in practice have been limited (Collins and Hayes 2007; Hancock 2011a).

On the international stage, the United Nations' (UN) eight Millennium Development Goals (UN 2002) created widespread political awareness of issues related to environmental sustainability, poverty, hunger, and disease. However, conventional biomedical and behavioural perspectives of health issues, which continue to dominate public discussion as well as the views of many politicians and decision-makers, tend to treat social and environmental issues as the background for approaches that focus on clinical disease prevention and individual responsibility (e.g. Nobel Tesh 1988; Krieger 2001; Willett et al. 2006; CDC 2009). Consequently, media attention and available project funding amplify a narrow approach to chronic disease prevention that primarily focuses on anti-smoking campaigns and the encouragement of physical activity and healthy weights. These activities have merit. That said, this extensive focus on lifestyle issues deflects attention from many key determinants of health, such as poverty, education, food security and environment, which often prevent many people from adopting healthy lifestyles. The general public seldom associates these issues with public health although they are recognised as both major social determinants of health and Millennium Development Goals (Hogstedt and

Pettersson 2011). Although the Millennium Development Goals recognised the interconnectedness of health and the environment, and sincere efforts and some progress have been made to act on them, we are far from resolving the wicked problems associated with these goals. Health, environmental and economic issues are still treated separately by our institutional system. Moreover, the contemporary compartmentalised or siloed

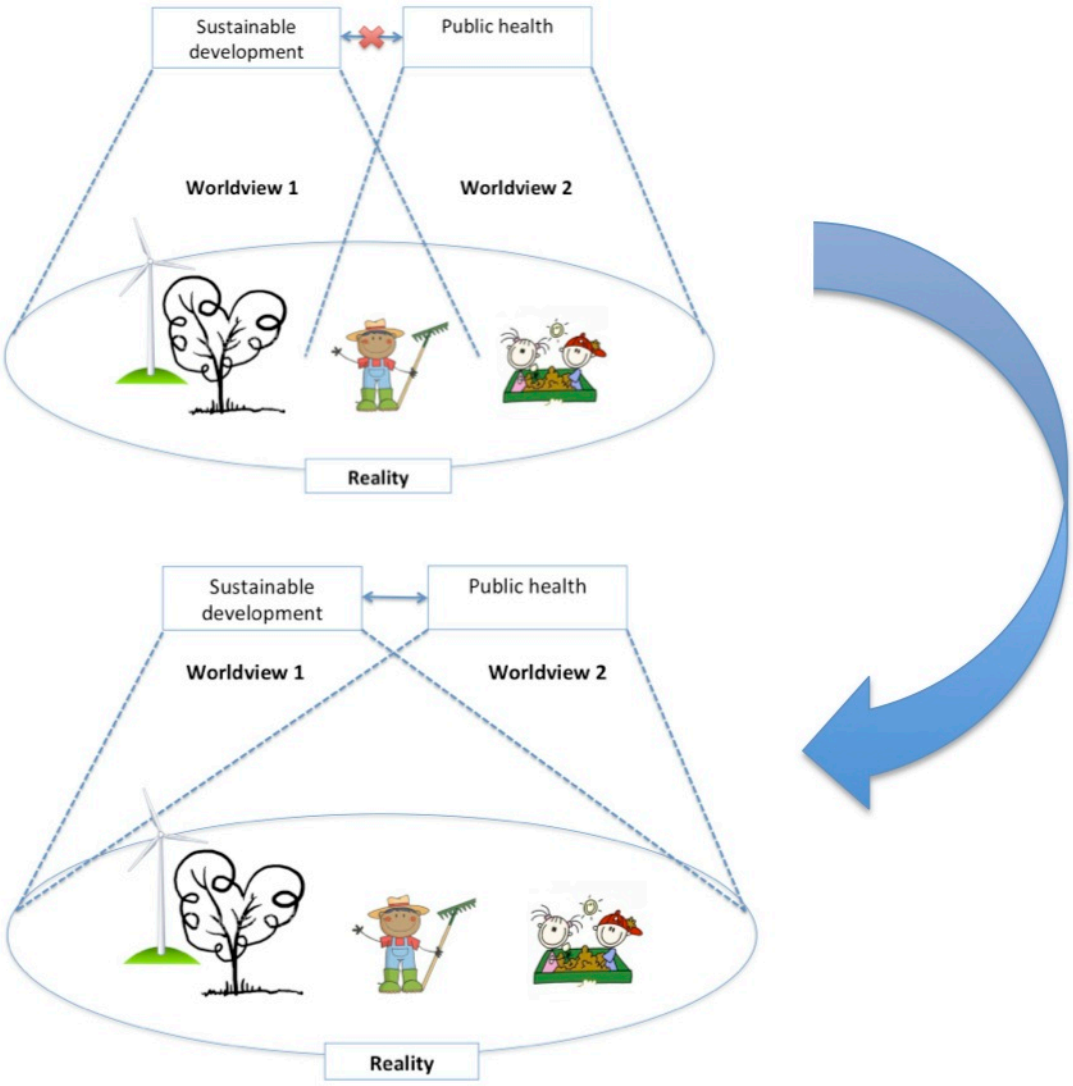

Figure 1.2: The change needed in sectoral worldviews. The image illustrates the current sectoral worldviews and the worldview that is seen as desirable for both sustainable and healthy community development. Adapted from Ingold's (2000:15) model of various worldviews regarding the same physical reality.

approach in academic and governmental practices has been identified as one of the main barriers to finding solutions for the complex, contemporary issues (Merrill et al. 2008; Orians et al. 2009; Juech, and Michelson 2011).

The guiding theme throughout this dissertation is the concept of bridging health and sustainable development with a special focus on children's environmental health. This research has examined successful and promising initiatives that bridge health and sustainable development. The idea was to explore innovative avenues to improve current practices in both fields, by identifying angles that have not yet been considered in the literature. Building on my own background[3] in natural and social sciences, applied academic research, and professional practice, this research explored the transdisciplinary domains of health and sustainability. While *Figure 1.1* illustrated an overview of the logic behind this thesis, *Figure 1.2* illustrates the desired long-term outcome.

1.2 Children's environmental health as a desirable outcome

Environmental paediatrics has been gathering evidence of the effects of environmental factors on child health for several decades (Landrigan and Miodvnik 2011). Recently, increased commitment to children's environmental health research in the United States and Europe at national levels, following new strategic frameworks on child health and the environment (EPA 1996; WHO 2004) has prompted many new academic and training initiatives, including those of 14 government supported Centers for Children's Environmental Health and Disease Prevention Research in the United States. The field is

[3] MSc in Biochemistry and MRes in Health Research combined with years of experience both as a scientist in life sciences and as a public health, with focus on chronic disease prevention and children's environmental health.

commonly known as 'children's environmental health' in North America and 'child health and the environment' in Europe (Guidotti 2007).

Available evidence indicates that early exposures to harmful environmental agents may produce not only significant effects during childhood but also disease that manifests later in life (Needleman et al. 1990; Pluim et al. 1993; Weisglas-Kuperus et al. 1995; ten Tusscher et al. 2003; Schettler 2001; Canfield et al. 2003; Olin and Sonawane 2003; Campbell et al. 2004; Opler et al. 2004; Genuis 2006; Grandjean et al. 2008; Tremblay and Hamet 2008 Hanson et al. 2011; Newbold 2011) . Furthermore, consequent epigenetic changes may affect subsequent generations (Birnbaum and Fenton 2003; Kalia 2008; Baccarelli and Bollati 2009; Barouki et al. 2012; Cortessis et al. 2012). In response, a number of scientists are calling for a paradigm shift in primary disease prevention towards a focus on developmental origins of health and disease. Barouki et al. (2012:8), for instance, argue that "measures which improve nutrition, and reduce exposures to environmental chemicals, from all environmental compartments (air, water, soil) and in food and consumer products" are key to reducing "disease incidence and the cost of health care overall, thereby increasing the quality of life globally". This shift in emphasis is noteworthy not just for public health, but also for sustainable development, which aims to foster intergenerational equity and the well-being of future generations. Along the continuum of current adult populations and future generations are the vulnerable cohorts of children whose environment-related well-being remains unaddressed by much of the sustainable development discussion.

Illig and Haldeos (2004) are two of the few scholars within sustainable development discourse who have explicitly highlighted threats to children's environmental health. They emphasise the credibility of the available science and the potential seriousness of the impacts. Illig and Haldeos' call to action, the topic of children's environmental health has largely been overlooked in sustainable development literature that relates to health. *Figure 1.3* illustrates some of the connections between children's environmental health and sustainability governance. The principle of children's right to a healthy environment can be traced back to the United Nations' Declaration of the Rights of the Child (1959) Article 2, which stated: "The child shall enjoy special protection, and shall be given opportunities and facilities, by law and by other means, to enable him to develop physically, mentally, morally, spiritually, and socially, in a healthy and normal manner and in conditions of freedom and dignity." National and other international bodies have also acknowledged the importance of children's environmental health by developing strategic frameworks, such as the "Canadian National Strategic Framework on Children's Environmental Health" (Health Canada 2010), "A Children's Environment and Health Strategy for the United Kingdom" (Health Protection Agency 2009), and the "Children's Environment and Health Action Plan for Europe" (WHO 2004). Yet this concept itself has remained largely unfamiliar to broader audiences.

The linkages between illness and the environment are complex and therefore challenging and expensive to assess by the current scientific methods. The existing consensus on scientific findings, however, offers sufficient evidence for exploring precautionary approaches to children' environmental health issues while they are under

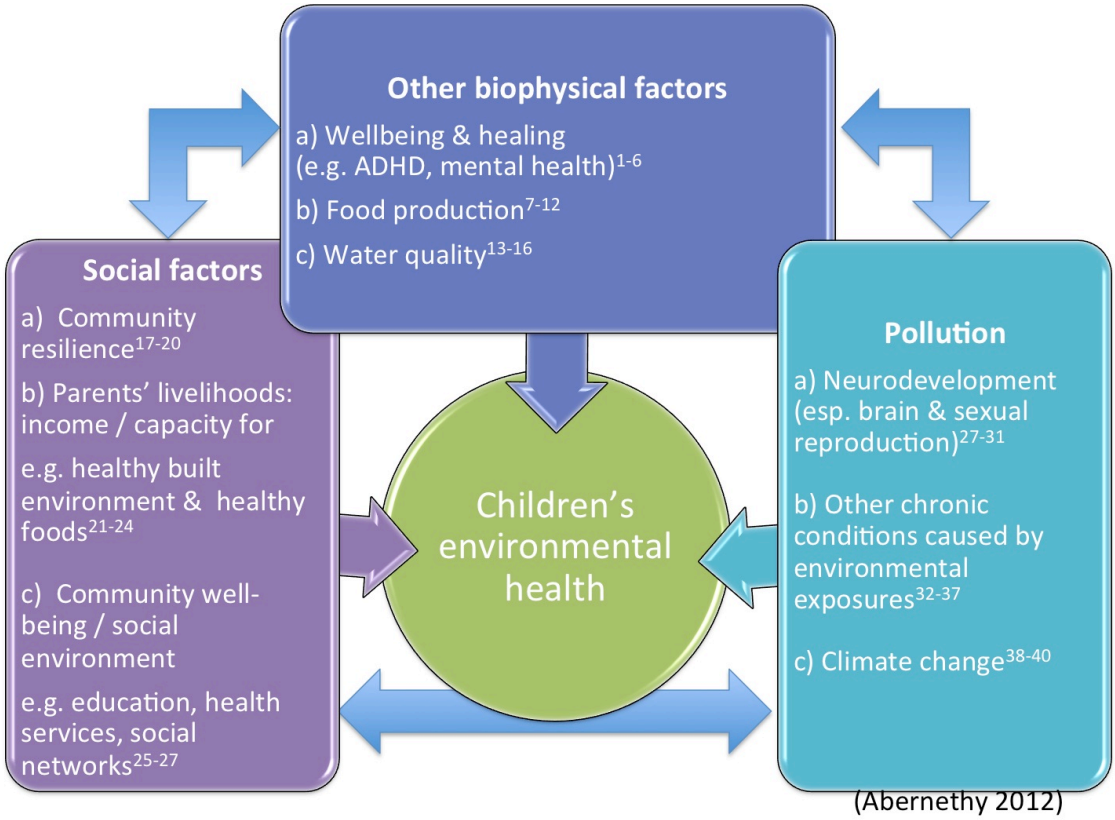

Figure 1.3: Illustration of some of the social-ecological environmental impacts on children's environmental health ([1]Kuo and Sullivan. 2001; [2]Wells and Evans 2003; [3]Kuo and Faber 2004; [4]Maller et al. 2006; [5]Dietz et al. 2009; [6]Haines-Young and Potschin 2010; [7]Simcox et al. 1995; [8]Eskenazi et al. 1999; [9]Ramos and Crain 2001;[10]Jurewicz and Hanke 2008; [11]Story et al. 2008 [12]Phalan et al. 2011; [13]Heberer 2002; [14]Wenzel et al. 2003; [15]Bassil et al. 2007; [16]Schwarzenbach et al. 2010; [17]Adger 2000; [18]Drukker et al. 2003; [19]Leyden 2003; [20]Tidball 2012;[21]Caraher et al. 1998; [22]Cummins and Jackson 2001; [23] Rundle et al. 2009; [24]Sallis and Glanz 2006; [25]Laverack 2006; [26]Brenner and Manice 2011; [27]McAllister 2011; [28]Colborn et al. 1997; [29]Landrigan and Garg 2002; [30]Lundqvist et al. 2006; [31]Grandjean et al. 2008;[32]Heindel 2003; [33]Newbold et al. 2009; [34]Latini et al. 2010; [3536]Casals-Casa and Desvergne 2011; [36]Barouki et al. 2012; [37]Johnson, N.A. et al. 2012; [38]Patz et al. 2005; [39]McMichael et al 2006; [40]Hill et al. 2009.

investigation. The existing scientific understanding coupled with public concerns make environmental threats to child health relevant for public policy agendas. The reasons that the issue of children's environmental health has been marginalised in our society have been discussed elsewhere (e.g. Seto 2011). However, the concerns for child health tend to cross the political party lines. The current Conservative government in Canada banned bisphenol

A (BPA) in baby bottles because of its endocrine disrupting impact on child development (Reuters 2010). This made Canada the first country in the world to ban BPA (Government of Canada 2010).

This PhD dissertation explores various theoretical and practical aspects of whether and how improved bridging of health and sustainability in cross-sectoral cooperation might lead to the betterment of children's environmental health as a shared outcome. In addition, the last article (Chapter 6) explores a new innovative approach to assess children's environmental health at the local level.

1.3 Research question and objectives

The main purpose of this dissertation is to address different facets of knowledge in bridging the current gap between public health and other sustainable development issues in practice. This research seeks to answer the following overall question:

> *Might the current gap between public health and sustainable development practices be bridged by integrating the academic, practical, and co-created collective knowledge that sees children's environmental health as a desirable shared outcome?*

More precisely, the study centres on three different types of bridging in various aspects of the cross-sectoral integration process: (1) bridging key discourses (bridging theoretical knowledge); (2) building links between relevant stakeholders (bridging practical knowledge); and (3) increasing the level of understanding of specific issues (bridging ethical knowledge). Aristotelian intellectual virtues (*epistemé*, *techné*, and *phronesis*) are used to analyse how these three different perspectives to bridging knowledge could

enhance the bridging of health and sustainability. The study also explored children's environmental health as a meaningful bridging concept, uniting practitioners for a shared outcome. The objectives for this research are described in *Table 1.1*. The way in which these objectives are addressed by specific research questions and appropriate research methods can be found in *Table 2.1*

Table 1.1: Overall objective and specific objectives to address the research question "*Might the current gap between public health and sustainable development practices be bridged by integrating the academic, practical, and co-created collective knowledge that sees children's environmental health as a desirable shared outcome***?**

Overall objectives	Specific Objectives
1 To identify and examine the overlapping and complementary elements in academic literatures studying health promotion and governance towards sustainable development, and to develop a conceptual transdisciplinary framework to guide the cross-sectoral integration process.	1.1. Describe the historical roots re the integration of health and sustainable development, highlighting the chronic disease prevention and children's environmental health perspectives; 1.2. Describe conceptual narratives and framing approaches re health, environmental issues, and sustainable development; 1.3. Describe the theoretical key concepts of health promotion and sustainability governance, with emphasis on overlapping themes at the place-based, landscape scale; 1.4. Develop a new conceptual ecohealth framework, combining health promotion and sustainability governance to facilitate theoretical understanding and practical integration; 1.5. Describe and analyse how knowledge is gathered and treated in respective literatures.
2 To understand ways in which bridging organisations are able to bring together stakeholders from both fields to work in collaboration around health and sustainable development; and to distinguish the drivers for and barriers to such cross-sectoral integration processes;	2.1. Describe UNESCO-mandated biosphere reserves as case studies and potential bridging agents bringing various sectors together to address health and sustainable development in an integrated manner; 2.2. Based on case studies, understand how environmental practitioners perceive health, environmental issues, and sustainable development; 2.3. Analyse drivers of, barriers to and facilitating factors for the practical integration of health and sustainable development, as identified by case study organisations, functioning as cross-sectoral bridging agents;

Table 1.1 continues

Overall objectives	Specific Objectives
	2.4. Analyse the results using the conceptual framework in 1.4. (NOTE: For academic publishing purposes an interdisciplinary approach will be used in the paper chapters to permit a greater emphasis on theories relevant to the publication in question).
3 To understand ways in which bridging organisations are able to bring together stakeholders from both fields to work in collaboration around health and sustainable development; and to distinguish the drivers for and barriers to such cross-sectoral integration processes;	2.2. Describe UNESCO-mandated biosphere reserves as case studies and potential bridging agents bringing various sectors together to address health and sustainable development in an integrated manner; 2.3. Based on case studies, understand how environmental practitioners perceive health, environmental issues, and sustainable development; 2.5. Analyse drivers of, barriers to and facilitating factors for the practical integration of health and sustainable development, as identified by case study organisations, functioning as cross-sectoral bridging agents; 2.6. Analyse the results using the conceptual framework in 1.4. (NOTE: For academic publishing purposes an interdisciplinary approach will be used in the paper chapters to permit a greater emphasis on theories relevant to the publication in question).
4 To document attitudes, perceptions, and main types of knowledge available within bridging organisations that could help assess the local, context-specific, situation concerning children's environmental health as an example of a potentially 'wicked' issue; and to assess the potential of biosphere reserves function as bridging organisation bringing together stakeholders for children's health and the environment.	3.1 Analyse how the various approaches to knowledge production, knowledge translation and knowledge sharing in health promotion and sustainability governance address knowledge production for decision-making; 3.2 Develop sensitising concepts related to children's environmental health, based on the current natural scientific understanding; 3.3 Analyse the interview results in relation to perceptions and knowledge related to health, children's environmental health as well as connections among health, environmental issues and sustainable development; 3.4 Validate the findings by document analysis, natural scientific knowledge, and participant reviews; 3.5 Assess the biosphere reserves as potential bridging organisations for children's environmental health.

Overall this research project's contribution to the literature is to explore alternative bridging approaches that enhance cross-sectoral collaboration and collective knowledge mobilisation integrating health and sustainable development.

1.4 Structure of the thesis

This dissertation adopts a hybrid form that includes conventional chapters, published or publishable articles, and integrative components that bring the pieces together to tell a single coherent story as in a conventional dissertation. The three papers in this thesis discuss different aspects of understanding and facilitating cross-sectoral collaboration bridging public health and sustainable development. The flow of the articles is illustrated in *Figure 1.4*. The content is divided into three key categories: Introduction and literature review; the three articles – approaches to bridging; and summarizing discussion and conclusion. The first two chapters provide the overall introduction to this complex trans-disciplinary topic:

- **Chapter 1** presents the lack of integrated practises to address challenges that involve both health and sustainability, such as threats to children's environmental health, as the overall problem tackled in the dissertation. It introduces the identified issues, the concepts employed to address the issues, the main overall research question, the objectives of the research, and the structure and logic of this hybrid thesis[4]. Furthermore, the chapter outlines the overall argument of the thesis concerning the potential for more comprehensive understanding of the integrated cross-sectoral knowledge needed for effective decision-making processes. It also

[4] See the preface on p.xii for details.

introduces use of modified Aristotelian intellectual virtues to help illustrate a new approach to collective integrated intelligence for health and sustainability.

- **Chapter 2** provides an overview of the conceptual framework, definitions and methods. It describes how the specific research questions addressed in the manuscript chapters were approached and the ways in which those questions relate to the objectives of this research. Considerations regarding ontological and epistemological aspects and the validity of the research are also discussed in this chapter.

- **Chapter 3** presents an introductory literature review of health promotion and sustainability governance, recognizing that some additional literature review material will be provided in the three articles. The overlapping areas of interest and complementary differences of the fields are also identified in Chapter 3. In addition, the parallel historic developments of the fields are described to provide a better overall picture of the situation.

Chapters 4, 5, and 6 consist of the three journal papers that discuss the theory and practice of bridging public health and sustainable development:

- **Chapter 4**, the first paper, focuses on bridging key discourses. It describes the theoretical aspects of bridging and is entitled, "Bridging conceptual 'silos': Bringing together health promotion and sustainability governance for practitioners at the landscape scale". This paper has been accepted for publication in the journal *Local Environment*.

- **Chapter 5**, the second paper, centres on the bridging of stakeholders for health and sustainability. It explores the practical successes of integrating health and sustainable development in "The promising potential role of sustainable development and conservation related bridging organisations in promoting health". This paper has been accepted in the *International Public Health Journal* for 2015, 7(1). It will also appear as a book chapter by the same publisher, titled "Bridging Organisations in Promoting Health" in Caron, R.M. and Merrick, J. *Public Health: Improving Health via Inter-Professional Collaborations*. New York: Nova Science, 2014 (Chapter 16).
- **Chapter 6**, the third paper, examines possible benefits of increasing the level of understanding of children's environmental health. It identifies the types of knowledge needed to assess the local situations related to children's environmental health and explores the potential of biosphere reserves to facilitate collaborative data gathering processes. This article "Bridging knowledge for children's environmental health in the local context: Exploring the knowns and the unknowns" has not yet been submitted.

The final component of the thesis, contains two concluding chapters:

- **Chapter 7** discusses challenges in transdisciplinary research and summarises the results of all three articles. In addition, the implications of the research findings are examined in light of Aristotle's intellectual virtues and presented as various types of knowledge that are desirable for community-level cross-sectoral integration of health and sustainability.

- **Chapter 8** presents the conclusions and overall implications, the main contributions to academic discussion, and future research needs.

Furthermore, a plain language report and fact sheets, in online format, will be made available for the participating organisations and public use. The importance of ensuring that academic research is made meaningful and accessible to stakeholders outside academia has been widely recognised (Van de Ven and Johnson 2006; Bartunek 2007). The documents from this doctoral research will be promoted to biosphere reserves through EuroMAB, UK Man and the Biosphere Committee (UK MAB), the Canada MAB Committee, and the Canadian Biosphere Reserve Association (CBRA). As is stated on the UNESCO

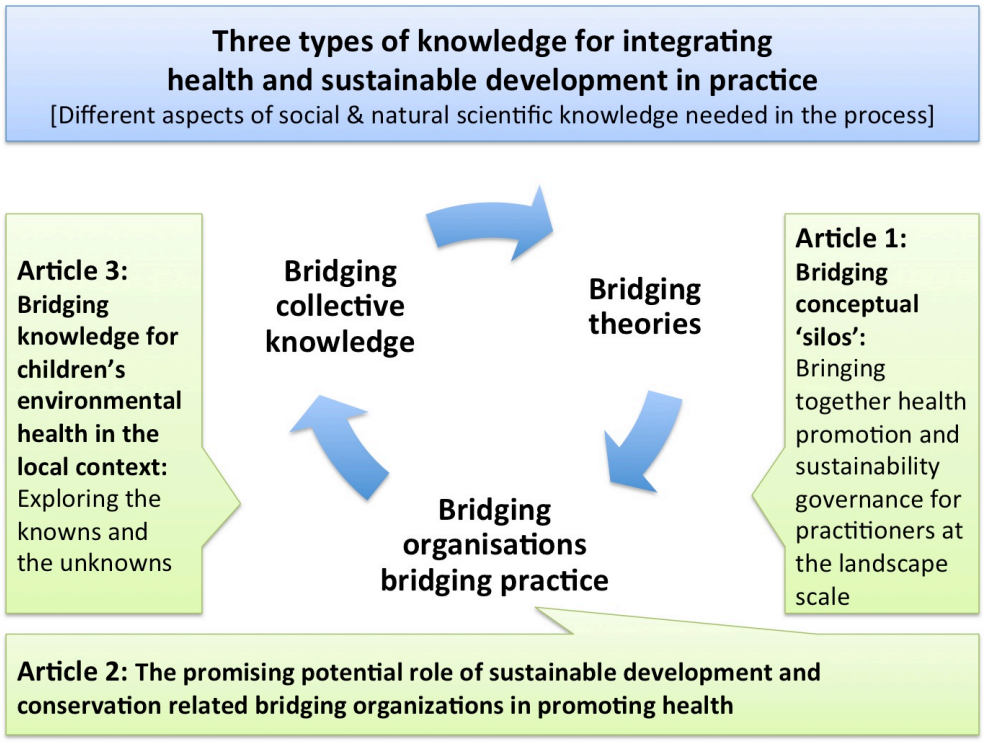

Figure 1.4: The interconnected-ness of the manuscripts. The cycle illustrates the continuum between the three aspects of bridging and how the three articles feed into one another. Bridging knowledge co-creates new knowledge that bridging theories, which in turn can further the work of bridging organisations towards more integrated knowledge creation.

website (2014c), "EuroMAB is the largest and oldest of the UNESCO Man and the Biosphere programme networks encompassing Europe and North America (52 countries in total).

EuroMAB meetings bring together MAB National Committees and have taken place almost every two years since 1986. The EuroMAB network shares best practice and disseminates information on a regional scale". Both UK MAB and Canada MAB are active members of EuroMAB.

While threats to children's environmental health is just one small segment of the complex social-ecological issues the current fragmented approach to governing has generated, transdisciplinary studies offer a venue to discover alternative mechanisms to addressing complexity. This dissertation is an ambitious attempt to explore bridging of the boundaries between applied social sciences (health promotion and sustainability governance), social and natural sciences (in connection with children's environmental health), as well as academia and practice. However, transdisciplinary research is still an emerging genre in academia and requires therefore a more exploratory course of action. The next chapter discusses the theoretical and methodological approaches used in this doctoral research investigating bridging of knowledge to enhance cross-sectoral collaborative practices.

2 Conceptual Overview and Methodology: Theories, concepts and methods

2.1 Introduction

This chapter introduces the theoretical and practical considerations relevant for this transdisciplinary doctoral research project. In *Bridging Scales and Knowledge Systems*, a book that discusses the concepts and applications of the Millennium Ecosystem Assessment, Bennett and Zurek (2007:275) highlighted the ability of "[i]nterdisciplinary research, and research that involves perspectives from inside and outside the academic sciences" to create a broader understanding of a given situation. Unfortunately, the mobilization of diverse sources of information also increases the potential for misunderstanding (Norgaard 2008). Bennett and Zurek (2007:276) drew attention to the challenges in cross-sectoral and multi-stakeholder engagement, which frequently includes "critical disconnects in language, approach, bounding of the problem, and even paradigm among different epistemologies". Explicit transparency and detailed description of the processes is necessary to minimise communication-related challenges in cross-disciplinary research.

2.2 Bridging theories and bridging concepts

The first perspective of this research focuses on bridging key discourses. Bridging processes for cross-sectoral and interdisciplinary collaborations have been broadly investigated (e.g. Mitchell and Shortell 2000, Jakobsen and McLaughlin 2004, Brown et al.

2010, Harting et al. 2011). For instance, finding common language and aligning mutual interests have been identified as key aspects of effective cross-sectoral collaboration. However, in non-acute issues related to health and the environment, attracting relevant stakeholders to the discussion table remains a challenge. Such is the case with children's environmental health with low-dose exposures to contaminants. This is because disciplinary perceptions and institutional mandates tend to dictate the work of most practitioners and, cross-sectoral issues must be seen by all as priorities before effective collaboration can take place (Flaman et al. 2010). As stated in chapter 1, this thesis aims to address this concern and posed the following overall research question,

> *Might the current gap between public health and sustainable development practices be bridged by integrating the academic, practical, and co-created collective knowledge that sees children's environmental health as a desirable shared outcome?*

In order to address this gap, the first article (Chapter 3) explores existing literatures for areas where institutional views of health and sustainable development may overlap. The two main bodies of literature that proved most useful were those of health promotion and sustainability governance. Both applied social science fields are widely recognised by practitioners working with public health and sustainable governance related issues, respectively. I merged insights from the two fields into a conceptual framework bound together by an ecosystem approach to health (*ecohealth*), which sees health as an outcome of effective sustainable management of all components of the environment (Lebel 2003; Dakubo 2010; Charron 2012). Ecohealth is an emerging, intervention-centred field that can technically be considered a branch of both health promotion (DePlaen and Kilelu 2004; Arya et al. 2009; Dakubo 2010) and sustainability governance (Wilcox et al. 2004; Rapport

2007; Connell 2010). This makes ecohealth an ideal conceptual tool for promoting the connections between health and sustainable development.

For reasons explained earlier children's environmental health was chosen as a key outcome for healthy and sustainable community development and an example to help illustrate the potential application of the transdisciplinary conceptual bridging framework.

2.3 Bridging organisations as facilitators for new knowledge

The second perspective introduced by this dissertation recognises the potential of bridging organisations to facilitate knowledge sharing among sectors. In my research, I studied UNESCO mandated biosphere reserves as examples of such organisations. By bringing together a diverse range of stakeholders, the sustainability work of biosphere reserves have the potential to address public health, environmental, and community issues. A biosphere reserve is a specific region, designated by UNESCO, within which people attempt to find ways to create sustainable livelihoods while maintaining the health of the ecosystem that supports their existence (Ravindra 2004; UNESCO 1995). Currently, there are 598 biosphere reserves in 117 countries (UNESCO 2012) and, relevant to this research, 16 are located in Canada and three in the UK. The structure, organisation and governance of biosphere reserves have been adapted to meet local conditions and needs and therefore vary significantly from one biosphere reserve to another (Dempster 2004; Francis 2004). Because of their mandate, biosphere reserves are often viewed as 'learning laboratories' for sustainable development (Nguyen et al. 2011; Matysek et al. 2006). The purpose of biosphere reserves is to demonstrate how efforts in conservation and sustainable development can be integrated, and the ideal is that the organisations "encourage further

development of local collaborative capacities to promote sustainable resource use, protection of environmental quality, and the conservation of biological diversity" (Pollock 2009:53). Furthermore, the latest UNESCO planning document, *The Madrid Action Plan* for 2008-2013, mandated that biosphere reserves "develop mechanisms to encourage the sustainable development of biosphere reserves carried out in partnership with all sectors of society to ensure the well-being of people and their environment" (UNESCO 2008).

2.4 Bridging collective knowledge

The third key piece in this research explores how the level of understanding of children's environmental health could be increased, by assessing the capacity of biosphere reserves to gather and generate local information related to children's environmental health issues. Practitioners associated with biosphere reserves are interviewed for their perceptions on health, sustainability, and children's environmental health to assess the nature of local understanding related to environmental paediatrics. The rationale for this exercise was derived from Burger et al.'s (2010) "Ecological Information Needs for Environmental Justice". They argued that knowledge is central for meaningful engagement of communities and other stakeholders in deliberative decision-making. Burger et al. (2010:894) stated that "[m]eaningful involvement requires that (…) communities can make informed decisions and take positive actions to produce environmental justice for themselves". According to them, neither decision-makers nor stakeholders can assess the situation if appropriate place-based, local, socio-ecological data are not available. This reflects the situation in children's environmental health: the general lack of information and appropriate decision-making, despite widely acknowledge children's right to a healthy environment. This research also investigated the chosen case study areas for social and

environmental concerns that could be strong enough to make it meaningful for their respective biosphere reserves to start bringing stakeholders together to assess the local situation. Sensitising concepts were used to guide the direction of research and help formulate the interview questions (See Appendices 1 and 3 for details). The study identified gaps and limitations in local, place-based knowing, as well as analysed the types of knowledge that could be of value for making meaningful decisions in local contexts. Both health promotion and sustainability governance literatures were searched for relevant approaches to producing and sharing knowledge.

2.5 Approach to addressing the research question

In order to address how the knowledge gap between public health and sustainable development might be bridged the following series of discrete research questions were addressed through research articles. Each article asks one main research question to explore one of the three chosen aspects of bridging, mentioned above. Research to answer the respective main question is guided by three specific research questions in the following manner:

a) **Article 1 (Chapter 3),** examines synergistic broadly applicable ('universal') aspects of academic theories in health promotion and sustainability governance asking "what are the overlapping and complementary elements in academic literature studying health promotion and governance towards sustainable development?"

    I. What are the overlapping areas of interest for health promotion and sustainability governance?

II. How can expertise in health promotion and sustainability governance, respectively, complement and strengthen one another?

III. What implications could the transdisciplinary conceptual framework have for practitioners, if children's environmental health were seen as a shared cross-sectoral outcome?

b) **Article 2 (Chapter 4)** investigates place-based practical mechanisms for bridging health and sustainability: how have some organisations been able to bridge the gap, bringing together stakeholders from both fields to create activities and programmes that embrace an integrated approach to health and sustainable development?

IV. What type(s) of health promotion related activities and programmes take place in biosphere reserves?

V. To what extent have biosphere reserves been able to function as bridging agents facilitating cross-sectoral collaboration between health and sustainability sectors?

VI. What barriers to and drivers for integrating health into their programming can be identified?

c) **Article 3 (Chapter 5)** explores the interaction between the more generally applicable and context-specific knowledge. The questions posits 'what type of knowledge and perceptions can be found in biosphere reserves as bridging organisations that could be useful when assessing their own local situations in regard to children's environmental health'.

VII. How do practitioners engaged in biosphere reserve activities perceive and understand concepts of health, children's environmental health, and sustainable development or the connections between health and the environment, in particular as they relate to disease prevention and children's environmental health?

VIII. What types of data, information, understanding, and skills are available to facilitate the meaning-making (function as bridging organisation) related to children's environmental health?

IX. How can theory and practice inform one another to create meaningful knowledge for decision-making in sustainable and healthy community development?

Table 2.1 describes the way in which each research question and the subsequent specific research questions relate to the overall objectives (See Table 1.1. for details) and the methods used to answer each respective question. Methods are discussed in greater detail in Section 2.6.

Table 2.1: Specific research questions, respective overall objectives, and methods used to answer the question that all aim to answer the overall research question "*Might the current gap between public health and sustainable development practices be bridged by integrating the academic, practical, and co-created collective knowledge that sees children's environmental health as a desirable shared outcome**?*** "

Specific research question	**Objectives addressed**	**Methods Used**
What are the overlapping and complementary elements in academic literature studying health promotion and governance towards sustainable development?		
1. What are the overlapping areas of interest for health promotion and sustainability governance?	1	• Literature Review • Conceptual Framework Development

Table 2.1 ***continued***

Specific research question	**Objectives addressed**	• **Methods Used**
2. In which way can expertise in health promotion and sustainability governance, respectively, complement and strengthen one another?	1	• Literature Review • Conceptual Framework Development
3. What implications could the transdisciplinary conceptual framework have for practitioners, if children's environmental health were seen as a shared cross-sectoral outcome?	1	• Literature Review • Conceptual Framework Development
How can non-governmental organisations function as bridging agents facilitating cross-sectoral collaboration between the health and environmental sectors?		
4. What type of health promotion related activities and programmes take place in the biosphere reserves	1, 2	• Literature Review • Document Analysis • Semi-structured Interviews • Participant Observation
5. To what extent have the biosphere reserves been able to function as bridging agents facilitating cross-sectoral collaboration between health and sustainability sectors?	1, 2	• Literature Review • Document Analysis • Semi-structured Interviews • Participant Observation
6. What barriers to and drivers for integrating health into their programming can be identified?	2	• Semi-structured Interviews • Participant Observation
What type of knowledge and perceptions can be found in biosphere reserves as bridging organisations that could be useful when assessing their own local situations in regard to children's environmental health?		
7. How do people engaged in biosphere reserve activities perceive and understand concepts health, children's environmental health, and sustainable development or the connections between health and the environment, in particular related to disease prevention and children's environmental health?	2,3	• Semi-structured Interviews • Participant Observation
8. What types of data, information, understanding, and skills are available to facilitate the meaning-making (function as bridging organisation) related to children's environmental health?	2, 3	• Literature Review • Document Analysis • Semi-structured Interviews • Participant Observation

Table 2.1 ***continued***

Specific research question	**Objectives addressed**	• **Methods Used**
How can theory and practice inform one another to create meaningful knowledge for decision-making in sustainable and healthy community development?	3	• Literature Review • Conceptual framework • Semi-structured Interviews • Participant Observation

2.6 Overview of methods

Transdisciplinary research, an emerging approach and evolving methodology, brings together elements from various disciplines. The research for article one (Chapter 4) was solely theoretical, whereas articles two and three (Chapters 5 and 6) were based on an embedded multi-case study (Yin 2009) that focused on health promotion-related aspects of biosphere reserve activities, using various methods and data sources to ensure identification of all critical aspects related to research questions. More details on the biosphere reserves selected as case studies can be found in Appendix 3.

The general approach to data gathering and analysis in this transdisciplinary research project is *analytic induction* (Robinson 1951; Patton 2002; Robson 2002). It is a procedure that explores preliminary hypotheses "based on hunches, assumptions, careful examination of research and theory, or combinations. Hypotheses are revised to fit emerging interpretations of the data over the course of data collection and analysis." (Gilguin 1995:268 as cited in Patton 2002:493-494). Analytic induction is an approach to developing new theory or improving existing theory. It builds on the principles of grounded theory by acknowledging that, as an experienced professional and academic, the researcher has some pre-existing knowledge and expectations related to the topic being

studied, which influences the research outcomes. In this way, analytic induction makes analytical processes more transparent, which is critical in transdisciplinary work. The direction in this doctoral research was guided by four sets of sensitising concepts (See Appendix 1 for details).

The aim is not to find universal or causal postulates but to develop descriptive hypotheses, which by "[identifying] patterns of behaviours, interactions, and perceptions" (Gilguin 1995) could guide future cross-sectoral collaboration and bridging work. The following six steps were specified to guide the analytical induction (as defined by Cressey 1950, cited in Robinson 1951):

1) Tentatively define the phenomena: "Formulate a rough definition of the phenomenon of interest" (Robson 2002: 322);

2) Develop hypotheses based on Step 1: "Put forward an initial hypothetical explanation of this phenomenon" (Robson 2002: 322);

3) Use Case 1 and 2 to determine if the hypotheses are confirmed: "Study a situation in the light of this hypothesis, to determine whether or not the hypothesis fits" (Robson 2002: 322);

4) If a hypothesis fails to be confirmed, redefine the phenomena, or revise the hypothesis;

5) Examine Case 3 and 4 based on revisions made in Step 4 (expect some certainty about the hypothesis);

6) Hypothesis will be reformulated (based on negative cases/ new information) until some certainty that is valid in all cases is reached.

These steps are followed throughout the three research components (three articles): in (i) developing the conceptual framework, building on the prerequisites for health outlined in the *Ottawa Charter for Health Promotion* (WHO 1986) and for lasting wellbeing in Gibson's *Sustainability Assessment Criteria* (Gibson et al. 2005); (ii) analysing activities in Canadian and British biosphere reserves, based on sensitising concepts from health promotion theories (See Appendix 1 for details); and (iii) exploring perceptions, knowledge, and understanding around children's environmental health, reflecting the results in the light of both current natural and social scientific understanding as well as the conceptual ecohealth framework, introduced in Chapter 3.

A major challenge of this type of transdisciplinary research is the extensiveness of available theory. Solid, explicit, criteria were selected to allow the reader to make an informed critique of the presented information. Although this is an exploratory exercise that aimed to identify the synergistic, complementary, or otherwise positively constructive components of both fields, a few 'negative' observations challenged my assumptions. For example, most participants had not heard the concept 'children's environmental health'. However, findings were treated as opportunities that expand our understanding. As Robson (2002: 490) also stated: "when developing new theory, the suggestion is that one should go out of one's way to look for negative evidence". This iterative and reflexive process ended up modifying the project to some extent, which had the greatest influence on the last article. A similar process was used to dissect the contemporary scientific

understanding on children's environmental health, in order to develop categories with which to assess the perceptions and knowledge of practitioners.

Methods used to gather data in this study included literature review, conceptual framework development, document analysis, semi-structured interviews as well as both participant and direct observation. Sampling strategies and details related to methods will be discussed in connection with each research component. The interview guide can be found in Appendix 2. The overall analysis of the different aspects of knowledge bridging is based on a modified interpretation of Aristotelian intellectual virtues and will be discussed in Chapter 7.

2.6.1 Potential bias and validity considerations

Health promotion and sustainability governance are fields that focus on studying social change with the goal of healthy and sustainable communities. Because the study explored perceptions and thinking processes in connection with the integration of health and sustainable development, there were components in the interviewing process that purposefully led participants to explore new ways of thinking. This means that under other circumstances participants might have responded slightly differently.

In order to build a nuanced and truthful picture of the local situation and to minimise the influence of my personal bias, the content flow during the interview process was taken into consideration in the analysis (identifying changes) and participants were invited to review the preliminary analysis summaries as well as their direct personal citations (as described by Patton 2002: 560-1). For the purposes of this research, the

partial dialogue format of the interview process produced narratives that reflected both the existing situation and future possibilities.

In general, the validation process included the practice of interviewee transcript review that allows "interviewees the opportunity to edit or clarify information provided in the original interview, with many interviewees providing corrections, clarifications, and in some cases, adding new material to their transcripts" (Hagens et al 2009:47). While the reviews may not have improved the quality of the data, the practice is often recommended for participatory research in order to create trust. Ensuring good community relations was particularly important for my research, because I spent less than two weeks in most of my study areas.

Case study validity was ensured using approaches as described by Yin (2009:40-47). In general, I used the following categories of triangulation (Patton 2002:556, 560) to contribute to the verification and validation of my results: (1) *multiple methods*: document analysis, semi-structured interviews and participant/ direct observation; (2) *multiple sources regarding health-related activities*: Web, printed documents and interviews; *validating findings* by inquiry participants.

Table 2.1 provides an overview of the methods used to answer each research question. Details related to specific methods used in the three research components will be discussed in the respective chapters.

3 Bridging health and sustainable development: Reviewing theory

3.1 Introduction

This chapter provides an introductory literature review of some of the key theoretical components used in this transdisciplinary doctoral dissertation. Additional literature reviews are included in each chapter. The literature review was guided by Ogawa and Malen's eight step method for conducting qualitative literature reviews as described by Randolph (2009).

This chapter draws from themes of literature that are relevant to bridging public health and sustainable development 'practices'. More specifically, it critically reviews the literatures of health promotion and sustainability governance. These literatures are analysed using specific sets of criteria for each field, focusing on prerequisites for health and sustainability criteria, respectively. In addition, this chapter critically reviews the existing literature related to two concepts that explicitly bridge the health promotion and sustainability governance fields: ecohealth and children's environmental health.

The health promotion component of this literature review centres on the 'new' health promotion literature that builds on prerequisites for health as defined by the Ottawa Charter for Health Promotion (WHO 1986). Some of the key pieces representing the literature are, for instance, Minkler 1997 and 2012, DiClemente et al. 2002, Jones et al. 2002, Bartholomew et al. 2006, O'Neill et al. 2007, and Glanz et al. 2008. Sustainability governance literature tends to be less explicitly defined than health promotion. In this

literature review, therefore it is understood as the literature studying governing processes that focus on social-ecological change leading towards sustainable development (e.g. Kemp et al. 2005; Foxon et al. 2008). This framing acknowledges the complexity and interconnectedness of the social and the biophysical systems, expanding from the conventional natural resource management to wider environmental governance for sustainability that explicitly integrates various social components. In turn, the approach to sustainability governance in this literature review is based on Gibson et al.'s (2005) sustainability assessment criteria. The conceptual foundation for the literature is reflected in the North American and British traditions of polycentric collaborative governance and adaptive co-management (e.g. Parson 2001, Durant et al. 2004, Gibson et al. 2005, Armitage et al. 2007; Adger and Jordan 2009a, Mazmanian and Kraft 2009a, Leach et al. 2010). This includes also a recognition of various frameworks that have been developed to study the complex social ecological systems, such resilience and adaptive capacity (e.g. Berkes et al. 2003) as well as transition management (e.g. Rotmans and Loorbach 2009)

3.2 Health promotion and community capacity building

The field of health promotion is concerned with the processes of behavioural and social change required for the development of a healthy society (Minkler 1997; Bartholomew et al. 2006). Furthermore, it seeks to provide health professionals and the general public with information, resources, and tools for the betterment of public health (Srinivasan and Dearry 2004). Overall, health promotion takes a holistic approach to health, as is crystallized in the definition of the social determinants of health (SDOH), a concept which includes the biophysical environment as one of the main determinants (Health Canada 1974; WHO 1986) and recognizes the interactions among the determinants.

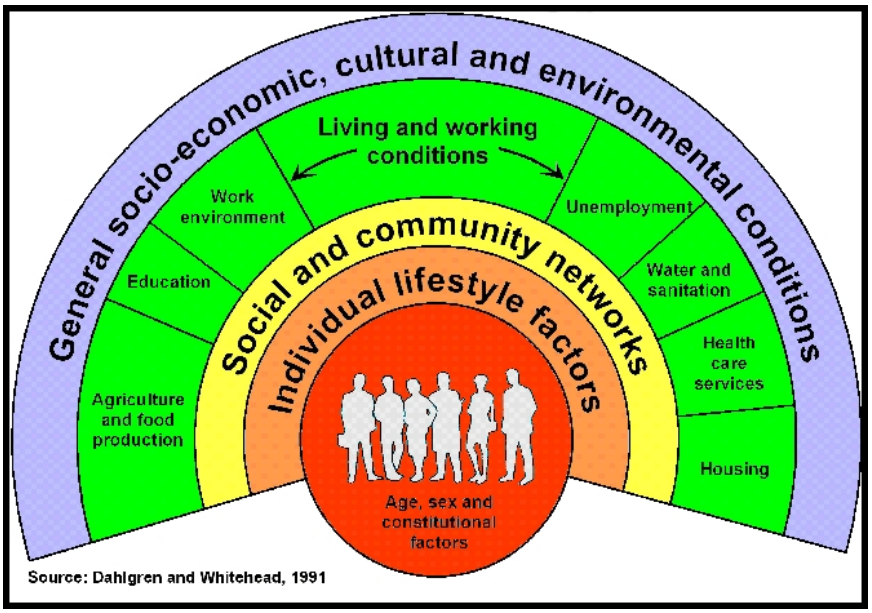

Figure 3.1 Visualising social determinants of health (Dahlgren and Whitehead 1991)

Health promotion literature is extensive and combines the knowledge of both academics and practitioners. This thesis provides a brief introduction to the field, identifying areas most relevant to the development of a transdisciplinary framework for healthy sustainable community development. Health promotion is about facilitating change towards a healthier society by addressing factors that influence the health and well-being of people. It is one of the primary functions of public health programme and service delivery (O'Neill and Stirling 2007:36).

Health promotion evolved from the health education practices of infectious disease prevention and the hygiene movement. As a result, early health promotion practices emphasised personal responsibility and lifestyle choices, such as washing hands, that were the typical for the prevention and control of communicable diseases (Freudenberg et al. 1995). In the 1980s, a 'new' health promotion movement challenged the narrowness of this focus on personal health goals and proposed a social model that took an ecological system

approach, which emphasised broader societal goals (Green and Raeburn 1988; Robertson and Minkler 1994). In 1986, when the first International Conference on Health Promotion released a position paper now world renowned as the Ottawa Charter for Health Promotion (WHO 1986), this movement began to reach broader audiences. The essence of the new approach was to expand the definition of health and well-being by acknowledging the social, political, and economic determinants of health (Robertson and Minkler 1994), which were explicitly laid out in the Charter as 'prerequisites for health'. These prerequisites further evolved to 'social determinants of health' (SDOH), which can be defined as changeable societal conditions that influence health (Krieger 2001; see *Figure 3.1* and *Section 3.2.2*).

The health promotion based on the Ottawa Charter was originally referred to as the 'new' health promotion (Green and Raeburn 1988; Robertson and Minkler 1994; Nutbeam 1998). Later on, particularly in Canada, the term 'health promotion' came to imply bottom-up, community-based approaches to enhancing public health as a contrast to top-down population health approaches (Raeburn and Rootman 2007). This 'new' health promotion, simply called 'health promotion' henceforth in this dissertation, saw individual life style strategies as only one component of a systems approach; embraced individual and collective empowerment; and advocated community inclusion and participatory approaches (Robertson and Minkler 1994). The Ottawa Charter defined health promotion broadly as "the process of enabling people to increase control over, and to improve, their health" but it also, for the first time, emphasized the role of public policy development as a key to improving health. Legislation, fiscal measures, taxation and organisational change were explicitly mentioned as examples of tools that could be used to develop health

policies both within and outside the health sector. In 2001, the *Joint Committee on Health Education and Promotion Terminology* specified health promotion as "any planned combination of educational, political, environmental, regulatory, organisational mechanisms that support actions and conditions of living conducive to the health of individuals, groups, or communities" (as cited in McKenzie *et al*. 2004:4).

Various schools of thought within health promotion focus on a range of public health issues. This dissertation, however, mainly focuses on healthy community development, because 1) community development, which aims to release and build community capacity, has been identified as "the most important single approach available to health promotion practitioners, one that fully embodies the central health promotion principles of empowerment, participation, and sense of control by ordinary people" (Raeburn and Rootman 2007:25); and 2) the activity of bridging organisations that is studied in this research aims to facilitate collaboration at the community level.

3.2.1 Health promotion theories

Health promotion recognizes that health issues have multiple causes. As such, the challenge of disease prevention has primarily been to develop effective multidimensional interventions (Freudenberg et al. 1995). Nutbeam and Harris (2004) classified health promotion theories into five distinct categories: health behaviour change at the individual level; change in communities and communal action for health; communication strategies for change; organisational change and the creation of health-supportive organisational practices; and the development and implementation of healthy public policy. In health promotion, concerted efforts in all five categories are seen as necessary to bring about

change. Many of the theories underlying health promotion interventions have been adapted from the theory of other disciplines, such as Paulo Freire's *empowerment education* theories of adult learning (Freire 1968), and the *social learning* and *ecological model* theories of social psychology (Freudenberg et al. 1995). Green et al. (1994) suggest it is the philosophical underpinning of this multidisciplinary approach that allows for the integration of various knowledge bases and aspects of reality into health promotion practice. Probably the best-known health promotion theory rests on Prochaska and DiClemente's (1982) *transtheoretical model* of the five stages of behavioural change. This theory, a 'fusion' of a number of different theories, emphasises the need for a different intervention at each stage (Freudenberg et al. 1995) and has been adapted for application more broadly in the sustainability governance literature (e.g. Allen et al. 2002).

Table 3.1: Effective health education interventions

Effective health education interventions (Freudenberg et al. 1995) should:

- be tailored to a specific population within a particular setting.
- involve the target audience in planning, implementation, and evaluation.
- integrate efforts aimed at changing individuals, social and physical environments, communities, and policies.
- link participants' concerns about health to broader life concerns and to a vision of a better society.
- use existing resources within the environment.
- build on the strengths found among participants and their communities.
- advocate for the resources and policy changes needed to achieve the desired health objectives.
- prepare participants to become leaders.
- support the diffusion of innovation to a wider population.
- seek to institutionalize successful initiatives and to replicate them in other settings.

Most health promotion theories can be categorised into two main types based on their purpose: problem-focused theories that aim to specify the causal relationship between determinants of health and health outcomes; and process-oriented, action-related theories that centre on interventions addressing the determinants of health (Freudenberg et al. 1995; Green 2001; Gielen et al. 2008). Together these two types of theories can be

used to create a step-wise programme model to guide the integration of various theoretical frameworks into planning processes (Gielen et al. 2008). Since the early 1980's, such models for health promotion planning have been emerging. Examples include Green and Kreuter's PRECEDE-PROCEED ("*P*redisposing-*R*einforcing-and-*E*nabling-*C*onstructs-in-*E*ducational-*D*iagnosis-and-*E*valuation" and "*P*olicy-*R*egulatory-and-*Organisation*al-*C*onstructs-in-*E*ducational-and-*E*nvironmental-*D*evelopment") and MATCH ("*M*ulti-level-*A*pproach-*T*o-*C*ommunity-*H*ealth"), which was developed by Simons-Morton's team to address the lack of focus in the original PRECEDE model (Gielen et al. 2008; Jack et al. 2010:75).

Models focusing solely on individual behaviour change are no longer considered to be sufficient representations of the change processes needed to achieve public health goals (Glass and McAtee 2006; Frohlich and Poland 2007; Wilcox 2008; Wagemakers et al. 2010). Since the 1990s, the relationship between health and the social and physical environment has been gaining attention in the health promotion literature (Freudenberg et al. 1995; Berkman et al. 2000; Heaney and Israel 2008; Wagemakers et al. 2010), highlighting the significance of social-ecological models of health (Stokols 1996; Schulz and Northridge 2004). This paradigm shift was evident in the definition of effective health promotion intervention proposed by Freudenberg et al. (1995:297-299; see *Table 3.1*), which highlights the need for a deliberative, inclusive, and context-specific approach to health promotion. Freudenberg et al. (1995:296) criticized earlier health promotion theories that proposed public health professionals lead the change rather than facilitate "individuals and communities in defining the goals of change and the methods to achieve those goals". Freudenberg et al.'s framework, which has since been adopted by many practitioners and

academics for use in health promotion intervention planning (e.g. Minkler 1997; Bartholomew et al. 2006), emphasized the importance of developing multi-component programmes that would integrate health promotion theories appropriate for the unique contexts and phases of public health practice (Freudenberg 2004; Bartholomew at al. 2006:14; Gielen et al. 2008; Glanz 2008:406).

Freudenberg et al.'s (1995) proposal represented a significant 'tidal shift' taking place within the health promotion field. It explicitly articulated the theory and practice of a systems approach, integration of the social principles of the *Ottawa Charter for Health Promotion*, and a critique of the epidemiological, population health style and outcome-centred interpretation of SDOH that focused on healthy life style choices. At the same time, public health practitioners with new, enriched and more inclusive perspectives shifted their practices towards community capacity building and process-focused interventions (Bartholomew et al. 2006:13; Raeburn and Rootman 2007). There have been, however, several critical voices among health promotion scholars, concerned with over-theorizing of practice. Wallander (1992), for instance, suggested that although a theory-informed intervention can be useful for guiding the selection of programme components, it may also create bias by hindering a more reflexive, adaptive approach. Similarly, Crosby et al. (2002) implied that individual, cultural, and contextual factors influences the applicability of theories. Glanz (2008:406) warned against the use of too many theories at once, although she acknowledged that more than one theory is often needed to address a health issue and that context determines what theories are suitable.

Even though public health efforts still appear to be largely focused on individual behaviour change (McGinnis et al. 2002; Armstrong et al. 2006), it is widely recognised that health outcomes are associated with circumstances that are beyond the immediate control of individuals (Raphael 2004; Dorfman et al 2007). Dorfman et al. (2007) argued that approaches that emphasise individual health behaviours inappropriately narrow the range of possible solutions and create situations that are doomed to fail. Indeed, supportive environments and social conditions are seen as key to creating the change in norms needed for improved health outcomes (Goodman et al. 1996; Boutilier et al. 1997; Wagemakers et al. 2010). Some see policy as the primary tool for directing change (e.g. Dorfman 2007) and others emphasize the critical role of empowerment and awareness creation as components that inform policy development processes (e.g. Joffres et al. 2004). In general, community capacity-building that includes awareness creation, engagement, empowerment and policy development components, is considered to be one of the most effective health promotion approaches to changing norms and behaviours (Vasquez et al. 2007; Raeburn and Rootman 2007; Minkler 2010; Wagemakers et al. 2010). That said, community capacity-building is not just a means of achieving improved health outcomes, but simultaneously it builds community resilience to various external stresses (Steckler et al. 1993; Norton et al. 2002; Benard 2007) and increases community capacity to pursue subsequent change.

Environmental health promotion is a branch of public health that has conventionally focused primarily on microbial contamination and acute pollution emergencies. During the past decade, its scope has expanded to include various environmental hazards, such as issues related to built environments and transportation. To address these issues, there has

been some adaptation of health promotion theories (Freudenberg 2004; Howze et al. 2004; Parker et al. 2004), yet translation of these theories into practice has been limited.

3.2.2 Prerequisites for health and 'Social Determinants of Health' (SDOH)

Multiple terms, such as social medicine, public health, collective health, disease prevention, and health protection are often used interchangeably with health promotion (de Salazar and Anderson 2008). Health promotion refers to the distinct process of improving health, however, manifested in the previously mentioned *Ottawa Charter for Health Promotion* (WHO 1986), which explicitly defined the concept of health promotion to be broader than that of conventional health education. The Charter also specified eight prerequisites for health: peace; shelter; education; food; income; a stable ecosystem; sustainable resources; and social justice and equity. These were seen as the "fundamental conditions and resources for health" and helped conceptualise the social determinants of health (SDOH). The history of health promotion will be discussed in greater detail in Section 3.4, but SDOH are critical to understanding how health promotion is significantly broader in its approach than disease prevention. The Ottawa Charter (WHO 1986) positioned health as a resource and thus made it the responsibility of all sectors in the society by stating: "Health is a positive concept emphasizing social and personal resources, as well as physical capacities. Therefore, health promotion is not just the responsibility of the health sector, but goes beyond healthy life-styles to well-being."

This holistic systems approach to health was further solidified by subsequent WHO documents, such as *Health for All in the 21st Century* (WHO 1998), *Bangkok Charter for Health Promotion* (WHO 2005), *Health in All Policies* (WHO and Government of South

Australia, 2010), and most recently *Rio Political Declaration* at the *World Conference on Social Determinants of Health* in October 2011 (WHO 2011). By ratifying the Rio Declaration in May 2012 (WHO 2012), all WHO member states acknowledged the social determinants of health as "the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels." This definition implies that in order to achieve improved health and well-being, SDOH need to be addressed. The declaration demanded action on the following five matters: 1) Adopt improved governance for health and development; 2) Promote participation in policy-making and implementation; 3) Further reorient the health sector towards promoting health and reducing health inequities; 4) Strengthen global governance and collaboration; and 5) Monitor progress and increase accountability. All in all, the principles of health promotion, prerequisites for health as defined by the Ottawa Charter (WHO 1986), and SDOH as defined by WHO (2012) have been recognised and ratified by all 194 member states of the World Health Organisation several times, in various formats, over the past 30 years.

3.3 Sustainability governance

The concept *sustainable development* (or sustainability) first reached a broader global consciousness in 1987, following the release of *Our Common Future*, a report by the UN's World Commission on Environment and Development (WCED), which was integrated with unusual speed into many governing policies across the world (Carruthers 2001; Meadowcroft 2000). Sustainability governance, which evolved naturally after the Brundtland Report merging environmental governance with components from

international development, fused a wide range of socioeconomic aspects and equity concerns with the conservation agenda. Sustainability governance is a concept that refers to our attempts to govern people and the planet towards more sustainable, fairer, and healthier future.

Governance and *sustainability* are very ambiguous concepts, and therefore possibly two of the most disputed terms of the social sciences (Jordan 2008:18). Their polyvalent and polycontextual natures make the terms appealing across boundaries but also result in diverse interpretations that create confusion and even contradiction (Stoker 1998; Jessop 2003; Kemp et al. 2005; Stirling 2009:196). The foundations of sustainability were originally described as three pillars reflecting social, economic and ecological perspectives, each of which indeed had its own range of definitions depending on context (Stirling 2009). In recent years, more nuanced versions of the foundations of sustainability have been gaining popularity, such as Roseland's (2005:8-10) idea of natural, physical, economical, human, social, and cultural capital, which differentiates between material man-made resources, natural resources, human skills, and allocation of resources. Social capital, for instance, is seen more specifically as community connectedness and cohesion, as the '*glue*' that holds a community together.

Dovers (2005:9) identified the following four topics as the issues of focus captured under the umbrella of sustainability: resource depletion and degradation; pollution and wastes; fundamental ecological life support services; and society and the human condition. Stirling (2009:193) suggested that there are three different ways to understand sustainability: 1) the *substantive*, which focuses on publicly deliberated goals; 2) the

normative, which centres on the social processes; and 3) the *instrumental*, which views sustainability "as a means to support and justify narrow sectional interests". Kemp et al. (2005:12), in turn, held that sustainability should be perceived as "a socially instituted process of adaptive change in which innovation is a necessary element". Indeed, Adger and Jordan (2009b:8) concluded that, "it is pointless searching for a precise definition of sustainability" because it is an ever-evolving adaptive process.

Governance conceptually expands on the term *governing* (Pierre 2000 as cited in Fischer 2006). Where *governing* previously referred almost exclusively to the activities of governments, *governance* implicitly refers to inclusion of various non-governmental actors in decision-making processes. *Governing* can be understood as the social activities that make a "purposeful effort to guide, steer, control, or manage (sectors or facets of) societies" (Kooiman 1993:2 in Jordan 2009:21). The term *government* is limited to governing activities undertaken by public agencies, in particular those operating "at the level of the nation state to maintain public order and facilitate collective action" (Stoker 1998:17). In principle, *governance* expanded this definition of governing to acknowledge "the patterns that emerge from the governing activities of social, political and administrative actors" (Kooiman 1993:2 in Jordan 2009:21). In general, the governance literature identifies three main forms of governance: hierarchies, markets, and networks (Jordan 2009).

Stoker (1998:18) stated that "the value of the governance perspective rests in its capacity to provide a framework for understanding changing processes of governing", but he also admitted that the definition of governance is contested and, at times, contains conflicting assumptions. In political science, governance often appears to refer to the kind

of governing led by public agencies and other government institutions (Ansell and Gash 2008). In environmental governance literature, however, governance usually refers to a more collaborative governing approach, in which multiple stakeholders govern and public agencies may or may not be an active participants (Paavola 2007).

Inherently, governance also considers the art of governing and the way the process of governing influence those who are being governed, a concept known as *governmentality*. The roots of this term can be traced to Foucault's studies on the linkages between power, knowledge, and subjectivity (Fox and Ward 2008). Governmentality refers to both the direct and indirect governing of human behaviour. In relation to both public health interventions that focus on healthy living and government efforts that promote sustainable living, studies in governmentality are particularly interested in how such normative discourses influence human actions by directing choices rather than explicitly governing decision-making (Petersen 2003; Fox and Ward 2008).

As is health promotion, sustainability governance is a field of multiple schools of thought and an array of theoretical frameworks. Scholars of economics, for instance, who focus on economic growth, tend to view unsustainability as merely a technical problem. Similarly, many sustainability scholars, in particular those interested in managing transition towards sustainable development, appear to be concentrating their efforts on technological solutions to address unsustainability (e.g. Edquist 2004; Hekkert et al. 2007; Rotmans and Loordbach 2009). Although such transition management approaches may recognise the complex social aspects of sustainability governance, these kinds of technological solutions are based on the idea of 'frontrunners' – visionary experts from

various fields who have come together to develop technology and market-based solutions to specific unsustainability challenges (Loorbach 2010). As with many approaches to health promotion, this participatory model still prioritizes the knowledge of experts over the knowledge of local communities.

Fischer and Black (1995) argued that a technocratic approach underestimates the critical role social and economic choices play in both the causes of and solutions for environmental problems. A focus on technology tends to engage the business community, but although the private sector is an important player in moving society towards sustainability, too much emphasis on market forces is unlikely to provide the solution. Jessop (1998 in 2003) argued that the more societal complexity increases, the less we can rely on the anarchy of the markets or the hierarchy of the state "as means of co-ordination" and the more appropriate a governance approach to sustainability becomes. Stirling (2009) defined the three normative aims of sustainability governance as human well-being (including health, education, community and economic development), social equity (both intra- and inter-generational), and environmental quality (in terms of pollution prevention and abatement, ecological integrity, and resource availability).

The perspective of environmental governance used to be limited to "the set of regulatory processes, mechanisms and organisations through which political actors influence environmental actions and outcomes" (Lemos and Agrawal 2006:298). Similar to the way the 'new' health promotion movement emerged as a response to the limited scope of behaviour change models, sustainability governance evolved as a critique of the narrow focus of environmental governance on natural and ecological sciences. Sustainability

governance expanded the scope of environmental governance by integrating social and economic elements along with those centred on the ecological and natural sciences (Dorcey and McDaniels 2001). This paradigm shift has translated into different approaches to practice. For instance, transportation policy discussions now consider not only the topics of pollutant emissions and energy conservation but also those of land use development and urbanization patterns, including their economic, environmental and social consequences of the latter (Dorcey 2004). Jordan (2008) pointed out that sustainability governance, because it encourages interdisciplinary debates, can be a valuable bridging concept. In general, sustainability governance can be seen as an approach that aims for a more sustainable and equitable future by reforming the socio-political practices that govern individual and collective action in complex social-ecological systems (Kemp et al. 2005; Bosselmann et al. 2008; Adger and Jordan 2009a; Meadowcroft 2009).

Sustainability governance can also be thought of as "a tool for social administration", which guides both the structure and the governing process (Rainham et al. 2008:173). As a tool, it embraces uncertainty, complexity and diversity and tries to find ways to '*steer*' through the unpredictable future. The reflexive, adaptive, collaborative and learning-based approaches of sustainability governance are rooted in collaborative and adaptive resource management theories (Dorcey 2004)[5], which are considered to be more responsive to the challenges of integrating environmental protection and economic development goals (UNEP 2009). Although extensive analysis of collaborative and adaptive governance approaches is beyond the scope of this paper, it is worth noting that such approaches can

[5] These theories in turn draw from a long tradition of deliberation and experimentation with participative democracy.

also enhance the collective understanding of current issues at hand and may function as a source of innovation (Kallis et al. 2009). Sustainability governance covers a broad range of topics that reaches beyond the scope of contemporary public health mandate. For instance, it addresses issues related to major institutional changes (e.g. Dovers 2001) or explores ways to govern towards new technological innovations that address sustainability challenges, as in transition management (e.g. Loorbach 2010). This difference in scope between health promotion and sustainability governance was one of the reasons the conceptual framework introduced in this dissertation concentrates on the community scale.

One essential component in sustainability governance is the concept of *good governance*, which reflects the current understanding of ideal governance that is implicitly embedded in contemporary values and cultural norms (Rainham et al. 2008). The most common interpretations refer to governance aspects that improve environmental justice and fairness, such as equity and transparency (e.g. Bosselmann et al. 2008). Bernstein (2005:668), for instance, defined good environmental governance practices as the complex mixture of different approaches to governing that is entrenched in the legislation, "compatible with the global marketplace (understood to be necessary for economic growth and development)", and combined with "greater participation, transparency, accountability, and fairness". He further a that good governance approach was vital for creating a sense of *ownership* among stakeholders. OECD (1995) and the World Bank (1992) interpretations of good governance included similar elements such as leadership and capacity building as essential to good governance. Rainham et al. (2008), however, criticised these types of agendas for supporting corporate interests and aiming to replace

the functions of state governments with market mechanisms, which, they argued, would not necessarily promote sustainable practices. In a way, sustainability governance can be seen as an improved version of *good governance* as it acknowledges ecological integrity and sustainability goals.

The strong academic roots of sustainability governance literature in political science and economics may provide the most vital contributions for the potential framework proposed in this dissertation. Where health promotion literature related to policy development has a relatively limited scope centred on the practical aspects of influencing decision-makers (Milio 1987; Hancock 2011b), sustainability governance literature has a more extensive system-wide understanding of the complexity of governing processes (Adger et al. 2001; Bulkeley 2005). Wallerstein (2007) pointed out that the term governance has only recently started appearing in the North American health promotion literature (e.g. WHO 2011). Governance concepts such as *multi-level governance* (Jessop 2003), *polycentric governance* (Ostrom 2010) or the *subsidiarity principle* can be useful in understanding alternative governing models that encourage the participation of civil society in decision-making processes. Inclusive governance can help address health disparities and promote health. The *subsidiarity principle* refers to "effective user participation and problem solving at the lowest feasible level of organisation" (Berkes 2010:489). Furthermore, sustainability governance literature puts greater emphasis on identifying power relationships and cross-scales influences between various sectors and levels of governance (Adger et al. 2001; Armitage 2008).

Although global issues as well as national and provincial jurisdictions need to be kept in mind, this doctoral research focused on sustainability governance at the community level, where discussion tends to emphasise social networks, contextualised knowledge and deliberative empowerment issues in policy development. This is also the level where the differences between health and sustainability issues start to blur. According to Roseland (2005:12), sustainable community development builds on the six forms of community capital mentioned above. Roseland (2005:30), however, argued that while the characteristics of sustainable communities may vary by location, the objectives and governance instruments used to develop sustainable communities should be applicable anywhere.

There is, indeed, no single definition of a sustainable community that everyone agrees upon. Roseland (2005:26), for instance, argued that each community should collectively determine its own sustainability criteria. Hempel (2009) identified five clusters of different types of sustainable community movements based on theoretical foundations: capital theory (economics and accounting); urban design (land-use planning and architecture); ecosystems management (ecology); metropolitan governance (regionalism); and ecovillages (neighbourhoods). For the purposes of this paper, a sustainable healthy community is understood as "one in which economic vitality, ecological integrity, civic democracy, and social well-being are linked in complementary fashion, thereby fostering a high quality of life and strong sense of reciprocal obligation among its members" (Hempel 2009:37).

3.3.1 Sustainability criteria

Various schools of thought assess sustainability take somewhat different approaches to assess sustainability (Pope et al. 2004) but the aim of sustainability criteria, which usually consists of principles, objectives, and indicators, is to provide strategic guidance for substantive objectives and deliberative processes of sustainability governance (Sinclair et al. 2009). One essential characteristic of these criteria is context specificity (Gibson et al. 2005; Norton 2005). Sustainability criteria are used in a number of different settings, but in the field of sustainable community development, they are vital for helping to bring theoretical discussions into "a context of practical problem solving" (Hempel 2009:51). The importance of developing community indicators is indeed one of the few things that scholars of sustainable development appear to agree on (Innes and Booher 2000; Hempel 2009).

Gibson et al. (2005:116-118) identified the following generic core categories as critical for sustainable development: (1) the integrity of the socio-ecological system in question, (2) sufficient opportunities to earn a living (livelihoods), (3-4) intra- and intergenerational equity, (5) resource maintenance and efficiency, (6) socio-ecological civility and democratic governance, (7) precautionary and adaptive approach, as well as (8) immediate and long-term integration of all principles of sustainability in the practices. Though the authors emphasize that these generic criteria must be made more specific for each case and context, the generic guidelines can be useful for a transdisciplinary framework development. For instance, they can help identifying common goals and process characteristics when developing improved indicators for health assessments.

A participatory approach to governance, which is central component in sustainable development, also influences sustainability criteria development. The concept of sustainability governance is strongly rooted in principles of deliberative democracy, such as reasoned debate, public justification, and political equality. As such, the fundamental idea is that an investigative discussion and public reflection should precede all decision-making. Further, "the public interest cannot emerge merely by summing pre-existing preferences" because it requires a deliberative process that "generates new insights and transforms initial perspectives" (Meadowcroft 2004:184). In general, deliberative approaches are assumed to improve the legitimacy and efficiency of environmental politics (Dovers 2005; Backstrand et al. 2010) although they are also good in themselves as a means of promoting human expression and growth. The underpinning philosophy for assessing sustainability is human well-being. Furthermore, sustainability criteria emphasize that we should aim to avoid any trade-offs between or among social, ecological and economic gains, especially, in the interest of quick, short-term, unsustainable benefits and instead seeks multiple mutually reinforcing, fairly distributed and lasting gains (Gibson et al. 2005:122-141).

3.4 Parallel historical developments

Historical developments have affected the practices of health promotion and sustainability governance in similar ways. Approaches in both fields have become more deliberative and less focused on top-down regulation. This evolution illustrates how universal social changes have influenced the theoretical and practical aspects of both fields. In *Figure 6*, selected benchmarks in both areas show the changes in approaches over the past 40 years.

Public health originated from the field of communicable disease prevention, which strongly emphasised a top-down, expert-led, regulatory approach to controlling the spread of bacterial and viral infections. When chronic diseases started to dominate mortality and morbidity statistics in the 1970s, the same health education methods were adopted for non-communicable disease prevention with a strong focus on lifestyle choices. This

	1960s	1970s	1980s	1990s	2000s	2010s
Environmental/ Sustainability Governance		**Top down regulatory approach ⇒⇒**		**Sustainable development, market forces, incentives ⇒**	**Sustainable community development ⇒⇒**	
Selected milestones in SG	1962 Rachel Carson *Silent Spring* 1969 *Cuyahoga River, OH* fire	1970 EPA 1971 Environment Canada	1987 Brundtland Report *Our Common Future*	1992 UNCED *Earth Summit* Rio de Janeiro – Local Agenda 21	2002 UNCED Johannesburg 2009 Copenhagen UN Climate Change	2011 Durban UN Climate Change Conference
Health Promotion		**Top down expert & lifestyle focused ⇒⇒**	**SDOH & population health approach ⇒**	**Healthy communities movement ⇒ ⇒**		
Selected milestones in HP	Chronic diseases (e.g., cancer, heart disease and stroke) replaced commu-nicable diseases as the leading cause of death	1972 ParticipACTION to promote healthy life styles 1974 Lalonde Report	1986 Ottawa Charter for Health Promotion 1986 WHO Healthy Cities project launch	1991 Sundsvall Statement on *Supportive Environments for Health* 1998 Adelaide recommen-dations on *Healthy Public Policy*	2005 Bangkok Charter for Health Promotion	2010 The 20th IUHPE World Conference on Health Promotion examined ways to build bridges between the fields of health promotion and sustainable development to improve health for all

Figure 3.2: Parallel historic developments in sustainability governance and health promotion

approach, however, did not provide the desired outcomes and a more ecological approach to health promotion was born (e.g. McLeroy et al. 1988; Glanz et al. 2008), then bolstered by the Ottawa Charter (WHO 1986). Also at the time, SDOH were integrated into the population health approach, which started to promote the development of public policies that made healthy behaviour the easy choice, such as smoke-free policies (Sallis et al.

2008). The population health approach that emphasises health policy that focuses on individual behaviour change and uses awareness creation and incentives as primary drivers, is still favoured by political decision-makers despite its narrow scope. Parallel to the top-down individualistic model, which some scholars argue is based on neoliberal ideology (Becker 1986; Minkler 1989; Young and Hayes 2002:29), a bottom-up, community-based participatory approach to health promotion has slowly been gaining ground (e.g. Minkler 1997; Cohen et al. 2007). This empowerment-centred health promotion, building on Paulo Freire's empowerment education theories (1968), aims for capacity building and progressive societal systems change (McGinnis et al. 2002; O'Neill and Stirling 2007). All three of these approaches to health promotion – regulatory, population health, and community-based – reflect the social changes and trends that have taken place in our society over the past decades, and to varying degrees still influence today's public health practices. What makes this interesting is that very similar trends have taken place in environmental governance (Illustrated in *Figure 3.2*).

Since the early 1990s, sustainable and healthy community movements have been gaining momentum as attempts to establish more integrated approaches to solving complex societal challenges. The underlying philosophy has emphasised deliberative participation and local level engagement as a channel to move from theory to action. For instance, in the 1992 *Agenda 21* action plan of the *Earth Summit*, United Nations Conference on Environment and Development in Rio de Janeiro, paragraph 28 stated: "As the level of government closest to the people, local authorities play a vital role in educating, mobilizing and responding to the public to promote sustainable development" (UNCED 1992). This paragraph became known as the basis for *Local Agenda 21* (LA21), because it

encouraged the development of inclusive, local participatory governance models and emphasized local accountability and democratization, thus creating opportunities for local governments to address sustainability issues in a new manner (Parker and Selman 1999). Furthermore, LA21 acknowledged that sustainable development will only become an effective norm if it is perceived as relevant and meaningful by ordinary people (Voisey et al. 1996). In 1986, the World Health Organization (WHO) initiated its Healthy Cities project, which also aimed to engage local governments in improving health, using an integrated holistic approach (Bentley 2007).

Of the many ways of looking at the historical development of environmental governance, a three-epoch framework proposed by Mazmanian and Kraft (2009b) is probably the best to illustrate the parallels with public health. Mazmanian and Kraft identified three distinct but overlapping eras of attempts to address environmental issues and promote sustainable development: 1) Regulating for Environmental Protection, 1970-1990s; 2) Efficiency-Based Regulatory Reform and Flexibility, 1980-2000s; and 3) Toward Sustainable Communities, from 1990s to the present. Roughly described, the first era refers to top-down approaches that focus on regulation focused approach; the second one to market-based and collaborative mechanisms that focus on cost-effectiveness; and the last one to community-based approaches that embrace an eco-centric ethos and "[bring] into harmony human and natural systems on a sustainable basis" (p.8). As with the course of public health, these three eras, illustrated in *Figure 6*, reflect the more universal social changes taking place at the time, although in public health the developments occurred slightly earlier within in public health. Characteristic to both fields is that all three

approaches are in use today and that the two latter periods build upon, and respond to the deficiencies of, the first one.

While we can see similarities in how social trends affected both fields, differences in historical roots likely explain the current institutional separation. In 1969, the fire of the polluted Cuyahoga River, in the United States, highlighted the importance of water management regulation and accelerated the developments of new ministries to address environmental issues. Yet when the Environmental Protection Agency in the US was established in 1970 and Environment Canada in 1971, a strong evidence base linking pollution with public health did not yet exist. As such, there was no obvious reason to establish a system that integrated the new ministries with existing public health bodies. At the time, public health was just beginning to recognise the new trends indicating that vector borne infectious diseases were becoming less prevalent as chronic diseases were increasingly dominating the mortality statistics. Scientific understanding of the roles of environmental factors and early childhood exposures in the development of disease and dysfunction were not yet well understood by science (e.g. Landrigan and Garg 2002; Gavidia et al. 2009; Barouki et al. 2012; WHO 2012).

Thus path dependencies[6] in our, primarily reactive, political establishment have created some administrative structures that currently hinder effective collaboration for a healthy, sustainable society. Recognising the history that led to this administrative

[6] *Path dependency* is a term used primarily in North America, e.g. in public policy literature, referring to development of events or practices when "initial moves in one direction elicit further moves in that same direction" (Kay 2003:306) or previous decisions make it challenging to change course towards a new direction (Gelcich et al. 2010).

compartmentalisation, while acknowledging the similar paths of philosophical evolution in both fields opens up for new alternative approaches to cross-sectoral collaboration.

3.5 Bridging public health and sustainability

As the above introductions to health promotion and sustainability governance imply, the fields have significant similarities. From the practical integrative work perspective, it could be beneficial to have a more explicit analysis regarding complementarities of the fields.

Health in general is a broad concept. In 1948, the World Health Organisation (WHO 1948) defined it ideally as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". Despite the narrower focus of the current dominant public health paradigm on individual responsibility related to change in health behaviours, this research uses health in its broadest sense, as outlined by the *Ottawa Charter for Health Promotion* (WHO 1986) and discussed in Section 2.1.2. The prerequisites for health and consequent social determinants of health offer a useful platform for addressing the relevance of health in all sectors. Similarly, a broader sense of sustainable development is harnessed by sustainability criteria (e.g. Gibson et al. 2005), which explicitly embrace the interconnectedness between diverse factors within complex social-ecological systems (See section 2.1.1). This similarity between the scopes of SDOH and sustainability criteria offers a promising platform for bridging the concepts of health and sustainability.

In the 1990s, the first suggestions about amalgamating the concepts of health promotion and sustainable development started to emerge (Kickbusch, 1989; Labonte, 1991a; 1991b; Hancock 1993; 1996), though with limited success. Hancock (2000:151),

who spearheaded this integrated approach at the local level, argued that "healthy communities must be both environmentally and socially sustainable, given that health depends on the quality of the built and natural environments, and that global change resulting from the industrial economy is affecting the web of life". Scholars have also made suggestions for connecting the fields of health promotion and resource management (Brown et al. 1992), in particular watershed governance (Parkes et al. 2003; Parkes and Horwitz 2009; Parkes et al. 2010; Webb et al. 2010; Bunch et al. 2011). In Australia, a coalition of universities developed a curriculum that incorporated a sustainability perspective into public health courses (Brown 2004). Masuda et al. (2010), in turn, talked about the synergies between health promotion and environmental justice and pointed out the potential for collective policy development.

The connection between unsustainable practices and infectious diseases has been widely documented (Waltner-Toews 2004; Crowl et al. 2008; Arya et al. 2009). Yet despite this growing body of evidence, the public acknowledgement of the linkages between non-communicable disease prevention, healthy ecosystem and human well-being remains limited. Although chronic disease prevention discourse still tends to focus on lifestyle choices (Choi *et al.* 2005; Willett et al. 2006), SDOH is about more than just developing environments that make the healthy behaviour choice the easy choice. Marmot (2004; Marmot and Wilkinson 2006) and, in the Canadian context, Raphael (2004) are probably the best known of the scholars who have documented and argued that poverty and inequity are the key determinants of health. Hancock (2011a) claims that the key determinant is the physical environment and other scholars have proposed food systems and access to healthy food as a critical area of focus (e.g. Foley et al. 2010). There is also an increasing

evidence base that indicates the picture may be significantly more complex than previously thought, particularly given the recent research on endocrine disruptors and child development (Landrigan and Garg 2002; WHO 2002; Raphael 2004; Grandjean et al. 2008; Kampa and Castanas 2008; Boyd and Genuis 2008; Birnbaum 2009; Egger and Dixon 2009; Geneau et al. 2010; Beaglehole et al. 2011; Corea et al. 2012; Porta and Lee 2012). According to these scientific studies, aspects of environmental resource management, urban planning, wastewater treatment, agricultural traditions, and industry practices have all produced environmental pollutants that are causing a noteworthy negative impact on health outcomes, in addition to the challenges posed by climate change, poverty and food insecurity.

However, efforts to put the above-mentioned theoretical frameworks into practice and get health sector professionals working together with stakeholders who are not directly associated with health have, however, been sparsely documented in the academic literature. Few publications explicitly focus on environmental health promotion (e.g. Freudenberg 2004; Howze et al. 2004; Parker et al. 2004). The ground-breaking works of community-based participatory health research scholars, such as Meredith Minkler (e.g. 2010), environmental justice case studies (e.g. O'Fallon and Dearry 2002; Wing et al. 2008), and Valerie Brown's efforts in Australia (e.g. 2008) are probably the best-known in the field, yet this recognition appears to be limited to the health research side of academia. Therefore I deemed it valuable to build understanding of the processes by which the integration of health and sustainable development has successfully taken place within the sustainable development and environmental conservation domain. Moreover, in order to improve the acceptability and usefulness of the results, this research produced a

framework, which was developed based on overlapping and complementary applied theories that are already used by practitioners on the field, instead of introducing brand new concepts.

3.5.1 Similarities in health promotion and sustainability governance theories

As discussed in Section 2.3, ideas and practices in health promotion and sustainability governance fields, which were influenced by many of the same intellectual influences and practical constraints, developed, possibly even co-evolved, along similar themes on parallel paths over the recent decades. Characteristic to both health promotion and sustainability governance theories is the intent to find a way to guide change towards a '*better*' society. This quality distinguishes the approaches of both fields from more conventional social science approaches that aim to describe and analyse to predict events without influencing the course of development (objectivism). Furthermore, both health promotion and sustainability governance literature emerged as a critique of top down governing approaches.

The nature of theories in both fields is also analogous. Each field is based on the same two types of theories on both fields: problem-focused and process-focused. Both practices are rooted in problem-focused theory, which emphasises natural scientific and quantitatively measured problems or causal relations that create a reason for action. In health promotion, the focus is on identifying the cause for disease and dysfunction as well as wellbeing. In environmental governance, the focus used to be primarily on the natural scientific and technical aspects of the management of human effects on the environment, However, the paradigm shift towards sustainability governance has expanded the

emphasis to include new aspects, such as fair access and livelihoods. While theories based on quantitative measures and more technocratic approaches to problem solving have traditionally been favoured by decision-makers in both fields, both fields have also faced, and often been forced to accommodate, pressures for more transparent, participative, context sensitive, broadly conceived, and integrated approaches.

Process-focused theories can favour quantitative measurements but their primary focus is to understand the actual procedures, developments or courses of action by using qualitative, descriptive analyses. Related academic research focuses on identifying what drives or blocks a given course of action, who the stakeholders are, and what social relationships and other factors are involved. In practice, because both fields have been guided by policies, the focus of academic research has highlighted policy development (e.g. Milio 1987; Sabatier 1988). In health promotion, policy analysis tends to concentrate on advocacy aspects of health promotion (e.g. Glanz et al. 2008), whereas academic work in sustainability governance has a more nuanced and broader understanding of the complexities in political governing processes (e.g. Adger and Jordan 2009a).

Fundamentally, however, similarities in SDOH concerns and the basic requirements for progress towards sustainability (the generic sustainability assessment criteria, which recognise the true complexity in social-ecological systems) offer the most solid argumentation for a shared conceptual framework. It is this commonality of criteria required for desirable outcomes that this doctoral research builds upon. The conceptual bridging of these two fields along with the use of process-oriented bridging venue, such as ecohealth, and an outcome-focused bridging concept, e.g., children's environmental health,

has the potential to break down the disciplinary and cross-sectoral silos, as is needed for sustainable healthy community development.

3.5.2 Ecohealth

The *Ecosystem Approach to Health* was developed by Canada's International Development Research Centre and later became known as *Ecohealth*. It acknowledges that human health cannot be addressed in isolation (Lebel 2003). The socio-ecological quality of the environment in which people live has a huge impact on their well-being: "for people to be healthy, they need healthy environments" (p.xi). This emerging field places equal emphasis on health and the environment (Lebel 2003; Dakubo 2010) and situates both in the larger context of healthy human socio-economic and biophysical relations. It sees health as an outcome of ecosystem management and "seeks to promote human health and well-being through sustainable management of all components of the environment" (Dakubo 2010:38). Furthermore, ecohealth sees both human and ecosystem health as part of a complex system, in which people participate as active players instead of passive recipients or victims. Rainham et al. (2008:172) argued that sustainability as a concept acknowledges the critical significance of a functioning ecosystem as "the primary determinant of health for humans and all other forms of life". Ecohealth has a research-focused orientation with a strong inclination towards participatory action research, yet as a field it is still rather undefined and searching for its boundaries (Brisbois 2011). Ecohealth builds on three fundamental pillars: transdisciplinarity especially linking health and environment, equity, and participation based on consensus and cooperation (Lebel 2003). Given the requirements of its participatory approaches, ecohealth has an implicit focus on the community. Up until now, ecohealth research has been primarily concerned with infectious

diseases, although in theory the concept can also be applied to non-communicable diseases as well (Davies 2006; Landrigan 2006; Hernke and Podein 2011).

Ecohealth perceives complexity through a systems science lens, which takes into account feedback loops and uncertainty. According to Waltner-Toews (2004:44), the fundamental rationale for establishing ecohealth as a concept was Checkland's *Human Activity Systems*, in which systems-thinking not only describes problems but also explains and solves problems them. In its current state, ecohealth does not provide many new theoretical concepts, but it offers a conceptual forum where health and the environment are considered inherently interlinked.

As Arya et al. (2009) emphasized, health cannot be promoted using simple solutions or narrow single sector approaches. Although their focus was primarily infectious diseases, Arya et al.'s findings are valid for chronic disease prevention as well. An ecohealth approach has the potential to bridge the most current scientific knowledge with place-based collaborative efforts, thereby facilitating innovative problem-solving and inclusive, more holistic decision-making when addressing complex multi-sectoral challenges.

There are very few studies about how sustainability governance can improve human health (Rainham et al. 2008), but as Rapport (2007:77) has pointed out: "Taking an ecohealth approach to sustainability science provides a unique perspective on both the goals and the means to achieve sustainability." He suggested progress towards sustainability be measured by various health indicators, such as resilience and vitality, which in SDOH terms imply livelihoods and equity as health determinants. Although this study will not focus on the extent to which sustainability governance may be able to

improve health, it recognises the need for more research and begins by seeing health as an outcome of sustainable development.[7]

While ecohealth literature explicitly discusses both health promotion and governance towards sustainable development, the discourse is primarily rooted in the disciplines of international development and veterinary medicine. Ecohealth literature does not tend to discuss theories of health promotion and sustainability governance in any greater detail.

3.5.3 Children's environmental health

Children's environmental health refers to the ways in which a child's physiology responds differently to various environmental factors than a mature physique does. Because of their developing bodies, physical size, biochemical pathways, and behaviour as well as many socioeconomic factors, children are significantly more vulnerable than adults to environmental influences (Landrigan and Garg 2002; American Academy of Pediatrics Committee on Environmental Health 2003; Wigle 2003; OECD 2006; Gavidia et al. 2009; WHO 2009; Barouki et al. 2012). In government policy literature, particularly in North America, children's environmental health usually refers primarily to health outcomes related to chemical exposures during the timeframe from pre-conception through puberty (e.g. EPA 2014). In other parts of the world, the definition is often broader, referring to aspects such as access to green spaces or public transportation (Health Protection Agency 2009).

[7] Charron (2012) included sustainable development as one of the six key principles of ecohealth. However, her interpretation of sustainability is limited to ensuring environmentally sound and socially sustainable changes, which is narrower than the approach to sustainability used in this dissertation.

Environmental threats to child health are not new and, despite a general lack of public awareness, they are widely recognised around the globe. According to Goldman et al. (2004), the field of paediatric environmental health is rooted deep in the Cold War, as far back as in the 1957-founded 'Committee on Radiation Hazards and Epidemiology of Malformations'. The current Children's environmental health movement is not new either. Its 25th anniversary will be celebrated in October 2014 (Etzel 2010). In 2003, the World Health Organization (WHO) recognized children's environmental health as a major challenge in itself and a key concept that highlights the interconnectedness between health and the environment (WHO 2003). This in turn resulted in a worldwide project to identify children's environmental health indicators (WHO 2004; 2009). Yet, particularly at the local level, children's environmental health is absent in most of the practical and political decision-making as well as most public health interventions.

Socioeconomic and biophysical complexity coupled with the temporal delays in symptom development make children's environmental health a challenging topic to address. Since Colborn et al.'s (1997) book, *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival?*, children's environmental health has been eventually gaining attention amongst researchers in academia. Over recent decades the number of research initiatives in environmental paediatrics has been growing almost exponentially (Landrigan 2011). Many researchers and health professionals argue that, based on the current evidence and the precautionary principle, new policies are necessary to facilitate a "fundamental redesign of production processes, products, and potentially hazardous activities" (Tickner and Hoppin 2000:281). However, policy development, particularly in North America, requires broad public support, which in turn depends upon both

appropriate data (evidence) and public awareness of the issues. There are significant differences between Canada, the United States, and the European Union in regulations related to matters relevant to children's environmental health (Kinney 2009), which are primarily concerned with who is responsible for the burden of proof. Because of the context-specific nature of pollution, however, a more local approach to children's environmental health assessment could be beneficial.

At the local level, an increased understanding of local children's environmental health status could be beneficial for society in many ways. The biochemical mechanisms that cause paediatric susceptibility to xenobiotic chemical exposures are ubiquitous in developing stages throughout the living world. Although the impacts of specific compounds vary between individual organisms and different species (Lister and Van Der Kraak 2001), the mixtures of excessive environmental contamination are influencing the health and function of all ecosystems. This makes a greater understanding of children's environmental health relevant for many aspects of sustainable community development, ranging from setting requirements for industrial and municipal waste purification to planning of for local urban infrastructure and natural resource management.

Exposures to toxic chemical pollutants, in particular to small doses of endocrine disrupting compounds, during the periods of embryonic, foetal and infant development influence health outcomes across the entire span of human life (Needleman et al. 1990; Pluim et al. 1993; Weisglas-Kuperus et al. 1995; Ilsen et al. 1996; Schettler 2001; Melnick et al. 2002; Mendola *et al.* 2002; Canfield et al. 2003; Olin and Sonawane 2003; Campbell et al. 2004; Opler et al. 2004; Euling et al. 2008; Grandjean et al. 2008; Lloyd-Smith and

Sheffield-Brotherton 2008; Kalia 2008; Tremblay and Hamet 2008; Barouki et al. 2012). Indeed, exposure to toxic compounds in childhood not only causes disease and disability in children but it may also lead to the development of chronic disease later in life (Landrigan and Garg 2002; Jirtle and Skinner 2007; Hanson and Gluckman 2008; Newbold 2011; Barouki et al. 2012). Wildlife studies indicate that mixtures of chemicals, such as those that make up common pesticides, can also weaken the immune system, making wildlife susceptible to bacteria normally benign to them (Hayes et al. 2006).

Endocrine disruptors are xenobiotic (environmental) chemical compounds that have the potential to cause undesirable health outcomes by interfering with hormonal regulation and disturbing the normal endocrine function, (Lintelmann et al. 2003; Genuis 2006; Baccarelli and Bollati 2009; Birnbaum 2012; Cortessis et al 2012). They have also been associated with reproductive dysfunction in both humans and wildlife (Colborn et al. 1993; Geschwind et al. 1999; Lister and Van Der Kraak 2001; Oehlmann et al. 2009; WHO 2012). These disruptors range from hormone mimicking compounds (hormone derivatives, such as Bisphenol A and phtalates) to chemicals that interfere with hormonal pathways by blocking them or stimulating undesirable activity, such as mercury, lead, and cadmium (Casals-Casas and Desvergne 2011). The effects of these contaminants are particularly disruptive in early developmental stages, because hormonal pathways control the development of the nervous, metabolic, and immune system as well as the brain (Colborn et al. 1993; Casals-Casas and Desvergne 2011; Barouki et al. 2012). Adverse health outcomes associated with exposures to endocrine disruptors include:

- neurodevelopmental disorders (Colborn et al. 1997; Landrigan and Garg 2002; Lundqvist et al. 2006; Grandjean et al. 2008);
- metabolic disorders, such as obesity and diabetes (Heindel 2003; Alonso-Magdalena et al. 2006; Catenacci et al. 2009; Newbold et al. 2009; Latini et al. 2010; Janesick and Blumberg 2011; Newbold 2011);
- cancer (Brisken 2008; Casals-Casa and Desvergne 2011; Johnson et al 2012; Fucic et al. 2012; Ventura et al. 2012); and
- many other conditions of compromised health (Colborn et al. 1997; Giasson and Lee 2000; Genuis 2006; Van den Hazel et al. 2006; Bornehag and Nanberg 2010; Latini et al. 2010; Tian et al. 2010; Masuo and Ishido 2011; Miodovnik et al. 2011; Clere et al. 2012).

One of the key aspects of dealing with environmental health hazards is acknowledging their complexity. Many reproductive disorders, for instance, result from prenatal xenobiotic chemical exposures, which tend to be first recognised during the teenage years or in adulthood (WHO 2012). The Multiple Exposure–Multiple Effects (MEME) model illustrates the complexity of children's environmental health issues (WHO 2003). It highlights the multitude of relationships between environmental factors and health outcomes, where "a single environmental agent or factor may contribute to multiple health outcomes, and a single outcome may be affected by multiple environmental factors" (Kyle et al. 2006:450). There are different mechanisms by which endocrine disruptors interfere with normal child development. The changes are called epigenetic, because they do not modify the DNA sequence but influence the activation and processing of DNA-coded information (Tremblay and Hamet 2008; Baccarelli and Bollati 2009). Not all the changes caused by environmental chemical exposures are permanent. Yet some of the permanent

modifications can be transferred to subsequent generations (trans-generational), which means that the epigenetic changes may have significant health implications for future generations (Baccarelli and Bollati 2009; Cortessis et al. 2012).

Epigenetic changes allow cellular level adjustment to environmental triggers (Tremblay and Hamet 2008). For instance, in response to starvation conditions, genes involved in metabolic programming activate the metabolic pathway most appropriate for survival in a given situation. From the evolutionary perspective such adaptive plasticity, e.g. altered need for less food, can be vital for individual survival later in life (Barouki et al. 2012). However, the adaptations can be detrimental when living conditions change, for instance, from scarcity to excess of food, or if toxic xenobiotic compounds cause the unnecessary cellular modification. Studies indicate that when epigenetic changes take place in early developmental phases, the altered patterns last not only throughout the course of a lifetime but beyond individual lifespans and the following generations (Tremblay and Hamet 2008). Such modifications are associated with early childhood exposures to low-doses of environmental endocrine disruptors and can result in long-term permanent changes related to disease and dysfunction.

There are biological, behavioural and socioeconomic reasons children are more vulnerable to environmental contaminants than adults (American Academy of Pediatrics Committee on Environmental Health 2003; Wigle 2003; Landrigan and Garg 2002; OECD 2006; Gavidia et al. 2009; WHO 2009; Barouki et al. 2012). In addition to the windows of vulnerability regarding the timing of the exposure, the effective dose in connection with endocrine disruptors creates a further concern in the environmental health discussion. The

model of traditional toxicology has been based on dose-response curves building on the principle 'the higher the dose the greater the impact'. A significant number of studies have, however, indicated that endocrine disrupting compounds may have a greater effect at lower concentrations (e.g. Melnick et al. 2002; Vandenberg et al. 2012). As Birnbaum (2009; 2012), the Director of the National Institute of Environmental Health, has emphasised, paradigm shifts in understanding are needed to address the fact that "environmental toxicants – even at very low level exposures – can have significant consequences, including dysfunction and disease" (Birnbaum 2009: A478).

This doctoral research project does not discuss the validity of various arguments in the current discussion related to children's environmental health, but rather, choosing to minimise damage when faced with scientific uncertainty and potential for serious harm, applies the precautionary principle (Myers and Raffensperger 2006:11-16) Current evidence is at least strong enough to support this application of precaution. As emphasised by the White Paper, *Developmental origins of non-communicable disease: Implications for research and public health*, "the developmental paradigm has reached the stage where the data, while not complete, are sufficiently robust and replicable across species, including humans, to require a policy and public health response. The current pandemic of non-communicable diseases and the increased prevalence of important dysfunctions demand an open interrogation of why current interventions appear insufficient" (Barouki et al. 2012:42). This statement implies that our current methods of managing natural resource, producing goods, and disposing of waste may be seriously inadequate if human and ecosystem health are to be sustained.

3.6 Conclusion

Chapter 3 described the theoretical foundations for this transdisciplinary doctoral research, covering the most vital concepts engaged in the project: health promotion, sustainability governance, ecosystem approach to health (ecohealth), and children's environmental health.

While the existing literatures in health promotion and sustainability governance are extensive, this literature review provided an introduction to the main characteristics of both fields as described within the selected writings (see p. 39-40). Moreover, the review identified parallel historic developments within public health and sustainable development (including environmental governance) discussions, which, overtime, evolved to emphasise the value of deliberative community-based approaches, either instead of or as complementary to top-down, expert-led, mechanisms.

Ecohealth and children's environmental health introduced two concepts useful for integrating health and sustainability. Ecohealth offers a process-oriented umbrella that covers both health promotion and sustainability governance. Children's environmental health, in turn, can be seen as a desirable shared process outcome, which has the potential to function as a bridging concept for cross-sectoral collaborations.

Chapter 4 explores how these four concepts can be merged into a conceptual framework that offers a theoretical platform for an integrated approach to health and sustainability. At the same time, the chapter illustrates the value of transdisciplinary theory, *epistemé*, in bridging collective knowledge.

4 Bridging conceptual 'silos': Bringing together health promotion and sustainability governance for practitioners at the landscape scale

4.1 Introduction

This paper introduces a new conceptual framework bridging health promotion and sustainability governance to facilitate practical cross-sectoral collaboration that targets complex environment and health related social-ecological challenges. Environmental health issues are a prime example of '*wicked problems*' that need to be better addressed but cannot be solved by one sector alone (Kreuter et al. 2004, Caron and Serrell 2009, Brown et al. 2010). Health problems associated with environmental factors usually involve intricate, muddled situations with groups of disagreeing stakeholders who see things from diverse perspectives. These situations are often made worse by the '*siloed*' problem-solving attempts of the current system (Brown et al. 2010). Indeed, 'w*icked problems*' cannot necessarily be solved but, according to some scholars, they can be managed (Caron and Serrel 2009). Others argue that complex environmental problems cannot be managed but merely addressed as parts of larger issues (e.g. Funtowicz and Ravetz 1994) and governed in a deliberative manner (e.g. Kemp and Martens 2007). Currently, however, the biggest challenge in environmental health problem solving may not be disagreement about how to address a given situation but what the issue is and who should be around the table responding to it. Disciplinary perceptions and institutional mandates guiding the work of practitioners tend to get in the way of cross-sectoral collaboration because organisations

cannot see the overlapping nature of institutional interests.

The complexity of environmental health issues is becoming increasingly recognised. The U.S. Department of Health and Human Services (2000:8-3), for instance, defines environmental health as follows:

> "In its broadest sense, environmental health comprises those aspects of human health, disease, and injury that are determined or influenced by factors in the environment. This includes not only the study of the direct pathological effects of various chemical, physical, and biological agents but also the effects on health of the broad physical and social environment, which includes housing, urban development, land-use and transportation, industry, and agriculture."

Despite this acknowledgement of broad determinants of environmental health, cross-sectoral partnerships that engage health, environmental, and private sectors to address public health issues are exceptions rather than general practice. Yet, for any community to be able to tackle complex environmental health challenges, (1) the situation needs to be acknowledged as a critical problem by all relevant stakeholders; (2) cross-sectoral disciplinary and institutional interests need to be aligned; and (3) new ways of thinking are needed (Brown et al. 2010). The bridging framework introduced in this paper aims to provide some conceptual tools to get people working together. The article focuses on concretising a more practice oriented conceptual bridging between health and sustainable development than hitherto discussed in the literature.

Processes in cross-sectoral and interdisciplinary collaborations have been widely studied (Mitchell and Shortell 2000, Jakobsen and McLaughlin 2004, Brown et al. 2010, Harting et al. 2011). For instance, scholars who have noted that once stakeholders have

agreed to work together they need to find a common language have underlined the importance of explicit alignment of paradigms, methods and other concepts in cross-sectoral and interdisciplinary collaboration (e.g. Mitchell and Shortell 2000, Jakobsen and McLaughlin 2004). A greater challenge in problematic environmental health scenarios relies, however, on getting the relevant people to the table when the value of collaboration is not clear to everyone. While academics tend to be freer to explore linkages among abstract, ambiguous concepts, practitioners on the field are often bound by their institutional mandates (Flaman et al. 2010). By offering a readymade analysis that uses terms familiar to practitioners, the conceptual framework proposed here aims to help overcome existing structural barriers particularly between stakeholders within health and environmental sectors. Being able to demonstrate, in a timely manner, a clear rationale and supporting evidence base for a desired course of action can often be the decisive factor in determining institutional activities.

To identify the key components for building bridges across the conceptual disciplinary and institutional barriers that currently impede collaboration between public health and sustainable development sectors, literatures in health promotion and sustainability governance were explored. The goal was to identify common ground upon which practitioners in respective fields could build a sound collaborative foundation. Health promotion literature is widely used as an evidence base for intervention development within public health, and concepts in sustainability governance are familiar to practitioners working towards sustainable development, e.g. within natural resource management. There are also good reasons to expect that better integration and application of insights from health promotion and sustainability governance would be useful for

healthy and sustainable community development, because both fields provide some specific conceptual tools for practitioners. While health promotion has a significant focus on theory-informed intervention (e.g. Bartholomew et al. 2006) and sustainability governance attempts proactively to assess the potential social and environmental impacts of given activities (e.g. Gibson et al. 2005), both fields recognise a need to improve the prevailing situation.

Practitioners often see the value in cross-sectoral collaboration but struggle to gain the necessary internal support from their organisations[8] (Flaman et al. 2010). By explicitly communicating the synergistic potential of the respective fields, practitioners will be able to justify cross-sectoral collaboration within their existing mandates and work to more effectively pool sparse resources within their communities. A framework that demonstrates a shared platform can help address institutional challenges, such as competing priorities and organisational mandates.

In addition to identifying the overlapping process-oriented aspects of health promotion and sustainability governance, this paper explores children's environmental health as an example of a desirable shared outcome (a bridging concept) that illustrates the interconnectedness of health and sustainable development. Because of its nature as a determinant of adult health, children's environmental health genuinely emphasises the vital interdependencies between health and the environment (WHO 2009, Health Canada 2010, Barouki et al. 2012).

[8] Barriers to cross-sectoral collaboration are complex and often context-specific. This paper focuses only on addressing the issue of theoretical silos that hinder the integration of health and sustainability in practice, aiming to help overcome some of the institutional lack of support identified, e.g., by Flaman et al. 2010).

The first part of the paper discusses why this type of a transdisciplinary conceptual bridging framework and children's environmental health as a bridging concept might be of value for healthy and sustainable community development. It also explores how this discussion currently is situated in the existing academic literature. In the mid-section of the paper, the identified overlapping concepts of health promotion and sustainability governance are discussed and integrated into a conceptual framework. The proposed framework builds on the existing ecohealth approach and emphasises children's environmental health as one of the critical overarching outcomes of all activities. The development of this conceptual bridging framework was guided by two main research questions: (1) What are the overlapping areas of interest for health promotion and sustainability governance? and (2) How can expertise in health promotion and sustainability governance complement and strengthen one another?

4.2 The lay of the land

Much of the current discussion about the interconnectedness of public health and sustainable development takes place in academic or higher level policy development venues without reaching frontline practitioners, other than in occasional, decentralised, autonomous projects (Hempel 2009). Practitioners work generally at the community level and therefore the paper focuses primarily on community and landscape scales. For the purposes of this research, Hempel's definition (2009:35) of the term *community* as "particular geographic associations of people who share some social, political, historical, and economic interests" was found most useful.

In this paper, health promotion is understood as "any planned combination of educational, political, environmental, regulatory, organisational mechanisms that support

actions and conditions of living conductive to the health of individuals, groups, or communities" (Joint Committee on Health Education and Promotion Terminology 2001 as cited in McKenzie et al. 2004:4). Sustainability governance, also known as *governance towards sustainable development*, in turn is defined as decision-making that involves multiple bodies (governments, private sector actors, civil society organisations, etc.) in directing individual and collective actions towards a more sustainable and equitable future (Kemp *et al*. 2005, Bosselmann *et al*. 2008, Adger and Jordan 2009a, Meadowcroft 2009).

Conventionally, responsibility for decision-making related to environmental health has been perceived primarily as the responsibility of regulatory authorities, most commonly above the community level (Tong and Lu 1999, Hattis 2009). The context specificity and complexity of environmental issues would, however, suggest that it might often be more meaningful to address these issues at the local level[9]. Although not explicitly focused on environmental health, both public health and sustainable development discussions have been moving from top-down governing towards a landscape scale governance focus, for over twenty years (Raphael and Bryant 2002, Mazmanian and Kraft 2009a). Landscape scale in this context refers to a regional, trans-boundary approach across jurisdictional and administrative boundaries (Pollock et al. 2008). Since the early 1990s, sustainable and healthy community movements have become increasingly important in attempts to direct development towards sustainability and improved public health, respectively. In 1992, one of the key paragraphs in the action plan of the *Earth Summit* (UNCED 1992) was *Local Agenda 21* (LA21). It encouraged the development of

[9] Promoting intervention at the local level does not undermine national or international level regulations. Governance at various scales serves different purposes and this research sees local interventions as complementary to national level policy development (More in Chapters 6 and 7).

inclusive, local participatory governance models and emphasized local accountability and democratization with the aim of creating opportunities for local governments to address sustainability issues in a new manner (Parker and Selman 1999). Furthermore, LA21 acknowledged that sustainable development would become an effective norm only if it is perceived as relevant and meaningful by ordinary people (Voisey *et al.* 1996). Since 1986, the World Health Organization (WHO) has similarly promoted the Healthy Cities project, which aims to engage local governments in improving health, using an integrated holistic approach (Bentley 2007).

That we have not seen the expected social changes is a result of numerous factors. Engaging diverse stakeholders in sustainable development issues, for instance, has not been as successful as anticipated (Bickerstaff and Walker 2001, Bosselmann *et al.* 2008, Kythreotis 2010, Yetano et al. 2010), and the current state of affairs indicates that we have not been effective in shifting governance practice towards sustainability. In contrast, successful deliberative approaches to public health policy development have been widely documented (Poland et al. 2000a, Joffres *et al.* 2004, Nykiforuk *et al.* 2008, Rutten *et al*. 2011, Sparks 2011), though the public health sector would likely benefit from broader cross-sectoral collaborations as well.

Broader cross-sectoral collaborations have been endorsed by several WHO declarations that aim to advance health as a responsibility of all sectors (WHO 2005, WHO and Government of Southern Australia 2010). There is, indeed, an increasing body of literature suggesting that health should be a driver for social and economic development and the goals should be built around determinants for improved health and well-being

(Hancock 2000, Lebel 2003, Corvalan *et al.* 2005, McMichael 2006, Dakubo 2010, Hancock 2011a, Hogstedt and Pettersson 2011).

4.3 Children's environmental health

The local epidemic of Minamata disease in Grassy Narrows, Ontario, which was linked to the consumption of fish contaminated by mercury (Takeuchi *et al.* 1977, D'Itri and D'Itri 1978, Wheatley *et al.* 1997, Harada *et al.* 2005, 2011, Takaoka *et al.* 2014) is an extreme yet in important ways typical example of a situation where public health and well-being are threatened by the local biophysical and socioeconomic conditions. Because of pollution caused by the chemical, pulp, and paper industries decades ago (Howard 1980), combined with current clear-cut logging practices, the mercury levels in the local watershed remain severely hazardous for human health (Garcia and Carignan 2005, Desrosiers *et al.* 2006, Kinghorn *et al.* 2007, Harada *et al.* 2011). Moreover, the 1970 commercial fishing ban, put in place to protect people's health, destroyed the local economy, which was heavily dependent on fishing and tourism. Subsistence living and a lack of meaningful communication between the community and relevant decision-makers have further complicated the situation (Erikson 1994). Children born decades after the industrial mercury pollution ceased are still being diagnosed with Minamata symptoms today (CBC News: The National, 5 Apr 2010, Takaoka *et al.* 2014).

This case represents a typical 'wicked' environmental health issue, a highly complex social-ecological challenge associated with natural resource management, local livelihoods, food security, poverty, and vulnerable populations. It is also a prime example of the dysfunctional, fractioned responses that result when the current system attempts to address an environmental health challenge that occurs in the context of strong socio-

economic interests. Grassy Narrows is an example of a disastrous industrial legacy that still affects human health, forestry, and fisheries in ways that cannot be addressed without effective collaborations that include public health, private business, and resource management sector, as well as affected citizens. Challenges related to this type of wicked problem have been acknowledged in a wide range of literatures, including health promotion, public administration, and environmental governance (e.g. Wang 2002, Kreuter et al. 2004, Weber and Khademian 2008, Brown et al. 2010). Yet few practical solutions have materialised so far.

Linkages between public health and the environment have been broadly acknowledged by, for instance, the renowned *Lalonde Report* (Health Canada 1974), the *Ottawa Charter for Health Promotion* (WHO 1986) and numerous academic scholars (Guidotti and Gosselin 1999, Aron and Patz 2001, Waltner-Toews 2004, Brown et al. 2005, Corvalan et al. 2005). Similarly, the health links with sustainability have been established. The Brundtland report (WCED 1987) drew connections between biospheric stewardship, intergenerational equity, livelihoods, and human well-being, when it defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

There is, indeed, a well-established, institutionalised collaboration between the public health and environmental sectors in connection with infectious disease prevention. In addition, project-specific collaborations have formed around chronic disease issues. For instance, s public health units and urban planners have started to work together, in collaboration with other food systems stakeholders, to address food security issues (e.g. Ontario Professional Planners Institute 2007, Desjardins et al. 2011). Yet the cross-sectoral

collaboration needed to address non-communicable diseases or the long-term impacts of environmental factors such as chemical pollution, particularly at the local level, has been neither consistent nor comprehensive. Despite the growing body of evidence linking environmental factors with the development of chronic diseases (e.g. Health Canada 1974, Ben-Shlomo and Kuh 2002, Barouki et al. 2012), sustainable development and public health decision-making practices have not been integrated.

Although an integrated approach to health and sustainability could illuminate work in many areas, including poverty reduction and food security, this paper focuses on the emerging subject of children's environmental health. Considering that sustainable development focuses on the well-being of future generations, the connections between children's health and the environment are inherently vital. For instance, although the environment affects all ages, specific windows of vulnerability in child development make low-dose exposures to endocrine disruptors in childhood more detrimental than they are later on in life (Goldman et al. 2004). This same paediatric susceptibility to environmental factors that may lead to chronic disease in adulthood (Barouki et al. 2012) poses a threat to several aspects of sustainability, including public health, ecosystem services, and economic productivity (Hinga and Batchelor (MEA) 2005; Grandjean et al. 2008; WHO 2012). The impacts of low-dose toxic exposures during early developmental stages have been widely documented in wildlife, for example in the feminisation of fish and severely compromised immune system in frogs (Colborn et al. 1993, Casals-Casas and Desvergne 2011, Harries et al. 1997, Hayes et al. 2006, Tyler and Jobling 2008, Birnbaum 2012, Vandenberg et al. 2012). These effects, extending across social-ecological scales, make children's environmental health an outcome relevant for the entire ecosystem.

Concern for paediatric environmental health has increased significantly over recent decades (e.g. Landrigan and Garg 2002, Kalia 2008). Unlike the relatively simple causalities of vector-borne infectious diseases, the complex aetiology of chronic diseases and dysfunction (Grandjean et al. 2008, Barouki et al. 2012, Davey Smith 2012) highlights our limited understanding and the importance of interdisciplinary and precautionary approaches to improving the current situation. In particular, life course epidemiology and an increased understanding of the developmental origins of non-communicable diseases have brought attention to children's environmental health issues (e.g. Ben-Shlomo and Kuh 2002, Grandjean et al. 2008, Barouki et al. 2012, Davey Smith 2012). Without underestimating the importance of the adult lifestyle model of chronic disease risks, both the biochemical data on epigenetic changes (e.g. Melnick et al. 2002, Baccarelli and Bollati 2009, Birnbaum 2012, Vandenberg et al. 2012) and epidemiological studies (e.g. Kaplan and Salonen 1990, Kyle et al. 2006, Galobardes et al. 2008) on associations between childhood conditions and later health status signal an increasing need for interdisciplinary collaboration on children's environmental health issues. As pointed out by Grandjean et al. (2008:2), the sensitivity of children's brains to toxic exposures "may have serious implications for future social functioning and economic activities, even in the absence of mental retardation or obvious disease" Furthermore, the fact that nutritional and toxic xenobiotic compounds share biochemical pathways in child development (Barouki et al. 2012) points to the value of including a wide variety of stakeholders, for instance, those working with food systems or childcare.

4.4 Exploring health promotion and sustainability governance

Some scholars consider the environment the most important determinant of health (e.g. Hancock 2011a). Social determinants of health (SDOH) have been explicitly connected to environmental health promotion (e.g. Howze et al. 2004, Schulz and Northridge 2004, Srinivasan and Dearry 2004). In principle, SDOH, as widely acknowledged by public health discussions, emphasise social and biophysical environmental influences, albeit interpretations regarding the importance of specific determinants vary. WHO (2011) defines SDOH as "the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels." Yet, despite broader intentions, most of these discussions have remained primarily within the public health sphere.

Over the years, a number of scholars have suggested the amalgamation of health promotion with sustainable development (e.g. Kickbusch, 1989, Labonte, 1991a, 1991b, WHO 1997, Jones 2002), natural resource management (Brown et al. 1992), and more specifically watershed governance (Parkes et al. 2010). Discussions about linking health promotion and sustainability have, ranged from exploration of cases in environmental politics (e.g. Jones 2002) and environmental justice (Masuda et al. 2010) to the idea of incorporating sustainable development explicitly into public health education at universities (Brown et al. 2005). Moreover, on an international scale, there have been a number of efforts to further an integrated approach to health and sustainability. The Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being: Health Synthesis*, for instance, addressed the interconnectedness of health and sustainable development very explicitly and directly (Corvalan et al. 2005). The United Nations' eight Millennium

Development Goals (UN 2002) helped to build widespread political awareness and spurred imperfect but notable responses on issues related to poverty, hunger, disease, and environmental sustainability, all of which are directly related to key SDOH (Hogstedt and Pettersson 2011). Regrettably, these large-scale concepts have not been very influential in generating more holistic, inter-disciplinary practices for national, regional, or local decision-making processes.

An extensive literature search revealed that a systematic conceptual integration of health promotion and sustainability governance has not yet been done, despite the many apparent similarities of the two fields. The closest attempts, in the health promotion field, has been the recognition, e.g. in the *Ottawa Charter for Health Promotion* (WHO 1986), that a 'stable'*[10] ecosystem and sustainable resources are prerequisites for health, and the consequent development of SDOH (Dahlgren and Whitehead 1991, Barton and Grant 2006). Similarly, sustainability governance acknowledges that health and well-being are key sustainability assessment criteria (Parris and Kates 2003, Pope *et al.* 2004, Gibson et al. 2005).

The only initiative that explicitly integrates some of the key principles in sustainability governance with public health issues, incorporating some aspects of health promotion, is the development of the *ecosystem approach to health* or *ecohealth*. This approach arose outside of the traditional health promotion literature to address the interconnectedness between health and the environment. In the early 2000s, Canada's *International Development Research Centre* (IDRC) introduced the ecohealth concept, which emphasises action research, and aims to address complexity with a systems science

[10] 'Stable' ecosystem was the term used in 1986. The term used in more recent literature usually refers to a 'healthy' ecosystem (e.g. Cole *et al.* 1999)

perspective (Waltner-Toews 2004). The work acknowledges that human health cannot be addressed in isolation and sees health as an outcome of effective ecosystem management (Lebel 2003). Ecohealth understands ecosystem management broadly as a systems approach to complex social-ecological systems governance, which includes social justice, gender equity, inclusive participatory engagement and transparency in deliberative processes (Waltner-Toews 2004). The approach "seeks to promote human health and well-being through sustainable management of all components of the environment" (Dakubo 2010:38). Ecohealth is an intervention-centred approach (e.g. Waltner-Toews 2004). Until now, ecohealth research has primarily focused on infectious diseases, although in theory the concept includes non-communicable diseases as well (Davies 2006, Landrigan 2006, Hernke and Podein 2011).

Indeed, scholars have discussed ecohealth in connection with both health promotion (De Plaen and Kilelu 2004, Arya et al. 2009, Dakubo 2010) and sustainability governance (Wilcox et al. 2004, Rapport 2007, Connell 2010). However, ecohealth discussions of health promotion, sustainable development, and environmental governance integration, so far, have taken place on the higher conceptual level (e.g. Wilcox et al. 2004, Butler and Friel 2006, Parkes et al. 2010, Charron 2012) and have not yet identified specific criteria for how the existing theories in health promotion and sustainability governance relate to one another. In general, awareness of the ecohealth approach has remained limited to a relatively small academic domain. Moreover, the concept is not particularly well-known in the developed country context, e.g. among public health practitioners (Leung et al. 2012). Nonetheless, because of the usefulness and flexibility of this existing concept, it was chosen as an umbrella for the framework presented below.

4.5 Synergies

In the literature review in *Chapter 3*, six overlapping themes underpinning both health promotion and sustainability governance approaches were identified: 1) Intentionality: explicit drive towards social change or some form of societal transition; 2) Holistic or systems approach; 3) Social justice or equity focus; 4) Deliberative participatory approach; 5) Precautionary principle; and 6) Knowledge translation or sharing[11] (Fig.4.2). Once the shared themes were established, a database search (Scopus) was performed to confirm the findings were representative. While not all scholars support this list of principles, the results of literature search indicated strong support for the identified similarities in epistemologies underlying and guiding place-based practices in health promotion and sustainability governance. The research for this paper followed the tradition of health promotion that centres on community capacity building and is practiced widely within public health systems in North America (e.g. Minkler 1997, DiClemente et al. 2002, Jones et al. 2002, Bartholomew et al. 2006, O'Neill et al. 2007, Glanz et al. 2008). Similarly, the approach to sustainability governance relied heavily on the North American and British traditions of polycentric collaborative governance and adaptive co-management (e.g. Parson 2001, Durant et al. 2004, Gibson et al. 2005, Adger and Jordan 2009b, Mazmanian and Kraft 2009b, Leach et al. 2010).

Both health promotion and sustainability governance gradually emerged as a critique of narrowly focused, top-down regulatory approaches, which were deemed insufficient to address complex social-ecological challenges. Due to the influences of the

[11] The six themes emerged through an iterative, heuristic, and reflexive analytic induction process in connection with the literature review presented in Chapter 3. The starting point for the analysis was the discovery of similarities between social determinants of health (prerequisites for health) and sustainability assessment criteria (See Fig.4.1), which were used as a basis for the search.

current healthy and sustainable community movements, the fundamental epistemological underpinnings of health promotion and sustainability governance research are particularly well aligned at the landscape scale. Interpretations of these theories vary in the field as they do in academia. The foundations of health promotion are, however, built on the *Ottawa Charter* (WHO 1986) and SDOH, both of which highlight a landscape scale and the contextual determinants of health and well-being. Though the health promotion literature classifies its theories into five distinctive categories that address change across scales, a significant emphasis remains on place-based approaches: health behaviour change at the individual level; change in communities and communal action for health; communication strategies for change; organisational change and creation of health-supportive organisational practices; and the development and implementation of healthy public policy (Nutbeam and Harris 2004). The best known health promotion theories already integrated within sustainable development discourse are probably the transtheoretical stages of change model (Prochaska and DiClemente 1982) and the settings approach (Poland et al. 2000b). Sustainability governance, in turn, is strongly rooted in the reasoned debate, public justification, and political equality of deliberative democracy. The fundamental idea is that open investigative discussion and public reflection should precede any decision-making, and that "the public interest cannot emerge merely by summing pre-existing preferences" because sustainability governance requires a deliberative process that "generates new insights and transforms initial perspectives" (Meadowcroft 2004:184). Moreover, it recognizes that general principles of application need to be specified in particular cases and contexts (Gibson et al. 2005). Deliberative discourse, being entrenched in participative social interaction, is best practiced at the landscape scale.

As fields of applied social sciences, both health promotion and sustainability governance build on many of the same foundational theories, such as Habermas' communicative action (e.g. Bosselmann et al. 2008; Wallerstein and Duran 2008; Leach et al 2010), Putnam's social capital (Armitage 2005; Butterfoss et al. 2006; Bodin and Crona 2009; Minkler and Wallerstein 2012), and Giddens' contextual theory (e.g. Poland et al. 2008; Smith et al. 2005; Stirling 2008). In addition, particularly in recent years, power issues have surfaced in discussions in both fields, referring to, for instance, Foucault's power and knowledge ideas (e.g. Freudenberg et al. 1995; Smith et al. 2005; MacDonald and Mullett 2008; Stirling 2008) and Freire's empowerment theories (e.g. Diduck 1999; Dupere et al. 2007; Bosselmann et al. 2008; Minkler and Wallerstein 2012).

Additional identified common denominators in health promotion and sustainability governance are the intentionality of the fields, as illustrated in the definitions, as well as their inherent interdisciplinarity. Both acknowledge that natural scientific research and quantitative statistics describe the unhealthiness and unsustainability of many current trends and the consequent need for social change. Health promotion, as a field, studies and applies an understanding of the processes that facilitate behavioural and social change towards a healthier society (Bartholomew et al. 2006, Minkler 1997). It also seeks to provide both health professionals and the general public with information, resources, and tools for the betterment of public health (Srinivasan and Dearry 2004). Sustainability governance is similarly exploring what it takes to advance sustainability. It emphasises that governance is practiced in many different forms and promotes the value of pursuing new modes of governance (Jordan 2008:29), such as investigating novel environmental policy

instruments, e.g., environmental management standards (e.g. Jordan et al. 2003, Meadowcroft 2009) or impacts of multilevel governance (e.g. Armitage 2008, Berkes 2010). *Table 4.1* provides an overview of key aspects of health promotion and sustainability governance. There is also some description about ecohealth, which has great conceptual potential to bring the fields together in a more extensive manner than hitherto acknowledged. Ecohealth research has, indeed, been defined as an effort to "formally connect[ing] ideas of environmental and social determinants of health with those of ecology and systems thinking in an action-research framework, applied mostly within a context of social and economic development" (Charron 2012:6).[12] This focus explicitly includes both health promotion and sustainability governance principles.

The research in these fields tends to be issue-oriented, attempting to address diversity, complexity and context-specificity (e.g. Freudenberg et al. 1995, Minkler and Wallerstein 2008, Cargo and Mercer 2008 in health promotion; Armitage et al. 2008, Brown 2009, Renn 2009 in sustainability governance; Lebel 2003, Waltner-Toews 2004 in ecohealth). In addition, various participatory and deliberative approaches, which take into account the needs, interests and knowledge of stakeholders, have become an acknowledged as part of the research processes (e.g. Bryant 2002, Waltner-Toews 2004, Berkes et al 2007, Reid et al. 2007, Armitage et al. 2008, Cargo and Mercer 2008, Berkes 2010). At least, this is the case in theory if not always in practice.

[12] Charron's (2012) expansion of the three pillars of ecohealth to the six principles of ecohealth, published after this framework was developed, demonstrates the usefulness of ecohealth as an umbrella concept for health promotion and sustainability governance. Charron's principles also reflect well the identified overlapping themes of the two fields: 1) systems thinking; 2) transdisciplinary research; 3) participation; 4) sustainability; 5) gender and social equity; and 6) knowledge to action.

Table 4.1: A conceptual overview at the landscape scale (regional/ community level) comparing health promotion, sustainability governance, and ecohealth approaches

	Health promotion	**Sustainability governance**	**Ecohealth**
Goal	Healthy people	Sustainable development	Sustainable resource management improving health
Key concerns	All influences on human health; e.g. smoking, physical activity, nutrition, food security, poverty, employment, injuries, social justice, pollution, vulnerable populations	All influences on sustainable development; e.g. food systems, resource management, ecosystem health, poverty, inequity, livelihoods, governing mechanisms	All influences on both human and ecosystem health and the biophysical and social environment; e.g. inequity, pollution, lack of transparency, exclusivity.
Approaches	Strong focus on intervention development with causalities in mind; emphasis on awareness creation, skill building and empowerment	Strong focus on systems approach and understanding of how actors and factors influence one another; emphasis on collaborative, adaptive governing	Strong focus on participatory action research (PAR); emphasis on equity and transdisciplinarity
Theories	Individual behaviour change; organisational change; community capacity change; policy change; knowledge translation	Governance theories; complex system theories; transition management; sustainability criteria; social learning	Complex systems theories; Adaptive Methodology for Ecosystem Sustainability and Health; applied practical research focus
Agents (Facilitator/ driver of process)	Health professionals and service providers (primarily public health); academic researchers; non-governmental organisations (NGOs)	Academic researchers, government and resource management practitioners: NGOs	Academic researchers, field practitioners
Actors (Stake-holders)	Health professionals, service providers, schools, workplaces, governments, NGOs, the civil society, etc.	Natural resource management professionals, landowners, service providers, governments, NGOs, businesses, the civil society, etc.	Health and natural resource management professionals, service providers, landowners, schools, workplaces, governments, businesses. NGOs, the civil society, etc.
Targets of action	Behaviour; policy; planning of community infrastructure; built environment; natural environment	Decision-making practice; planning and design of policies and projects; reversal of unsustainable trends; improving steward-ship, equity and learning	Behaviour; policy; natural environment; infrastructure/ built environment

This is where children's environmental health is presented as a bridging concept and exemplary bridging venue to help illustrate how the theoretical framework might be used in practice. For complex issues, such as environmental paediatrics that cannot be solved by one sector alone, inclusive deliberative approaches are necessary. The bridging concept highlights the necessity of integrated, participatory, practices, which are illustrated by the following case study of an environmentally induced chronic disease cluster (Minkler 2010). A high incidence of paediatric asthma in Brooklyn, New York, associated with local bus depots, was investigated by a community-university partnership. The findings of this public health collaboration convinced the U.S. Environmental Protection Agency (EPA) to change both the national approach to air quality monitoring and state regulations. Furthermore, all New York City buses were converted to clean diesel. Had all relevant stakeholders approached the matter earlier on from a more integrated health promotion-sustainability governance perspective, the issues could have been solved with significantly less cost and more efficiency, without cumbersome legal processes.

Indeed, at the conceptual level, both fields aim to include all stakeholders and to use a holistic, systems approach for managing situations and solving problems. The Bangkok Charter for Health Promotion (WHO 2005), for instance, emphasized explicitly the responsibility of all sectors to advocate, invest, and build capacity**,** as well as to regulate and legislate for health and equity-based policies, actions and infrastructure to address the determinants of health. The Charter also encouraged practitioners "to partner and build alliances with public, private, nongovernmental and international organisations and civil society to create sustainable actions". The prerequisites for health, identified in the Ottawa

Charter (WHO 1986), had already drawn attention to the complex relationship between health and the social and physical environment. These prerequisites had a significant impact on the health promotion literature (McLeroy et al. 1988, Israel et al. 1994, Freudenberg et al. 1995, Berkman et al. 2000, Heaney and Israel 2008, Wagemakers et al. 2010), by highlighting the importance of social-ecological models of health (Stokols 1996, Schulz and Northridge 2004). In turn, the term sustainability governance, in itself, implies multiple stakeholders and systems of governance are required to "guide and steer these collective [sustainability] discussions towards a satisfactory level of consensus" (Jordan 2008:20) and to expand the awareness, commitment and capacities of a larger multi-sectoral range of key participants for the needed transition. Moreover, in sustainability governance literature, a specific term, complex *Social-Ecological Systems* (SES), is often used to indicate a holistic systems approach is needed, one that embraces both the social and natural scientific aspects of governing towards sustainable development (e.g. Berkes et al. 2003, Folke et al. 2005, Armitage et al. 2009).

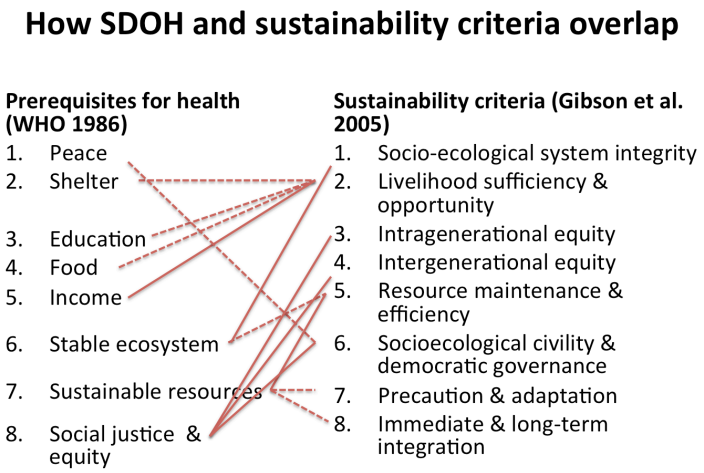

Figure 4.1: How the social determinants of health (SDOH) and sustainability criteria overlap. Comparing the themes identified by prerequisites for health and sustainability assessment criteria. Solid lines refer to the directly comparable similarity of the subject matter and dotted lines indicate implicit inclusion or relatedness of the topics.

Both health promotion and sustainability governance emphasise the need for a

proactive, precautionary, and preventative approach instead of a reactive one, which tends to operate in damage control mode (e.g. Kreuter et al. 2004, Martuzzi and Tickner 2004, Farquhar et al. 2007 in health promotion; and Gibson et al. 2005, Bosselmann et al. 2008, Stirling 2009, in sustainability governance). Equity and social justice are equally vital for desirable outcomes in the respective fields (Beauchamp 1976, Israel et al 1994, Schulz and Northridge 2004 in health promotion; Ringquist 2004, Kearney et al 2007, Lockwood 2010 in sustainability governance). Indeed, similarities of the fields are well illustrated when sustainability assessment criteria (Gibson et al. 2005) and the prerequisites for health in the Ottawa Charter (WHO 1986) are considered side by side (Fig.4.1). Both concepts consist of principles, objectives, and associated indicators, and provide guidance for developing strategies in the respective fields (Robertson and Minkler 1994, Sinclair et al. 2009). The sustainability criteria, for instance, are generic but must be specified for particular contexts (Gibson et al. 2005, Norton 2005). Gibson et al. (2005) identified eight core generic categories that are critical for sustainable development and should be addressed in practical applications. Although the terms are different, as they reflect the foci of interest of the respective fields, the contents can be directly linked with one another.

Last but not least is the role of multidirectional knowledge transfer as an active component in both health promotion and sustainability governance. Because health promotion has roots in health education and still has a relatively strong tradition of expert-led one-way communication (e.g. Graham et al. 2006), there are some differences in the ways the two fields approach knowledge sharing. Where health promotion, over the years, has specialised in various forms of information diffusion (e.g. Green et al. 1994, Hornik 2002), for example, media advocacy (e.g. Galer-Unti et al. 2004, Glanz et al. 2008), and

knowledge translation (e.g. Glasgow et al. 2003, Graham et al. 2006, Kontos and Poland 2009), the sustainability governance literature started discussing collective or social learning first in the 1990s (Webler et al. 1995). However, many participants studying sustainability governance had already established links with early initiatives in community development, participatory democracy and related social movements dating back two or more decades. The introduction of various deliberative practices to natural resource management, such as participatory environmental impact assessment, helped to demonstrate that a new type of shared learning was taking place. The concept of social learning has since evolved in different directions (e.g. Webler et al. 1995, Wildemeersch 1998) and under different names (e.g. Daniels and Walker 1996, Diduck and Sinclair 1997). As Reed et al. (2010) pointed out collective learning has become part of the normative discourse in sustainability governance.

In health promotion, social learning refers explicitly to a certain type of learning also explored in Social Cognitive Theory (e.g. McAlister et al. 2008). Nevertheless, from a synergistic point of view, the key role that knowledge sharing and learning play in both fields is that they are essential to the processes of finding common epistemological ground. There is also great potential for mutual process-related learning on both sides, which will be discussed in the next section.

In all, the six identified themes discussed above represent key fundamental principles that can help to create an epistemological shared base for an integrated approach to public health and sustainability practice. Children's environmental health, in

turn, illustrates a vital shared outcome that cannot be reached without more integrated practices.

4.6 Identified complementarities of divergent approaches

For potential practical collaborations, the differences in academic tradition are complementary and present a valuable opportunity for the fields to learn from one another. Sustainability governance literature has strong roots in the study of governing structures and processes, which provides a solid foundation for understanding the political and administrative aspects of social change. Health promotion, in contrast, has grown from the development of interventions and programmes that facilitate desired changes and build on practitioner experiences, and thus has achieved an understanding of how to create conditions that support social change. This is reflected in the *Table 4.1,* which shows health professionals and service providers as primary agents in developing health promotion theory but places academics at the forefront in developing sustainability governance theory.

The historical origins of health promotion and sustainability governance are also different. Despite the emphasis of environmental governance on natural sciences, sustainability governance has strong roots in international development studies and political science, which has resulted in a good understanding of the complexities of political decision-making. Health promotion, in turn, originates from infectious disease prevention, and the sanitation and social hygiene movement, which included an emphasis on individual behavioural change that still influences today's policies and practices in health promotion. These differences in expertise hold offer a potential for increased learning, in particular if they are seen as an opportunities to improve current practices.

One aspect of collaborative approach to social change, where health promotion may have something to offer, is in its comprehensive systems approach to facilitated change known as theory-informed intervention (e.g. Freudenberg et al. 1995, Edwards et al. 2004, Bartholomew et al. 2006). This approach plans for multiple intervention programming, which consists of several components and multichannel delivery, connected by interlinked strategies targeting multiple sectors and multiple levels of the social-ecological system (Edwards et al. 2004). The aim is to generate long-term systemic change in active collaboration with the community in question. The traditionally more theoretical approach in sustainability governance could be significantly strengthened by these practice-based health promotion theories that facilitate behavioural and social change.

Sustainability governance, in turn, has the strength of understanding societal mechanisms, such as social networks, power relationships, and political decision-making processes. Its comprehensive systems approach to governance, such as in multilevel governance (Jessop 2003) and polycentric governance (Ostrom 2010), could greatly enrich the less nuanced understanding of policy development in health promotion. Within the sustainability governance field, some thinkers and practitioners, including those engaged in collaborative and adaptive natural resource management, have adopted a significantly stronger participatory approach to developing a common understanding of and consequently more appropriate policy solutions for environmental issues (Adger et al 2001, Folke et al. 2005). Although health promotion has acknowledged the importance of engaging stakeholders in problem identification and solution formulation for almost two decades (Kretzmann and McKnight 1993, Freudenberg et al. 1995), the idea of collective learning has been relatively slow in winning ground. Much of the collective learning in

health promotion is limited to the idea of "uptake of knowledge" in interaction between academics, health professionals, policymakers, and some selected stakeholders, as in *Knowledge Exchange* (Mitton et al. 2007) and *Knowledge-to-Action* (Graham et al. 2006). Indeed, Cargo and Mercer (2008, p.327) argued, community-based participatory research is "unique among public health research approaches in combining research with education (or co-learning) and coordinated collaborative action to democratize the knowledge production process". They consider it to be the only process that attempts to ensure that everyone directly touched by a given health issue is included in the knowledge production processes. This is where the quickly growing sustainability governance literature on collective learning and acknowledging the value of local knowledge (e.g. Berkes et al. 2007) could possibly provide some valuable insight into knowledge creation efforts in health promotion.

The differences in academic heritage emphasize the great potential of a more integrative approach, which would bring together complementary expertise as well as local knowledge holders to solve today's complex challenges. At the same time, explicitly identified similarities make such integration meaningful and easier in practice.

4.7 Proposed conceptual adaptation of the ecohealth framework

The adapted ecohealth framework introduced below aims to facilitate cross-sectoral discussions. Understanding that both health promotion and sustainability governance fundamentally rest on very similar principles increases the potential for future collaboration. Children's environmental health as an essential shared outcome helps cement the interconnectedness of health and sustainable development.

There are two vital aspects in this exercise of creating a base for collaboration within existing mandates: recognising the similarities in process-related epistemological values, and identifying shared outcomes. At the landscape level, which includes local and regional governance aspects, both health promotion and sustainability governance involve commitment to supporting local livelihoods and resilient social-ecological systems, in a just and equitable manner, while practicing precautionary damage control. Furthermore, both fields favour addressing their respective challenges in a participatory and inclusive

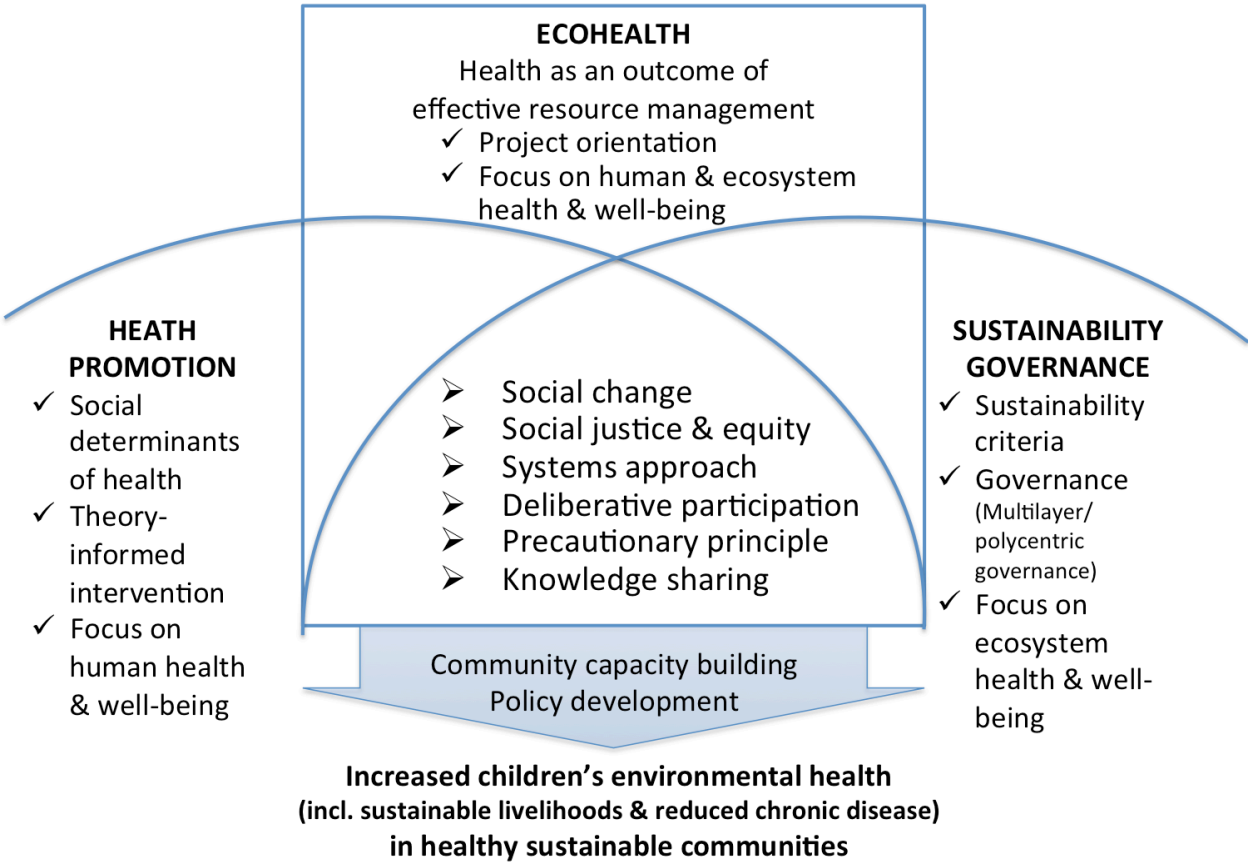

Figure 4.2: Overview of the adapted ecohealth framework approach: The framework illustrates how theories in health promotion and sustainability governance, under the umbrella of an ecohealth approach, have specific process-related overlapping attributes that allow practitioners of respective fields, within their existing mandates, to justify cross-sectoral collaboration towards shared outcomes in healthy and sustainable community development.

manner, which promotes respectful knowledge sharing and mutual learning. Acknowledging the fundamental similarities, in the ideal approaches of respective fields, creates the first foundation to constructive collaboration.

The six shared themes identified in the approaches that aim for healthy and sustainable community development, respectively, are in the centre of *Figure 2*. They rationalise cross-sectoral collaboration, even when the practitioner mandates appear significantly different from one another on the surface. In addition, the themes provide good epistemological guidelines for practitioners to desirable processes when working towards a common goal. The dedication of both fields to deliberative approaches could, indeed, be the most fundamental advantage the local focus of health promotion and sustainability governance has over the large scale population health and other government-led approaches. For instance, EPA sees children's health as its highest priority (Goldman 1998) but, as illustrated by Minkler's (2010) example in Brooklyn, local pollution hotspots can often only be identified and addressed by local cross-sectoral collaboration.

The fact that ecohealth states explicitly that human and ecosystem health and well-being are outcomes of the sustainable management of all components of the environment makes it an ideal concept for promoting the connections between sustainability governance and health promotion. Focusing on children's environmental health as a bridging concept and as one of the critical cross-sectoral process outcomes, in turn, draws attention to some of the key mechanisms of pollution-related damages in both human and ecosystem health. The developmental susceptibility of higher living organisms to low-dose endocrine disruptors and the consequent impacts on the immune, reproductive, metabolic,

and nervous system play a significant role in human and ecosystem well-being and productivity. At the same time, because of its complexity, children's environmental health cannot be achieved without attention to both SDOH and sustainability criteria. Understanding this vital role of all sectors, particularly business and environmental stakeholders, in achieving health outcomes, invites efforts to initiate cross-sectoral discussions that are significantly broader than those currently taking place about sustainable livelihoods, industrial processes, municipal regulations, and natural resource management.

Cross-sectoral engagement, including non-governmental stakeholders, has a potential to enable, for instance, broader and better integrated local monitoring efforts that in turn facilitate more meaningful and efficient decision-making. In addition to the natural scientific understanding of human or ecosystem well-being, mutual understanding of social processes relevant to these issues could be improved by increased cooperation. Public health practitioners could convey their health promotion expertise on awareness creation and community engagement. Environmental sector participants, familiar with collaborative learning and networking ideas in deliberative governance processes, could in turn share their knowledge of conflict resolution and consensus building.

Cross-sectoral collaboration is arguably necessary for healthy and sustainable community development. Resource management decisions are unlikely to be effective and sustainable without attention to health outcomes. Similarly, chronic disease statistics[13]

[13] Whilst statistics of individual chronic diseases may be influenced by specific interventions, this statement refers to the increasing overall incidences of chronic diseases that require a more

cannot be improved without the consideration of natural resource management and other SDOH and sustainability criteria. A broader cooperation between the public, private, and not-for-profit sectors around an integrated approach to health and sustainability also has other benefits. It could help create awareness about the possibilities for (a) more system-wide *normative* and *instrumental* solutions, by pointing out the strengths and weaknesses of respective fields; and (b) fruitful collaboration or knowledge sharing. From a practical perspective, community level engagement on concrete local issues occurs at a feasible scale for experimenting with transdisciplinary work[14].

The potential significance of this type of framework relies on its value in applications. It is not likely that we will be amalgamating resource management practices and public health activities in the near future, but creating a more concrete conceptual platform that paves the way for practical discussions is a significant step in the right direction. The next step would be to take the framework to cross-sectoral discussion forums, such as the Ontario Healthy Communities Consortium (also known as HC Link[15]) or UNESCO-mandated biosphere reserves (Chapter 5), where practitioners themselves could further develop the framework to meet their needs. Future research, in turn, will need to focus on better understanding the environmental health impacts related to

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systemic SDOH-based approach, which includes both top-down and bottom-up cross-sectoral interventions.

[14] Arya et al. (2009) arrived at similar conclusions in connection with their analysis of infectious disease outbreaks in Canada.

[15] An online web platform that "works with community groups, organizations, and partnerships to build healthy, vibrant communities across Ontario" and "[offers] consultations, learning and networking events, and resources (…) Funded by the Government of Ontario; www.hclinkontario.ca

activities in various sectors, and explore the practical implications of shared cross-sectoral projects with children's environmental health as an outcome.

4.8 Conclusions

Health and well-being as central components in sustainable development receive insufficient attention in practical decision-making, despite broad international acknowledgement of their importance. This paper has explored how an explicit identification of synergies and complementary divergent approaches related to familiar concepts in health promotion and sustainability governance may help facilitate cross-sectoral collaboration in practice. The adapted ecohealth framework integrates six concrete overlapping themes linking health promotion and sustainability governance. Moreover, the framework highlights examples of areas where the fields could benefit from one another. In addition, children's environmental health was proposed as a desirable shared outcome and a possible venue for potential collaboration, because of its vital role in the public health and well-being of future generations.

This type of transdisciplinary exploration in social and natural scientific literatures proposes a paradigm shift that may be necessary to enhance governance towards healthy and sustainable community development.

5 The Promising Potential Role of Sustainable Development and Conservation Related Bridging Organisations in Promoting Health

5.1 Introduction

Promoting health has remained strongly in the domain of the health sector, despite the ambitious rhetoric of international agreements such as *Bangkok Charter for Health Promotion* (WHO 2005) and *Health in All Policies* (WHO and Government of South Australia 2010) that declared health as a responsibility of all sectors. Environmental health is an area where health outcomes cannot be the sole responsibility of the health sector. Complex environmental issues are not solvable without active collaboration of the public, private, not-for-profit, and academic sectors together with the communities in which they function. Furthermore, environmental pollution and other social determinants of health, such as food security and sustainable livelihoods, are interests shared by diverse health and environmental stakeholders, as well as communities in general.

In current compartmentalized societies, however, someone needs to take the initiative to cross the disciplinary or interest-specific boundaries. Often neither health professionals nor environmental authorities see themselves as having the mandate or capacity to take the lead in addressing environmental health issues. Non-governmental organisations, however, have a greater flexibility in directing their activities. Social movements and organisations addressing specific social determinants of health are known to facilitate cross-sectoral collaborations, such as the 'Vibrant Communities' initiatives

focusing on poverty reduction (Born 2008). A Dutch study (Harting et al. 2011), explored health brokers as specific agents facilitating cross-sectoral health promotion. There has been little study of organisations whose cross-sectoral mandates are only implicitly health-related, yet sufficient as a basis for bringing together diverse stakeholders to promote health. This paper explores the potential of UNESCO mandated biosphere reserves as bridging organisations bringing together communities for health and sustainable development.

A biosphere reserve is a specific region, recognized by UNESCO, guided by an organisation of the same name that attempts to help people find ways to build sustainable livelihoods while maintaining the health of the ecosystem that supports their existence within the area (UNESCO 2008; 2014). Currently, there are 621 biosphere reserves in 117 countries (UNESCO 2014b). The structure, organisation and governance of biosphere reserves have been adapted to meet the local conditions and needs and therefore vary significantly from one another (Francis 2004). Because of their mandate, biosphere reserves are often viewed as 'learning laboratories' for sustainable development (Matysek et al. 2006; Nguyen et al. 2011). The purpose of biosphere reserves is to demonstrate the integration of conservation and sustainable development.

In this study, biosphere reserves were analysed as examples of organisations outside of the health sector that have begun to bring together diverse stakeholders to address public health and environmental issues as an integrated part of sustainability. Because of the local adaptations of the mandate, only some biosphere reserves have included health promotion explicitly in their operations. This study explored how and why

some biosphere reserves have explicitly integrated health into their activities, whilst others have not. Furthermore, it investigated the types of health related programming as well as drivers for and barriers to implementing health focus.

Bridging organisations is a new concept to health promotion and public health but is used in, for example, international development (Brown 1991) and environmental governance (Schultz 2009; Biggs et al. 2010; Crona and Parker 2012) literatures. The term refers to local groups or associations that facilitate horizontal linkages between sectors as well as foster vertical connections across administrative layers, which allow local influence on higher level decision-making and policy development (Brown 1991). The Millennium Ecosystem Assessment (Malayang et al. 2007) defined their purpose as to facilitate collaboration among actors by providing "arenas for multisector and/or multilevel collaboration for conceiving visions, trust-building, collaboration, learning, value formation, conflict resolution, and other institutional innovations". Bridging organisations are often seen critical for community capacity-building (Malayang et al. 2007) and for adaptive co-management of natural resources (Berkes 2010), because they provide both services and facilitate collaboration between non-governmental organisations, government agencies, research organisations, and other stakeholders.

The Millennium Ecosystem Assessment as well as adaptive environmental governance literature, in general, have identified biosphere reserves as bridging organisations (Hahn et al. 2006; Malayang et al. 2007; Schultz 2009; Biggs et al. 2010). The role of biosphere reserves as bridging organisations is to create a safe meeting forum to facilitate cross-sectoral collaboration (Berkes 2009; Schultz et al 2011; Crona and Parker

2012). Many biosphere reserves appear also to be functioning as bridging organisations in practice. Forty-six of 146 surveyed biosphere reserve managers said their organisations were 'effectively achieving developmental goals' by engaging local stakeholders, academics, politicians and government administrators in sustainable development and conservation promotion (Schultz et al. 2011). This study by Schultz et al. emphasized the great potential role of biosphere reserves as bridging organisations in linking ecosystem services and human well-being, which is a complex, long-term, experiment requiring continuous innovation and learning.

The factors influencing health and well-being extend from biophysical to socioeconomic elements, thus finding meaningful, sustainable solutions to the complex public health challenges requires complex solutions. Already in 1973, Rittel and Webber (Rittel and Webber 1973) labelled these complicated, messy challenges as 'wicked problems' and the discussion has been on-going. By their nature, environmental health issues fall under this category (Kreuter et al. 2004; Caron and Serrell 2009; Brown et al. 2010). They involve a great range of stakeholders, who perceive the problem and its solutions in various ways. Wicked problems can be managed, if not solved[16] (Caron and Serrell 2009), but that requires natural scientific as well as social scientific understanding and solution alternatives. Because wicked problems often are created by pigeonholed problem solving attempts, tackling them demands opening up for new ways of thinking (Brown et al. 2010). This paper explores one unconventional, alternative approach to

[16] While 'solving' or 'managing wicked problems' are contested concepts within academia (See p.4 and 76), they are still broadly accepted working terms among practitioners though with 'managing' typically understood as muddling through rather than exercising effective authoritative control or finding a specific solution.

facilitating cross-sectoral collaboration to promote public health that addresses limitations of the current system.

5.2 Methods

The research project focused on cross-sectoral bridging of health and sustainable development. This particular component of the study centred on asking: How can non-governmental organisations function as bridging agents facilitating cross-sectoral collaboration between the health and environmental sectors? The data were collected by document analyses, semi-structured interviews and, overt participant observation. The analysis was made by analytic induction (Patton 2002: 493-494), using sensitising concepts based on health promotion theories to frame the investigation with the desired focus (*Table 2.1*) (Patton 2002: 493-494; Appendices 1 and 4). The research aimed to find answers to the following four questions: 1) What type of health promotion related activities and programmes take place in the biosphere reserves? 2) To what extent have the biosphere reserves been able to function as bridging agents facilitating cross-sectoral collaboration between health and sustainability sectors? 3) What type of barriers to and drivers for integrating health into their programming can be identified? This research followed the normal procedures for health research concerning human participants with full ethics clearance by the Office of Research Ethics at the University of Waterloo (ORE #18477).

Explicitly health-related projects were investigated in all Canadian (n=16) and British (n=3) biosphere reserves that follow the guidelines specified by the Madrid Action Plan (24). The Canadian analysis was based on a project database created by Helene

Godmaire of the Canadian Biosphere Reserve Association (CBRA), semi-structured interviews, and participant observation at two Annual General Meetings of CBRA, in 2011 and 2012, respectively. The British analysis was based on document analysis, semi-structured interviews, and one week of participant observation in the two established biosphere reserves.

North Devon, Dyfi, Frontenac Arch, and Georgian Bay biosphere reserves were selected for detailed case studies to identify all activities that can be considered health promotion, and to understand the collaborative relationships, drivers for, and barriers to the integration of health into programming. The selection was based on three criteria: two case studies per country; two organisations that had programming with an explicit health focus and two that did not focus on health; and comparability of their geographic profiles.[17]

Semi-structured interviews (n=29) were conducted at all four locations between November 2012 and May 2013. The interviewees were all experts in the field, staff, partners or Board members of the biosphere reserves, and therefore the qualitative in-depth interviews followed an inter-active style (23). The interview guide covered four specific areas: health-related projects, barriers to and drivers for health integration, available local knowledge, and cross-sectoral bridging capacity. The order and format of the questions varied depending on the flow of the discussion and the professional role of

[17] Because of its local adaptation of the universal UNESCO-mandate, each biosphere reserve has its own somewhat unique structure and activities; therefore these case studies cannot be considered reliably representative. However, the overall similarities of biosphere reserves make these case studies suitable for assessing the potential of biosphere reserves as bridging organisations for health and sustainability

the interviewee. Interviews were conducted until saturation was observed and the same topics kept reappearing in responses.

5.2.1 Data analysis

All the interviews were recorded and transcribed by the author. The coding was created based on sensitising concepts and additional codes were created when unanticipated health promotion related topics appeared (See Table 5.2 and 5.3 for results and Appendix 1 for sensitising concepts). Participants were provided with a summary of all findings and specifics related to their own interviews for review and validation. Triangulation of the results was further strengthened by engaging other health promotion professionals to assess the analysis and appropriateness of coding. Because of the rural and small community context, all the results have been pooled to one single general story of biosphere reserves as bridging organisations for health and sustainable development to protect the confidentiality and relative anonymity of the participants

5.3 Results

The results come successively from the pilot project and the case studies. The pilot component of the project explored the status of health in the universal UNESCO mandate and in the activities of biosphere reserves. Attitudes towards health-related activities among biosphere reserve practitioners were also explored. The pilot results provided justification to the four in-depth case studies.

5.3.1 Document analysis and participant observation assessing health focus in the UNESCO mandate, in general, and in Canadian and British biosphere reserves in particular

The 3rd World Congress of Biosphere Reserves, held in February 2008, produced the *Madrid Action Plan* for the biosphere reserves. It can be considered as the overall strategic mandate for biosphere reserves for 2008-2013. Building on the Seville Strategy of 1995 (UNESCO 1995) that shifted the focus from conservation to sustainable development, the Madrid Action Plan aimed "to raise biosphere reserves to be the principal internationally-designated areas dedicated to sustainable development in the 21st century" (UNESCO 2008:3). In the document, the words health and well-being show up once and ten times, respectively (See *Table 5.1*). Well-being is also included in both vision and mission statements for the 'World Network of Biosphere Reserves', which aim

- To foster "harmonious integration of people and nature for sustainable development through participatory dialogue, knowledge sharing, poverty reduction and human **well-being** improvements, respect for cultural values and society's ability to cope with change, thus contributing to the [Millennium Development Goals]"; and
- "To ensure environmental, economic, social (including cultural and spiritual) sustainability through: development and coordination of a worldwide network of places acting as demonstration areas and learning sites with the aim of maintaining and developing ecological and cultural diversity, and securing ecosystem services for human **well-being**".

Many biosphere reserves mention health on their website, promoting healthy economy, healthy environment, healthy society, and healthy culture (e.g. Bras d'Or Lake

Biosphere Reserve and Georgian Bay Biosphere Reserve). However, only two out of the sixteen biosphere reserves in Canada and one out of the original two (now three) in the UK explicitly addressed human health in their activities, when the research project was embarked in 2011. When asked about their interest in integrating health in biosphere activities, organisations that did not explicitly focus on health expressed a unanimous desire to learn more about the opportunities to collaborate with the public health sector.

Table 5.1: Examples of how *health* and *well-being* were addressed in Madrid Action Plan (UNESCO 2008)

The potential role of biosphere reserves in addressing emerging challenges caused by climate change, biodiversity loss, and rapid urbanization (p.4)**:**
• "From these challenges, several opportunities for change arise, through increased awareness at all levels of the need to maintain and secure access to ecosystem services for human **well-being**, including **health**, security and justice/equity." • "Develop mechanisms to encourage the sustainable development of biosphere reserves carried out in partnership with all sectors of society (i.e. public and private institutions, [non-governmental organisations], stakeholder communities, decision- makers, scientists, local and indigenous communities, land owners and users of natural resources, research and education centres, media) to ensure the **well-being** of people and their environment…" [emphasis added]
The Madrid Action Plan's overall goals are to (p.5)**:**
• "anchor the research, training, capacity building and demonstration agendas of [Man and the Biosphere-project] at the interface between the interlinked issues of conservation and sustainable use of biodiversity, mitigation and adaptation to climate change, and socio-economic and cultural **well-being** of human communities" • "enable the active use of places included in the [World Network of Biosphere Reserves] as learning sites for sustainable development, i.e. demonstrating approaches to enhance co-operation amongst epistemic (academic), political, practitioner and stakeholder communities to address and solve context specific problems to improve environmental, economic and social conditions for human and ecosystem **well-being**" [emphasis added]

Only one of the studied biosphere reserves, Clayoquot Sound Biosphere Reserve, has adopted healthy communities as one of its three core priorities and also extensively focuses on health in its activities. The biosphere reserve is located on traditional lands of Nuu-chah-nulths First Nations, who represent fifty per cent of the current all-year

population in the area. Originally the Western term sustainable development was replaced by healthy communities, but nowadays the terms appear interchangeably in the Clayoquot public documents.

Clayoquot Sound Biosphere Reserve is also the only one of all the Canadian and British biosphere reserves studied that explicitly defines health on its website:

> **"Health** encompasses everything from walking trails and clean water to access to recreational opportunities, adequate housing and stable employment. The [Clayoquot Biosphere Trust] is committed to supporting projects that support health, in its broadest sense." (clayoquotbiosphere.org; emphasis added)

These findings were deemed sufficient to advance to the four case studies, which is the main focus of this paper.

5.3.2 Further document analysis, semi-structured interviews, and participant observation, focusing on the four cases studies

Almost all activities in the Canadian and British biosphere reserves depend on project specific grants from private foundations or governments. Moreover, most of the activities rely on community volunteers and are supported by *in kind* contributions from partnering organisations. The actual operational funding of the biosphere reserves is relatively small and reflected in the number of paid staff, which ranges from two part-time individuals to five full-time employees in the biosphere reserves in question. Only one of the four organisations has a full-time paid manager. One biosphere reserve has two paid part-time managers sharing the duty, and two biosphere reserves have volunteer-based management. The staffing and funding structures vary from region to region. In 2012, federal government prematurely terminated five-year operational funding support for the Canadian biosphere reserves, as part of the broader financial cuts to the environmental

Table 5.2: Health promotion projects in biosphere reserves since the adaptation to the Seville Strategy, which also demonstrate their ability to function as bridging organisations for health and sustainability.

Health promotion category	Examples of projects related to public health	Types of partners engaged
PROMOTING HEALTHY BEHAVIOUR CHANGE		
A) Focus on individual behaviour change		
Physical activity	"Walking for Health": local walking groups that provide walks specifically tailored to support good health through exercise and social interaction; e.g., tinyurl.com/WalkingGroups [Accessed Jan. 15, 2014]	Public health (NHS*), local governments, ENGOs*, other NGOs*, community volunteers
Nutrition (physical activity)	"Local Flavours": a programme promoting local food production and healthy, nutritious eating, combined with local art, and connecting food and nutrition with physical activity; includes over 100 local food producers, retailers, and food services; e.g., tinyurl.com/LocalFlavours and tinyurl.com/ActiveBody [Accessed Jan. 15, 2014]	Public health unit (nutritionist), local governments, private the private sector, ENGOs*, community volunteers
Nutrition	Free, food-related, community workshops in collaboration with local volunteers: growing own fresh food, identifying edible wild plants, raising chicken and keeping bees; e.g., tinyurl.com/BR-ActionGroup and tinyurl.com/GrowOwnFood [Accessed Jan. 15, 2014]	Public health unit (community health promoter); HNGO* (intellectual disabilities); other NGOs*, community volunteers
Environmental health	"Life on the Bay": guidance for healthy and sustainable septic tank management, handling of domestic toxic chemicals, drinking water and waste treatment, etc. e.g., tinyurl.com/EnvGuide [Accessed Jan. 15, 2014]	Federal and provincial governments (Parks Canada, Environment Canada, Ontario MNR*), the private sector, and ENGOs*
Mental health (physical activity)	"Tirwedd Dyfi": promoting well-being gained by understanding the linkages between the sense of place, language, culture, landscape and being outdoors; focus on lifestyles; "trying to get people to appreciate the importance of the outdoors in Welsh language culture, in other words tempt them to go out and to see the outside and landscape as being part of their innate culture…" (Participant); e.g. tinyurl.com/HealthyCulture and tinyurl.com/CulturePaths [Accessed Jan. 15, 2014]	National and regional governments (National Park Authority and CCW*), schools, ENGOs* and other NGOs*, community volunteers

Table 5.2 continued

Health promotion category	Examples of projects related to public health	Types of partners engaged
B) Focus on community level behaviour change		
Food security	Cookbook supporting local foods: emphasizing what people eat and how its produced leaves lasting traces in the local landscape and culture, connecting food with the living and working countryside; e.g., tinyurl.com/CookLocal [Accessed Jan. 15, 2014]	University of the Third Age, NGOs*, the private sector
Food security	Interactive collaborative school programme to promote local food, engaging children to analyse the local food system and engage the community in their research; e.g., tinyurl.com/Food-Kids [Accessed Jan. 15, 2014]	Schools, university, government, ENGOs*, other NGOs*, local food producers and the private sector
Active transportation (nutrition/ food security)	Interactive trails maps with health messaging and sustainable development focus; e.g. bringing together over 30 regional trail organisations; e.g., tinyurl.com/TrailNetwork and tinyurl.com/ActiveWithNature [Accessed Jan. 15, 2014]	Public health, federal and provincial governments (Parks Canada; Ontario Parks, MTCS*, MOE*, and MNR*), municipal governments, ENGOs*, other NGOs*, the private sector, community volunteers
Focus on community level behaviour change continues		
Active transportation	Easy access trail mapping project to promote active transportation and outdoors experiences to mobility challenged individuals. e.g. tinyurl.com/EasyTrails [Accessed Jan. 15, 2014]	ENGOs*, HNGO* (physical disabilities), local governments, community volunteers
Environmental Health	"Catchment Sensitive Farming": a partnership to reduce diffuse pollution from agriculture and grant management: e.g. tinyurl.com/HealthyFarming and tinyurl.com/FarmingGrants [Accessed Jan. 15, 2014]	ENGOs*, national government (Environment Agency), local farmers

Table 5.2 continued

Health promotion category	Examples of projects related to public health	Types of partners engaged
PROMOTING SYSTEMS LEVEL CHANGE		
Food security (poverty reduction)	Collaborating to expand the existing community gardens, providing workshops (see above example A3), arranging "Food Festivals" and a "Food Forum" to create awareness and to develop a sustainable food system as part of poverty reduction efforts and sustainable community development [in rural communities efforts are often intertwined]; e.g., tinyurl.com/LocalFoodMap and tinyurl.com/LocalFoodsystem and tinyurl.com/HealthyUrbanForest [Accessed Jan. 15, 2014]	Public health (community health promoter), local hospital, HNGO* (intellectual disabilities); other NGOs*, municipal government, community volunteers
Healthy and sustainable community development	Initiating and organizing a "Regional Sustainability Initiative", a "Community Survey" and "Integrated Community Sustainability Plans", inviting a broad range of community stakeholders to the table; e.g., tinyurl.com/AskingCommunity and tinyurl.com/BRdrivenICSP and tinyurl.com/CrossSectoralCollaboration [Accessed Jan. 15, 2014]	Public health (MOH*), health professionals (family physicians), local municipalities, public library, ENGOs*, HNGO* (developmental disabilities), other NGOs*, school boards, the private sector
Environmental health (Poverty reduction)	"Sustainable Energy Action Plan and Sustainable Energy Partnership": including public, private and voluntary sector interests and education/training providers; coordinating strategic planning and action towards zero carbon energy use goal (includes tackling fuel poverty); e.g., tinyurl.com/SustEnergyPlan and tinyurl.com/CommPartnerships [Accessed Jan. 15, 2014]	A broad range of the public and private sector stakeholders, NGOs, *schools, public housing, etc.
Environmental health	"State of the Bay": ecosystem health report card; presents information about key ecosystem health indicators along the Bay. Key indicators were selected in the areas of water quality, wetlands, fisheries, and landscape; summarizes existing scientific reports from the local perspective; e.g. preview.tinyurl.com/EnvAssessment [Accessed Jan. 15, 2014]	5 other local ENGOs*; federal and provincial governments (funding)

sector. One of the three biosphere reserves in the UK operates autonomously under the Regional Council; the other two are essentially grassroots organisations, despite their UNESCO status. All four case study organisations perceive themselves as partnerships or networks and see the role of their staff to function as networking facilitators, who bring together partners to work on shared issues.

Table 5.2 provides an overview of the types of health promotion related activities that have taken place within the four biosphere reserves, since adaptation to the Seville Strategy. Mapping all the projects and involved partners of the biosphere reserves was beyond the scope of this project, but *Table 5.2* helps illustrate the range of identified health-related activities as well as the scope of bridging potential that this type of organisations may hold.

The sensitising concepts were based on generally accepted health promotion categories and concepts (Nutbeam and Harris 2004; Bartholomew et a. 2006). They acknowledge health promotion efforts needed at multiple levels of the society, from facilitating the individual behaviour change to systems-wide policy change, as well as the impact of social determinants of health. Some examples could fit under multiple categories but they are included only once to illustrate the diversity. Biosphere reserves aim to remain politically neutral and therefore the organisations do not engage in advocacy and direct policy development activities.

To assess the future potential of the biosphere reserves as bridging organisations bringing together health and sustainability the key drivers for and barriers to such

Table 5.3: Participant comments on barriers to and drivers for integrating health and sustainable development in biosphere reserve (BR) work:

Drivers for and barriers to integrating health	Identified themes and examples of verbatim quotes from interview responses
Health being explicit vs. implicit in mandate/ activities	• **Not explicit:** "It's not explicit in the biosphere 's vision statement (…) – or in the strategic level of what the BR is doing, that it should be promoting health. I think there is a natural kind of overlap, but the priorities that have been set don't spell it out…" • **Disadvantage of health not being explicit:** "If we're not being pulled in a health direction, it might not be spelled out as that, it might not be identified as that, or it might not happen." • **Value of making health explicit:** "If you think that public health is part of sustainability, these are some of the areas that would be particularly relevant and these could maybe some of the techniques that could be used." • **Supportive vs. active role:** "happy to encourage [health promotion]. (…) But I don't see my role, at the moment, to initiate that sort of project."
Knowledge and awareness	• **Unawareness within the health sector:** "Going to health meetings where there is absolutely no interest at all – they talk about healthy foods and healthy eating – but there is no interest at all to what food is produced [here] – or no knowledge. There is no attempt at choosing local produce." • **Unawareness within the BR:** "It's the individuals who sort of shape the organisation. Take a look at our Board, it's the same thing. If [the health researcher interviewing] were to join our Board then you would introduce new ideas and new concepts and help us explore new ideas. If it isn't there, it is not part of the organisation background – in terms of the people that are involved." • **Understanding within the BR:** "From the mandate point of view, if you look at the statistics of the BR, you can see that it is a lot of deprivation and disease. That has been collected nationally, so we can compare ourselves as a region. We can even interpolate between those areas, since it's all national statistics. So we can see that in the BR region there are some real critical health and economy issues for a lot of people. So the mandate that really should come from that is that when you look at the sense of bride somebody has in an area, their likely health status according the stats, their income, all these three things that, you know, they all go overlap geographically."
Perception	• **Health as a driver for sustainability:** "If we look at human wellbeing as the driver of sustainable development and the driver of individual's position within sustainable development, then you could say that their own personal health and economic and social wellbeing is a key factor in how a community wellbeing is built up. (…) Theoretically and strategically it's all there, but operationally it get a bit challenging"

Table 5.3 continued

Drivers for and barriers to integrating health	Identified themes and examples of verbatim quotes from interview responses
Perception continued	• **Lack of general awareness:** "I think [the interconnectedness between health and sustainable development] is explicit but getting the awareness – how would it come? • **Polarized perspectives:** "You get two camps – this is mostly the scientific measurable stuff and we do all that, and then we have a group of people who are all about process and the emotional wellbeing (…), the personal health. Obviously health is both."
Community champions and networking	• **Among the professionals/ practitioners:** "[The Medical Officer of Health] down here has really kind of knitted together a health unit enterprise and brought diverse groups into large and more cohesive units. And her focus is to work with the community." • **In the community:** "People in this area don't like to push themselves. They're naturally shy and whenever you have a public meeting, you always find that the hall will fill up from the back to the front. Nobody wants to sit in the front row and this is something we have to recognise (…) You have to identify those individuals in the community who are naturally more assertive to speak up on their behalf." • **Cross-sectoral bridging:** "Then again [the public health staff] will decide 'what resources do we have in our area, if they can help us [reach our operational goals]. 'Oh the BR s here – what can we do to encourage people to use their trails?' (…) we can do [health promotion] together. (…) So that's how it would happen from our end. Then from their end, they might say 'we're really interested in this' and then [the 'champion' from the BR] would speak to me and I would say 'sounds like a fit with what we're doing. I'll give you [Z]'s name' – and he knows [Z] cause she's one of the public health nurses – 'why don't the two of you talk together if we can actually make that happen'. So it would happen both ways."
Drivers for and barriers to integrating health	**Identified themes and examples of verbatim quotes from interview responses**
Funding/ time	• **Operational funding challenge:** "I can go to a [granting body] and (…) probably get somebody to do healthy communities. Say if you have a contingency of three or four staff and you want to keep them going. As a manager, you are managing those folks but you are also trying to ensure that there is continuity – so that grant follows grant follows grant, so you can keep them on-board. (…) Capacity issue is a pretty significant issue. Because you're still also trying to do all that outreach. We should be able to take the organisation to another level to be able to take on-board a healthy communities coordinator. [That requires] adding some management time, but where does that money come from."

integration processes were explored. Some of the main topics identified can be found in with examples of the responses categorized under respective themes.

5.4 Discussion

The in-depth interviews, analysis of public documents, and participant observations, summarized above, indicate that, the universal UNESCO mandate appears to support efforts promoting health and well-being although it is not explicitly stated. Moreover, a great range of projects undertaken by biosphere reserve organisations fall under the umbrella of health promotion (*Table 5.2*). The projects have involved both health-related activities that focus more narrowly on individual health behaviour change, such as physical activity, and those that address key social determinants of health, including poverty and food security.

All the participants in the case studies saw health and sustainable development as inherently interlinked topics, although most of the interviewees felt that the connection was intuitive rather than explainable. Individual interpretations of this interwovenness were strongly influenced by professional backgrounds, but the ubiquitous perception of interconnectedness creates a promising platform potential for increased practical integration of health and sustainability.

Three out of the four case organisations have bridged health and sustainable development by engaging health stakeholders. The fourth biosphere reserve has indirect engagement through its core partner organisations, which have active collaboration with the health sector. The greatest range of health promotional activities could be identified when the biosphere reserve had direct collaboration with the administrative top-level of

health organisations. Although it was not always explicitly expressed, all case-study biosphere reserve s have health promotion programmes related to both individual health behaviour change and systems change addressing wider social determinants of health (See *Table 5.2*).

All participating organisations noted that the interest of local individuals is the main determining factor for addressing health-related issues. Despite the differences in organisational structures (three organisations being strictly non-governmental and one functioning as an autonomous entity within the regional council), all four biospheres have interpreted their responsibility under the UNESCO mandate as building, in an inclusive manner from bottom-up, on local assets and needs. This deliberative approach, which is supported in much of the community-based health promotion literature (Kretzmann and McKnight 1993; Minkler 1997), fosters the local issue ownership vital for sustainable social and behavioural change. In the current resource-scarce reality of biosphere reserves, however, the approach that requires community initiation for projects also limits most activities to the topics of community partner interests.

The perceived mandates of both stakeholders and the bridging organisations appear to influence cross-sectoral collaboration in a much more complex manner than anticipated. The biosphere reserve organisations that did not explicitly integrate health into their activities did not see health as part of their mandate, whereas those focusing on health did interpret the same UNESCO mandate as inherently including health. Evidently some ambiguity surrounds the term 'well-being' and whether it is about health or sustainable development. While health stakeholders see health and well-being as synonymous, other

influential voices, for instance the Government of Wales, treat well-being as identical to sustainable development. This vagueness of terms can facilitate cross-sectoral collaboration, but it also may cause unnecessary variation in interpretation of the mandates.

Similarly, interpretations of the institutional mandates were important factors determining the ability of local health professionals to engage actively in biosphere reserve activities. Responses indicated that frontline health practitioners often feel strictly limited by their narrow mandates, despite the personal perceptions of the relevance of cross-sectoral integrated approach to health promotion. Particularly, environmental health practitioners are often excluded from professional collaborations, because their heavy workload is strictly guided by government directives. This is precisely the problem that Rittel and Webber identified in 1973 (Rittel and Webber 1973), when they developed the concept of "wicked problems".

The perceptions of upper management within healthcare organisations also strongly influence how government dictated mandates are understood and to which extent innovative cross-sectoral collaboration is encouraged in practice. For instance, in Ontario, some health units are engaged with their local biosphere reserves, whereas others remain unresponsive to invitations. Moreover, some participants expressed a desire to engage primary health care providers, e.g. to issue Green Gym prescriptions (promoting outdoors activities instead of prescription drugs or inside gyms) or to discuss the potential role of nature in mental health therapy. These findings suggest that the health sector might benefit from a more open approach to stakeholder engagement. Indeed, broad cross-sectoral

engagement of unconventional partners is encouraged particularly by the settings-based health promotion perspective (Poland et al. 2000b).

All participants throughout the study recognized that they had limited knowledge and understanding of one another's mandates. This was evident whether or not any active cross-sectoral collaboration with the health stakeholders was taking place. The admitted ignorance illustrates how personal perceptions, interpersonal interaction, and sense of mutual trust appears to play a much greater role in the initiation of collaborative activities than actual shared knowledge. Trust has been identified as a key factor in cross-sectoral collaboration (Wakefield and Poland 2005), but it would be interesting to explore the impact of better mutual understanding of the mandates of respective partners on potential partnership development. The lack of knowledge about others' mandates does not necessarily prevent cooperation, as long as an overall understanding of shared issues is present. It, however, appeared to cause some form of a barrier to people's ability to identify potential unconventional collaborators.

An explicit, open, cross-sectoral dialogue might enhance the integration of health and sustainable development. The potential for more extensive bridging activities was exemplified by one environmental stakeholder, who stated that:

> "To be totally honest, until quite recently, I haven't given the relationship with human health a great deal of thought. But when I think about it, it is actually extremely relevant, even though the management is focused on the ecosystem and habitat and species. It is actually extremely important for human health as well, because of things like water storage, carbon storage, and the other ecosystem services that the site provides".

Similarly, the public health management attendance at a meeting on integrated community sustainability plans, organized by the local biosphere reserve, resulted in the following

statement: “It was an exciting meeting and really helped me see how our work in public health fits within the sustainable community’s movement”.

A number of participating non-health stakeholders pointed out that many current limitations to health-related activities reflect limited understanding of possible public health matters. In general, biosphere participants recognized that the focus of activities within their respective organisations is usually directly dependent on the engaged individuals and their expertise or interests. Only where health professionals are actively participating does health promotion become an explicit component of the bridging efforts. As noted above, open cross-sectoral discussions contain the potential to stimulate action. For example, one Canadian biosphere reserve was recently inspired to partner with the local health unit to arrange walking groups and invited the engaged Public Health Nurse to join their Board.

While biosphere reserves are effective bridging organisations bringing diverse stakeholders together (*Table 5.2*), interviewees reported that it was a challenge finding the right language to attract the health sector to join meetings. Forty years after the globally recognized Lalonde Report (Health Canada 1974) declared environment as a determinant of health, the health sector evidently remains slow to engage with environmental stakeholders. The interview results reveal that integrating health in projects outside the health sector still depends directly on individuals who take it upon themselves to bring people together. Although each biosphere reserve organisation clearly is driven by a group of passionate people, the current success of health stakeholder integration seems to depend on a few visionary individuals, who are good at connecting people. Some of these

community champions work within the health sector and others are networkers within biosphere reserve organisations who see health as an integral component of sustainable communities. Studies on effectiveness of community-based health promotion support the value of community champions in driving change (NCCCE 2007).

Despite the barriers, biosphere reserves have had some success in developing cross-sectoral activities that promote health-related changes both at the individual behaviour and the systems level (*Table 5.2*). Not all interviewees saw the necessity of having an explicit focus on health in biosphere reserves' programme development. As one participant pointed out: "I think [health] is implicit in what we're doing already." To justify the shift to an explicit health focus would require, for instance, availability of some health funding consistent with the criteria set for biosphere reserve activities. That said, making the implicit explicit would probably also help health practitioners justify their participation in cross-sectoral collaboration with biosphere reserves.

This study indicates that organisations with a primary focus other than health have the potential to play a meaningful role in providing a neutral, apolitical, platform that helps bringing diverse community stakeholders to the table to promote health. In the case of biosphere reserves, this potential could be significantly increased by making health an explicit part of the biosphere reserve mandate and exploring the mandates of potential health-related partners in greater detail. The health sector within biosphere reserve regions, in turn, has an innovative opportunity not only to promote health but also to facilitate application of 'Health in All Policies' approach. In addition to ideological goals, such collaboration could strengthen the local health promotion capacity in resource-

strapped rural communities. This would, however, require more proactive strategies among the health professionals. In general, biosphere reserves have a great potential role as bridging organisations that help integrate health and sustainable development in practice. The in-depth qualitative analysis reported here indicates that this type of bridging organisation represents a promising new venue for meaningful solutions to wicked public health problems at the community-level

6 Bridging knowledge for children's environmental health in the local context: Exploring the knowns and the unknowns

6.1 Introduction

Emerging issues in children's environmental health present a challenge for decision-making processes aimed at healthy and sustainable community development. Threats to children's environmental health typically pose 'wicked problems'. Because they are complex, dynamic, and influenced by multiple factors, the problems cannot be solved by one sector alone (Caron and Serrel 2009). Furthermore, they can be interpreted in various ways depending on the values and interests of stakeholders (Kreuter et al. 2004). To address children's environmental health issues knowledge from a wide range of stakeholders is necessary (Koppe et al. 2006), as is often the case in decision-making processes related to both public health and sustainable development (Ansell and Gash 2008; Cargo and Mercer 2008). This paper explores problems related to the complex knowledge needed to understand the linkages between children's health and the environment. Moreover, it investigates the potential of bridging organisations to improve information-gathering processes relevant to local governance and policymaking approaches that affect children's environmental health.

6.1.1 Children's environmental health and sustainability

In the context of this research, children's environmental health refers to the susceptibility of children's developing physiologies to various environmental factors. In Europe, the term

'children's health and the environment' is more commonly used to address the same issues (Guidotti 2007). Environmental threats to child health are not new and many of the issues are recognised internationally. Indeed, the children's environmental health movement will be celebrating its 25th anniversary in October 2014 (Etzel 2010). Since Colborn et al.'s (1997) book, *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival?*, the subject of children's environmental health has been gaining attention amongst researchers. Over the past decade the number of researchers engaged in environmental paediatrics has been growing rapidly (Landrigan and Miodovnik 2011). In the United States alone, 14 government supported Centers for Children's Environmental Health and Disease Prevention Research have been established. By 1996, the *United States Environmental Protection Agency* (EPA) had already developed a National Agenda to Protect Children's Health from Environmental Threats and the following year a specific *Office of Children's Health Protection* was established (EPA 2014).

In 2003, the World Health Organization (WHO) recognized children's environmental health as a major challenge and a key concept that highlights the interconnectedness between health and the environment. This was followed by a worldwide project to identify children's environmental health indicators (WHO 2003; 2004; 2009), which resulted in a series of international and national strategic planning documents, such as the *Children's Environment and Health Action Plan for Europe* (CEHAPE; WHO 2004). There are, however, differences in interpretations of what children's environmental health entails. In the United States, children's environmental health primarily refers to undesirable health outcomes that are caused by exposures to environmental chemical contaminants and microbial vectors during childhood (e.g. EPA 1996; 2014). In Europe, CEHAPE takes a significantly

more holistic approach (WHO 2004). It builds on the United Nations' *Convention on the Rights of the Child* and emphasises sustainable development as a key component, stating explicitly that "protecting children's health and environment is crucial to sustainable development" (WHO 2004:1).

Nevertheless, many topics concerned with children's environmental health hazards remain remarkably absent from most sustainable development and public health discussions, particularly those taking place at the local level. For example, both the acute toxicity and infectious disease aspects of environmental health have, in general, been widely studied and appropriate decision-making processes tend to be well-integrated into respective policies (e.g. Knudsen and Slooff 1992; Waring and Brown 2005; OPHS 2008). Yet such efforts do not focus specifically on children's environmental health and studies that inform local decision-making related to low-dose, chronic exposures to hazardous compounds and subsequent health outcomes are scarce. Minkler (2010), one of the few scholars working to highlight this issue and demonstrate potential solutions, describes community-academia partnerships as one venue to help create the needed data. Indeed, large-scale statistical research often misses small-scale local pollution 'hotspots'. Therefore literature that addresses chronic environmental health challenges tends to emphasise the importance of community-based participatory approaches (e.g. Morello-Frosch et al. 2002; Israel et al. 2005; Payne-Sturges et al. 2006; Minkler 2010; Brenner and Manice 2011).

At the local level, an increased understanding of children's environmental health issues would help inform municipal sustainable community development, ranging from the practices of industrial and municipal waste purification to the planning of local urban

infrastructure and natural resource management. For instance, the increase of micropollutants in waterways has been identified as one of the emerging challenges to public and ecosystem health (Schwarzenbach et al. 2006; 2010). Eventually, this environmental health hazard will require the attention of wastewater management agencies that operate at the local and regional levels. Understanding the impacts of pollution on child health will help the development of appropriate water treatment solutions.

One approach to identifying the hotspots most in need of pollution monitoring could be to scan for existing issues by assessing the local data related to children's environmental health. Minkler (2010) documented such an approach in their community-based study on high rates of childhood asthma in Brooklyn, a study that was initiated by local concerns for

Table 6.1: Adverse health outcomes associated with exposures to endocrine disruptors include but are not limited to:

CEH outcome	Reference
Neurodevelopmental disorders, such as autism, ADHD and learning disabilities	Colborn et al. 1997; Landrigan and Garg 2002; Lundqvist et al. 2006; Grandjean et al. 2008; Lewandowski 2011
Metabolic disorders, such as obesity and diabetes	Heindel 2003; Alonso-Magdalena et al. 2006; Heindel and vom Saal 2009; Newbold et al. 2009; Latini et al. 2010; Catenacci et al. 2009; Janesick and Blumberg 2011; Newbold 2011)
Cancer	Brisken 2008; Ruden et al. 2008; Casals-Casa and Desvergne 2011; Johnson et al 2012; Fucic et al. 2012; Ventura et al. 2012
Sexual reproduction, such as feminisation of males and infertility in both human beings and wildlife	Colborn et al. 1993; Geschwind et al. 1999; Lister and Van Der Kraak 2001; Oehlmann et al. 2009; WHO 2012
Many other conditions, such as schizophrenia Alzheimer's and Parkinson diseases	Colborn et al. 1997; Euling et al. 2008; Giasson and Lee 2000; Genuis 2006; Schoeters et al. 2006; Bornehag and Nanberg 2010; Tian et al. 2010; Masuo and Ishido 2011; Miodovnik et al. 2011; Clere et al. 2012

children's environmental health and observations of possible causes. The multi-stakeholder collaboration that conducted this research effected policy change at the local, state, and national levels, including new environmental standards for the New York City bus fleet. However, without the context-specific, spatially and culturally appropriate, ecological and human health-related information gathered by this kind of community-based research, governing bodies cannot make such effective decisions (Burger et al. 2010). Many scholars have, therefore, highlighted that government agencies need to work with communities if they are to gain all information necessary for sound decision-making (Ayala et al. 2005; Morello-Frosch et al. 2005; Shepard et al. 2008; Burger et al. 2010).

In addition to local knowledge, expert knowledge of the multiple key factors influencing children's environmental health is also essential to help identify possible problems. For instance, according to current scientific research, the greatest threat to children's environmental health is posed by endocrine disrupting compounds (EDCs). EDCs, which include hormone mimicking compounds (hormone derivatives, such as Bisphenol A and phtalates) and heavy metals (such as mercury, lead, and cadmium), have the potential to cause undesirable health outcomes by interfering with hormonal regulation and disturbing the normal endocrine functions (*Table 6.1*). The greater challenges toxic pollutants, however, have to do with the complex ways they interact with human physiology. For examples, they follow many routes of exposure and are potentially processed by a number of different metabolic pathways. Furthermore, in the environment, chemicals do not appear in isolation and the chemical behaviour of many environmental pollutants changes when they are together with other compounds, such as chemical mixtures used on the fields and ending up at waterways (e.g. Hayes et al. 2006) or the

compilation of xenobiotic toxic compounds found in human blood (e.g. Nanes et al. 2014). A general lack of understanding concerning the potential impact of low-doses of pollutants in mixtures poses a threat not only to public health but also to the viability of many ecosystem services (Koppe et al. 2006). Despite the uncertainties associated with this type of complex science, there is sufficient evidence and international consensus to promote a precautionary approach to addressing threat to children's environmental health.

A key aspect of dealing with environmental health hazards is, indeed, acknowledging this complexity. As Pessah (2011) stated in the opening plenary of the 27th International Neurotoxicology Conference, "most clinical disorders of the nervous system arise from complex interactions among multiple risk factors". In other words, in the case of such health outcomes, single, linear, causal pathways can rarely be identified (Koppe et al. 2006). Rather, health outcomes are the result of a messy complex matrix of interactions among volatile mixtures of environmental stressors (e.g. chemical compounds), individuals' genetic heritage (DNA), and physiological pathways that fine-tune bodily functions. Moreover, during certain periods of child development, known as 'windows of vulnerability', even small concentrations of xenobiotic compounds have a great potential to permanently affect health outcomes (Jurewicz et al 2006; Landrigan and Miodovnik 2011; Barouki et al 2012; Fucic et al. 2012). Early exposures to EDCs may cause chronic disease and disability not only in childhood but across the entire span of human life (Landrigan and Garg 2002; Jirtle and Skinner 2007; Grandjean et al. 2008; Barouki et al. 2012). This temporal susceptibility, a main characteristic of child physiology, makes children significantly more vulnerable than adults to environmental health hazards.

Of additional relevance for healthy sustainable community development is the social and biophysical context of children's environmental health. Children from low-income families are disproportionately exposed to environmental threats (Outley 2006). Furthermore, the social and physical aspects of health may play a greater role than was hitherto appreciated. For instance, while studying the relationship between lead exposure and learning disabilities, a research team at Johns Hopkins University (Guilarte et al. 2003) discovered that positive social interaction changed the metabolic pathways of toxic compounds at the molecular level. In Guilarte et al.'s study, social interaction and intellectual stimuli counteracted the negative impacts of lead exposure.

Children's environmental health experts argue that the exponentially growing base of natural scientific and epidemiological evidence, albeit an area of research that is still evolving, indicates that many of our contemporary societal practices are potentially hazardous to child development (Landrigan et al. 1998; Faustman et al. 2000; Tickner and Hoppin 2000; DeSouza et al. 2003; Jurewicz et al. 2006). While some authors focus on policy changes that affect monitoring practices and regulations (e.g. Jurewicz et al. 2006; Sheffield and Landrigan 2011), others demand more radical measures, such as policy development that facilitates fundamental changes to the ways in which commodities are currently produced (Tickner and Hoppin 2000). However, a major barrier to developing effective policies for children's environmental health is the lack of appropriate, context-specific, data needed to assess local situations.

Uncertainties that persist in the fields of both toxicology and epidemiology can also hamper effective decision-making (Brown et al. 2010)[18]. However, developing precautionary local monitoring processes and adopting a more "ecosocial outlook" while taking a participatory approach, as proposed by Morello-Frosch et al. (2005:385) could lead to an alternative, cost-efficient, mechanism to gather the needed data. Morello-Frosch et al. argue that using community-based participatory practices to address environmental health issues not only enhance scientific understanding of the problem but also help focus intervention efforts on solutions that promise the greatest positive impact on local well-being. Moreover, deliberative approaches tend to merge knowledge from various stakeholders and create a more meaningful context-specific information base for local decision-making.

6.1.2 Bridging knowledge

As mentioned above, knowledge needed for effective governance, in general, has become progressively more dispersed and specialized, which has lead to deliberative and more collaborative approaches to decision-making (Ansell and Gash 2008). Yet, the literature on policy related to public health pays curiously little attention to the types of knowledge that contribute to policy development (Bryant 2002). At the same time, many advocates for children's environmental health focus on a very narrow scientific interpretation of the issues. For instance, the Committee on Environmental Hazards of the American Academy of Pediatrics recommends that risk calculations related to children's environmental health

[18] 'Uncertainties' here refer to both the technical limitations of statistical analyses (overall 'roughness' of population-based approaches as well as challenges of statistical inquiries to recognise complex, unknown, or unanticipated factors) and consequent differences of opinion, for instance, related to analyses of the findings

threats should be included in all aspects of government decision-making (Goldman et al. 2004). However, by basing decisions on only hazard identification and the dose-response considerations such approaches ignore the socioeconomic and biophysical complexity of the issues (Brenner and Manice 2011). As pointed out by Raymond et al. (2010:1766), "[to] manage the scope, complexity and uncertainty of global environmental problems, it is important to take account of different types and sources of knowledge".

Considering the wide range of environmental threats that result in poor health outcomes for children and the complexities related to the interconnectedness of children and the environment, an array of different types of knowledge is, indeed, needed. Pollution is often spatially specific. Its potential impact on human health depends on the particular characteristics of a given community, including geographic location, surrounding biophysical landscape, local industries, infrastructure, regulations, demographics, etc. Conventionally monitoring pollution levels is the responsibility of various environmental agencies, whereas the health sector tracks and reports on health statistics. Because of the administrative 'silos', the two sets of data are seldom merged analysed as one. Nevertheless, the diverse range of adverse health outcomes (*Table 6.1*) in itself indicates that it could be prudent to watch for additional outcomes, for instance monitoring trends in learning disabilities, mental health, occupational health, and income statistics. Moreover, current research findings concerning chemical mixtures and low-dose impacts on human and ecosystem health imply that monitoring a broader range of compounds might also be beneficial (Koppe et al. 2006; Sheffield and Landrigan 2011).

However, in most cases, local and regional authorities do not have the capacity to monitor and collect the data required for effective decision-making related to children's environmental health by conventional means. Facilitating extensive stakeholder gatherings across jurisdictional boundaries to address local pollution issues would be beyond both the mandate and skillset of most community-level decision-makers. Yet complex social-ecological issues, such as those that affect children's environmental health, do not disappear just because there is no capacity to address them. As has been emphasised by numerous scholars, to govern towards sustainable development, academic, practitioner, and lay knowledge need to be integrated through collaborative approaches that facilitate a common understanding of local issues (Folke et al., 2005; Armitage et al. 2008; Berkes, 2009; Raymond et al. 2010).

Non-governmental bridging organisations have been recognised for their potential to help bring together stakeholders from diverse sectors (Brown 1991), including actors from the environmental and health fields. Indeed, the role of a bridging organisation is to facilitate cross-sectoral collaboration and to provide a safe arena for diverse stakeholders to meet and learn together (Hahn et al. 2006, Berkes 2009; Crona and Parker 2012). By doing so, these organisations can also contribute mechanisms that promote mutual learning and deliberation among participants, which has been identified as imperative for collaborative knowledge integration (Raymond et al. 2010). The goal of these organisations is to ensure that local knowledge is included in governance practices (Jamal et al. 2007; Leys and Vanclay 2011). At the same time, by acting as intermediaries and coordinating networking processes, bridging organisations also "provide relief for local participants who are generally time restrained" (Leys and Vanclay 2011:576). In addition, they can assist in

conflict resolution to help communities overcome tense disputes, prejudice and power struggles. For instance, in its role as a bridging organisation, Charlevoix Biosphere Reserve in Canada managed not only to discover the true source of contamination in local waterways but also improved the social cohesion of the town (Godmaire et al. 2013). Indeed, Millennium Ecosystem Assessment (Malayang et al. 2007:207) as well as the adaptive governance literature identified UNESCO-mandated biosphere reserves as examples of bridging organisations (Schultz 2009; Biggs et al. 2010; Hahn 2011). There are many other possible organisations that may have the potential to provide bridging services. However, this study focused on biosphere reserves because of their unique global mandate and their demonstrated potential for bringing together health and sustainability stakeholders (Chapter 5).

A biosphere reserve is a geographic region and also an organisation that promotes sustainable livelihoods in its designated region while working to conserve or improve the well-being of local ecosystems (UNESCO 2008). Biosphere reserves have a universal mandate from UNESCO that combines commitments to ecological stewardship, sustainable livelihoods and learning. Because biosphere reserves adapt this basic agenda to meet their local, context-specific, needs (Dempster 2004; Francis 2004), organisational structures and governance approaches vary among biosphere reserves. Indeed, biosphere reserve organisations do not usually have any juridical or administrative powers but rather function as stakeholder partnerships that span over multiple jurisdictions (Pollock 2009). Currently, there are 621 biosphere reserves in 117 countries (UNESCO 2014) are mandated to be "learning laboratories" that "develop mechanisms to encourage the sustainable development of biosphere reserves carried out in partnership with all sectors

of society to ensure the well-being of people and their environment" (UNESCO 2008). Biosphere reserves as bridging organisations have demonstrated their function as learning sites that aim to secure ecosystem services for human well-being (Schultz 2009). They have also helped to create locally relevant knowledge and empower people in the process (Jamal et al. 2007). Jamal et al. studied how the work of biosphere reserves led to new initiatives . These initiatives were based on the knowledge gained and relationships formed during the various stakeholder meetings, facilitated by biosphere reserve organisations. Some biosphere reserves also explicitly integrate health explicitly into their sustainable development activities (Chapter 5).

The 'real world' problem that triggered the idea for this study was that, despite its relatively long history and increasing prevalence of environmental health hazards, children's environmental health is still not taken into consideration by local decision-making processes. As pointed out by a number of scholars (e.g. Morello-Frosch et al. 2005; Koppe et al. 2006; Burger et al. 2010), a wide community of stakeholders needs to be engaged to gain sufficient understanding of the local conditions concerning child health and the environment. This research explores bridging organisations as potential mechanisms for gathering context-specific information related to children's environmental health. Four biosphere reserves, chosen as case studies, are explored as possible bridging organisations that could bring stakeholders together for children's environmental health and ultimately increase decision-making capacity at the local level. The bridging potential of the organisations is assessed by interviewing staff, Board and partners to identify their perceptions and knowledge of local assets and needs related to children's environmental health. The aim is to gain an improved understanding of the local knowns and the

unknowns related to children's environmental health, while exploring possible mechanisms for improving local decision-making processes.

6.2 Methods

This study focuses on asking: What types of knowledge and perceptions can be found in biosphere reserves as potential bridging organisations that could be useful for communities assessing their own local situations regarding children's environmental health? Analytic induction (Patton 2002:493) was chosen as the approach to answer the question for two reasons: (1) the existing knowledge on children's environmental health offers some indication of the types of information that could be useful; but (2) it was unclear at the beginning what could be expected to be found. Because of this dichotomy the direction of the exploration was guided by two categories of sensitising concepts (Bulmer 1969; Patton 2002:278-279; see Appendix 1 for details): (a) Health determinants or environmental health hazards; and (b) Possible poor environmental health outcomes. The research explored perceptions and knowledge of issues relevant to children's environmental health among the biosphere reserve stakeholders as well as their attitude towards these issues. Findings were analysed and validated through triangulation by document analysis and observation. The sensitising concepts were developed based on the latest scientific research on environmental paediatrics, including evidence of possible environmental causes of poor health outcomes in children and the results of indicators set to monitor those outcomes. The themes that the study wanted to cover included, for instance, perceptions of the interconnectedness between health and sustainability, understanding of children's environmental health and its potential value for the work of the organisation, awareness or knowledge of local stakeholders, local environmental health

problems, monitoring practices, etc. The research aimed to answer the following three research questions: (1) How do people engaged in biosphere reserve activities perceive and understand concepts of health, children's environmental health, and sustainable development as well as the connections between health and the environment, in particular as they relate to disease prevention and children's environmental health? (2) What types of data, information, understanding, and skills are available to facilitate the sense making (function as bridging organisation) related to children's environmental health? (3) How can the theory and practice inform one another to help develop meaningful knowledge for decision-making in sustainable healthy community development? The project followed the ethical guidelines for health research concerning human participants outlined by the Office of Research Ethics at the University of Waterloo (ORE #18477).

Biosphere reserves in Canada and the UK were selected because both countries developed national children's environmental health strategies around the same time, Canada in 2010 (Health Canada 2010) and the UK a year earlier in 2009 (Health Protection Agency 2009). North Devon and Dyfi biosphere reserves in the UK and Frontenac Arch and Georgian Bay biosphere reserves in Canada were chosen as the case study locations, because the selection offers a set of two geographically comparable regions in each country, of which one organisation has and one has not conducted activities with an explicit health focus. The research was guided by a conceptual framework that brought together health promotion and governance for sustainable development (See Chapter 3 and 4).

The data were collected using semi-structured interviews, document analysis, and participant observation. Semi-structured interviews (n=29) were conducted at all four

locations between November 2012 and May 2013. The interviewees were selected based on purposeful sampling, using a snowballing approach to identify suitable participants. Because all participants, staff (n=9), partners (n=16), or Board members (n=4), were experts in their respective fields, the qualitative in-depth interviews followed an interactive style (Patton 2002:402). Eight of the participants were health professionals. The interview guide included topic relevant themes based on the sensitising concepts. The order and format of the questions varied depending on the flow of the discussion and the professional role of the interviewee. Interviews were conducted until saturation was observed (the same topics began to recur in responses). This research was an embedded multi-case study (Yin 2009) that explored the perceptions and knowledge of children's environmental health among people associated with biosphere reserves, using various units of analysis and iterative replication design (Yin 2009) to ensure identification of all critical aspects of the research questions. Participant observation in this study was guided by the work of Spradley (1980) and the document analysis in multiple method triangulation by Robson (2002:348-373) as well as Patton (2002:555-560). The document analysis was chosen as an unobtrusive method of validating and supplementing information revealed by the interviews. This method involved gathering information from websites, newspapers, brochures, and a great range of other academic and grey literature. For primary searches key words related to children's environmental health were used to mine databases: Scopus and Web of Science for academic sources, and Google search for non-academic information.

6.2.1 Data analysis

All the interviews were recorded and transcribed. The coding procedure followed the guidelines of Fonteyn et al. (2008) and Patton (2002: 447-453). The initial codes were created based on the sensitising concepts and additional codes were developed when unanticipated health promotion related topics were mentioned. Due to the exploratory, iterative, and reflexive nature of analytic induction (See appendix 4) and the size of the research sample, the topic being only a small component of a larger study, the data were analysed manually. Categories were then developed based on themes that emerged from the results (Patton 2002:452-471). Because of the rural and small community context, all the results were pooled into one single general story of biosphere reserves as bridging organisations for health and sustainable development, to protect the confidentiality and relative anonymity of the participants. In a further attempt to protect the anonymity of interviewees identifiers related to the responses were omitted.

Three types of triangulation were used to strengthen the data: (1) multiple methods, (2) multiple data sources, and (3) review by inquiry participants (Patton 2002:556-561). Participants were provided with a summary of findings and specifics related to their own interviews for review and validation. Both document analysis and participant observation were used to cross-examine interview findings.

6.2.2 Potential Bias

This project originated from an identified need to improve children's environmental health and assumes that bringing diverse stakeholders together at the local level creates a potential for assessing local situations. Both public health and sustainable development

approaches inherently promote social change. This study's conceptual approach is based on the evidence and academic literature of both health promotion and sustainability governance. Researcher bias was minimized by iterative and reflexive research practice and triangulation (Patton 2002:544-561).

6.3 Results and discussion

Despite official national frameworks, such as the Canadian National Strategic Framework on Children's Environmental Health (Health Canada 2010) and A Children's Environment and Health Strategy for the United Kingdom (Health Protection Agency 2009), children's environmental health appears to remain an unfamiliar concept to broader audiences. In her study "A 'tricky business' – knowledge production in children's environmental health," Seto (2011:ii) argued that "the influence of neo-liberalism, corporate power and over-reliance on strictly evidence-based biomedical reductionism is slowing down assessment and regulation of chemicals while many health professionals and grassroots activists have called for swifter responses based on the precautionary principle". Results in this study indicate, however, that awareness of environmental impacts on child health remains limited even among health professionals and at the 'grassroots level'. Only two of the participants had an explicit understanding of the concept of children's environmental health prior to this study. Though these two were both public health practitioners, they worked in different geographic regions. None of the other interviewees (n=27), including those with professional connections to children's health and wellbeing, recalled being familiar with the concept before their involvement with this research project.

This general lack of familiarity with the concept does not mean that people are not aware of paediatric vulnerabilities or possible environmental hazards. Rather, when asked what they thought children's environmental health could entail, participants responded with a range of possible ways in which children might be different from adults. Their responses, which suggested awareness of differences in behaviours, daily environments, and physiologies, are illustrated by the following examples:

- [Children] "would probably be a bit more in the dirt, in the grass, closer down to things, crawling, hands in the mouth – so more exposure to if there're toxins in the environment" (Participant);
- [Children need] "healthy school policy: healthy meals, healthy playgrounds, appropriate shade, just a healthy environment for them to learn in" (Participant); or
- "I think a child is much more susceptible to their environmental surroundings – like they are not as resilient as much as we might be… maybe more affected… I think also when you are growing and developing – your brain, your muscles, your body, everything – that it would be more affecting (…) I just think that there is a relation" (Participant).

Responses were grouped into eight themes and summarised in *Table 6.2*. In general, *Table 6.2* demonstrates the holistic views many practitioners appear to have. Yet, they often referred to intuition when asked about the possible interconnectedness between health and sustainability. Their reliance on 'intuition' as less valuable justification in the absence of apparent rational explanation reflects how hierarchies of disciplinary 'silos' have been implicitly imprinted in the public discourse.

Table 6.2: A summary of participant perceptions of what children's environmental health could mean

1. Quality of physical environment (especially lack of pollution)
• The relationship between the physical health of children and environmental stressors. The quality of the biophysical environment in which they live. E.g., air quality (causes) and asthma, (health outcomes)
• "A suite of environmental parameters that are relevant to children's health" (Participant) - the way in which children may be more susceptible to some pollutants than adults are
• Absence of pollutants and environmental hazards that are detrimental to children's development (incl. traffic)
2. Access to natural environment
• "More time spent outdoors in the nature" (Participant) - as opposed to being indoors and built environments
• Mind and body connection (term used by a participant referring to linkages between nature and various physical and non-physical aspects of child development): "Education should involve being taken out to the countryside unless they already live in a rural area – into rural areas to experience the countryside" (Participant)
3. Mental well-being related to independent exploration in nature
• Freedom to go and explore the nature/ environment – mental health and general personal development
• "Forest bathing, fresh air, kind of thing – that is something that I think does not feed enough to health discussions but maybe it's getting there" (Participant)
• "The natural environment is where kids were meant to play and learn and grow and that our responsibility as adults is to facilitate that – not put boundaries on that" (Participant)
• "… should be part of encouraging children to take responsibility for their own actions and their own body" (Participant)
4. Skills for interacting with nature in a healthy manner
• Familiarity with nature and understanding how to use the environment in a healthy way
• "[Children's] understanding and use of and the engagement with the environment" (Participant)
5. The way in which children see environment and health
• Children's personal perspective
6. Understanding what healthy and sustainable community means
• Understanding of food they eat and where it comes from
• Getting children to understand what is sustainable (perceived as a challenge)
7. Healthy built environment
• Healthy schools and institutions
• Healthy woods and trees but also healthy school and home environments
• Sustainable buildings
8. Healthy future
• What children, as the future/ next generation, will encounter when they grow up
• "Children are the next generation" (Participant)

The results from this research suggest that there is a need to reconsider how children's environmental health issues are approached. One of the participants familiar with children's environmental health pointed out that the government's focus on toxic compounds reflects the "technical part of kids being exposed to bad things in the environment" but it excludes the "healing power of the environment or environment as a playground". This emphasis on the relation between the natural environment and children's social empowerment in connection with children's environmental health is a valuable discovery, even if the emphasis in the findings may be skewed because of the mandate of biosphere reserves reflecting the priorities of the people engaged in biosphere reserve activities. Creating a more holistic approach to children's environmental health has the potential to make the topic not only more meaningful to the general public but also more relevant to the perspectives of social determinants of health and sustainable development.

Participants clearly had some idea of possible linkages between child health and the environment, but the overall lack of familiarity with the concept of children's environmental health indicates that current approaches to improving children's environmental health are insufficient. Indeed, while the results (*Figure 6.1 and Table 6.3)* imply that an extensive amount of knowledge related to children's environmental health*[19] exists within biosphere reserve organisations and their respective communities, there appears to be a general lack of overview of the current local situation. The available knowledge is fragmented and spread among community members, but a coherent,

[19] Information that is of relevance when trying to assess the local situation concerning children's environmental health

comprehensive, shared understanding or assessment of the local situation concerning children's environmental health is missing. Furthermore, it was evident that participants did not have a scientific understanding of the mechanisms by which and the extent to which the environment can influence child development. These findings emphasise the need to develop alternative approaches to assess children's environmental health in a community context, in order to make the topic more meaningful to people.

6.3.1 Knowledge of possible problems related to children's environmental health in the communities

Local knowledge about possible environmental health concerns in biosphere reserves was surprisingly extensive, despite the fact that all participants highlighted the relatively healthy state of the local environment. Whilst awareness of specific issues related to children's vulnerability to environmental pollutants was not very high, participants nevertheless demonstrated knowledge of a number of environmental factors that could have negative impacts on health. All four regions were self-identified as socioeconomically deprived, predominantly rural areas with high rates of unemployment and higher aging populations than the national average. In all regions, there appeared to be a general understanding that poverty has an impact on the local health outcomes. One biosphere reserve had used Geographic Information System (GIS) technology to map the needs of their region and identified that pockets of poor health were strongly associated with low income neighbourhoods.

Participant concerns related to environmental health included possible sources of pollution as a health threat (train derailments, inadequate septic tanks, and chemicals used

in sheep drenching) and poor health outcomes (obesity, cancers, and learning disabilities); see Appendix 5 for more details. Furthermore, participants touched on many biophysical concerns, such as mould in houses after flooding, processed foods, or lack of fluoride in drinking water, and social concerns, including energy poverty and social isolation causing mental health issues and suicides.

Despite the great range of environmental concerns identified, there did not appear to be a single children's environmental health threat mentioned by all participants in one region. Although none of the participants was aware of the national children's environmental health strategic frameworks, in two cases, the differences in responses reflected corresponding differences in national strategies. Canadian participants focused slightly more on pollutants, while the British participants were more concerned about access to nature. Similarly, the British children's environmental health strategy is significantly broader and more detailed than the Canadian framework, and includes a component on access to green spaces (Health Protection Agency 2009:23). While both frameworks address the social determinants of health and sustainable development as key components of children's environmental health, interpretations of these components vary. In addition to pollution, the British strategy asserts that physical activity, obesity, sustainable transportation, and mental health all contribute to children's environmental health. The Canadian strategic framework (Health Canada 2010), in turn, emphasizes the role of health determinants more in relation to risk management, an approach which is aligned with the dominating discourse in the United States (EPA 1996). However, the Canadian strategy also highlights the importance of collaboration and communication for knowledge sharing and pooling resources. The fact that participants remain unaware of the

concept of children's environmental health despite the existence of these two national frameworks can be seen as an indirect critique of inefficient information dissemination and top-down policy development practices.

In the interviews, similar topics came up in all regions, although each region's unique biophysical characteristics and economic histories influenced the nuances of concerns (See Sections 6.4.1 and 6.4.2 for examples). In general, water pollution was a common theme in all interviews. Examples of four types of concerns related to water pollution will be discussed in more detail in Sections 6.4.1 and 6.4.2. The four example cases demonstrate concerns with (1) current water management practices; (2) the scientifically proven presence of toxic contaminants; (3) a lack of comprehensive, systematic monitoring; and (4) poor local health outcomes, such as high paediatric cancer incidences. In addition, climate change and invasive species appeared to cause worry in all studied regions. An unexpected concern, which is not mentioned by either of the national children's environmental health strategies, was the impact of the social environment on child health. Mental health concerns were highlighted equally by both Canadian and British participants (approximately one fourth of total participants), as was the need for environments that make healthy choices the easy choice.

Not all observations relate to critical or solvable health issues, but the extent of the concerns expressed implies that children's environmental health threats do exist in all four studied regions. Furthermore, some findings from the interviews were not identified as a threat by participants but are known possible children's environmental health hazards, according to a number of scientific studies. For instance, glyphosate (RoundUp) was mentioned as the most effective means to control invasive species like Garlic Mustard.

Glyphosate is an endocrine disruptor and glyphosate-containing pesticide mixtures have been identified as a health risk for both human and animal development, especially aquatic wildlife (Savitz et al. 1997; Dallegrave et al 2007; Annett et al. 2014; Mesnage et al. 2014).

6.3.2 Flooding

Flooding came up as a potential health concern in two of the biosphere reserves. Two examples of these concerns will be discussed briefly in relation to children's environmental health, in order to illustrate possible implications of these research findings for local decision-making. The first example is the practice of allowing excess wastewater flow to bypass the sewage treatment facilities when large quantities of storm water exceed system capacity. The second example refers to old mines and tailing ponds that have been flooded repeatedly within a short period of time, resulting in the discharge of heavy metals into the soils of nearby valleys, including local vegetable gardens.

Conventionally, the greatest concern in contemporary wastewater treatment is faecal bacteria and other vectors carrying infectious diseases. However, sewage sludge also contains a complex mixture of endocrine disrupting chemicals from heavy metals to persistent organic compounds, such as phthalates. Many of the compounds cannot be removed by existing wastewater treatment systems (Lee et al. 2006). Furthermore, storm water, especially the runoffs from roads, is known to carry pollutants, in particular high levels of metals (Ellis and Mitchell 2006; Bjorklund et al 2009; Ferreira et al. 2013). In the UK, for instance, multiple studies have demonstrated that significantly higher prevalence of feminised and intersex fish can be found in the vicinity of sewage effluent point sources (Gross-Sorokin et al. 2005). Similarly, mixtures of EDCs have been shown to impair sexual

and neural development, even when the concentration affecting an individual remains below current acceptable levels or single compounds in isolations show no effect (Hayes et al. 2006; Hass et al. 2012). There is enough broadly accepted scientific evidence about the challenges related to the growing EDC contamination of waterways to support some level of action to assess the situation regarding the concerns expressed by interview participants. Gathering available data and assessing the local situation could be a good starting point to evaluate whether any further action needs to be taken, e.g., towards alternative solutions or improved monitoring. If communities are to achieve both public health goals and sustainable local economies, a more collaborative discussion about local water management might be beneficial.

In the case of the second example, which relates to the heavy metal contamination of local vegetable gardens, the presence of heavy metals was confirmed by local academic research. Lead from the old tailing ponds was indeed found in local garden plots, though research concluded that the detected quantities of lead were below acceptable levels, according to current national environmental regulations. Academic literature reviews that pooled international research indicate, however, that there is no safe level for lead contamination in relation to childhood exposure and adverse neurodevelopmental effects (Lanphear et al. 2005; Crump et al. 2013). Furthermore additional document analysis revealed that other studies in the same region have shown lead levels to be up to 82 times higher than the current acceptable level and observed health impacts in the local cattle indicate a potential cause for concern (See *Table 6.3*).

Combining local children's environmental health statistics that possibly relate to

Table 6.3: Local collective knowledge: Two examples of how local collective knowledge can enhance current monitoring practices [* CEH=children's environmental health]

	Case 1	Case 2
Local knowledge (Interview)	"*So this is old lead and silver mining activity and the water still runs through those tailings, picks up the heavy metals and takes them down the estuary*." (Participant 1) "*… a well established allotment society – gets flooded from catchments and is known that here's high levels of lead in there – which would have been accumulated over many years."* "*And somebody at the university actually did some research and took some samples out there*." (Participant 2)	*"Like learning disabilities – I hear that those are really high, but I don't know how that compares to other areas."* (Participant 3) *"I had never heard the word cancer come up more in my life and I am from a small town"* (Participant 4) *"… you hear of a lot of young people dying of cancer suddenly"* (Participant 5)
Verification of local knowledge (Document analysis)	***Environmental monitoring:*** While the measured lead concentration in the garden plots was found to be below the current acceptable level, that was not the case everywhere in the area: "Analysis of overbank sediment following widespread flooding in west Wales in June 2012 showed that flood sediments were contaminated above guideline pollution thresholds, in some samples by a factor of 82. Most significantly, silage produced from flood affected fields was found to contain up to 1900 mg kg^{-1} of sediment associated Pb, which caused cattle poisoning and mortality." (Foulds et al. 2014)	***Health monitoring:*** In many of the local schools, 50% of the students have special education needs (Fraser Institute 2014). The study area showed up as an anomaly in a provincial paediatric cancer mortality study, with significantly higher rates than the provincial average and the neighbouring districts (Hampson 1991); significantly high rates of paediatric cancer (particularly brain tumours) were verbally confirmed by a health professional. ***Historic data:*** Uranium mining (Besner Mine, Henvey Twp and McQuire Mine, Conger Twp, http://www.mindat.org); chemical industry, e.g. explosives and dyes (Parry Sound Library 2014), municipal waste desposal site issues (http://tinyurl.com/landfillconcerns).
CEH* issue	No safe level for lead exposure (Lanphear et al. 2005)	Learning disabilities, high rates of cancer

CEH* issue verification/ disproval	Examples of possible targeted monitoring:
	• Health, e.g.,
	  o Learning disability statistics in nearby schools compared to the national average (American Academy of Pediatrics on Environmental Health 2003);
	  o Chronic disease statistics related to lead toxicity, such as renal issues (Payton et al. 1994; Sabath and Robles-Osorio 2012);
	  o Crime statistics (Nevin 2007; Mielke and Zahran 2012).
	• Environmental, e.g.,
	  o Lead in drinking water and food produced.
		Examples of possible targeted monitoring:
		• Health, e.g.,
		  o A closer study of learning disability statistics in nearby schools as well as all local cancers compared to the national average to identify specific clusters;
		  o A closer study to possible other threats CEH* in the area (see if clusters match with the other chronic conditions).
		• Environmental, e.g.,
		  o Based on cluster findings targeted chemical profiles of local water samples (especially drinking water).

lead exposure with chemical monitoring and local observations would facilitate a more efficient approach to situation assessment and long term planning for the area. Studies elsewhere have demonstrated some concerning correlation between heavy metal content in waterways and neurodevelopmental disorders. For instance, Palmer et al.'s (2006:203) epidemiological research findings indicated that "[o]n average, for each 1000 lb of environmentally released mercury, there was a 43 per cent increase in the rate of special education services and a 61 per cent increase in the rate of autism". Chemical exposure alone is not likely to determine the status of children's health and well-being, as was indicated by Guilarte et al.'s (2003) study on the impact of lead exposure on neuro-development in context with social environmental stimuli (Section 6.2.1). However, lead toxicity generated by flooding has the potential to affect a host of social and biophysical health determinants, which can result in negative health outcomes at the local level. For instance, if flooding continues to intensify with climate change, local food systems and livelihoods are at risk because of the resulting lead contamination. This complexity demonstrates that the knowledge needed to address such situations is much broader than that required to conduct conventional risk assessments of single chemicals in isolation.

Bridging organisations, such as biosphere reserves, could play a vital role in mobilising this broad base of local knowledge. In general, a more precautionary approach to local issues coupled with inclusive public participation has the potential to encourage the consideration of various alternative solutions (O'Brien 1999:210). Such an approach also promotes discussion about the advantages and shortcomings of potential solutions. In addition, lay knowledge can help identify and respond to significant, hidden risks that would otherwise remain unexamined (Whiteside 2006:125, 128). For instance, in this

particular case in which lead levels are known to be elevated, a collaborative assessment of children's environmental health could include local knowledge about learning and behavioural issues, autism incidences, and any other conditions associated with low-dose childhood lead exposure as well as levels of chemical contamination in the area. With support of GIS technology, such information has the potential to significantly improve local decision-making processes. Indeed, inclusive governing practices often increase trust and enhance network development (social capital) within communities. As Adger argues (2000), such practices build social resilience, which in turn helps the communities endure external challenges, such as floods.

6.3.3 Drinking water

The quality of drinking water, including local well water, was among the main concerns identified by interviewees. Two sources of potential pollution were identified: agricultural runoffs and industrial discharges. The concerns related to agricultural runoffs contaminating well water focused primarily on bacterial contamination and a lack of systematic monitoring of fertilisers:

> "groundwater issues in the region and the aquifers and different types of bedrock and [we] found that there are lot of wells (…) [that] need maintenance…"
>
> "… there were few contaminated wells in the past and they were being monitored.. I think the main things were nitrogen and phosphates… which is generally from agriculture and fertilizers"
>
> "…found that there are a lot of gaps in research [monitoring wells]… each municipality has sort of their own research but it wasn't really linked [to any bigger picture of the regional water system]"

From a children's environmental health perspective, it was interesting to discover what appears to be a piecemeal approach to water quality monitoring, in terms of what is monitored, by whom, how, and what happens to the data once it has been collected. In the

era of web-based solutions, there could be value in developing a more system-wide approach to collecting the data that informs water governance. Bringing relevant stakeholders together to assess local water quality situations and develop practical solutions is another potential project bridging organisations could help facilitate in their respective communities.

Furthermore, while monitoring nitrogen and phosphorus, which cause eutrophication of waterways, provides vital information for ecosystem health, it would be equally important to monitor the prevalence of common EDCs in drinking water. In an area where agricultural runoff is recognised as a problem, undesirable pesticide contamination could also be an issue. For instance, atrazine, the most commonly used pesticide in North America (Ackerman 2007), is also the most common pesticide contaminant of ground water in the United States (Ackerman 2007). Studies in Ontario, Canada and elsewhere have demonstrated associations between atrazine in the drinking water and stomach cancer incidences (Van Leeuwen et al. 1999; Bassil et al. 2007). Atrazine is also a known EDC, characterized by its high water mobility and environmental persistence (Kramer et al. 2001). It is therefore banned in the European Union (Ackerman 2007). Yet the issue remains under the radar in many rural communities in North America. In an area where most of the residents rely on wells, preventable contamination of the drinking water caused by agricultural runoff has the potential to expose local children and pregnant women unnecessarily to additional toxic compounds on a daily basis.

The last example of a concern related to water quality focuses on interviewee observations of possible children's environmental health outcomes, such as high incidences

of childhood cancers and learning disabilities. While some interviewees emphasised unusually poor health outcomes, others noted past industrial activities and consequent possible pollution hotspots. Because confidential cancer statistics were not included in the scope of the ethical approval for this study, document analysis was limited to information accessible in the public domain. However, this preliminary document analysis implied that further investigation might be worth the effort if communities are to assess and consequently improve the local status of children's environmental health (See *Table 6.3* and *Figure 6.1*).

An additional challenge for rural communities is the low density of their populations. Particularly, in rural communities comprehensive monitoring approaches that combine both health and environmental data have a greater potential of identifying possible causes of concern than studies based on single data sources. Such assessments require an improved understanding of the complex causalities related to low dose exposures and chronic disease conditions as well as the dynamics of multidisciplinary cross-sectoral collaborations. The findings of this research indicate, however, that much of this knowledge already exists within communities. A facilitated approach to collecting available information and prioritising the possible concerns would not only strengthen community decision-making processes but also foster the sense of collaborative ownership that is needed to solve local problems.

6.3.4 Knowns and unknowns in children's environmental health

In the process of validating identified environmental health concerns, the reasons it has been so difficult to gather evidence on this subject in a practical context became obvious. In

the areas studied, there appears to be little effort to generate the data needed to assess threats to children's environmental health. The approach to water quality monitoring in one biosphere reserve illustrates the potential complexity of local situations. As participant responses in this biosphere reserve were validated by document analysis the following four findings were revealed: (1) public health monitors only bacterial contamination of the drinking water in wells (upon request) and in small water systems (by law); (2) municipal drinking water systems, which use surface water, monitor primarily water quality for bacterial contamination (chemical content of the water is monitored upon request); (3) inland surface water pollution monitoring is monitoring only for a small number of contaminants (varies based on location, usually mercury) in a few fish species in selected lakes (1-2 per lake); (3) levels of phosphorus, nitrates, salt (chloride), and suspended solids were monitored at seven locations until 2005, when the activities were terminated. Further secondary research indicated that provincial legislation around chemicals and water quality is very limited. For instance, organic contaminants in surface waters are not systematically monitored (Molot et al. 2001; Mohapatra and Mitchell 2003). These findings illustrate fundamental challenges related to assessing possible threats to children's environmental health and determining causes of existing diseases, such as paediatric cancers.

In general, the data revealed by this research, in both interview and document analysis, imply that the information needed to assess local children's environmental health situations is not gathered comprehensively. Furthermore, existing information that could be relevant to situational assessments is spread across various organisations and has not been shared or integrated. There is little public transparency about who monitors

indicators relevant to children's environmental health or whether such monitoring takes place. Participants appeared to assume that someone, somewhere, is monitoring local conditions, yet there is no indication of a centralised data collection approach to assessing the local status of children's environmental health. Public health sets their priorities according to large district wide sets of data that do not explicitly or systematically focus on context-specific issues related to children's environmental health, such as paediatric cancers, asthma, allergies, learning disabilities, autism, etc. Furthermore, the data collected to assess the health status of local environments seems to be limited to information specific to infectious diseases and acute toxicity related to emergencies.

In light of current chronic disease statistics and particularly the growing number of paediatric problems possibly associated with environmental causes, this lack of appropriate monitoring is disturbing. An increase in neurodevelopmental disorders, for instance, has been associated with environmental EDCs (*Table 6.1*). However, many of these conditions are not nationally monitored and there are also significant regional differences in incidence rates, as is the case with autism (CDC 2014; Ouellette-Kuntz et al. 2014). Furthermore, national statistics are rarely effective in determining environmental causes of such health outcomes. Local data, which could help reveal complex causalities, are currently not sufficiently monitored to identify possible context-specific problems (Table 6.3, Figure 6.1 and Appendix 5). These health issues may have the potential to result in significant human and economic costs for society, yet comprehensive attempts to investigate whether such conditions are environmentally induced have remained limited (e.g. Betts 2014).

Although only tentative, the results of this study point to environmental issues in all four regions that have the potential to cause current or long-term harm to local children's health and are therefore worth assessing collaboratively. Though these findings do not provide evidence confirming any aspect of environmental impacts on children's health, current scientific understanding indicates that there could be reasons for concern. Many issues raised in the interviews were confirmed to varying degrees by document analysis and participant observation (e.g. *Table 6.3*). This implies that further efforts, particularly collaborative investigations, would likely be able to confirm or refute concerns, as was demonstrated, for instance, by Minkler (2010) and Morello-Frosch et al. (2002; 2005). While scientific laboratory research and epidemiological studies can explain mechanisms and indicate causal relationships, in connection with 'wicked' problems such as children's environmental health threats, only context-specific data can lead to meaningful answers that will more effectively inform local governance decisions. Therefore, this research has focused on information that is available but not yet mobilised by local communities

The next question is: what else do we need to know? Issues concerning uncertainties, risks, *unknown unknowns*, and *known unknowns* have been discussed elsewhere in the literature (e.g. Wynne 1992) as has the value of diverse stakeholder knowledge (e.g. Berkes 2009). Less attention has been paid to the *unknown knowns* of local stakeholder knowledge, "[t]hings one allegedly knows without being aware that one knows them" (Hutchinson and Read 2011:944). According to some scholars, *unknown knowns* are defined as *tacit* knowledge, the kind of internalised knowing that cannot be made explicit (Polanyi 1958; Collins 2010). In this research, *unknown knowns* refer to the local lay knowledge that emerges in narratives, can be made explicit and complements expert

knowledge (Wynne 1991; Berkes 2009). The perspective that sees people as experts of their own communities is a foundation of community-based health promotion (e.g. Raeburn and Rootman 1998) and rooted in the Freirian empowerment theories of education (Freire 1969). Although not yet widely recognised, the value of local knowledge has been acknowledged by both health and sustainable development scholars, especially in connection with in community-based health promotion (Minkler 1997; Raeburn and Rootman 1998) and sustainability governance (Gibson et al. 2005; Berkes 2009) literatures respectively.

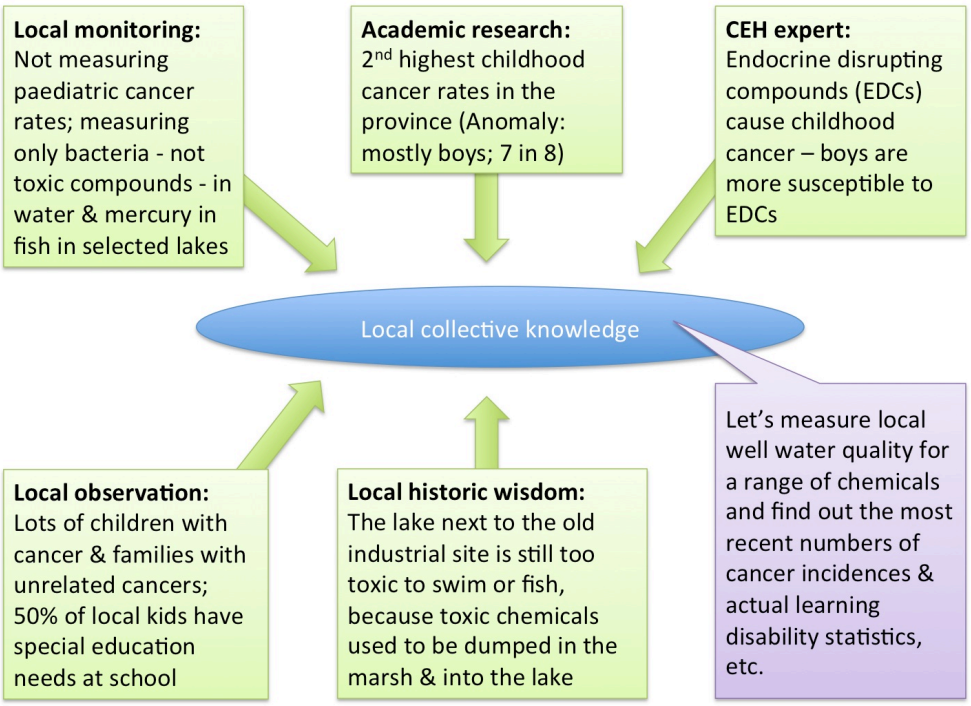

Figure 6.1: The way in which the combined expert and local knowledge can help enhance monitoring practices related to CEH* (based on the example by Minkler 2010): A local bridging organisation facilitates the process. Local people gather local stories; public health analyses the data; environmental stakeholders measure the water quality; school boards provide special needs data – then community collectively assesses

In the context of children's environmental health, there are, in a way, two layers of *unknown knowns*: local knowledge that is often experienced as *tacit* because it is not understood in a 'scientific' context, and expert knowledge which though explicit, often misses context-specific meaning and struggles with complexity. The latter has the potential to help make sense of local knowledge, while lay knowledge could help inform expert

knowledge. This research indicates that finding out what people know about local environmental conditions relevant to paediatric health could help assess local situations and identify what more needs to be known.

The abovementioned dual nature of hidden knowledge (*unknown knowns*) is highly relevant to the process of knowledge integration. In deliberative governance, knowledge tends to be defined by the "representation of the actors involved" (Raymond et al. 2010:1774). As such, areas of knowledge not present among involved stakeholders will not be considered. The findings in this study indicate that these gaps in knowledge might perpetuate the disconnection between local and expert knowledge and explain why children's environmental health issues remain outside conventional local decision-making processes. One of the tasks of a bridging organisation would be to engage stakeholders that represent both local and expert understanding related to children's environmental health in the discussion of local issues.

6.3.5 Implications of collective knowledge for local decision-making and policy development

The extensive local knowledge related to environmental concerns discussed above indicates that a systematic, collective approach to gathering existing local information related to children's environmental health could be useful for communities in both Canada and in the UK. Indeed, it was intriguing to discover how much social and natural scientific knowledge people have about their living environment. The results in this study imply that (a) within biosphere reserves, there may be reason for concern regarding the environmental health of local children; (b) knowledge of local people is useful for

identifying issues that may need further attention; and (c) if made explicitly aware of the community-level knowledge needed to assess children's environmental health issues, biosphere reserves have the potential to address these gaps in local knowledge by bringing people together.

As mentioned, not all local perceptions of possible environmental health issues are necessarily valid or serious enough to merit intervention, but bringing people together to assess identified issues through a facilitated process could help determine whether or not further attention is required. By recognising the value of local concerns, such as observations of exceptionally high childhood cancer rates or increased exposure of children to heavy metals, collaborative community assessments challenge current practices of public health and environmental monitoring. While academic discussions within both public health and sustainable development literatures have acknowledged such limitations, monitoring practices in both fields remain devoted to more conventional discourses.

6.3.6 The role of experts

Within biosphere reserves, interviewees' lack of familiarity with children's environmental health issues highlighted an additional challenge related to *unknown knowns*: How does the community know which questions to ask? As Raymond et al. (2010) and several interviewees pointed out, the activities that take place in communities and organisations are determined by engaged citizens. As such, people with children's environmental health knowledge, particularly academics, may need to more actively engage with communities to help them become aware of their children's environmental health issues.

Based on the findings in this research, *Figure 6.1* depicts an example of how the

knowledge of experts and the knowledge of local people can be combined to build 'collective local knowledge'. It illustrates types of knowledge that can be useful in assessing a complex social-ecological situation. The principles of community-based data gathering have been discussed elsewhere in the literature, e.g. 'popular epidemiology' (Brown 1992; 1993). The overview in *Table 6.1* presents a concrete case to help illustrate the practical implications of collective knowledge for decision-making related to children's environmental health.

6.3.7 Biosphere reserves as bridging organisations for children's environmental health

Within biosphere reserve organisations, the level of existing knowledge related to children's environmental health indicates that biosphere reserves have the potential to initiate and guide the collaborative data gathering processes needed to address children's environmental health issues. The biosphere reserves in question also have a history of working on health-related projects and bringing public health and environmental stakeholders together (Chapter 5). In addition, most of the interviewees could see the relevance of children's environmental health to their work. While not all had thought of children's health in the context of sustainable development, many pointed out the vulnerability of children, children as the future of the community, the role of community in the upbringing of children, and the need to strengthen children's relationship with nature. Some participants also saw the potential value of generating more interest in biosphere reserve work because "most people care about children" (Participant). Not everyone saw the need to make children's environmental health, or even health, an explicit component of biosphere reserve activities. For a few participants, the implicit linkages between health

and the environment were sufficient for biosphere reserve purposes. Nonetheless, the great majority of the participants saw the value children's environmental health could potentially add to their work.

Then again, perceptions around the relevance of children's environmental health to the work of biosphere reserves or the value of explicitly incorporating health-related components are not the only factors that determine whether biosphere reserves can function as bridging organisations for children's health and the environment. Most biosphere reserves, including those studied, struggle with financial limitations and small budgets. Moreover, their activities are primarily determined by community interests and the mandates of their partners. The active engagement of children's environmental health experts and dissemination of study results, such as the findings of this one, would likely be necessary to initiate the interest of biosphere reserve communities. Collaboratively preparing applications for project funding could also be useful, although, as was emphasised by one participant, money does not necessarily buy success:

> "[not having money] is not necessarily a barrier - instead it means that you don't develop a large overhead and bureaucracy to look after something, but it depends on the willpower of the community. If the willpower is there, it'll float. If there is not the community willpower, it'll die. You can have a very large funded programme for something but no buy-in from the community. No buy-in is as good as having no money."

Creating buy-in can be a tricky business. In order for community members and stakeholders to be engaged in initiatives, they must be aware of related needs and issues. Knowledge translation and collective learning are both processes that aim to raise awareness and understanding. The former focuses on transferring knowledge from one actor to another (e.g. Armstrong et al. 2006), whereas the latter emphasises the mutual learning process and co-creation of shared knowledge (e.g. Brown 2008). Scholars who

study participatory approaches to solving community problems (e.g. Gibson et al. 2005; Cargo and Mercer 2008; Armitage 2008; Minkler 2010) stress the importance of creating issue ownership by including participants in all phases of a project, from issue identification to implementation and evaluation. If the philosophy of collective learning was adapted to the work of bridging organisations, the intuitively holistic perceptions of biosphere reserve stakeholders, identified by this research, could be harnessed to develop a new, broader yet context-specific approach to children's environmental health. From a complex social-ecological systems perspective, such a collaborative approach might result in more effective and meaningful community decision-making processes.

The ability of biosphere reserves to function as bridging organisations for collaborative knowledge mobilisation has already been demonstrated (Jamal et al. 2007; Leys and Vanclay 2011) and the findings of this research indicate that they can also promote health (Table 5.2). Furthermore, the example of Charlevoix Biosphere Reserve illustrates how a "combination of scientific knowledge, meeting facilitation, competency recognition and participants goodwill" (Godmaire et al. 2013: 19) generated the collective local knowledge that helped identify and address a specific environmental health threat. While awareness of children's environmental health issues was not present in the biosphere reserves prior to this research project, time will tell the impact of these findings.

Seto (2011) argued that the greatest barrier to improving children's environmental health outcomes is the lack of political will to acknowledge the situation in children's environmental health, but this study indicates that the reason for this lack of political support may be a broader lack of broader awareness of the issues. While political and

economic interests have undoubtedly played a role in the slow dissemination of research findings (e.g. Proctor 1995; Kroll-Smith et al. 2000), a deliberative approach and community engagement, facilitated by bridging organisations, might work to democratise children's environmental health while improving the quality of available knowledge. Furthermore, the apolitical nature of biosphere reserve organisations makes them a safe forum where diverse stakeholders can appropriately engage in collective knowledge production or social learning at the community level.

6.4 Conclusion

A growing body of literature expresses concerns related to the increasing presence of endocrine disrupting compounds and other hazardous compounds in the environment and even in the umbilical cords of new-born babies. These concerns are compounded by an improved scientific understanding of developmental biochemistry and possible associations between xenobiotic compounds and the increased prevalence of chronic diseases, particularly in children.

This study demonstrated that local knowledge has the potential to help inform and complement scientific knowledge and thereby to improve decision-making around environmental issues that affect children's health. Local observations and concerns can direct attention to health issues that otherwise remain undetected. Furthermore, local understanding of the complex contextual factors surrounding sources of possible hazards and health outcomes could guide communities towards sustainable solutions. Expert knowledge can offer the general scientific information, needed to understand mechanisms of action and to help focus on relevant factors, but without the contextual lay knowledge

experts may not be able to identify the right questions and therefore will not arrive at the answers most useful for effective decision-making.

The findings also indicate that biosphere reserves have the knowledge and experience necessary to function as bridging organisations that could bring together relevant stakeholders to assess the local children's environmental health situation. However, because of the apparent lack of specialised knowledge concerning children's environmental health, such a project would require the active engagement of children's environmental health experts. The results also question the adequacy of the conventional approach to children's environmental health, which focuses on the pollution aspect, and suggests that a more holistic approach might promote both awareness creation and effective governance of social-ecological systems.

Collecting information for local decision-making is a complex process and the findings of this small explorative study are, by no means, conclusive. The results can, however, be used to justify further inquiries into whether and how collaborative information gathering that combines local and expert knowledge can uncover possible needs for new directions in monitoring for public health and ecosystem services.

7 Making *epistemé*, *techné*, and *phronesis* work for children's environmental health

7.1 Introduction

This chapter summarises the three research components, presented in Chapters 4-6. It also includes a discussion about challenges the contemporary discourse has with complex knowledge, starting with transdisciplinary research and finishing with the three approaches to bridging cross-sectoral knowing presented in this dissertation. Flyvbjerg's (2001) interpretation of the Aristotelian intellectual virtues was further adapted to describe various aspects of collective intelligence in connection with cross-sectoral partnerships.

While each of the three articles represents a new aspect of cross-sectoral bridging of public health and sustainable development, the essence of this research is explicitly identifying different types of knowledge needed for practical collaboration around complex socio-ecological issues. In this chapter, the theoretical scientific expert knowledge, practical collaborative working knowledge, and collective wisdom will be examined as three distinct types of cross-sectoral knowing that can help form a more comprehensive integrated multi-disciplinary approach to health and sustainability.

7.2 What makes research transdisciplinary?

Transdisciplinarity in this research was understood as working with multiple disciplinary approaches in a synoptic fashion, where each framework contributes to and gains from the emerging knowledge and no one of discipline is seen as primary (Stein 2007). By

methodologically bringing together two independent fields, this research aimed to demonstrate a systematic approach to transdisciplinarity that was both conceptual and substantive. Conventionally, academic research has had the tendency to focus either on producing results that can be easily measured, emphasising relatively simple, linear, and disciplinary approaches to analysis, or on the highly theoretical development of complex ideas, making few empirical connections. Brown (2007:1-2) illustrated this lack of "synthesis-based thinking, whole-of-community engagement, collaborative inquiry, and integrative management" in contemporary approaches by comparing it to a man looking for his lost keys under a lone street light, although they lay in the dark area. Without underestimating the value of conventional academic research or vertical, in-depth expertise, this research focused on improving the horizontal understanding, necessary for cross-sectoral, interdisciplinary or transdisciplinary work. Building on earlier systemic approaches to problem solving, such as sustainability assessment criteria (Gibson et al. 2005) and the Ottawa Charter for Health Promotion (WHO 1986), this research explored possible new mechanisms for bridging health and sustainability.

As stated extensively in the literature, finding innovative solutions to health and sustainability challenges requires new, unconventional approaches to research. Newton and Parfitt (2011: 85), for instance, pointed out that "[t]ackling the challenges of sustainability demands innovation and all the knowledge, wisdom and insight we can muster". Despite this critique of conventional disciplinary approaches, the theoretical work for this dissertation was, indeed, made possible by the interdisciplinary nature of both health promotion and sustainability governance. Both literatures, each of which incorporates original observation and integrated concepts from other fields, offer a wide

range of academic thought and practice-derived research results that in turn provide evidence and ideas for alternative solutions. The originality in my research stemmed in part from an explicit transdisciplinarity that treated both fields with equal weight and thereby created a synoptic perspective and approach. Bringing the two discourses together, along with ecohealth and some of the latest natural scientific research results, has the potential of strengthening the academic support needed for alternative action.

Transdisciplinarity has emerged as a response to "developments in contemporary society [that have created] a shifting landscape of knowledge production" (Russell et al. 2008:460). This transdisciplinary PhD research tackled the challenges of knowledge production by exploring the less tangible, harder-to-measure, bridging aspects of cross-sectoral collaboration in health and sustainability integration, while acknowledging the intentionality inherently embraced in both concepts. I questioned the somewhat compartmentalised approaches to problem solving that persist in both health promotion and sustainability governance fields, and examined if indeed transdisciplinary thinking could help bridge the kinds of knowledge produced by each field. To best describe the significance of this transdisciplinary bridging exercise from an alternative perspective, I used the three Aristotelian virtues as types of knowledge, *epistemé, techné,* and *phronesis*, and, building on Flyvbjerg's (2001; 2012) analysis, focused explicitly on the knowledge in the collective context.

7.2.1 Challenges of transdisciplinarity

Barriers to bridging concepts and practices are not limited to those practitioners face when crossing institutional boundaries or academics tackle when wishing to reach out to

practitioners. Rather, one of the less anticipated barriers in this transdisciplinary research turned out to be the challenge of getting the results published in academic peer-reviewed publications. Whilst the academic establishment is increasingly open to interdisciplinary research that treats one discipline as the primary 'expertise' to which knowledge from other disciplines is integrated (as defined by Stein 2007:99), transdisciplinary analysis extends the work beyond what is comfortable for the existing structures of research validating mechanisms, such as peer reviewed journals.

One of the issues is that transdisciplinary research, which treats all disciplines equally, requires a significant degree of conceptual explanation to ensure that the content remains comprehensible to readers of various disciplinary discourses. This can become a challenge for writers of academic articles. In the cases of health promotion and sustainability governance, this dilemma simply becomes a practical matter related to word counts and disciplinary jargon. In addition, most respected journals have limited disciplinary interests, which are often specified in the submission guidelines.

In order to overcome the disciplinary limitations of current academic structures, I chose to report some of my research findings in an interdisciplinary (as described by Stein 2007) manner, using health promotion as the primary discipline into which sustainability governance concepts were integrated. For practical purposes in Chapter 5, I deemed that using health promotion lens to highlight the work of biosphere reserves has the most potential to facilitate the integration of health and sustainability, because it translates their work in conservation and sustainable development to the language of health professionals. One of the barriers to cross-sectoral collaboration identified by this research was the

challenge to engage the health sector to work with biosphere reserves. For the broader purposes of building academic literature that bridges health and sustainable development, the results will later be translated also into the language of sustainability governance.

7.3 Collective epistemé, techné and phronesis

In recent years, increased understanding of complexity and its demands to knowledge has led some scholars to re-examine ancient wisdom. Aristotle's three types of knowledge, or 'intellectual virtues', for instance, have gained renewed popularity. His intellectual virtues have been discussed in connection with social scientific research in general (Flyvbjerg 2001; 2012), the professional development of individuals, such as medical doctors (e.g. Flyvbjerg 2001; Montgomery 2006), and artificial intelligence (Dreyfus and Dreyfus 1986). I found Flyvbjerg's approach particularly useful when I was tackling the concept of knowledge in the transdisciplinary integration of health and sustainability. My three different approaches to bridging apply Flyvbjerg's adaptation of Aristotle's three types of knowledge to the collective integrated knowledge. Focusing on collective knowledge at the community-level, as opposed to individual knowledge, I view:

(1) integrated academic literatures (conceptual transdisciplinarity) as *epistemé*;

(2) practical integration of fragmented knowledge in cross-sectoral collaboration facilitated by a bridging organisation (practical application; includes both skills to bring together diverse stakeholders and the integration of health and sustainability in practice, which are inseparable) as *techné*; and

(3) the collaboratively gathered and mobilised, cross-sectoral, knowledge produced by communities as *phronesis*.

Although both *epistemé* (universal truth as understood in the natural sciences, e.g., laws of nature) and *techné* (technical/ practical know-how) are vital, Flyvbjerg et al.'s (2012:1) argument that *phronesis* is "the most important of the intellectual virtues, because it is needed for the management of human affairs, including the management of epistemé and techné, which cannot manage themselves" is well supported by the findings in this research (See particularly Chapter 6). An overview illustrating how the Aristotelian intellectual virtues are reflected in this research is presented in *Table 7.1*.

Table 7.1: A conceptual overview that bridges the three key components (Chapters 3,4 and 5) and all the key concepts in this PhD dissertation

Aristotelian intellectual virtues (Flyvbjerg 2001)	**PhD dissertation key research concepts**	**How cross-sectoral partnerships can *" improve deliberation at other levels of the political system* – including representative bodies and broader societal discussion" (Meadowcroft 2007: 201)**	**Conceptual examples used in this PhD dissertation**
Epistemé	Bridging theories and bridging concepts	Bridging key discourses (science, law, the popular press)	Health promotion and sustainability governance; Social sciences (SDOH and sustainability criteria) and natural sciences (Bridging concept: children's environmental health)
Techné	Bridging organisations	Building links among important groups	UNESCO-mandated biosphere reserves
Phronesis	Bridging collective knowledge	Increasing the level of understanding of specific problems	Children's environmental health

To address the identified critique regarding compartmentalised problem solving, I investigated how academic thinking and conceptual analysis could benefit from cross-sectoral collaboration using a transdisciplinary approach. In Chapter 4, the existing health promotion and sustainability governance theories were analysed for areas of overlap

where potential synergies and complementarities may help justify enhanced cross-sectoral collaboration. This focus on theory revealed the artificial disciplinary separation between health and environmental discourses (*Figures 4.1* and *4.2*). Six overlapping themes were identified: social change, social justice/equity, ecological systems approach, participatory deliberative mechanisms, precautionary principle, and active knowledge sharing/mobilisation. As well, topics of expertise in each field were discovered, most notably theory-informed intervention in health promotion and extensive understanding of governance practices in sustainability governance, which could complement the theory and practice of the other field. Similarly, the historic developments illustrated (*Figure 3.2*) how collective *epistemé* evolves along entwined epistemological paths. In addition to the theoretical process-related aspects of the respective literatures, children's environmental health was examined as a typical 'wicked' problem, potential bridging concept, and possible shared desirable outcome. This analysis informed a new transdisciplinary framework for integration of health and sustainability, which in turn adds to the growing *epistemé* of both cross-sectoral bridging and integrated approaches to health and sustainability.

On a more practical note, bridging theories and concepts familiar to practitioners has a greater potential to help create a sense of entity and a conceptual working platform across disciplinary boundaries than a development of entirely new concepts. *Ottawa Charter for Health Promotion* (WHO 1986) and health promotion theories are widely used by public health practitioners in both the strategic and operational planning of their work (e.g. Bartholomew et al. 2006). The term sustainability governance, on the other hand, may be less familiar to practitioners of sustainable development, for example those working in environmental management or other economic development related activities. However,

the concept of governing towards sustainable development is not new. Sustainability is already an integral component of economic development discussions. Sustainability assessments, in some cases required by law in connection with new economic development project proposals, can be seen as the next generation of environmental impact assessments. Sustainability assessments shift the focus from commercial to public interests. Furthermore, they evaluate long and short term environmental, economic, and social impacts of future developments (e.g. Gibson et al. 2005). There can be political concerns around the focus on normative change that is characteristic of sustainability assessments, because the assessment process includes a broader range of stakeholders and new forms of knowledge. Nevertheless, sustainability concepts have become increasingly familiar to practitioners and are discussed in policy development circles (e.g. Manitoba Law Reform Commission 2014).

In Chapter 5, practical knowledge, *techné*, was examined in the collective context of the cross-sectoral work facilitated by bridging organisations. The processes of building linkages among sectors were studied by investigating how UNESCO-mandated biosphere reserves as bridging organisations have managed to bring together a diverse range of stakeholders for projects related to health and sustainability. The existing practices of biosphere reserves were examined for their potential to facilitate the integration of health and sustainability. Projects and activities , as well as possible barriers to and drivers for health and sustainability integration process, were analysed through a health promotion lens. The results indicated that even biosphere reserves that do not explicitly focus on health actively engage in projects that contribute to improved health outcomes and integrate vital health promotion aspects into their work. In addition to the usual challenges

of time and financial constraints, participants identified a lack of both appropriate health-related knowledge and stakeholder engagement, as barriers to the work of integration. Further impeding particularly the initiation of cross-sectoral collaboration, stakeholders' understanding of one another's institutional mandates appeared to be relatively poor. The interviews revealed another interesting barrier related to the interconnectedness between health and sustainability. Either because many interviewees had not thought about the linkages before or because they found the connection somewhat intuitive and hard to express in an environmental context, the topic was often left unaddressed. The interview questions inspired participants to engage in lengthy discussions of philosophical and practical ideas throughout the interview session This implies that more explicit public discussions might be useful, if we want to see health and sustainable development treated as an integrated, synoptic entity. Nevertheless, biosphere reserves in their activities as bridging organisations demonstrated *techné* of health and sustainability integration.

The last article, Chapter 6, explored how Aristotelian *phronesis* could be harnessed, in the form of community knowledge for the collective good, through cross-sectoral collaboration. *Phronesis*, which also translates as 'practical common sense' (Flyvbjerg 2001:56), is well exemplified in the case of collective knowledge addressing children's environmental health threats. Aristotle warned against generalisations and universal truths when studying human activity (Flyvbjerg 2002:70), which was echoed in the results of this study.

The research concentrated on the ability of collaborative partnerships to increase the level of understanding of specific problems. This meant exploring the perceptions and knowledge of local issues related to health, particularly children's environmental health,

and sustainability, within the studied bridging organisations. I also examined the potential of these bridging organisations, specifically biosphere reserves, to facilitate collaborative children's environmental health assessment processes at the local level. In addition to discovering an overall openness to addressing children's environmental health, the research findings helped to identify a significant body of knowledge and insights about local conditions that could be relevant to environmental paediatrics, although some significant gaps were also discovered. Furthermore, an interesting difference between the perceptions of practitioners and experts regarding the meaning of children's environmental health was consistently observed. This observation will be discussed further in Section 7.4.3.1 below.

Each of these components stands as an independent contribution to the academic debate. As is usually the case with most research, however, the sum of the individual pieces is greater than the standalone value of each. While detailed research results can be found in respective chapters, this chapter's discussion focuses on the collective contribution of the research components. The rest of this chapter is divided into two separate but related discussions, concerning (1) bridging in cross-sectoral collaboration for health and sustainability; and (2) bridging in cross-sectoral collaboration for children's environmental health, where the former discusses the processes studied and the latter focuses on outcome implications.

7.4 Process implications of this research

The contemporary trend of shifting landscapes related to knowledge production is reflected in a number of ways in current academic discussions. The emergence of

transdisciplinary research (Russell et al 2008) and the launch of Future Earth at Rio+20 in 2012 are just a few examples of current developments. Future Earth is an international research project that highlights the academic and stakeholder engagement in co-design, co-production, and co-dissemination of knowledge and focuses on transdisciplinary global change and cross-sectoral bridging of knowledge (Mauser et al. 2013). The theoretical foundations of Future Earth are similar to those guiding this research and, in general, the parallel focus of such approaches reflects worldwide developments in sustainability and health research.

The comparison drawn between Aristotle's intellectual virtues and the types of knowledge explored in this paper are vital for understanding both the overall usefulness of this research and the role of each component as its own entity. Where Future Earth focuses on generating transdisciplinary research findings, my transdisciplinary research emphasised the importance of transdisciplinarity in the practice of frontline practitioners. Aristotle's theory of knowledge helps illustrate what is needed to bridge relevant areas of practical knowledge, which may or may not be informed by on-going academic research. It explains various facets of knowledge, all of which must be considered when facilitating intentional social change, as anticipated in both health promotion and sustainability governance. In practice, it demonstrates that all three types of knowing are desirable for meaningful knowledge production in local decision-making processes. (Meaningful in this context refers to effective, ethical, and fair decision-making.) Furthermore, the parts of Flyvbjerg's interpretation of Aristotle's intellectual virtues (Flyvbjerg 2001; Flyvbjerg et al. 2012) that emphasise collective aspects of knowledge are particularly useful for this research. They help illustrate the value of cross-sectoral collaboration as a venue for

creating the complex knowledge needed for local decision-making, particularly in the context of bridging health and sustainability.

However, cross-sectoral partnerships are by no means a panacea for democracy and do not guarantee fairness in decision-making processes (Meadowcroft 2007). Indeed, they have the potential to do precisely the opposite by, for instance, engaging only a narrow subset of relevant stakeholders in discussions. Despite such criticism, they also have the capacity to empower communities and create a sense of ownership as they work to collectively identify and address local issues (e.g. Sabatier et al. 2005; Wallerstein 2006; Minkler 2012). Such potential has been demonstrated by the community-based participatory research traditions of both health and sustainable development (Israel et al. 2006; Newton and Parfitt 2011). Meadowcroft (2007:201), for instance, identified a number of features of partnerships that promise to improve deliberative democracy. He identified various characteristics of partnerships that enhance democratic processes, such as their tendency to differentiate the contexts in which they operate, focus on the practical, move from discussions to action, create potential for long-term learning, and expand the discussion topics beyond the scope of top-down decision-making to include broader societal discussion. This research was grounded in the abovementioned frame of deliberative and participatory approaches. The way the three different research components came together to strengthen deliberative democracy in healthy and sustainable community development will be examined below.

7.4.1 Implications of the proactive development of a shared conceptual understanding (Bridging key discourses)

Transdisciplinary research should ideally merge methodologies and epistemologies (Wickson et al. 2006). The development of the proposed ecohealth framework, for example, generated a new theoretical platform by merging the fields of health promotion and sustainability governance. However, the analysis that resulted in this 'new' framework revealed that the epistemological foundations in both health promotion and sustainability governance were already quite closely aligned. Where both public health and sustainable development practices use natural sciences and quantitative statistics as a rationale for planning programs and services, health promotion and sustainability governance focus on understanding processes that create equitable social change.

This type of academic exercise is a good example of Aristotelian *epistemé* and can be understood as broadly applicable (referred to as "universal" by Flyvbjerg 2001) knowledge that is relatively independent of time and space and based on analytical rationality (Flyvbjerg 2001: 55). From a practical perspective, a focus on bridging academic theories and concepts (*epistemé*), as a standalone exercise does not differ significantly from the focuses of existing academic literatures on the topic of health and sustainability integration. There are, however, two aspects that made this research unique: (1) using a transdisciplinary approach categorically to bridge existing theories that practitioners recognise, and (2) explicitly connecting the new framework with both practice, *techné*, (Chapter 5), and with applications that combine *epistemé* in both natural and social sciences with *techné* and adding local knowledge to actively generate *phronesis*, collective wisdom (Chapter 6).

Despite the focus on transdisciplinarity and practical applications, my emphasis on bridging should not be interpreted as an attack on the value of theoretical or conventional academic research. Theoretical research and complex analytic analyses of theoretical concepts are vital as they generate innovative ideas and expand our overall understanding of existence. I am only highlighting some of the missing links and narrow interpretations that limit our ability to address contemporary challenges. By doing so, the critique in this dissertation suggests that stronger, more effective mechanisms should be in place between the various spheres of knowing in order for the vast knowledge we possess to better serve the common good.

Grounding the research in practice is also characteristic of transdisciplinary research (Wickson et al. 2006). For instance, although developing the framework in Chapter 4 was, in principle, a purely theoretical exercise, the process was informed by my own experience as a frontline health care practitioner in children's environmental health and as a researcher in the natural sciences[20]. Indeed, two vital pieces in this research, my use of Grassy Narrows to help illustrate the problems and my selection of children's environmental health as a potential shared outcome demonstrate the potential implications of this type of practice-based research.

7.4.1.1 Emphasising the need for bridging

The results of my empirical research highlighted that the explicit integration of theoretical frameworks is desirable to overcome institutional barriers. As mentioned previously, for public health practitioners, one of the key barriers to participation in cross-sectoral

[20] See footnote 1 on p.15

collaboration is a lack of organisational support, particularly when health is not the primary mandate of the collaborating institution. Flaman et al.'s (2010:37) research on barriers to and drivers for community-level chronic disease prevention, for instance, identified that frontline workers often felt they were not able to engage in cross-sectoral collaboration, because management did not see such activities as relevant to the organisation's mandate. Practitioners interpreted this barrier as a lack of "understanding about activities happening at the ground level".

In my research (See Chapters 5 and 6), the challenges related to institutional mandates were reflected in statements such as:

> "Because the problem is that we don't work outside of our mandate. Our mandate is clear. If it's not clear[ly related to our mandate], we don't do anything about it. I would be interested as a regular citizen, resident of this area, but not as a professional because I cannot" (participant in public health); or

> "as long as it fits in with organisational policies, anything that I can come up with, projects that would promote activities, which lead to a more healthy population, would be approved of – unless they were going to conflict with the conservation principles." (participant in natural resource management).

Furthermore, my research results indicated that for practitioners linkages between health and sustainability had either not really been thought about or were primarily perceived as intuitive. They spoke of the connection as something that should be self-evident yet was hard to explain in terms of the analytical rationality that frames their current formal understanding of the sciences. Although the results of the interviews were determined after the transdisciplinary theoretical framework was already developed, they reinforced the potential value of making explicit connections between health and sustainability.

7.4.1.2 Similarities in health promotion and sustainability governance

It was not particularly surprising that the very first component of this research, bridging theories, identified deliberative and participatory approaches, along with an equity and social justice emphasis, as key similarities in health promotion and sustainability governance. Indeed, although the literatures of both health promotion and sustainability governance are rooted in the applied social sciences, they often draw from other disciplines for many of the same supportive literatures. For instance, both literatures contain references to Habermas' communicative action (e.g. Stirling 2005; Bosselmann et al. 2008; Wallerstein and Duran 2008), Putnam's social capital (Armitage 2005; Butterfoss et al. 2006; Bodin and Crona 2009; Minkler 2012), and Giddens' contextual theory (e.g. Poland et al. 2008; Smith et al. 2005; Leach and Scoones 2005). Although the applied social science lens generally orients towards practice, it was interesting to discover that, particularly in recent years, theoretical discussions of power imbalances have resurfaced. Moreover, references to Foucault's power and knowledge (e.g. Freudenberg et al. 1995; Smith et al. 2005; MacDonald and Mullett 2008; Stirling 2008) and Freire's empowerment theories (e.g. Diduck 1999; Dupere et al. 2007; Bosselmann et al. 2008; Martinson and Su 2012; Minkler and Wallerstein 2012) can be found in both fields. Although, rather unexpectedly, the sustainability governance literature appears to focus significantly less on power inequalities than health promotion does. For health promotion, it is the focus on vulnerable populations (Raeburn and Rootman 1998; Frohlich and Poland 2007) and the significant role of poverty and societal status (Evans et al. 1994; Marmot 2004; Marmot and Wilkinson 2006) in health outcomes that make power and empowerment especially vital concepts. In practice, addressing power imbalances in cross-sectoral collaboration is key to the success

of any project (Wallerstein and Duran 2008).

Also this research pinpointed six overlapping themes or similarities between prerequisites for health and sustainability assessment criteria. All six also reflect, more or less, principles that are based on the United Nations declaration of Human Rights (UN 1948). What makes this discovery significant is that these principles are not explicitly recognised by related discourses, such as population health or environmental governance. Furthermore, it is noteworthy they are little if at all recognised in primary healthcare approaches, economic theories or engineering practices. It can be argued that the six themes are implicit in the objectives of most ethical economic, medical, or technological activities. However, both health promotion and sustainability governance emerged as critiques of these conventional models and argued for more explicit systematic regard of their normative aspects, from methods and processes to values and desirable outcomes.

Figure 4.2, in Chapter 4, illustrates the shared interests of sustainability governance and health promotion in sustainable livelihoods, education, healthy ecosystem, well-being, etc. Both fields are based on the same principles of inclusive, fair, participatory engagement of people and on similar desires to find ecological solutions to improve the current situation, using a precautionary approach. Increased awareness of these similarities enhances the potential for a shared understanding of what it takes to create sustainable and healthy communities. This, in turn, could help practitioners justify cross-sectoral collaboration in light of their institutional mandates.

This methodical analysis of similarities also made it easier to identify complementary aspects of health promotion and sustainability governance. For example, as

the extensive debates related to governance issues were recognised in sustainability governance literature, a lack of such discussion in the health promotion literature became rather obvious. Indeed, according to Wallerstein (2007), a broader discussion of 'governance' is missing in North American health promotion discourse. In terms of approaches in policy development, Sabatier's advocacy coalitions (1988) in environmental studies and Milio's ecological framework for health policy (1987) were very much aligned. Yet, as the two fields evolved, sustainable development discussions focused on analysing various aspects of governance in policy development, while health promotion went on to specialise in advocacy and community mobilisation for policy change. At the same time, the two policy development approaches remained complementary in some respects, such as in the previously mentioned example of health promotion's theory-informed interventions and multi-level planning processes being compatible with the governance expertise in sustainability governance. In addition to the recognition of similarities in epistemological approaches, an ability to see how expertise in other fields can directly benefit one's own mandate has the potential to enhance cross-sectoral collaboration.

7.4.1.3 Grounding the bridging in practice and implications

The theory-bridging component of this research, however, was not just a conceptual exercise. By drawing from discourses that are already widely used by practitioners – for example, health promotion theories that guide the work of public health – the proposed framework offers a platform that can be readily used to facilitate visualisation and planning processes. Similarly, using concepts, such as sustainability assessment and adaptive governance that are familiar to diverse stakeholders with shared interests in ecosystem services, has the potential to make innovative cross-sectoral approaches more meaningful

in practice. Furthermore, identifying the similarities between the health promotion and sustainability governance fields provides practitioners with the language that may help justify the value of cross-sectoral collaboration for their respective organisations.

The practical value of this type of new *epistemé*, which was created as an academic exercise, is that it offers a theoretical platform that can be used to facilitate cross-sectoral discussions. The idea is that this ecohealth framework could be employed much like alternative future scenarios are applied in resilience assessment workshops (Resilience Alliance 2007). It provides a concrete starting point that allows participants to discuss and contemplate the proposed model in relation to their own knowledge and experiences.

Several of the experiences shared during the interview sessions illustrated the value of intentional cross-sectoral discussions. Interview questions prompted comments that indicated untapped potential among practitioners for health and sustainability integration. The following quote is a good example of such potential:

> "to be totally honest, until quite recently, I haven't given the relationship with human health a great deal of thought. But when I think about it, it is actually extremely relevant…" (…) "I don't think there is likely to be much in the way of obstacles to implementation, quite quick implementation – if it could be shown that the benefits didn't cause any dis-benefits. What I would need to do is to put a project plan within my management plan and get approval from my area manager and the people who oversee the management plans for protected sites in the organisation, and that could be done quite quickly" (Participant).

Indirectly, this comment also emphasises the value of using concepts grounded in the language and background of participants, as this research attempted to do when it conceptualised the merging of health promotion and sustainability under the umbrella of the emerging field of ecohealth.

Despite the fact that I used existing theories and concepts in the development of this integrated framework, this research carries the same risk of not reaching its target audiences as does all academic research. The ecohealth concept itself is still relatively unknown among practitioners (Leung et al. 2012). This risk highlights the key role bridging organisations could play in knowledge sharing and the usefulness of the second main component in this dissertation.

7.4.2 Implications of bridging organisations for health and sustainability

From a health and sustainability integration perspective, it was significant that all four studied biosphere reserves were engaged in activities that can be considered health promotion. Bearing in mind that two of the biosphere reserves chosen as case studies did not explicitly focus on health, it is also noteworthy that health stakeholders were directly engaged three of the biosphere reserves. Since all biospheres reserves are mandated to function as bridging organisations and the operations of the four investigated biosphere reserves are built exclusively on partnerships, these organisations hold considerable potential to facilitate health and sustainability integration. The interviews indicated that the knowledge and skills biosphere reserves bring to bridging initiatives range from a holistic understanding of complex social-ecological systems to listening skills and an ability to connect the right people with one another. Their visionary approaches, such as superimposing cross-disciplinary geographic information to identify locally relevant issues, combined with their innovative practice of bringing together social service, and public health and environmental sectors, represent a kind of practical knowledge that cannot be generated by any one sector alone.

Techné represents local, context-specific, practical knowledge (Flyvbjerg 2001:56). My study of collective *techné*, in this case the actual practical bridging of health and sustainability, produced an analysis of empirical evidence that can both inform local healthy, sustainable community development processes and further the progress of contemporary academic *epistemé*. Moreover, *techné* of bridging organisations also provides communities with a venue that can promote new developments in academic *epistemé* for the common good, such as the transdisciplinary ecohealth framework presented in this dissertation.

7.4.2.1 Understanding techné of bridging organisations

The findings in this study supported the findings of others (e.g. Malayang et al. 2007; Schultz 2009; Biggs et al. 2010) who have recognised UNESCO biosphere reserves as examples of effective bridging organisations. In their work as active bridging organisations and "learning laboratories", biosphere reserves demonstrated all the potential positive aspects of cross-sectoral partnerships that Meadowcroft (2007) listed: (1) they bring together stakeholders on particular issues, such as health and sustainability; (2) they engage with real issues that "ground the deliberative interactions in the experience of participants, and focus attention on meaningful outcomes" (p.201); (3) they collectively plan, execute, and implement locally appropriate solutions, instead of just recommending them; (4) they engage in adaptive and reflexive social learning; and (5) they expand the discussions of issues across a wide range of sectors within local communities. The analysis of activities demonstrated that all the examined biosphere reserves were working on projects that affect health outcomes, such as food security or physical activity, and can therefore be categorised as health promotion initiatives (see Chapter 5 for details).

Furthermore, the results indicated that biosphere reserves can potentially play a much greater role than they currently do in bringing health and sustainable development stakeholders together than currently is the case. Both the pilot study and the four case studies demonstrated openness to and interest in exploring more opportunities to integrate health and sustainability.

That said, there are also significant barriers to such integrative work. These were identified in Chapter 5. According to the results in this study, the strongest drivers for bridging health and sustainability in practice appear to be (1) mobilising innovative, visionary, individuals; (2) establishing broad social networks; and (3) creating spaces for safe, open dialogue. These findings are very much aligned with general findings related to social transitions and behavioural change, such as the importance of community champions in health promotion (e.g. NCCCE 2007; Woodall et al. 2013) or frontrunners in sustainability governance (e.g. Rotmans and Loorbach 2009; Meadowcroft 2009), the value of social networks (e.g. Schulz and Northridge 2004; Minkler and Wallerstein 2012), and the role of bridging organisations (e.g. Brown 1991; Schultz 2009) in community development.

In addition to assessing the potential for health and sustainability-related bridging capacity of biosphere reserves, this research explored ways to enhance that capacity. However, not everyone interviewed thought it necessary to establish health as an explicit outcome of biosphere activities. While most interviewees saw an advantage to stating the links between health and sustainability more unequivocally, some participants pointed out the benefits of being less explicit about the health connection. These participants saw the

value of (1) considering health as an implicit integral part of all activities; (2) keeping focused on only a few topics; and (3) remaining faithful to the themes prioritised by current partners, supporters, and sponsors. Similarly, while most participants identified lack of funding as a significant barrier to bridging activities, others did highlight the indirect benefits of not having money. The activities of biosphere reserves are usually dependent on external funding sources, which often restrict the direction and operations of projects they finance. Independent of grants, biosphere reserves can more readily engage in innovative programme development. As expressed by one interviewee, "[not having money] is not necessarily a barrier – instead it means that you don't develop a large overhead and bureaucracy to look after something, but it depends on the willpower of the community. If the willpower is there, it'll float. If there is not the community willpower, it'll die" (Participant). These contradictory perspectives add depth to the research findings and help us understand the complexity of practical work. At the same time, they also reflect the social diversity that tends to help community partnerships improve local social resilience (Jackson et al. 2003; Nelson 2011; Johnson et al. 2012).

The main barriers to health and sustainability bridging within biosphere reserve organisations were related to knowledge: (1) a lack of familiarity with the mandates of partners (or sectors other than one's own) within the biosphere partnership; (2) limited understanding of the complex web of linkages between health and sustainability; and (3) few engaged stakeholders with pertinent expertise and interest in health issues. These barriers illustrated the challenges associated with complex knowledge, which has been discussed particularly in sustainability governance literature. Ansell and Gash (2008:544), for instance, pointed out that "[a]s knowledge becomes increasingly specialized and

distributed and as institutional infrastructures become more complex and interdependent, the demand for collaboration increases". At the same time, these results also emphasised the potential usefulness of some of the other research reported in this dissertation. Where the content of Chapters 4 and 5 might help resolve the issues related to lack of understanding of institutional mandates and approaches, the discussion and analysis around collective bridging of knowledge in Chapter 6 could help overcome the other two barriers.

7.4.3 Implications of bridging knowledge and creating local ownership

Phronesis refers to a practical wisdom "that grows out of intimate familiarity with practice in contextualised settings" (Shram 2012:17). Shram included tacit knowledge in the different types of local knowledge that form *phronesis* and argued that such knowledge grows from bottom up. Flyvbjerg (2001:56-57) emphasised that *phronesis* involves an analysis of values and focuses on the ethics of practice rather than on science. I see these reflections on *phronesis* as closely describing the kind of collective local knowledge discussed in Chapter 6, because the latter also depends on context-specific experience, involves interaction between theory and practice, and values consideration, judgement, and choice (Flyvbjerg 2001:56-57).

7.4.3.1 Developing and assessing the local phronesis in children's environmental health

The last key component of my research can be seen as a direct critique of the compartmentalised approach to assessing health and well-being in complex social-ecological systems. This approach is particularly detrimental in sparsely populated rural

communities, where local administration has limited resources to monitor indicators that are critical for appropriate decision-making (See Chapter 6 for details). Instead of focusing on specific problems or laying blame, this research envisions an alternative solution. This last component also illustrated a practical implication of the interconnectedness between health and sustainability. Children's environmental health was used as a bridging concept and as an example of a health outcome of sustainable development.

Within children's environmental health (*epistemé* of natural science) categories of knowledge were identified and used to assess the existing knowledge of local situations. I proposed that each community should assess its own situation by engaging the expertise of its own practitioners, experts, and community members. The traditional approach in community-based health promotion assumes that people are experts of their own lives and communities (e.g. Raeburn and Rootman 1998), This assumption was reinforced by the findings in this research (Chapter 6 and Appendix 5). With the guidance of *techné*, which would be provided by the bridging organisations, an improved understanding of the local situation could be developed (the local collective *phronesis*).

This research, which focused on the potential bridging capacity of biosphere reserves, assessed only the knowledge within bridging organisations. Naturally, firm conclusions about local situations related to children's environmental health cannot be drawn from this type of exploratory assessment because of the small sample size. The findings, however, bring to light concerns for children's environmental health that need to be addressed. They also indicated that bridging organisations may have a valuable role to play in gathering necessary, context-specific information by bringing together relevant

stakeholders. The details of both my reasoning and the way in which biosphere reserves were assessed for their potential as bridging organisations for children's environmental health can be found in Chapter 6. The greatest relevance of this research on bridging knowledge for local integration of health and sustainability is twofold. The results explicitly highlight the importance of (1) cross-sectoral collaboration for the sake of meaningful local knowledge; and (2) empowered communities that are in charge of their own situations, despite limited resources and economic challenges.

7.4.3.2 The role of bridging organisations in creating local phronesis

In general, this last component explored the complexity of the knowledge that links health and sustainability, particularly the knowledge needed to assess local situations for decision-making purposes. I identified the types of knowledge needed and the types of knowing available, including a process that identified how the gaps in collective knowledge could be filled. This exploration produced interesting matrices that mapped local knowledge related to children's environmental health in each biosphere reserve. Considering that all but two participants said that they had never heard of the concept children's environmental health prior to the interview, the results were rather impressive. Yet information about the status of local children's environmental health has ever been gathered in any of the case study regions. The findings imply that there is great potential for communities to drive their own situational assessments and monitor their own local conditions related to children's environmental health, which could be beneficial considering that local authorities rarely have the capacity to address these issues.

How a community chooses to use the gathered information would depend on the nature of the community, composition of the partnership, and types of information discovered. In the case of the four biosphere reserves studied, we see only indications of what the issues might be and a clearly demonstrated need for additional information gathering. Whether the possible issues are related to lead pollution of local vegetable gardens due to heavy floods and old mines, or exceptionally high rates of cancer and possible ground water contamination by former chemical industry (See Chapter 6 and Appendix 5), the findings in this research indicate that there is a need for improved local assessments of children's environmental health.

Participatory monitoring is not a new concept to sustainability governance (e.g. Fraser et al. 2006) or health promotion (e.g. Draper et al. 2010). However, it requires significant coordination and long term planning. Community organisation could begin with a one-time mapping exercise of the existing situation that creates community a sense of ownership and collective understanding of local conditions. The gathered information could then be used as a baseline assessment to gain a better understanding of possible points of concern and how to prioritise local capacity in the long run.

Following the local situation assessment, the four key questions known to initiate classical phronetic research (Flyvbjerg 2001: 60) – "where are we going?"; "is this desirable?"; "what should be done??; and "who gains and who loses; by which mechanisms of power?" – would make a useful working template for bridging organisations, but that is the subject of a whole other research project and is outside the scope of this dissertation.

7.4.3.3 Critiquing the current state of affairs

In principle, my findings also imply a harsh critique of the current approach to knowledge in both sustainability governance and health promotion. For instance, considering that environmental health issues, particularly those related to children's well-being, are complex, 'wicked' problems, narrow, limited sets of data can result in a significant degree of uncertainty at best and, at worst, be directly mislead efforts to address the issues. Indeed, the contemporary narrow approach to science and evidence-based decision-making may be too limited in capacity, too reactive (as opposed to proactive), and too rigid to support effective governance of complex social-ecological systems. The findings in this research indicate that there are a number of issues, currently ignored and unaddressed, that could cause serious harm to human and ecosystem health. Furthermore, unless a conscious effort is made to identify all necessary knowledge needed around the discussion table to address specific questions, no matter how adaptive or collaborative a given cross-sectoral partnership is, it may not have adequate understanding to address the issues at hand.

7.4.3.4 Respecting all knowledge

The discrepancy between lay interpretations of children's environmental health and the expert interpretations indicated by government documents in both the UK and in Canada was rather thought provoking and unexpected. It would be interesting to explore what has made Louv's (2005; 2011) nature deficit disorder so compelling that it dominates public perceptions and associations related to how the environment affects child health. It was very interesting to discover that the pollution aspect of children's environmental health that governments, researchers, and international policy statements emphasise had registered to a lesser extent among practitioners.

From the perspective of effective community engagement, which is highly relevant to both health promotion and sustainability governance, it is vital to acknowledge these discrepancies between perceptions. If we want to engage communities, community members need to see the meaningfulness of the topic (Hart 2008). Less inclusive practices tend to impose knowledge on communities, by raising awareness of the 'truths' deemed most valuable by experts (Wallerstein and Duran 2008). In contrast, more deliberative and participatory approaches, such as those promoted by community-based or participatory action research initiatives, emphasise the inclusion of different types of knowledge. This research was based on a form of critical realist philosophy that assumes that accurate natural scientific findings and broadly applicable social constructs (*epistemé*), such as the United Nations' understanding of human rights, will be validated, adapted and appropriately applied through rational discourse. The approach further assumed that such *epistemé* will be complemented by the context-specific *techné* and individually held *phronesis* of local stakeholders to form a collective understanding of the issues, the collective *phronesis*.

In practice, this would mean that instead of trying to identify a dominant discourse, biosphere reserves could aim to facilitate a dialogue that embraced and merged many different aspects of child well-being and perceptions of children's environmental health. Indeed, this kind of work can also be seen as a form of transdisciplinary knowledge creation, which would hopefully result in a collective understanding of local issues related to children's environmental health. In complex social-ecological systems of non-linear dynamics where well-being is influenced by social determinants of health, a multidimensional interpretation of children's environmental health is likely to be more

accurate than any of the narrower interpretations of related issues.

A vital aspect of approaches that respect all kinds of knowledge is the active engagement of the appropriate experts. This dissertation's 'dissection' of the current scientific understanding of children's environmental health matters aimed to illustrate the types of knowledge needed to assess the situation. If key pieces of information are missing, such as local indigenous knowledge or an overall understanding of the science behind children's environmental health, it is essential that the bridging organisation ensures that relevant stakeholders become part of the process.

This research did not address all aspects of knowing relevant to decision-making, such as how to address, manage, and govern uncertainties or power relationships within participatory processes. Rather, this research focused on identifying what the community knows (known knowns) and what individual members of the community know, though the individual knowledge is not yet collectively gathered or acknowledged (unknown knowns). The aspects of knowledge that are not known or cannot be known also need to be taken into account in related decision-making and have indeed been discussed widely in the academic literature. Wynne (1992), for instance, talked about four types of uncertainty in environmental learning: risk (we know the odds, 'known unknowns'); uncertainty (we may know the parameters but do not know the odds; 'known unknowns' or 'unknown unknowns'); ignorance (when we don't know what we don't know, 'unknown unknowns'); and indeterminacy (causal chains or open networks). Although gaps ins knowledge require further research, uncertainties, which represent an essential aspect of collective knowledge production and collaborative learning, should not stop the process of collectively gathering

local knowledge. A precautionary approach, one of the six main overlapping themes identified in sustainability governance and health promotion, offers alternative courses of action to address uncertainties. Similarly, another one of the six overlapping themes – social justice and equity - requires the acknowledgment of existing power relationships. Indeed, in the non-linear dynamics of complex social-ecological systems, where well-being is influenced by social determinants of health, transdisciplinary framework developed in this dissertation offers a starting platform to further research on health and sustainability integration in practice.

7.5 Conclusion

Although the importance of interdisciplinarity, transdisciplinary research, and cross-sectoral bridging are widely acknowledged, the contemporary discourse has serious challenges handling complex knowledge. Chapter 7 illustrated some of those challenges by describing difficulties academics face when trying to publish transdisciplinary research results in high-impact papers. However, the main focus of the chapter was to discuss the overall essence of the research for this PhD: three new approaches to knowledge useful for cross-sectoral bridging of health and sustainability in practice.

Chapter 1 introduced the adaptation of Aristotelian intellectual virtues as a tool to frame collective cross-sectoral knowing in practice. This chapter presented the practical implications of using *epistemé, techné,* and *phronesis* in cross-sectoral bridging to represent the theoretical scientific expert knowledge, practical collaborative working knowledge, and collective wisdom, respectively. The approach offers a set of new mechanisms to

approaching practical cross-sectoral collaboration by combining the theoretical, practical, and context-specific, value-laden, local knowledge into one interconnected threesome.

While the results are summarised more in detail in Chapter 8, this chapter elaborated on the overall of implications of the findings in the three research components. Bridging key discourses familiar to practitioners has the potential to bring down barriers to cross-sectoral collaboration by explicitly emphasising the shared components and the complementary learning potential. Furthermore, the adapted ecohealth framework offers a tool for opening discussions at cross-sectoral forums, which allows practitioners to develop their own stance on bridging health and sustainability. A theoretical framework is not much value for practice without a practical forum and a facilitating agency that brings stakeholders together. A bridging organisation with practical, context-specific knowledge that understands the local socio-ecological dynamics coupled with interest on a holistic approach to health and sustainability offers another type of vital knowing for cross-sectoral bridging in practice. To illustrate how the theoretical and practical bridging can have concrete added value for local decision-making, mobilisation of the collective knowledge for children's environmental health was introduced as an example of the third type of cross-sectoral bridging. The chapter demonstrated how all three types of cross-sectoral bridging of knowledge are essentially needed, in order to effectively assess and monitor the local situation concerning children's environmental health.

In general, Chapter 7 summarised the way in which the three research components presented in Chapters 4-6 each demonstrate a different aspect of cross-sectoral bridging of health and sustainability. The chapter highlighted some critique of the current system in

regard to children's environmental health, revealed by the findings in this research, but it also established constructive suggestions for solutions, based on the research results.

8 Conclusions

8.1 Introduction

Complex social-ecological systems require inter- and transdisciplinary approaches to address the increasing number of 'wicked problems' threatening public health, ecosystem well-being, and sustainable development. Despite the interconnectedness between health and sustainability widely acknowledged in theory, in practice, decision-making and programming still primarily take place in administrative silos. The transdisciplinary research presented in this dissertation addressed two knowledge-related problems related with the practical bridging of health and sustainable development: the compartmentalisation of knowledge and the absence of mechanisms that facilitate the mobilisation of cross-sectoral information and co-production of knowledge. This study answered the following overall research question by exploring various approaches to bridging sustainability and health in practice:

> *Might the current gap between public health and sustainable development practices be bridged by integrating the academic, practical, and co-created collective knowledge that sees children's environmental health as a desirable shared outcome?*

Children's environmental health was chosen as a concept that illustrates the linkages between health and sustainability and needs to be addressed through multidisciplinary processes.

This research looked alternatives to the conventional knowledge claims and practices associated with cross-sectoral collaboration by focusing simultaneously on theoretical bridging, practical bridging, and collective knowledge mobilisation. Flyvbjerg's

(2001) conceptualisation of the Aristotelian intellectual virtues, *epistemé, techn*é and *phronesis*, was modified to help describe aspects of collective intelligence that could enhance the integration of approaches to health and sustainability. The focus was on the three characteristics of cross-sectoral partnerships that were identified as valuable for improving decision-making processes: bridging key discourses, bringing together key groups, and generating new knowledge (Meadowcroft 2007). These three topics were explored as follows:

1. **Bridging theories and bridging concepts (*epistemé*):** Health promotion and sustainability governance literatures were analysed as applied social sciences platforms that could be used by practitioners to help bridge key theoretical discourses. The exercise generated a conceptual tool that explicitly highlights the similarities and complementarities of the two fields. Children's environmental health was chosen as a bridging concept because of the increasing incidences of poor health outcomes, particularly chronic conditions, associated with children's exposure to environmental hazards, and further because effective solutions to this problem require cross-sectoral collaboration.

2. **Bridging organisations (*techn*é):** UNESCO-mandated biosphere reserves were studied as bridging organisations for their ability to link important stakeholders and facilitate the integration of health promotion and sustainability governance in practice. The universal mandate of the biosphere reserves as learning laboratories for sustainability makes them ideal candidates for bringing together multi-sectoral interest groups for health and sustainable development.

3. **Bridging collective knowledge (*phronesis*):** Practitioners related to biosphere reserve organisations were examined for perceptions and knowledge concerning children's environmental health to assess their potential capacity to facilitate knowledge mobilisation for children's environmental health.

Each topic was presented as a chapter, and all three chapters introduced new ways of looking at cross-sectoral bridging practices. Activities in all Canadian and British biosphere reserves were assessed for the extent of their focus on health. In addition, by investigating four biosphere reserves as case studies, this research identified barriers to and drivers for integrating health goals into biosphere reserve activities. At the same time, organisational understanding of issues relevant to children's environmental health was studied.

8.2 Summary of results

This research focused on the cross-sectoral integration of health and sustainable development practices. Complex challenges associated with both public health and sustainable development were explored in a transdisciplinary manner, using conventional academic research methods while building equally on literatures from two separate fields, health promotion and sustainability governance. In addition, contemporary natural scientific and epidemiological research results related to children's environmental health were used to develop categories for monitoring and mobilising knowledge. The identified categories were then employed to assess an alternative approach to the production of local collective knowledge, potentially facilitated by bridging organisations. An overview of the results, categorised by research questions, can be found in *Table 8.1.*

In general, the research findings indicate that, by enhancing local practices of building cross-sectoral partnerships, a broader approach to knowledge mobilisation could improve democratic and deliberative decision-making processes related to healthy sustainable community development. Adapting the Aristotelian differentiation of intellectual virtues to collective intelligence offers a useful tool for integrative approaches to health and sustainability (Discussed in Chapters 1 and 7). The trinity of cross-sectoral bridging examined in this dissertation, highlights the unnecessary narrowness of contemporary thinking regarding knowledge, particularly collective knowledge.

The three Aristotelian intellectual virtues were also used to illustrate a way in which complex challenges can be approached by simultaneously examining multiple knowledge perspectives. Flyvbjerg (2002:56) argued that *phronesis*, the 'practical common sense', is needed to manage both *epistemé* and *techn*é. This is well exemplified by the findings from this research, which suggest that collective knowledge needs to be mobilised to guide both

Table 8.1: Overview of the research results categorised by research questions

Identification or assessment of components of research questions	**Brief summary of research findings**
Chapters 3 and 4: Examined synergistic and complementary aspects of the academic theories in health promotion and governance towards sustainable development	
Overlapping areas of interest in health promotion and sustainability governance theories	Six themes identified: social change; social justice/ equity; ecological systems approach; participatory deliberative mechanisms; precautionary principle, and active knowledge sharing/ knowledge mobilisation.
Complementary areas of expertise in health promotion and sustainability governance theories	E.g. theory-informed interventions in health promotion complement extensive understanding of governance practices in sustainability governance (polycentric/ multi-level governance).
Potential for bridged transdisciplinary approach (using children's environmental health (CEH) as an example)	Primary outcome: Transdisciplinary ecohealth framework to facilitate cross-sectoral collaboration; Secondary outcome: Multi-sectoral responses and solutions to e.g. waste water management, economic and urban planning, etc..

Chapter 5: Investigated place-based practical mechanisms for bridging health and sustainability	
Type(s) of activities and programmes that take place in biosphere reserves (BRs), which can be categorised as health promotion	**Promoting healthy behaviour change: a)** ***Focus on individual behaviour change*****:** Physical activity, nutrition, environmental health, mental health; **b)** ***Focus on community level behaviour change*****:** Food security (accessibility to local, healthy, nutritious, foods), active transportation, environmental health; **Promoting systems level change:** Food security and poverty reduction, healthy and sustainable community development, environmental health and poverty reduction, environmental health.
Ability of BRs to function as bridging agents facilitating cross-sectoral collaboration between health and sustainability sectors	All BRs bring together a wide range of diverse stakeholders; all studied BRs conduct activities that can be categorised as health promotion (either implicitly or explicitly); the health sector was engaged directly by 3 of the 4 studied BRs and indirectly by 1 of the 4 BRs.
Barriers to and drivers for integrating health and sustainability in practice	Better if health is explicitly vs. implicitly recognized in BR mandate/ activities; importance of knowledge and awareness, perceptions, community champions, networking, and funding/ time.
Chapter 6: Explored the interaction between general and context-specific knowledge	
Perceptions and understanding related to health, sustainability and CEH	Interconnectedness of health and sustainability seen as self-evident, but mostly intuitive and not explicit; CEH is an unfamiliar concept, but when participants were asked what it could be, a range of alternative interpretations emerged; CEH in general seen as a useful concept for bridging.
Availability of skills and knowledge that facilitate the collective sense-making (a key function of bridging organisations) related to CEH (to assess the local situation)	Extensive but somewhat sporadic knowledge of various local environmental factors impacting health, particularly CEH; limited monitoring data available and limited knowledge of who does what; sufficient quantity of knowledge and skills available to facilitate bridging processes of CEH knowledge.
Ability of theory and practice to inform one another, to co-create meaningful knowledge that informs decision-making in sustainable and healthy community development	Pooling locally relevant scientific knowledge related to health and sustainability; local monitoring data on disease, disabilities, deformities and environmental conditions; and other local skills and knowledge have the potential to generate more meaningful place-based data.

the understanding (theoretical and practical) and the governance of children's environmental health issues in sustainable community development.

The results also indicate that a more explicit approach to the bridging of theoretical cross-sectoral academic knowledge has the potential to help justify cross-sectoral collaboration in practice. Such theoretical bridging may also help to lower disciplinary barriers within academia. The most significant finding of the theoretical component of this research was the number of epistemological similarities between health promotion and sustainability governance. The identification of six overlapping themes (*Table 8.1*) suggests that cross-sectoral collaborative planning could also be doable in practice, without major changes in current administrative mandates. Indirectly, such findings illustrate how disciplinary boundaries may unnecessarily impede healthy sustainable community development.

Studying UNESCO-mandated biosphere reserves as bridging organisations that can facilitate the bridging process showed in turn how the integration of health and sustainability can take place in practice. The responses of interviewees implied that actively involving health stakeholders in sustainable community development activities generates co-learning and broadened understanding. As discussed in Chapters 5 and 7, the role of bridging organisations is not only to bring people together to facilitate social learning and mobilise knowledge for decision-making, but also to create collective ownership of local issues and increase social capital and resilience by empowering communities. This function was clearly demonstrated in a participant's description (also partially cited on p.166) of a biosphere reserve-led bridging activity that engaged 200 local stakeholders in the topic of food security and health:

> "It started as a kitchen table conversation, involved a few farm producers the first year and it's grown and grown and grown – and now it's become the biggest non-government food network in Canada. That didn't take money to do. It just took probably not having money - in some cases, it's not necessarily a barrier - instead it means that you don't develop a large overhead and bureaucracy to look after something, but it depends on the willpower of the community. If the willpower is there, it'll float. If there is not the community willpower, it'll die. You can have a very large funded programme for something but no buy-in from the community. No buy-in is as good as having no money."

In addition, practitioners' perceptions and knowledge of children's environmental health revealed inadequacies of the current approach to monitoring health and related environmental indicators, indicating that the knowledge base used to make decisions at the local level is not sufficient. However, it was enlightening to discover how much local knowledge relevant to children's environmental health is available within biosphere reserves. This knowledge could be powerful if pooled methodically, as is outlined by way of example in *Table 8.2.*

In general, *Table 8.2* illustrates the broader transdisciplinary understanding generated by this iterative research process. Using children's environmental health as an example, it summarises the three types of bridging studied using children's environmental health as an example, coupled with the sensitising concepts developed to guide the research (See Chapters 5 and 6, as well as Appendices 1 and 3). The transdisciplinary outcomes of this research are highlighted in yellow. Furthermore, *Table 8.2* demonstrates how the main findings of this research can be applied to local situation. It shows that, in order to integrate health and sustainability in practice, a more open and diversified approach to bridging knowledge is essential.

Table 8.2: Summary of different types of knowledge that is useful when assessing the local children's environmental health status

Knowledge type	Examples of knowledge	Rationale
Epistemé		
Natural sciences (health)	• Knowing possible specific poor health outcomes; • Identifying relevant symptoms and symptom combinations; • Understanding human physiology, biochemical pathways, and molecular biological mechanisms involved.	Broadly applicable (Aristotelian 'universal') understanding of the latest scientific knowledge is needed • to assess possible causalities; • to identify useful indicators; • to assess the relevance of observations; • to analyse the results. This knowledge can contain uncertainties, which may require precautionary approaches. These aspects need to be taken into account when assessing validity.
Natural sciences (ecosystem)	• Knowing the signs of unhealthy ecosystem; • Understanding the complex social-ecological system interactions, dynamics, uncertainties and feedback loops; • Understanding ecological, physiological, biochemical and chemical mechanisms involved.	
Natural sciences (transdisciplinary)	• Understanding the universal biochemical mechanisms and chemical interactions common to shared evolutionary pathways of all species.	Explicit transdisciplinary understanding helps to facilitate cross-sectoral collaborations.
Social sciences (health promotion)	• Tools (theories) to assess the needs and assets of a given community and to facilitate change processes at individual, organisational, community and policy development level.	Broadly applicable understanding of the latest social scientific knowledge is needed • to understand the complex aspects of the social influences; • to help steer the social sphere in a collectively desirable direction.
Social sciences (sustainability governance)	• Tools (theories) to assess sustainable development, such as sustainability criteria; • Understanding of elements needed and processes involved in governance, e.g. inclusion of all stakeholders, social learning, power relationships, political processes, economic aspects, conflict resolution, etc.	
Social sciences (transdisciplinary)	• Understanding the synergistic and complementary trends in various aspects of the social sciences.	Explicit transdisciplinary understanding helps to facilitate cross-sectoral collaborations.

Knowledge type	Examples of knowledge	Rationale
Techné		
Local monitoring of natural scientific data (health statistics)	• Chronic diseases (e.g. asthma, allergies, cancers, metabolic conditions, Parkinson's disease, Alzheimer's disease, etc.) • Infectious diseases (possibly caused by pollution-induced compromised immune response) • Disabilities (e.g. autism, ADHD, learning disabilities, etc.) • Mental health indicators (e.g. schizophrenia)	All three types of local knowledge are needed to assess the local situation, to develop the local collective knowledge and locally meaningful solutions.
Local natural scientific monitoring (ecosystem statistics)	• Water quality (e.g. heavy metals, persistent organic pollutants, pesticides, fire retardants, phthalates, etc.) • Soil quality (regarding pollution) • Air quality (regarding pollution indicators, incl. particles and aerosols) • Deformed, strangely behaving, sick, or dead animals • Plant diseases (possibly caused by pollution-induced compromised immune response) • Changes in ecological patterns	
Local social system understanding	• Local population demographics • Local economic structure (players, strengths, vulnerabilities) • Stakeholders and other political players • Local history, practices and traditions (incl. traditional knowledge) • Local observations	
Local transdisciplinary skills	• Knowledge and ability to bring diverse stakeholders together and facilitate collective processes (e.g. bridging organisations)	Explicit transdisciplinary understanding helps to facilitate cross-sectoral collaborations
Phronesis		
Transdisciplinary co-created collective knowledge (Community scale)	• Multidisciplinary/ cross-sectoral collectable knowledge generated by diverse stakeholders, including experts, practitioners, and the general public (Requires compiling - often referred to as co-creating knowledge).	Collective understanding: • to assess the local situation (needs and assets) • to identify hotspots • to develop healthy sustainable solutions • to evaluate and improve the process • to develop healthy, sustainable policies

8.2.1 Challenges

Academic theories are meaningful only if they are discussed and used by other scholars. The purpose of this study was to create academic research that would also be useful for practitioners. Biosphere reserves as bridging organisations are useful forums for introducing this type of frameworks to broader audiences. As mentioned in Chapter 4, other venues also have the potential to facilitate interactive dissemination processes, through which practitioners can modify and own the proposed ideas.

From a practical perspective, the ideal universal mandate and open-minded, passionate, and knowledgeable practitioners of biosphere reserves make them ideal organisations for the work of bridging health and sustainability. Yet, as discussed in Chapter 7, their current funding struggles severely limit their capacity to carry out their mandate as intended. Moreover, some of the biosphere reserves were explicitly not interested in addressing issues that may be politically contested, such as those identified by the findings described in Chapter 6. A more proactive approach by all potential stakeholders, including their respective funders would be necessary to make any extensive health and sustainability integration work possible. Furthermore, there are only a limited number of biosphere reserves in each country. Thus other organisations with similar mandates would need to become involved by recognising the issues and having the means to mobilise stakeholders to address them.

As highlighted in Chapter 6, additional challenges include the inadequacy of monitoring practices regarding children's environmental health. To collectively generate the consensus needed to leverage a response in such issues, a strong collaborative effort

would be required. However, such collaborations are not likely to form and find solutions until challenges have been highlighted and community awareness of the problem exists.

8.3 Contributions

As an academic exercise, this dissertation offers multiple new findings and a range of contributions to scholarly knowledge, particularly to the field of transdisciplinary research. When exploring the ways in which sustainability and health could be bridged in practice, both theoretical and practical insights were uncovered.

The theoretical adaptation of the Aristotelian intellectual virtues presented in this dissertation offers a new approach to conceptualising the multi-faceted nature of knowledge in complex social-ecological systems. Though this framing may still need fine-tuning, the research findings highlighted the value of all three types of knowledge, *epistemé*, *techné*, and *phronesis,* for decision-making and policy development in healthy and sustainable community development. By explicitly generating (1) discussion templates based on broadly applicable knowledge, *epistemé* (bridging discourses: bridging theories and bridging concepts); (2) intentional and safe discussion arenas by harnessing practical knowledge, *techné* (bridging organisations); and (3) ownership of local issues by building on existing local knowledge, *phronesis* (bridging collective knowledge) for health and sustainability integration, this research also helps bridge the gaps between academia, practitioners, and other areas of community knowledge.

Another contribution is the exploration of similar epistemologies in health promotion and sustainability governance theories, as is demonstrated by the parallels between the prerequisites for health in the Ottawa Charter for Health Promotion (WHO

1986) and Gibson et al.'s (2005) sustainability assessment criteria (See *Figure 4.1* and *Table 8.1* for details). These normative characteristics were used as a foundation to develop a new conceptual transdisciplinary framework that expanded on the existing ecohealth concept, which takes an ecosystem approach to health.

The third key contribution is the conceptual framework introduced in *Chapter 4* that offers an integrated theoretical approach to bridging health and sustainable development. In the development of this adapted ecohealth framework, the scholarly works in both fields that deviated only in emphasis were described as complementary components that could function as incentives for multi-disciplinary collaboration. In general, the exercise produced a shared conceptual platform that can facilitate cross-sectoral collaboration for healthy sustainable community development. For example, the framework can be used as a starting point to open up conversations at meetings on community health concerns and options. Adapting the framework to meet the context specific needs of different communities has the potential to foster identification and shared understanding of possible solutions to local issues that offer a broader suite of mutually reinforcing benefits and a stronger sense of ownership among community members. These outcomes were discussed throughout the dissertation (See e.g. *Section 7.4.3*).

The fourth contribution is the introduction of children's environmental health as a bridging concept and an area of practice for sustainability governance and health promotion. While many other concepts, such as food security and poverty, can be used to bring together stakeholders for healthy sustainable community development, findings in

this dissertation indicate that children's environmental health could have special strength as a bridging concept.

For example, the discovered lack of local data has the potential to have serious impacts not only on public health but also on ecosystem services. Children's environmental initiatives that apply insights from sustainability governance and health promotion could involve enhanced and expanded local community engagement in ways that would (1) strengthen the data base for validation or questioning the contemporary scientific and epidemiological findings about environmental threats to children's health, and (2) increase the potential for recognising local needs and opportunities for children's environmental health actions that would benefit both public health and ecosystem services. On the other hand, advantages could also flow the other way. These findings imply that children's environmental health may have a greater role to play in the development of both health promotion and sustainability governance theory in the future than has hitherto been the case.

The fifth significant contribution is the expanded concept of 'bridging organisations' and the identification of ways in which environmental nongovernmental organisations that traditionally function outside the health sector can promote health. Biosphere reserves as bridging organisations revealed their capacity to operate as innovative community-based forums for the integration of sustainable development and public health. Indeed, bridging health and sustainability in practice is one of the essential aspects of community development that unites the social, economic, and environmental components of sustainability in a meaningful manner.

The sixth contribution stems from the findings that reveal an insufficiency of local data collection on children's environmental health threats. Awareness of these information gaps provides a new angle to existing discussions of the kinds of knowledge included in policy development processes. While both health promotion and sustainability governance literatures have addressed the deliberative mobilisation of knowledge, the results of this doctoral research indicate that a more nuanced approach to knowledge mobilisation for decision-making is necessary. Indeed, the current patchy approach to monitoring local data and mobilising local knowledge highlights the value of more systematic deliberative approaches, which has been recognised by both health promotion (e.g. Minkler 2010) and sustainability governance (e.g. Berkes et al. 2006) theory. Furthermore, these findings bring new insights to the potential value of bridging organisations as facilitators of this type of collaborative processes.

8.4 Outcome implications and recommendations

The outcome implications of this research encourage (1) increased transdisciplinarity of theory in health promotion and sustainability governance; (2) increased transdisciplinarity of the knowledge used in decision-making, particularly in relation to children's environmental health; and (3) the facilitation of broader cross-sectoral collaborations to enhance tools and ideas for bringing stakeholders together for health and sustainability. Since the research underlying this dissertation has built on participatory and deliberative principles of inclusive, communicative action and collaborative governance, it does not offer final insights and definite outcomes.

The results do, however, offer malleable concepts, such as ecohealth, sustainability assessment criteria, and social determinants of health, as tools to create new lenses for looking at familiar topics when integrating health and sustainable development. Moreover, outcomes of this research offer practical ideas that can be adapted to local conditions. Findings also suggest that a new approach to assessing children's environmental health might be necessary. Furthermore, *Table 8.2* illustrates the applicability of these results as it outlines types of knowledge needed to effectively assess children's environmental health situation.

Contemporary challenges related to children's environmental health made it a useful bridging concept for illustrating the interconnectedness of health and sustainable development. However, findings in this study, particularly those related to the lack of general awareness about children's environmental health and to the lack of monitoring of appropriate indicators, indicate a great need for collective bridging approaches. Furthermore, not only does the deliberative approach to knowledge mobilisation proposed in this dissertation have the potential to facilitate healthy sustainable community development, but it also introduces a mechanism to validate or refute the results of contemporary natural scientific research in children's environmental health.

8.5 Further research

The manner in which this research documented similarities between health promotion and sustainability governance, the practical knowledge of bridging organisations, and the insufficiency of contemporary approaches to children's environmental health assessments

offers a great range of future research opportunities. Six examples of possible further research directions are listed below:

1) From the theoretical perspective, a further analysis could be carried out to explore how various complementary aspects of health promotion and sustainability governance theories could enhance the scholarship in respective fields.
2) From the practical perspective, the usefulness of the conceptual ecohealth framework could be empirically assessed in the context of a cross-sectoral collaborative workshop.
3) It would also be useful to analyse the ways in which bridging of health and sustainable development takes place in other innovative social contexts, such as sustainable villages or intentional communities, or when facilitated by other bridging organisations. Moreover, it could be beneficial to assess how the integration of health and sustainability practices within such arrangements compare with the integration work in biosphere reserves.
4) The bridging work convening a diverse group of stakeholders inevitably involves some value differences and power dynamics. Both health promotion and sustainability governance literature could benefit from a better understanding of how bridging organisations navigate such challenges in small rural communities.
5) The findings in this dissertation suggested that the mobilisation of collective knowledge could be beneficial for local decision-making, but more research is needed to investigate how scientific knowledge and local knowledge about children's environmental health can be bridged in a more methodical manner.

6) In addition, the potential implications of deliberative approaches to knowledge mobilisation including increased community empowerment and understanding of current socio-political power relationships might be worth further exploration.

8.6 Concluding remarks

This doctoral research was designed to explore aspects of knowledge bridging that would contribute to both theoretical and empirical discussions on the integration of health and sustainability. The long-term contribution of such discussions would be to improve the quality of knowledge being used in decision-making and healthy sustainable policy development. In the short-term, the findings in this dissertation contribute to theory and practice of integrated approaches to health and sustainability in complex social-ecological systems.

Overall this research introduced three new perspectives for mobilising knowledge as it relates to the cross-sectoral integration of health and sustainability: (1) the bridging of health promotion and sustainability governance theories, using children's environmental health as a bridging concept; (2) the idea of bridging organisations offering their skills and functional platforms as mechanisms to facilitate bridging in practice; and (3) the importance of bridging collective knowledge and combining the theoretical, practical, and ethical aspects of the integration process. Moreover, adapting the Aristotelian three intellectual virtues for a collective context offers a version of three perspectives that is more digestible and easier to apply in practice. All in all, the findings in this research indicate that an integrated ecohealth approach, children's environmental health, and bridging organisations together offer a conceptual and practical frame, which has the

potential to integrate health and sustainability by facilitating cross-sectoral collaboration. Furthermore, the frame also has the potential to enhance approaches to knowledge mobilisation, thereby more effectively informing decision-making and policy development for healthy sustainable communities.

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Appendix 1: Sensitising concepts

In social scientific research, the value of qualitative research is in the exploration of the unknown and ability to discover the unanticipated information. This doctoral research studied bridging of health and sustainable development in practice, however, the approach was kept relatively open during the field research. Use of sensitising concepts allowed the researcher to steer the investigation but remain open to new unexpected findings. The lack of specific, predetermined, attributes helped guiding the research by suggesting the direction yet allowing the empirical experience to modify the conceptual framework (Bulmer 1969; Patton 2002:278-279).

Sensitising concepts were used in three instances during this research but in a slightly more specified manner than they conventionally are understood:

1. Chapters 3 and 4: In the literature review, the prerequisites for health from the Ottawa Charter of Health Promotion (WHO 1986) and Gibson et al.'s (2005) sustainability assessment criteria, guided the iterative formation of the sensitising concepts that ended up becoming the centre piece for the conceptual framework:
    i. Intentionality - social change
    ii. Social justice – equity
    iii. Holistic – systems approach
    iv. Deliberative – participatory – inclusive
    v. Precautionary principle
    vi. Making & moving knowledge: Awareness creation – information gathering - knowledge mobilisation
2. Chapter 5: When studying the health promotion activities in biosphere reserves, the key themes from health promotion literature were used with emphasis on social determinants of health and primarily chronic disease prevention:
    i. Food
    ii. Physical activity
    iii. Health and well-being
    iv. Environmental health
    v. Mental health
    vi. Poverty reduction
    vii. Healthy environments/ urban planning

    Each of these components was very broadly interpreted in the early analysis phase. For instance, 'food' ended up covering topics from nutrition and local food to food insecurity

and food systems; and 'physical activity' included activities ranging from forest trails and public transit promotion to walking groups and children's outdoor activities.

3. Chapter 6: Exploring children's environmental health perceptions, knowledge, and status in biosphere reserves was guided by two sets of information:

   (a) Health determinants or potential environmental health hazards;
   i. Pollution
   ii. Industry (current & historical)
   iii. Agriculture/ farming
   iv. Traffic
   v. Infrastructure
   vi. Population demographics
   vii. Socioeconomic factors
   viii. Culture and tradition (e.g. food)
   ix. Local concerns, incl. folklore and historic stories
   x. Nature

   (b) Possible poor health outcomes related to children's environmental health threats - based on current scientific understanding:
   i. Neurodevelopmental disorders: Learning disabilities, ADHD, autism, etc.
   ii. Metabolic disorders: Diabetes, obesity, etc.
   iii. Immune deficiencies (human or animal)
   iv. Cancers
   v. Physical deformations

While some of these concepts may appear relatively definitive to person not engaged in chronic disease prevention or children's environmental health, they were used to identify and extract a great range of information from a diversity of sources, in order to assess the local situations.

Appendix 2: The semi-structured interview guide

Semi-structured interview approach used in this study covered four main themes: (1) Health related projects; (2) Barriers to and driver for health integration; (3) Perceptions & knowledge; (4) Role as a bridging organisation. The interview process followed the general principles of semi-structured interviews, as described by Robson (2002:270) below:

> "Semi-structured interview has predetermined questions, but the order can be modified based upon interviewer's perceptions of what seems most appropriate. Question wording can be changed and explanations given; particular questions which seem inappropriate with a particular interviewee can be omitted, or additional ones included"

The table below contains the themes and questions submitted to the Office of Research Ethics at the University of Waterloo for ethics approval, prior to the field study (ORE #18477).

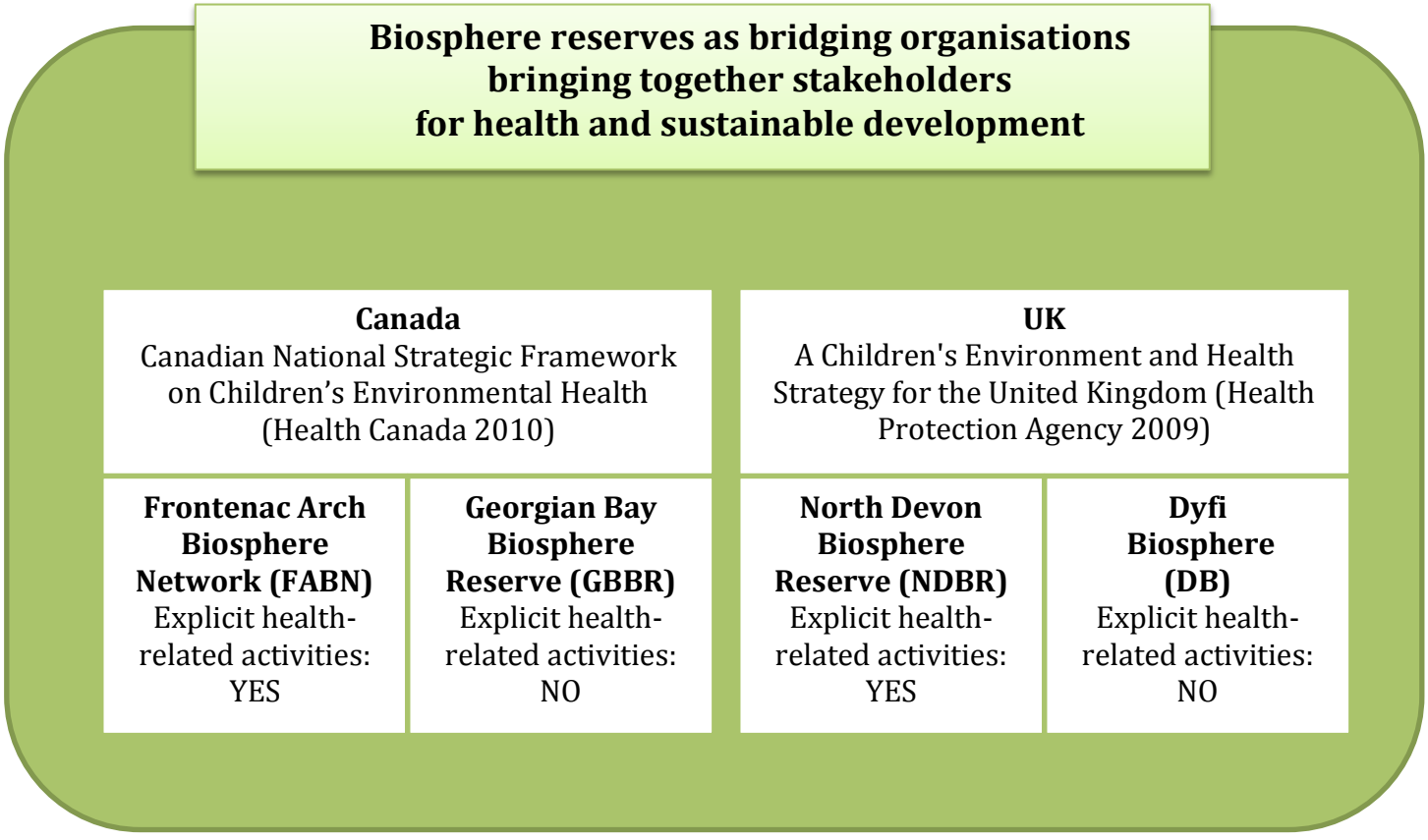
Topic/ theme	**Example questions, including probes**
To identify health related projects	Your BR has been doing x,y & z kind of health-related projects… 1. What other kind of health-related activities your BR has done? 2. How come you decided to integrate health as a specific component of your programming? What is the history?
To identify barriers to & facilitators for connecting health and the environment/sustainability in BR activities	3. What has been facilitating/ carrying the health projects? 4. How have you funded the projects? 5. Who are your partners in health projects? a. Any partners from the health sector? Whom? How did they get involved? b. If not, why not? 6. What kind of challenges did you have when doing the projects? What type of skills do/would you need to develop & implement health related activities? 7. What prevents you from doing more health related projects?

	8. How free reign do you have to decide about your own programming? If you decided to have health integrated to all of your projects would that be possible?
To identify the existing knowledge related to linkages between health & sustainability	9. How do you see the linkages/ interconnectedness between health & sustainable development? 10. How do you see health fits into your mandate? 11. Sustainable development is about intergenerational equity – how do you see that related to health? 12. What do you think children's environmental health might relate to your work (or vice versa)? 13. Have you ever had particular pollution threats or environment & health related conflicts in the area that you know of? Former factories polluting the waters, environmental accidents/ disasters, excessive use of pesticides, or other? Please tell more about it. 14. Who is monitoring the local pollution levels? What do you know about it? Are they connected to the BR? Do you have access to that data? 15. Who is monitoring the local health statistics? What do you know about it? Are they connected to the BR? Do you have access to that data? 16. Any special environmental health related local stuff/ news that you can think of?
Role as a bridging organisation	17. What type of role have you been playing in the collaboration among the local stakeholders within health & environmental sectors? 18. What type of role would you like to play in the collaboration among the local stakeholders within health & environmental sectors? What prevents you from doing that? 19. What type of role do you foresee playing in the collaboration among the local stakeholders within health & environmental sectors? 20. What type of role do you foresee your BR playing in promoting health? 21. Do you have any questions?

Appendix 3: Case study research

This study was an embedded multiple case study (Yin 2009: 46-47) that collected data from four different biosphere reserves to tell one story of biosphere reserves as bridging organisations for health and sustainability. Biosphere reserves were selected as examples of bridging organisation because of their global network and universal mandate. However, the case study was limited in scope and explored only the health aspects of activities in the studied biosphere reserves. This research focused on health and sustainability integration and exploring the potential of biosphere reserves as bridging organisations for children's environmental health. The selected case study model was an embedded multiple case study, because two of the four biosphere reserves studied had explicitly integrated health into their activities and the other two of them had not. Because of the rural location and small size of each organisation, the findings were pooled into one shared story of biosphere reserves as bridging organisations for health and sustainability. This dissertation contains two separate components of the story:

1. The potential of biosphere reserves to function as bridging organisations that promote health;
2. The potential of biosphere reserves to help facilitate collective knowledge gathering and mobilisation for children's environmental health.



"Frontenac Arch Biosphere Reserve is "an effective facilitator for multi-stakeholder collaboration across the functions of conservation, sustainable development and education. Working through partnerships and brokering dialogue among disparate organizations, Frontenac Arch Biosphere Network has supported the development of eight distinct sub-networks that together make up a membership of over 80 partners for their *Biosphere Network*" (Pollock 2009: 315)

Overall case study: Biosphere reserves as bridging organisations bringing together diverse stakeholders for health and sustainable development (One pooled story to have a sufficient number of interviewees and to protect the privacy of rural participants)

Rationale: Biosphere reserves: A concept with universal, locally adapted mandate to function as 'learning laboratories' for sustainability

Selection criteria:

Country selection: Both countries have developed National children's environmental health frameworks around the same time: Canada 2010 & the UK 2009

Biosphere reserve selection: Two biosphere reserves in each country with explicit health focus and two without explicit focus

Embedded units of 4 case studies:

	Canada	**UK**
Explicit health activity	Frontenac Arch	North Devon
No explicit health activity	Georgian Bay	Dyfi

Field research: November 2012 - May 2013

Methods: Four sources of evidence (Yin 2009:102)

1. Semi-structured interviews (n=29 participants: UK n_1=8; UK n_2=6; Canada n_3=7; Canada n_4=8);
2. Documentation (websites, brochures, peer-reviewed articles, reports, etc.)
3. Participant observation
4. Direct observation

Validity Triangulation by (Patton 2002; Yin 2009):

1. Multiple data sources
2. Multiple methods
3. Participant validation

The case study biosphere reserves:

Canada	
Georgian Bay Biosphere Reserve	
Established	Designated 2004
Location	Northeastern Ontario
Website	www.gbbr.ca
Further information	Pollock, R. (2009).“The Role of UNESCO Biosphere Reserves in Governance for Sustainability: Cases from Canada”. Unpublished PhD Thesis, Trent University, Peterborough, ON
Frontenac Arch Biosphere Network (=Frontenac Arch Biosphere Reserve)	
Established	Designated in 2002 and expanded and renamed in 2007
Location	Southeastern Ontario
Website	www.frontenacarchbiosphere.ca
Further information	Pollock, R. (2009).“The Role of UNESCO Biosphere Reserves in Governance for Sustainability: Cases from Canada”. Unpublished PhD Thesis, Trent University, Peterborough, ON
UK	
Biosffer Dyfi Biosphere (=Dyfi Biosphere Reserve)	
Established	Designated in 1970s and expanded and renamed in 2009
Location	Western Wales
Website	www.biosfferdyfi.org.uk
Further information	Hebden, M. (2006). “Environmentality: UNESCO biosphere reserves, and the globalisation of environmental governance”. Unpublished Master’s Thesis, Aberystwyth University, Aberystwyth, Wales, UK
North Devon Biosphere Reserve	
Established	Designated in 1976 and expanded in 2002
Location	Southwestern England
Website	www.northdevonbiosphere.org.uk
Further information	Boychuk (2013). “Modeling Change: A Case Study Comparison of Biosphere Reserve Governance in Canada and the United Kingdom”. Unpublished Master’s Thesis, Royal Roads University, Victoria, BC

Appendix 4: Analytic induction

Analytic induction used in analysing the data in this research is one type of inductive analysis, which begins deductively by formulating a form of hypothesis (Patton 2002:94-95), which are based on "hunch, assumptions, careful examination of research and theory, or combinations" (Patton 2002:493). The original proposition is iteratively revised throughout the research process in search of generalisations.

The process used the following six steps to approach the data (As defined by Cressey 1950, cited in Robinson 1951):

Step	Action in each step
1	Tentatively defining the phenomena: "Formulate a rough definition of the phenomenon of interest" (Robson 2002: 322)
2	Developing hypothesis based on #1: "Put forward an initial hypothetical explanation of this phenomenon" (Robson 2002: 322)
3	Case 1 & 2 used to determine if the hypotheses are confirmed: "Study a situation in the light of this hypothesis, to determine whether or not the hypothesis fits" (Robson 2002: 322)
4	If hypothesis fails to be confirmed, phenomena will be redefined or hypothesis revised.
5	Case 3 & 4 will be examined based on redefined or revised condition in step #4 – some certainty about the hypothesis expected.
6	Hypothesis will be reformulated (based on "negative" cases/ new information) until some certainty that is valid in all cases is reached.

Below is a simplified example to illustrate how the process was adapted for this doctoral research. Because of the iterative nature of transdisciplinary research, the actual research process was much more extensive, consisting of multiple reflexive loops:

Step	Action in each step
1	***Tentatively defining the phenomena*** a) Health and sustainable development practices are 'siloed'; health and sustainability are viewed as separate entities despite academic literature and international policies about the linkages; b) Non-governmental bridging organizations have a role to play in bringing together health and sustainable development (environmental?) stakeholders; c) Children's environmental health demonstrates linkages between health and the environment, requiring sustainable development.

2	***Developing hypothesis based on #1:*** *The role of knowledge in the phenomena* a) Narratives we tell about health and sustainable development are siloed/ compartmentalized; we perceive health & sustainability as two separate issues; b) Understanding the overlapping aspects of mandates in different sectors improves cross-sectoral collaboration; c) Children's environmental health could be a concept that helps bridging health and sustainability related interests; children's environmental health creates a meaningful narrative for transdisciplinary collaboration in health & sustainable development.
3	***Case 1 & 2 used to determine if the hypotheses are confirmed*** a) FALSE: Individuals perceive health and sustainability either as heavily overlapping or inseparable; b) TRUE: Mandates are seen as limiting/ restricting factors re the actual integration of health & sustainability; there appears to be lack of understanding of one another's mandates; where knowledge and/or vision about the overlapping of mandates exists, the active bridging attempts take place c) MAYBE/ POTENTIAL: No-one had ever heard the term children's environmental health; perceptions of children's environmental health broader and/or different from the conventional scientific/ political understanding of children's environmental health (which has roots in environmental justice, pollution/ toxicology & neurodevelopmental/ chronic disease issues); clear lack of awareness/ limited scientific knowledge & understanding both about children's environmental health or local pollution issues & their possible consequences; practitioners felt that children's environmental health could be useful in engaging more people in their work. Some interesting local knowledge is available, e.g. i) flooding of fields/ local vegetable gardens and resulting lead & other heavy metal residues from old quarries/ released from the sediment (incl. academic research confirming the problem); and some mention of children's behavioural issues; ii) agricultural practices: a specific over-the-counter chemical (intended for other purposes), sheep drenching, and serious water pollution; iii) water management practices: excess wastewater made to bypass the sewage treatment facilities when too much rain *A raising question:* What type of knowledge (local or general) would be useful to help people understand the linkages relevant to identifying/ understanding possible children's environmental health issues and decision-makers to make informed decisions?
4	***If hypothesis fails to be confirmed, phenomena will be redefined or hypothesis revised*** a) Despite the current institutionalised separation between health and sustainability, individuals working with either sustainable development or health see the interconnectedness of the issues (which creates openness for potential cross-sectoral collaboration); b) Unchanged (see 2b above);

	c) CEH could be a concept that helps bridging health and sustainability related interests; CEH creates a meaningful narrative for transdisciplinary collaboration in health & sustainable development – a broader discussion around inter-linkages between children's health and environment is needed both to create awareness and to help people make meaning of the CEH issues & solutions in their own local/ organizational context.
5	**Case 3 & 4 were examined based on redefined or revised condition in step #4:** a) MOSTLY TRUE: Despite the current institutionalized separation between health and sustainability, individuals working with either sustainable development or health see the interconnectedness of the issues (which creates openness for potential cross-sectoral collaboration); i) Some practitioners have more narrow interpretation of what health entails than others; lots of focus on behavioural aspects, not as much on social determinants of health. b) MOSTLY TRUE: Understanding the overlapping aspects of mandates in different sectors will improve cross-sectoral collaboration; i) Practitioners have surprisingly little knowledge about one another's mandates, even those who collaborate; ii) Individuals (community champions) function as drivers for the collective process, but the most successful ones are good at mobilising and connecting others (Emphasis on listening of people's interests & needs). c) WRONG STARTING POINT: Children's environmental health could be a concept that helps bridging health and sustainability related interests; children's environmental health creates a meaningful narrative for transdisciplinary collaboration in health & sustainable development – a broader discussion around inter-linkages between children's health and environment is needed both to create awareness and to help people make meaning of the children's environmental health issues & solutions in their own local/ organizational context. i) Practitioners have an intuitive, holistic approach to children's environmental health and as a collective cover the important aspects relevant to children's environmental health and add new perspectives to the knowledge, but there is very limited understanding re the extensiveness of the issues; some expert knowledge is needed to make sense of all this available local knowledge and some form of bridging is needed to bring all this knowledge together; ii) The local data relevant to make meaningful decisions concerning children's environmental health is not available; iii) All in all there is plenty of information available in each biosphere reserve but it needs to be brought together.
6	**Hypothesis will be reformulated (based on "negative" cases/ new information) until some certainty that is valid in all cases is reached.** a) Despite the current institutionalized separation between health and sustainability, individuals working with either sustainable development or health see the interconnectedness of the issues (which creates openness for potential cross-sectoral collaboration); differences in perceptions offer diversity that could be beneficial for a more holistic approach if a shared understanding was created through a dialogue.

	b) Understanding the overlapping aspects of mandates in different sectors will improve cross-sectoral collaboration but practitioners are often unaware of one another's mandates, even when they collaborate on projects; mandates are seen as limiting/ restricting factors re the actual integration of health & sustainability in practice; where knowledge and/or vision about the overlapping of mandates exists, the active bridging attempts take place; often the process is initiated by visionary individuals who lead from 'behind'*[21] (community champions), which usually are individuals who have the ability to hear people and connect those with shared interests. c) The knowledge concerning children's environmental health is extensive but it is so fragmented among lay people and experts that it needs to be bridged together; the studied biosphere reserves have the right mandate, appropriate approach, and sufficient amount of knowledge to function as bridging organisations, if they are made aware of the issue; bridging of children's environmental health knowledge is needed at the local level, because the information and awareness are currently not available in a meaningful format.

[21]These 'community champions' do not have big egos but have a strong sense of the collective and see importance of bringing people together; do not see themselves as leaders but they empower other people to empower the community.

Appendix 5: Other methods

Due to the nature of a hybrid thesis, all methods used are not discussed in detail in the text. Appendix 5 offers further clarification of various steps used in this research project.

Steps used in literature review (Randolph 2009)

Step 1: Create an audit trail: evidence that supports each finding was documented, i.e., where that evidence can be found, and how that evidence was interpreted.

Step 2. Define the focus of the review: it was determined what to include in the review and what to leave out.

Step 3: Search for relevant literature: in addition to academic papers, relevant grey literature (such as memos, newspaper articles, or meeting minutes if relevant) were identified and included.

Step 4: Classify the documents: Sort according to the types of data the documents represent.

Step 5: Create summary databases: Coding schemes and summaries and notes of the relevant documents were created. Starting point in this study: prerequisites for health (WHO 1986) and sustainability assessment criteria (Gibson et al. 2005).

Step 6: Identify constructs and hypothesized causal linkages: The essential themes of the documents were identified and hypotheses about the relationships between the themes were created.

Step 7: Search for contrary findings and rival interpretations: Contrary findings and rival interpretations were actively searched to assess the strength of the hypotheses.

Step 8: Use colleagues or informants to corroborate findings. The framework and drafts of the report were shared with colleagues and informants, requesting that they critically analyze the review.

Participant observation (Spradley 1980:100-111)

The participant observation took place openly (in an overt manner with moderate participation) when visiting biosphere reserves and participating in their activities. The primary approach was focused observation identifying matters relevant to the integration of health and sustainable development (See Appendix 1 for selection details). The observations were documented and used to complement and assess the analyses of other findings.

Interview transcript analysis

Coding and classifying was thematic and based on the sensitizing concepts (Appendix 1), the ecohealth framework (Chapter 4), and emerging themes as described by Patton (2002:462-482). The approach was primarily theory-based but remained open for unexpected themes (e.g. alternative interpretations of children's environmental health). Coded segments were collected in tables under each research question and further analysed and regrouped. Because of the small number of samples, the analysis was done manually, using analytic induction as the general approach to analyses in Chapter 5 and 6.

For instance, for the research question "what type of BARRIERS to integrating health into their programming can be identified?', the following 15 key themes were identified in the first round, which then were further grouped to main themes discussed in Chapter 5:

1. Competing priorities
2. Not explicit
3. Not recognised as health promotion
4. Not integrated in planning
5. Opportunity-based, reactive/ *ad hoc* planning
6. Limited capacity & funding
7. Too abstract concepts/ ambiguity
8. Mandate issues
9. Lack of awareness
10. Powerful individuals blocking action
11. Culture clash
12. Administrative structure barriers
13. Politics
14. Different approach/ values
15. Funding/ manpower issues

Appendix 6: Exploring collective knowledge related to children's environmental health

This transdisciplinary doctoral research explored bridging of different types of collective knowledge to enhance cross-sectoral bridging for health and sustainability in practice (an integrated approach to health and sustainable development).

To be able to assess capabilities of a bridging organisation, the research needed to examine what type of knowledge (information and skills) is needed to assess a 'wicked problem' in practice and, furthermore, how to gain such information. The following tables illustrate knowledge investigated (gathered and analysed) for the research discussed in Chapter 6, which includes different types of general, widely-applicable, theoretic academic knowledge (*epistemé*), context-specific, applied, local knowledge of practitioners (*techné*), and local lay knowledge combined with both *epistemé* and *techné* (*phronesis*).

The data gathering was extensive and the diversity of the data made the categorisation and public presentation of the results challenging, which is characteristics to both wicked problems and transdisciplinary research. The following tables attempt to illustrate the ways in which data was gathered, validated, and categorised. Because of the large quantity of the collected data, the tables contain only examples of the kind of data that was explored.

Table A6-1: Generally applicable theoretical knowledge: Collected primarily by academic literature searches and discussions with academic experts in respective fields.*

Knowledge type	Examples of knowledge	Rationale
Epistemé		
Natural scientific (health)	• Human health effects of developmental exposure to chemicals in our environment (Grandjean et al. 2008); • Role of nutrition and environmental endocrine disrupting chemicals during the perinatal period on the aetiology of obesity (Heindel, and vom Saal 2009); • Environmental factors associated with a spectrum of neurodevelopmental deficits (Mendola, et al. 2002); • Epigenetics and environmental chemicals (Baccarelli and Bollati 2009). • Developmental origins of non-communicable disease: Implications for research and public health (Barouki et al. 2012).	Broadly applicable (Aristotelian 'universal') understanding of the latest scientific knowledge is needed • to assess possible causalities; • to identify useful indicators; • to assess the relevance of observations; • to analyse the results. This knowledge can contain uncertainties, which may require precautionary approaches. These aspects need to be taken into account when assessing validity.

Natural scientific (ecosystem)	• Adverse effects on sexual development in rat offspring after low dose exposure to a mixture of endocrine disrupting pesticides (Hass et al. 2012); • Endocrine disrupting compounds in waterways (Schwarzenbach et al. 2006; 2010); • Feminization of fish (Tyler and Jobling 2008) • Pesticide mixtures causing compromised immune system (Hayes 2006).	(Valid for knowledge both categories)
Natural scientific (transdisciplinary)	• Developmental effects of endocrine-disrupting chemicals in wildlife and humans (Colborn et al. 1993; 1997); • Scientific and policy statements on environmental agents associated with neurodevelopmental disorders (Gilbert et al. 2010).	Explicit transdisciplinary understanding helps to facilitate cross-sectoral collaborations.
Social sciences (health promotion)	• Prerequisites to health/ Social determinants of health (WHO 1986); • 5 categories of health promotion theories: individual level behavioural change; change in communities and communal action for health; communication strategies for change; organizational change; and the development and implementation of healthy public policy (Nutbeam and Harris (2004); • Theory informed intervention (Bartholomew et al. 2006).	Broadly applicable understanding of the latest social scientific knowledge is needed • to understand the complex aspects of the social influences; • to help steer the social sphere in a collectively desirable direction.
Social sciences (sustainability governance)	• Sustainability assessment criteria (Gibson et al. 2005); • Adaptive governing approaches (Armitage et al. 2007); • Polycentric governance of complex systems (Ostrom 2010).	
Social scientific (transdisciplinary)	The conceptual adapted ecohealth framework introduced in Chapter 4.	Explicit transdisciplinary understanding helps to facilitate cross-sectoral collaborations.

Table A6-2: Context-specific local knowledge: Collected by interviews, observation, document analysis and literature search. Findings were validated by method and data triangulation as well as participant validation. (Only a limited number of specific results and respective validations were selected for public presentation, in order not to compromise participant anonymity).

Knowledge type	Examples of knowledge	Rationale
Techné		
Local monitoring of natural scientific data (health statistics)	• Public health in all four case studies assesses nationally collected data at the regional scale to identify areas of concern (Participants and online data, e.g. http://tinyurl.com/publichealthdata and http://tinyurl.com/publichealthdataUK); • No national data on autism (Ouellette-Kuntz et al. 2014; http://tinyurl.com/autismUK); • Approx. 3.2% of Canadian children have a learning disability (Statistics Canada 2006) – the school district, in which the biosphere reserve with observed high rates of learning disabilities is located (Interviews), 10.5% of the students have been diagnosed with learning disabilities[xxii]; 50% of the students in local schools require some form of special education (Fraser Institute 2013); • Community level data not centrally collected (Some desirable data is not monitored).	All three types of local knowledge are needed to assess the local situation, to develop the local collective knowledge and locally meaningful solutions.
Local natural scientific monitoring (ecosystem statistics)	• Quality of surface water is monitored by the Ontario Ministry of Environment (MOE – www.ene.gov.on.ca[xxiii] accessed Jul. 6, 2013): o Monitored compounds usually phosphorus, chloride, nitrates and suspended solids; o In BR1 region 7 rivers were monitored over various periods of time 1973-2005, where after monitoring ceased; o In BR2 region 6 rivers have been monitored over various periods of time 1966-present; • In Ontario selected species of fish are monitored in some selected lakes for various pollutants (usually mercury) - www.ontario.ca/environment-and-energy/eating-ontario-sport-fish	

[xxii] Near North District School Board reports 1107 students with learning disability (www.ldao.ca/wp-content/uploads/Sudbury_March_2012.pdf) and a student population of approximately 10,500 students (https://www.nearnorthschools.ca/schools/)

[xxiii] www.ene.gov.on.ca/environment/en/mapping/provincial_stream/index.htm

	• Government-university collaboration to monitor the environment in BR3 (http://preview.tinyurl.com/DyfiWater*); • According to a government website in BR4, drinking water "monitoring is carried out relatively infrequently, particularly for the smaller supplies, and hence quality is unknown for most of the time and because private supplies are often of very variable quality, particularly following heavy rainfall, monitoring does not always identify failures." (http://tinyurl.com/WaterND*)	
Local social system understanding	• "Within the geographical area of the BR, there are probably four or five significant linguistic groups" (Participant) – a relevant but often ignored fact; • "That's going to turn people off, you're going to make more enemies than friends – it's [important] to know what is going on." (Participant) – aspect mentioned by multiple participants; • "I know that a lot of locals were concerned about that expansion of the landfill, because of course that goes down into Mill Lake and right into town, where the water tower is and everything" (Participant) - http://tinyurl.com/landfillconcerns*; • "There are some big health issues here around rural isolation. The suicide rate in the farming community is extremely high." (Participant) – referred to by multiple participants.	
Local transdisciplinary skills	• Biosphere reserves as bridging organisations (Chapter 5)	Explicit transdisciplinary understanding helps to facilitate cross-sectoral collaborations
Phronesis		
Transdisciplinary co-created collective knowledge (Community scale)	• Collective shared understanding of local children's environmental health status does not exist for the time being (See Chapters 6 and 7 for proposed action).	Collective understanding: • to assess the local situation (needs and assets) • to identify hotspots • to develop healthy sustainable solutions • to evaluate and improve the process • to develop healthy, sustainable policies

*http://tinyurl.com was used for the longer website addresses to safe space

The last table provides an example of the analyses of interview results that took place in the early phases of data analysis (simple sorting of the data). The process involved multiple layers of data analysis and circular process, which is characteristic to analytic induction, to reach the final conclusions presented in this dissertation.

Table A6-3: Possible concerns relevant to children's environmental health (CEH) in respective communities identified by participants; semi-structured interviews – questions not specific to CEH but possible local environmental health concerns

Type of concern	Specific issue	Associated tags
Flooding caused pollution	Heavy metals, e.g. lead, silver, etc. from old mines and tailing ponds	Water, history, industry (mining), livelihoods
Flooding caused pollution: bypassing of water treatment system to prevent overflow	Toxic compounds, disease vectors, & other contaminants	Water, industry (incl. agroindustry), livelihoods, urban planning, infrastructure
Flooding caused health hazards	Mould	Water, infrastructure, housing
Agricultural pollution & runoffs	Pesticides, fertilisers, manure & chemicals used in husbandry, such as sheep drenching	Water, agroindustry, livelihoods
Smog & poor air quality	Chemical contaminants	Industry, livelihoods, urban planning, infrastructure, transportation
Beach closures	Faecal coliforms	Water, industry (agriculture), infrastructure (waste management)
Lack of information re any possible land or water contamination by former & existing industry	Chemical pollution in the water	Water, industry (mining, chemical industry & other), livelihoods, social environment
High cancer rates of unrelated cancers/ paediatric and youth	Assumed causes include inadequately managed waste disposal sites & former chemical industry (dyes and explosives)	Health outcome
High rates of learning disabilities/ overweight and obesity	Association with possible environmental factors, incl. pollution & lack of access to environments that facilitate physical activity	Health outcome
Train derailments	Major chemical pollution	Water, industry, livelihoods, urban planning, infrastructure, transportation
Septic tanks	Chemical and bacterial runoff from inadequate septic tanks	Water, housing, infrastructure,
Nuclear accident	Nuclear submarines in the close vicinity of residential areas	Water, air, industry, transportation
Uranium mining	Mercury and other heavy metals in drinking water as a result of old mining practices	Water, history, industry (mining), livelihoods
Excess of salt in drinking water	Road salts (for winter road safety) detected in well waters	Water, pollution, infrastructure, transportation

Tourism industry/ property development at the shoreline	Threat to coastal ecosystems & water quality	Water, industry (tourism, construction, etc.), livelihoods, housing, urban planning, infrastructure
Variations in flora & fauna	Pollution & climate change was assumed to play a role in the changes	Water, air, industry, livelihoods, urban planning, infrastructure
Fluoride added to drinking water (lack of it)	Children's oral health	Water, health intervention
Large number of ticks	Lyme disease	Disease vector
Light pollution	Threat to well-being (?)	Urban planning, infrastructure
Invasive species (incl. pest management by RoundUp)	Primary issue: invasive species threatening the native species & ecosystem services; secondary issue: glycophosphate	Water, forestry, industry, livelihoods
Isolation of farms	Mental health problems and suicides	Social environment
Isolation of newcomers & aging population/ lack of employment opportunities	Mental health problems, suicides, substance misuse, etc.	Social environment
Nature Deficit Disorder	No access to nature (developmental/ mental health issues), ADHD	Social environment
Large scale vs. small scale windfarms	Windmills caused ill-being	Industry, livelihoods, housing
Road safety	Traffic accidents	Injuries, urban planning, infrastructure
Farming accidents	Occupational health hazards	Injuries

These examples illustrate the types of information collected and how the data were analysed for Chapter 3.

This research explored the potential of biosphere reserves as bridging organisations to help mobilise local knowledge for children's environmental health. The interview questions, data analysis, and observations aim to reveal whether the perceptions and understanding of issues relevant to children's environmental health, found within the biosphere reserves, were sufficient for facilitating a local dialogue around these issues. The validation of findings assessed the credibility of the information as 'a possible reason for concern in the local context'. It tried to identify issues that a larger portion of the local population was concerned about and not focus on the perceptions of one single individual (See Table A6-3 for examples of concerns identified by participants). In addition, the validation process explored additional information concerning the issues in question. The exercise was not to validate facts about local children's environmental health but to find examples of local issues that may be associated with children's environmental health.