Ecosystem Approaches to Health for a Global Sustainability Agenda

Running title: Ecohealth for Global Sustainability

In January 2012, a Lancet editorial predicts a major move "away from development and towards sustainability" in health research (Anonymous 2012). It raises concerns about possibly diminishing marginal returns on recent gains from large investment programs targeting disease and malnutrition. Major gains have been achieved by recent high-investment health programs focused on targeted treatments or interventions (e.g. anti-retroviral therapy for HIV-positive patients, preventative chemotherapy to control helminthiases, insecticide-treated bed-nets for malaria control, and protein supplements for malnutrition). These programs are important but not sufficient for achieving and sustaining global health. Too great a focus on end-of-pipe strategies like treatment or prevention of contact with vectors can lead to missed opportunities to modify up-stream risk factors or to synergize investments in health with investments in development – agriculture, urban development, or industry.

The Lancet editorial argues that sustainability (rather than development) should be the central argument for future global health and prosperity - that economic development without heed to ecological and social sustainability is insufficient to achieve global health. Health and well-being depend on favorable environmental and social conditions, which in turn are derived from complex and dynamic inter-relationships between societies, economies and ecosystems. Development activities are a strong driver of these inter-relationships, with both positive and negative health implications. Ecosystem approaches to health, part of the field of ecohealth, employ a systems perspective to understand how social, economic, and ecological dynamics affect health. To do this, researchers from different disciplines collaborate with communities and other stakeholders to address trade-offs, test strategies and generate evidence to inform policies for improving health, environment, and livelihoods in ways that are locally sustainable and equitable. This kind of research is particularly suited to address persistent, sometimes

controversial, multi-factorial health problems, and that require interventions on multiple fronts: livelihoods, environmental degradation, social and cultural norms, and policies. It may succeed where more conventional strategies have failed, but it is also heavy in terms of transactions, investment in community participation and commitment to a change agenda. Because of this, it is not necessary to employ ecosystem approaches to address straightforward public health problems that will respond to more conventional methods (Waltner-Toews 2004).

Ecohealth research integrates different disciplines and world-views to tackle difficult health issues. Waage et al. (2010) argue that much more could have been achieved had the Millennium Development Goals (MDG) been better integrated across sectors and better anchored in the local context; indeed, they propose that any future development goals be based on principles of holism, equity, sustainability, ownership, and global obligation. These principles are closely aligned with those of an ecosystem approach to health. Beyond responding to the Lancet's call for greater integration of disciplines and approaches for sustainability, equity and health, the field of ecohealth provides a forum for validating ideas and new knowledge, and for vigorous debate by academic peers, decision makers, and affected communities.

The foundational theory and methodologies for ecosystem approaches to health, their early history and heritage in public health are covered in several publications (Forget and Lebel 2001; Parkes et al. 2003, 2005; Wilcox and Kueffer 2008; Bunch et al. 2008; Charron 2012). In essence, health and well-being are considered in the context of dynamic interactions between society, economies and ecosystems. The concepts emerged from the marriage of participatory action-research common in development research and conventional environmental health research in the mid-1990s (Forget and Lebel 2001). The consideration of health or illness as more than just the result of the (cumulative) effects of social or environmental determinants was a cornerstone of the approach, together with contemporary thinking

in public health (WHO 1986), sustainable development (Brundtland 1987); and, Latin American social medicine (Waitzkin et al. 2001; Iriart et al. 2002). Although Canada's International Development Research Centre (IDRC), a development research donor, contributed to the original ideas and has promoted similar approaches for more than 15 years (Webb, et al. 2010; Charron 2012), the field benefits from a wide and growing range of influences, including those promoted by the editorial position of this journal (Parkes 2011).

This article draws on a recent volume from IDRC (Charron 2012) that sought to update the concepts of ecosystem approaches to health, and assess its main contributions, using illustrative examples from the literature, including those summarized below. A long-standing ecohealth project explored mercury contamination in the Tapajos river basin in Brazil, a problem originally attributed to gold mining upstream. Initial findings were not compatible with point-source contamination upstream. Exploring the problem from all angles, the research found that mercury was leaching from deforested soils, affecting a much larger area than the potential mining exposure (Roulet et al. 1999). Downstream populations had been exposed to substantial levels of mercury that varied seasonally (Lebel et al. 1997; Dolbec et al. 2001) and people experienced substantial neurological deficits at low-level exposure (Lebel et al. 1998; Dolbec et al. 2000). Consumption of fruit and nuts rich in selenium helped offset the toxic effects of mercury (Passos et al. 2007; Lemire et al. 2010). Using a participatory framework, recommendations were developed that allowed continued consumption of fish, while limiting consumption of heavily contaminated species (Mertens et al. 2012). Guimarães and Mergler (2012) weave together the findings of this long-standing research, highlighting the contributions of an ecosystem approach.

New strategies for controlling Chagas disease in rural Guatemala were developed with ecohealth research. Several species of insects transmit the disease and are adapted to living in walls of adobe brick

houses, feeding nocturnally on people and domestic animals. Annual fumigation of houses using residual insecticide has successfully controlled some vectors, but in Central America, several species have endemic sylvatic reservoirs from which they can rapidly re-infest dwellings. The research on environmental risk factors identified housing as the most important modifiable driver of infestation (Bustamante et al. 2009). A participatory process led to the development of a cost-effective, long-lasting defense to reinfestation. The key was a new recipe for wall plaster made of local materials that, when applied using traditional methods, seals the adobe walls inside and out, thus destroying vector habitat for at least 5 years (Monroy et al. 2009). Combined with health promotion, youth mobilization and education, and improved environmental hygiene, the strategy successfully eliminated the vector from project households.

Another example lies in the study of the high prevalence of echinococcosis (a cystic parasitic disease) among people living and working in the butcher slums of Kathmandu (Waltner-Toews et al. 2003). The research evolved from a focus on disease control to an urban ecosystem approach. It identified root causes in poor slaughtering practices and household hygiene associated with exclusion (low social class, lack of land tenure or legal status), lack of education or access to infrastructure (Waltner-Toews et al. 2005; Neudoerffer et al. 2005). The community, empowered with new knowledge and political voice, changed their environment and their livelihood practices. The researchers brought the success stories to the decision makers, engaging them in the development of new policies to promote new meat hygiene legislation (Joshi et al. 2012).

The first presentations of an ecosystem approach to health stressed transdisciplinarity, stakeholder participation in research, and social and gender equity – referred to as "the three pillars" (Forget and Lebel 2001). In practice, applications of this thinking also addressed sustainable development,

responsibility for environmental stewardship, and complexity. Most research using ecosystem approaches to health were oriented toward implementation of a social change agenda. Although disseminated as a single approach based on "three pillars", a review of applications reveals a plurality of ecosystem approaches to health. Augmenting the pillars, six principles are proposed to inform research implementation and help define expected outcomes. Principles do not replace good methodology. They help conceptually frame an effective process of inquiry to generate and apply new knowledge to problems arising from complex interactions of societies and ecosystems.

Principle 1: Systems Thinking

Health problems rooted in poverty, social inequity and degraded ecosystems are entrenched and difficult to address because so many different factors and influences are at play at different scales. Systems thinking exposes patterns and linkages important to understanding this kind of problem. Concepts such as coupled social-ecological systems (Berkes and Folke 1998) help connect the already complex social and economic dimensions of health with the ecosystems that underpin human wellbeing. Ecohealth draws on these concepts, using both natural and social sciences methodologies for assessing system behaviors. By using systems thinking, researchers understand the dynamics and boundaries of a problem from several perspectives, over different scales. Systems thinking and related theoretical background of ecosystem approaches are treated in greater depth in Waltner-Toews and colleagues (2008). Systems thinking and participatory methods were used effectively in the Kathmandu butchers' slum project to develop diagrams and pictures of the relationships between stakeholders, their ecosystem, and determinants of health (Waltner-Toews et al. 2003, 2005; Neurdoerffer et al. 2005). With input from the community, echinococcosis was situated in the context of other concerns and perceived needs, and action plans that addressed the disease and its root causes were eventually implemented by the community (Neurdoerffer et al. 2005, 2008). This well-documented example is particularly useful for learning to apply systems thinking in field research. .Systems thinking is

increasingly being applied in managing various situations. The WHO's publication on systems thinking (De Savigny and Adam 2009) is a practical resource, with concise theoretical background and ample examples in the health sector. Williams and Hummelbrunner's (2010) toolkit provides concepts and methodologies for applying systems thinking to in complex and dynamic situations.

Principle 2 : Transdisciplinary Research

The application of an ecosystem approach to health hinges on achieving a strong level of transdisciplinarity. An evolving concept, transdisciplinarity in health research has been defined as the integration of academic disciplines through use of a common conceptual framework and a merging of concepts and theories to address a problem (Rosenfield 1992). But transdisciplinary ecohealth research goes even further to integrate methodologies from different academic disciplines with non-academic perspectives (Parkes et al. 2012, 2005; Wilcox and Kueffer 2008). It facilitates stakeholder participation in the development of new information, strategies, and action (Bopp and Bopp 2004; Pohl and Hirsch Hadorn 2008). Transdisciplinarity takes time to build; it requires consensus-building, negotiation, facilitation, and strategic planning skills. Ecohealth researchers have used social analysis systems (Chevalier and Buckles 2008) and outcome mapping (Earl et al. 2001) to engage stakeholders, identify the changes sought, and facilitate transdisciplinarity.

Principle 3: Participation

Stakeholder participation in research helps generate new knowledge and enhances the likelihood of uptake and ownership of that knowledge. Participation leads to locally rooted innovation (STEPS Centre 2010) and to cooperation, collaboration, and eventually, to breakthroughs in resolving long-standing differences that impede progress (Parkes et al. 2012). Stakeholder participation helps identify barriers to change, clarify information and knowledge gaps, and provide means to negotiate concrete steps for moving forward. The literature cited earlier makes for good case studies in part because it contains

published stakeholder analyses (Neudoerffer et al. 2005; Monroy et al. 2009; Mertens et al. 2012). Participatory research presents constraints, including differing or conflicting stakeholder interests, intentions, and expectations of different actors (including researchers). The iterative nature of ecohealth research helps address these issues, but high numbers of transactions and relatively high uncertainty at the outset mean that the process takes time. Ecosystem approaches to health have frequently involved some variation on participatory action research methods (e.g. MacIntyre 2008); but they are not always suited or feasible to the scale of the problem under study. Stakeholder participation in research occurs along a wide spectrum, from minimal involvement, through to regular consultation and advice, and to full integration into the research team.

Principle 4: Sustainability

Ecological and social sustainability underpin the field of ecohealth and are evident in foundational and more recent conceptual papers on ecosystem approaches to health (Forget and Lebel 2001; Soskolne et al. 2007; Waltner-Toews et al. 2008; Boischio et al. 2009; Parkes and Horwitz 2009; Butler and Weinstein 2011), and discussed in papers on ecosystem health (e.g. Rapport 2007). Ecohealth research contributes to more environmentally sustainable approaches to problems by addressing environmental degradation as a contributor to poor health (in Kathmandu's butcher slums, for example) or by promoting health strategies that rely less on insecticides (wall plastering to prevent Chagas disease transmission). Drawing on his own and other ecohealth research on Chagas disease, Gürtler (2009) explores both environmental and social sustainability dimensions of a new strategy for controlling Chagas disease in the Gran Chaco in remote northern Argentina, where people live in socially marginalized, impoverished conditions with inadequate infrastructure and services. He argues that the disease is better controlled through a sustainable development strategy that addresses many of the drivers at once (poverty, poor housing, inadequate health care) rather than by the health sector alone.

In parts of the Amazon basin, mercury contamination of fish is attributable to deforestation. In addition

to providing indisputable evidence of the cause of mercury contamination, ecohealth research has developed more environmentally sustainable land-use strategies for local farmers, not only reducing exposure to mercury, but allowing for longer-term farming and reducing pressure on the remaining forest (Guimarães and Mergler 2012). Such comprehensive studies linking health and sustainability are uncommon, however, pointing to the need for still greater integration of ecological and other sustainability dimensions in applications of ecosystem approaches to health.

Principle 5: Gender and Social Equity

Ecohealth research explicitly addresses unequal and unfair conditions impinging on the health and wellbeing of women and other disadvantaged groups. Research for health cannot ignore the differences between members of different social, economic, class, age, or gender groups in all societies. These differences are reflected in their relationships with ecosystems, their exposure to different health risks, their health status, and their well-being. Understanding differences in gender roles and power structures may be crucial to discovering new levers for implementing change. Monroy et al. (2009) drew on the traditional female homemaker role to design a housing improvement strategy for controlling Chagas disease. The plaster formula used to prevent vector infestation had to be suitable for manual application, as women were traditionally responsible for keeping up the appearance of the house. A new flooring method was developed with men, who are responsible for structural aspects of the home. Mertens et al. (2005, 2012) analyzed participation and equity in their research on mercury intoxication among fishing communities in the Brazilian Amazon. They showed how health promotion campaigns needed to take into account that men and women discuss health issues preferentially with individuals of the same gender, limiting transfer of information between genders. Equity-oriented research documents social and gender differences in causal pathways, outcomes and actions; it also strives to reduce inequities. Inequities are often deeply rooted in multi-faceted economic and cultural patterns

that stubbornly resist change. Methodologies and tools for gender and social analysis suitable to transdisciplinary health research are few (WHO 2002; Saint-Charles et al. 2012).

Principle 6: Knowledge-to-Action

Ecosystem approaches to health inform an action-oriented research endeavor where knowledge gains are applied in some way to improve health and well-being, and to promote equity and sustainability. These interventions or actions in turn generate additional knowledge about the problem, leading to further changes and actions. The examples in the Amazon, Kathmandu and Central America are illustrative of a series of research-action cycles, typical of an ecosystem approach to health. Actionresearch for development engenders tension between scientific endeavor and action to address a problematic situation. Local participants expect and often demand such action. Researchers have a responsibility to be aware of this tension, and to document both pre-existing conditions and changes wrought by the research process (not just the results of planned interventions). An action-research agenda need not compromise high quality research contributions – the dozens of publications emanating from the Amazon mercury study are one strong example of this. But even the strongest ecohealth research teams struggle to publish the social benefits, political gains, and other outcomes important to achieving lasting change. Outcomes, in this sense, refer to changes in behaviour, relationships, and activities that arise from the process of a research project, interactions between the research team and stakeholders or beneficiaries or through deliberate actions and interventions as part of the research. Outcome mapping (Earl et al. 2001) has been promoted by IDRC and others for capturing these kinds of results, but there are few examples in the refereed literature (Nyangaga et al. 2012). Researchers used a post-hoc outcome mapping of their ecohealth project in the slums of Chennai, India (Bunch and Morley 2009). The project was interrupted by the devastation of the tsunami in 2004. It helped them identify the contribution of their project on building community leadership and

organization (and therefore enhanced political voice and empowerment); improving health and hygiene through lasting behavior changes by individuals and at the community level. Bennett and Jessani (2011) have summarized current practical thinking on knowledge translation in their toolkit to help academics understand how to extend the reach of their research. Ecohealth can also draw on implementation sciences, knowledge translation and related concepts in health research (Straus et al. 2011).

Putting Ecohealth Principles into Practice

Several frameworks have been used in ecohealth research. Parkes et al. (2010) analyze several of these, including the Prism framework for watersheds and the Millennium Ecosystem Assessment. Waltner-Toews et al (2004, 2005) propose a guide to an iterative process to study interlinked social and ecological dynamics in their adaptive methodologies for ecosystem sustainability and health (and apply it post-hoc to the Kathmandu example in Neudoerffer et al. 2008). An ecosystem approach to health is not a recipe or a methodology. Informed by this approach, researchers then develop or adapt frameworks and methodologies that are appropriate to the problem and the perspectives at hand. That being said, some common themes were extracted from a scan of the literature and available case material (Charron 2012). Taken together, these themes can be linked into a prototypical process for research using an ecosystem approach to health. Such research usually follows an emergent design. That is, the initial research questions and methods proposed to address them are likely to change based on preliminary results or unforeseen conditions in the field. This kind of ecohealth research operates in iterative cycles of knowledge generation, action, and validation or re-assessment (figure 1). Research can be initiated at any point in a cycle of four overlapping phases: participatory research design; knowledge development; intervention strategy development and testing; and systematization of knowledge.

During the design phase, the research team identifies and recruits stakeholders and defines research questions and methodologies. For example, in the Guatemala Chagas project, a small group of researchers joined the vector control staff to visit remote villages in Jutiapa. Their discussions with the communities helped to frame the project in a community development approach, in order to address local priorities as well as identify the best opportunities to control Chagas disease. Exploratory research helps describe and understand the system context. Then, with some consensus around what the research is about, knowledge development begins in earnest. In Guatemala, analysis of survey and disease vector data in several villages indicated that poor quality housing was most strongly associated with the presence of vectors. Research collaboration with the community helped identify factors that motivate people to improve the construction of their homes; exposed the gender differences in responsibilities for house upkeep; and identified local materials and resources. Architects and engineers then collaborated with the community to develop a strong, inexpensive and long-lasting plaster made mostly from locally available materials, that could be applied by hand in the traditional way, as preferred by the community.

The intervention phase is a period of activities targeted at making a change. Intervention ideally occurs within an evaluative framework so that its effectiveness can be gauged and offer lessons for researchers and end-users. In Guatemala, some homeowners were recruited to test the new plaster formula (several versions were trialed), in combination with improved environmental hygiene, different animal housing, and other health promotion activities, for controlling the Chagas vector. The effectiveness of these intervention packages was evaluated by the researchers, but community endorsement was crucial to its uptake by others. In this case, systematization also occurred. Through regular interactions with the project, health ministry staff were aware of the success and, impressed by community uptake, adopted the intervention package as part of a national Chagas strategy. The Pan-American Health Organization is working with the research team to explore how to implement a similar strategy (Chagas control with

housing improvements as part of a community development approach) throughout Central America. When new policies and programs are implemented based on research evidence, systematization is successful. But it does not always occur quickly. Often, it takes a long time and persistence by advocates for new knowledge and new ways of doing things to have an impact on large populations or on ecosystems.

Benefits of an Ecosystem Approach to Health

Innovation is a hallmark of research conducted with an ecosystem approach to health. Innovation (new ways of doing things) encompasses new ideas, institutions and practices that affect how science and technology are developed and how results are applied (STEPS Centre 2010). Innovations resulting from ecohealth research include the application of new methods, ideas, and technologies. Guatemalan homes were improved using a formula for long-lasting wall plaster developed thus preventing Chagas disease vector infestations (Monroy et al. 2009). In Yaoundé, Cameroon, an inexpensive and hygienic water-storage container was developed and distributed to reducing childhood water-borne diseases (Ngnikam and Tanawa 2011). The process of developing these technologies in tandem with community development, and the engagement of policymakers in their uptake for wider use were also innovative.

An ecosystem approach to health led to the innovative application of existing technology. Improved legume crops were used to enhance soil fertility and nutrition in an ecologically sound manner in Malawi (Bezner-Kerr et al. 2011) ; in Kathmandu, community-led ideas resulted in the design, construction, and operation of small, local and hygienic abattoirs (Joshi et al. 2012) reducing the spread of echinococcosis and other foodborne disease, and improving environmental conditions. In the Amazon, social innovations led to changes in diet that reduced problems related to mercury exposure (Mertens et al. 2012).

Collaborative participation and engagement of community and other stakeholders in ecohealth research helps organize and empower communities to take action. Greater social cohesion and representation, better equity among groups, and the ability to draw political attention and investment can be attributed to sound scientific evidence and its effective communication to decision makers. In the Kathmandu example, political organization of previously marginalized groups and formalization of different sectors (sweepers, slaughterers, and butchers) were achieved through an ecohealth research process (Joshi et al. 2012).

Ecohealth research has provided evidence for informed decision making, leading to more effective policies. New policies governing butchering in Nepal were developed based on ecohealth research evidence and advocacy by researchers (Joshi et al. 2012). In Ecuador, the use of highly toxic pesticides and their importation into the country were banned based on demonstration of widespread ill-effects and cost-effective alternatives with research using an ecosystem approach to health (Cole et al. 2011). In Cuba (Diaz et al. 2009; Bonet et al. 2007) and Uruguay (Basso 2010), the public health sector collaborated with other sectors in developing community based dengue control strategies and early warning systems. The action-orientation and transdisciplinarity of ecohealth research enhance and promote engagement with policy-making processes on multiple political levels (Koné et al. 2011).

Policy environments do not always favor uptake of research results. Ecohealth research supports other forms of systematization, like word-of-mouth, private sector leadership, or socialization of knowledge through cultural, religious and non-governmental organizations (NGO). In Malawi, uptake of legume crops and dietary changes are being transmitted from farmer to farmer with NGO support, despite a countervailing policy environment (Snapp et al. 2010). Ecohealth research results— being participatory in design and execution —tend to be site-specific. This can pose a barrier to systematization of results. While not always replicable, knowledge gained from participatory research can be transferred to other contexts or applied on a wider scale; based on appropriate evidence.

Where Ecohealth Can Do Better:

Considerations of ecosystems (their quality, their functioning, and their implications for health and livelihoods) are not always explicit in research conducted under the banner of an ecosystem approach to health. To some extent this is an artifact of the long-standing emphasis on the "three pillars" to the detriment of ecology and sustainability (see Koné et al. 2011 for example). But in order to meet the potential of an ecosystem approach to health, and to respond to the health and sustainability challenge set by the Lancet special commission on the MDGs (Waage et al. 2010), greater attention is needed on the ecological dimensions of health.

Economic arguments are also under-utilized in ecohealth research. Household economic indicators, livelihoods and various income-generating strategies are frequently studied as indicators or conduits for exposure to environmental health hazards and are cornerstones of health-improvement strategies. Despite widespread recognition in ecohealth of the importance of the economic dimension in decision making (from the household to the national level), cost-benefit or cost-effectiveness analyses are still too few. Monroy et al (2009) presented a partial cost-effectiveness analysis of their plastering technology for Chagas disease vector control. They compared the cost of residual spraying (US\$9.12 annually, in 2004 dollars) to the cost of materials and transportation for the plaster (US\$30). The plaster was shown to be 100% effective in preventing infestation (unlike the spraying) and to last at least 5

years, making it more cost effective, along with many other benefits (no exposure to pesticide, better quality of housing). The cost estimates for the plaster technology did not factor in the cost of labor (since it was applied by householders) or of ancillary community education and outreach, but these can be assumed to be minor. Policy makers in Guatemala and elsewhere in the region have been attentive to these and similar economic analyses and arguments, and have adopted the new practices in disease control programs.

Looking Forward

Ecohealth is an emerging field. It is engaging in active debate of the key environment and health issues facing the world today (e.g. Boischio et al. 2009; Webb et al. 2010; Butler and Weinstein 2011). Although technical findings generally find their way into peer-reviewed science publications, many results of ecohealth research (insights from participatory design, integrated approaches to knowledge generation, cost-effectiveness of interventions, policy influence, social capital, and other outcomes) are not fully captured as a matter of routine. More systematic attention to monitoring the research process and documenting what is going on can help the field of ecohealth become more systematic about capturing research outcomes, and greater demand from ecohealth conferences and journals can help motivate researchers to publish these findings.

Will examples of policy influence and widespread change in ecohealth research become the rule rather than the hard-earned exception? The systematization of results acquired through ecohealth research is a challenge, whether scaling up through levels of government or scaling out to other geographic or thematic contexts. The more distant or indirect is the desired impact, the greater the challenge to exert influence, due to the complexity of the pathways to achieving change. Researchers are now grappling with the development of tools and methods to better understand and measure intermediate and long-

term outcomes of ecohealth research. Researchers and donors like IDRC are also striving assess how ecohealth research contributes to community resilience and adaptability to new challenges that arise long after a project has ended. There is growing academic interest in how to utilize ecohealth research results on a scale beyond the locality of the project. More work is needed to understand the circumstances that promote uptake and multiplication of research results. Beyond more effective dissemination of ecohealth research activities and results, ecohealth as a field has an opportunity to link more effectively to innovation systems — the national and international systems that link research, policymaking, and application.

Scientific rigor and peer-review are essential to the growth and recognition of any new field in science and ecohealth is no exception. Contributions to local problem-solving and development are as important to defining the field and further debate is needed on how best to do this. Ecohealth communities of practice and other networks facilitate this dialogue. New media and technologies enhance the capture, presentation, and diffusion of a broad range of results, and promote greater knowledge exchange. Engagement of networks with decision-making processes, from the local to international levels, can also help shape decision-making processes to be more receptive to research inputs, and eventually develop a policy culture that seeks out evidence from research.

The understanding that human health depends on healthy ecosystems is a very old idea, represented in the beliefs of aboriginal peoples around the world, in the writings of Hippocrates from 2500 years ago, and in the ancient writings and beliefs of many other cultures. Ecosystem approaches to health (and the wider field of ecohealth) have a strong and well-documented pedigree. Indeed, the field is growing, deepening its roots in every region of the world. In her EcoHealth editorial, Dr. Parkes (2011) champions the field while also drawing attention to significant challenges ahead. According to the Lancet and to

the 2012 Global Report for Research on Infectious Diseases of Poverty (WHO 2012), global health depends on innovative, transdisciplinary and action-oriented research that integrates health, environment and sustainability into the development agenda. Ecosystem approaches to health are aligned with the latest thinking in innovation, global health and international development. With a deepening evidence base and growing tool-box, ecohealth will contribute to pressing national and international global health and environment research agendas for years to come.

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