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Original Contribution

Sustainable Livelihoods and Ecosystem Health: Exploring Methodological Relations as a Source of Synergy

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Abstract: Using ecohealth as a transdisciplinary lens to explore the connections among overlapping domains of inquiry, this article examines methodological relations between Sustainable Livelihoods and Ecosystem Health, two approaches for improving rural health and well-being. The experience of working on a project tasked with developing an integrated, systems-based approach for understanding the nature of rural livelihoods and ecosystems provides the base for analysis. Several key insights are discussed: The overarching goals of health and sustainability facilitate collaboration among disciplines; differences arise from how each approach operationalizes systems as variables and indicators; the dependent variables for one approach can be used as the independent variables for the other. In summary, while broad concepts like health and sustainability help transcend differences across disciplines and scales of analysis, variables and indicators cannot, as they are bound to how an observed system is operationalized. An advantage of using an ecohealth lens is that it creates conceptual and analytical spaces in which differences can be reconciled and used as sources of synergy. A source of synergy revealed in this article is the interdependence of variables used by each approach.

Key words: ecohealth, ecosystem health, rural development, sustainable livelihoods, systems thinking, transdisciplinary

INTRODUCTION

A key benefit of the transdisciplinary nature of ecohealth is to foster a mindset that is open to new avenues of inquiry for human health and well-being, and to see opportunities that are otherwise obscured by disciplinary inquiry. By its nature, transdisciplinarity infers an area of overlapping domains. By exploring these overlapping domains, we can better understand the connections between nature, society, and health, and how these connections can create ''an extraordinary amount of synergy'' (Wilcox et al., 2004, p. 3).

A particular relationship among overlapping domains of ecohealth is the reciprocal relation of using ecological concepts for the study of human health, and using health concepts for the study of ecosystems (Wilcox et al., 2004). The purpose of this article is to explore this reciprocal relation by examining two approaches for the study of human health and well-being: Sustainable Livelihoods (SL) and Ecosystem Health (ESH). These two approaches have been used primarily as distinct frameworks for empirical studies. SL is a people-centered approach that focuses mainly on rural poverty (Ashley and Carney, 1999; Carney, 1999, 2002; Farrington et al., 1999; Hussein, 2002), but also on issues such as rural development and environmental management (Scoones, 1998). ESH is an ecosystem-based

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approach that focuses on the resilience, organization, and vitality of ecosystems to improve human health and social well-being (Rapport, 1998). The following discussion centers on synergies emerging from the overlapping domains of Sustainable Livelihoods and Ecosystem Health.

Context: Dealing with Complexity

In a policy statement issued in 2003, *Promoting Sustainable Rural Development through Agriculture: Canada Making a Difference in the World*, the Canadian International Development Agency (CIDA) recognized the need for an integrated, systems-based approach for understanding the nature of rural livelihoods and ecosystems (CIDA, 2003). The combined concepts of sustainable livelihoods and ecosystem health were presented as ways to think about the potential effects that a development intervention may have on ecosystem integrity, social equity, and other social processes in rural settlements.

To implement this rural development policy, the University of Guelph helped to develop and test practical tools that CIDA personnel and its partners, both in Canada and overseas, could use to operationalize the principles of SL and ESH. This project, *Building Institutional Capacity for Sustainable Rural Development: Tools from Best Practice and Analytical Thinking*, employed a series of workshops and policy discussions to stimulate thinking about these approaches and principles. The aim was to help CIDA's planners, programmers, practitioners, and evaluators incorporate systems-based concepts of livelihoods, ecological integrity, health, and sustainability into their program development and evaluation.

Thus, a project team came together under the multidisciplinary concepts of sustainable livelihoods and ecosystem health. Each member of the team contributed different skills and experiences. As well, members of the team joined at various stages of the project, introducing new perspectives along the way, which created spaces for continued discussion about the relation between SL and ESH. With the benefit of hindsight, it is reasonable to suggest that members of the team used similar concepts and shared similar concerns and outlooks that fall within the scope of ecohealth.

While the concepts of health and sustainability were most easily shared among members of the group, what moved the group forward was the idea of *dealing with complexity* in rural development and agriculture. The intrigue of "dealing with complexity" was shared by members of our group at the outset and, as we soon realized, emerged as a ubiquitous theme, surfacing throughout the project's workshops and policy discussions.

Presuming complexity means to look differently at the world; it is to no longer believe that we can understand the world better by collecting more information and doing better science. We learned that one cannot look *at* complexity nor *discover* complexity; rather, we learned that one *experiences* complexity. The experience of complexity evokes a corresponding need to acknowledge the validity of multiple perspectives and for managing interdependencies across multiple scales. In this way, dealing with complexity resonates with several "postmodern" views that challenge the positivist, value-free objectivity of "normal" science. To acknowledge this complexity is to accept, among other things, that no single perspective can encompass the system in question. Different people with different perspectives may understand the same system in very different ways. Thus, accepting complexity as a methodological principle also means embracing participatory approaches that recognize the influence of values in all inquiry, scientific or otherwise (Waltner-Toews et al., 2004). To "deal with complexity," practitioners, planners, and policymakers need to dialogue with persons having various interests and worldviews. Such participatory approaches are essential to both understanding and defining goals and issues.

This view of "dealing with complexity" encapsulates our project team's shared starting point: the world as one whole, complex system. Any part of the whole, whether social or ecological, can be viewed as a "holon," an open, complex system that can be viewed as a whole in its own right. This worldview provided the context for our recurring debate that centered upon the relation between SL and ESH. We continually asked each other where SL and ESH intersect and whether they can be fused. Should they be fused? As a group, members of the project team did not have a single, shared response to these questions, as we each had different views. In the extremes, we can divide these views about the relation between SL and ESH into three themes. One theme emphasizes differences; it centers upon which approach is better vis-à-vis others. A second theme is more interested in merging approaches, thus emphasizing similarities. A third theme is concerned about the empirical order of systems: Are livelihoods embedded in ecosystems or are ecosystems embedded in livelihoods?

The transdisciplinary lens of ecohealth allows us to step back from the debate about the relation between SL and

ESH. In this way, ecohealth is viewed not as an approach but as an overarching perspective that encompasses integrative and cross-disciplinary approaches involving both the ecological and health sciences. This view is consistent with the aim of this journal, which recognizes the inherent interdependence of the health of humans, wildlife, and ecosystems (Wilcox et al., 2004).

For present purposes, ecohealth must also be distinguished from ecosystem health. A point of confusion arises because ecohealth and ecosystem health can be used interchangeably (e.g., Lebel, 2003). As used here as a transdisciplinary lens, ecohealth is not viewed as an ecosystem approach *to* human health; rather, ecohealth encompasses both ecosystem health *and* human health. This explanation not only distinguishes ecohealth from ecosystem health, it also provides analytical space for "exploring the perspectives, theories, and methodologies emerging at the interface between ecological and health sciences" (Wilcox et al., 2004, p. 3). Ecohealth is used in this way to observe the methodological relation between ESH and SL, and to reveal both similarities and differences between ESH and SL while remaining open to all sides of the debate.

The ideas that follow represent the author's insights gained as a member of the project team. These insights coalesced at the end of the project, culminating in a discussion paper presented at a final conference (see Brown, 2006). The conference addressed the challenge of providing the mental models and conceptual tools that enable planners, programmers, practitioners, and evaluators to use livelihoods and ecosystems thinking for agricultural and rural development policy and programming. The overarching aim of the conference was to propose a research agenda for future rural development inquiry and practice. Through this article, the author seeks to advance this research agenda with a particular focus on the methodological implications of an integrated, systems-based approach for understanding the nature of rural livelihoods and ecosystems.

Overview of the Two Approaches to Rural Development

The following descriptions of the SL and ESH approaches are not intended to provide a comprehensive account of each. Rather, the primary intent is to briefly describe SL and ESH as understood by members of the project team by drawing from materials, especially Robinson et al. (2006), that were developed for the project and its participants.

Sustainable Livelihoods

Sustainable Livelihoods (Ashley and Carney, 1999; Carney, 1999, 2002; Department for International Development, 1999; Farrington et al., 1999; Helmore and Singh, 2001; Scoones, 1998, 2009) is an attempt to break away from ways of thinking that ignore the complexity of the lives and livelihoods of rural poor people. By embracing a holistic, people-centered understanding of poverty, the idea of sustainable livelihoods seeks to transcend Western conceptions of "making a living" through employment or farming. Instead, a livelihood comprises a full range of assets, activities, and strategies that households might employ.

In his historical review of what has become known as the Sustainable Livelihoods Approach, Scoones (2009) describes a mix of perspectives that have evolved in the midst of debate, tensions, ambiguities, and challenges over the past 50 years. While the early focus on village studies, households, and farming systems remains, related concepts have expanded to include such topics as rural or urban locales, pastoral or fishing livelihoods, gender, age-defined livelihoods, livelihood pathways and trajectories, and sustainability.

> Thus all these approaches—village studies, household economics and gender analyses, farming systems research, agro-ecosystem analysis, rapid and participatory appraisal, studies of socio-environmental change, political ecology, sustainability science and resilience studies (and many other strands and variants)—have offered diverse insights into the way complex, rural livelihoods intersect with political, economic and environmental processes from a wide range of disciplinary perspectives, drawing from both the natural and social sciences. (Scoones, 2009, p. 174)

In the context of this diversity, the livelihoods perspective guiding the *Building Institutional Capacity* project was centered on assets and resilience, which can be summarized as follows. Using the holistic concept of livelihood as a starting point, one looks externally to assess people's vulnerability to shocks and stresses that might affect the assets, activities, or strategies of their livelihood. These forces encompass both public and private sector structures

and processes, including policies, legislation, institutions, social relations, and culture. These forces interact to affect the value of people's assets, entitlements to those assets, people's capabilities to carry out particular livelihood activities and strategies, and the returns on these activities. It is primarily through the coping and adapting mechanisms that people use that both resilience and innovations emerge within the livelihood system. Above all, as Scoones (2009, p. 172) states, "Livelihoods perspectives start with how different people in different places live."

Ecosystem Health

The fundamental aim of Ecosystem Health is to protect and restore the health of the environment (Haskell et al., 1992; Rapport et al., 1999; Wilcox, 2001). By definition, "An ecological system is healthy and free from 'distress syndrome' if it is stable and sustainable—that is, if it is active and maintains its organization, and autonomy over time and is resilient to stress" (Costanza, 1992, p. 248). This definition emerged at a time when the field of environmental management was looking for a new paradigm to replace the old approach (Berkes and Folke, 1998; Norton, 1992), which was characterized by positivist reductionism that separated humans from the environment, and by economic determinism that gave humans dominion over the environment. The shift to a new paradigm sought to recognize a fundamentally different relationship between humans and the environment, one that recognized with greater sensitivity the coupling of human and natural systems. Over time, there has been a movement from a focus on environmental determinants of health, to environment and health, to environmental health, to ecosystem health [Bunch M, personal communication, August 10, 2010]. This increasing attention to the coupling of human and natural systems is also evident in the evolving concept of ecological integrity. Manuel-Navarrete et al. (2004) describe a shift from deterministic management of pristine environments untouched by humans, to adaptive management of ecological systems under stress from human activities, to ongoing adaptive management of complex ecological systems intimately related to the needs and wants of humans. In addition to the changed relation between humans and the environment, the increasing role of systems thinking within this evolution has helped conceptualize complex ecological problems at multiple scales and involving multiple perspectives (Norton, 1991). ESH is an outcome of this shift in environment management.

What helps distinguish ESH from other ecological frameworks is its adoption of the concept of health (Nielsen, 1999; Norton, 1991; Rapport et al., 1999; Waltner-Toews, 2004). "Health at the level of the ecosystem describes its capacity for maintaining biological and social organization on the one hand and the ability to achieve reasonable and sustainable human goals on the other" (Nielsen, 1999, p. 66). Because health draws upon both biophysical and social sciences, assessing the health of an ecosystem necessarily involves societal values and biophysical realities (Rapport et al., 1999).

Members of the project team understood ESH in similar terms. The health of an ecosystem was further described by the team as a resource that people use in their daily lives. As such, ESH implies that human systems and ecosystems are inextricably linked. Thinking about the health of an ecosystem is also a way of framing related questions of policies, assessment, and management strategies.

The idea of "achieving" health must be considered as a moving target, not an end state that we will ever reach. As summarized by Robinson et al. (2006, p. 8), this way of thinking has a number of implications:

- The health of an ecosystem is a continually renegotiated outcome, accommodating multiple perspectives and trade-offs;
- Power and information are key elements in this negotiation—there is a need for equity and free flow of information;
- We need to pay attention to cross-scale relationships—personal, household, and village health, population sustainability, ecosystem self-organization; and,
- Health is not stable over time because ecosystems are not stable over time.

In this way of thinking, social, economic, and political systems are viewed as embedded within an ecological context. Effectively, this privileges ecological systems as essential points of entry for achieving the overarching goals of improving human health and social well-being.

Analyzing the Relations

While ecohealth provides a transdisciplinary mindset to explore relations between SL and ESH, a more detailed framework is required to identify methodological similarities and differences between the two approaches. The aim

is to analyze how each approach is operationalized. For instance, given a particular case of rural development, each approach would share an overall concern with improving human health and well-being. However, each approach to the case would have particular qualities, with specific points of entry, questions to ask, and data to collect. It is these qualities that distinguish each approach and that can be analyzed in order to understand underlying structure. To get at this underlying structure, a set of questions was developed based on the tenets of scientific research, namely, the process of moving from identifying an issue to defining concepts, and from operationalizing concepts to measuring indicators. The set of guiding questions is as follows:

What are…

- the worldviews?
- the theories that frame inquiry?
- the primary issues that define the context?
- the guiding principles?
- the most important goals?
- the main concepts?
- the units of analysis?
- the key variables?
- the indicators?

These questions, from top to bottom, provide a ''storyline'' leading from broad concerns to specific details of inquiry. The answers to these questions help reveal the nature and logic of each approach, which can then be used as the basis for exploring opportunities for synergy.

Although there are many approaches used in both SL and ESH, members of the project team adopted a *systems*-based approach for both SL and ESH. This approach is consistent with the CIDA policy on sustainable rural development. Importantly, this singular perspective provided the project team a critical conceptual and methodological link between the two approaches, as dealing with complexity meant to observe both livelihoods and ecological communities as complex systems. Therefore, to understand how members of the project team observed livelihoods and ecosystems, it is necessary to understand how the boundary, elements, and relations among elements of each livelihood and ecological system were defined.

A review of a case study that was designed for discussing SL and ESH approaches will help to illustrate how the above questions can be applied. The subject of study is the mountain pine beetle (MPB) epidemic in central interior British Columbia. Following a brief overview of the ecological and human impacts of the epidemic, the set of guiding questions is applied to the case and discussed in relation to both SL and ESH approaches. The following information about the MPB epidemic is extracted from Burton and Connell (2005).

The central interior of British Columbia is a diverse landscape resulting from years of disturbance. The frequency and intensity of ecosystem stressors depend on a number of factors, particularly yearly weather conditions, long-term climate trends, and forest management practices. These disturbances have created a mosaic of forest ecosystems differing in species composition, age class, and structure.

In recent years, British Columbia (BC) experienced an increase in the intensity of insect-related disturbance, particularly the mountain pine beetle. At endemic levels, MPB is an integral component of a healthy functioning ecosystem. Conversely, at epidemic levels, MPB has the potential for negative large-scale impacts on forest health and socioeconomics. Analysis of the current MPB outbreak indicates epidemic levels at an order of magnitude higher than any previous outbreak in Canada—both in area of land infested and volume of trees killed. In addition to volume loss, outbreaks of MPB infestations outside of parks upset harvesting plans, reduce the timber volume and the monetary gains of the high-value mature trees, and cause marketing and operational problems. At the same time, environmental problems, such as loss of critical wildlife habitat, displacement of animals, and erosion of landscapes, arise when large volumes of dead pine are harvested for control and salvage purposes. Estimates show that the beetles have affected about 10 million ha and 700 million cubic meters of timber in BC. This area of forest represents approximately 40% of the commercial forest (or 17% of the total forest) of all BC, and a slightly lower proportion of industrial timber stocks.

The impact on timber supply raises critical questions about the potential boom that results from higher levels of harvest, and about the potential bust when the MPB-killed timber supply runs out. We can surmise that a dramatic story unfolds for central interior BC, with greater highs and a more significant drop in timber supply levels over the next 10 years. Beyond 10 years, the forecasted level of timber supply is significantly below pre-MPB harvest levels, which presents socioeconomic and ecological challenges. After the boom of raised harvest levels, the ''uplift'' period, what happens when the jobs disappear? What happens to the ecological integrity of the forest?

As summarized in Table 1, the set of guiding questions can be applied to the mountain pine beetle epidemic. From an ESH perspective, the story revealed is about how the ecological integrity of the lodgepole pine forest systems has been affected by the MPB epidemic. The functionality of the forest as a resource has been compromised, as evident in the significant changes in the age, class, and structure of the ecosystem. From a SL perspective, the impacts of the MPB epidemic are viewed in terms of expected losses of employment and income from forest sector. The timber supply areas, which represent the economic system of central interior British Columbia's forests, depend on the lodgepole pine for direct employment and related spinoffs. The loss of amenity values also impacts non-timber economic benefits of the forest, such as recreation. In summary, the information presented in Table 1 helps to reveal the dominant methodological structure of each approach, and this structure is related to how the objects and subjects of study are observed using each approach, as well as the objectives and needs of the observer.

Two other case studies prepared for the *Building Institutional Capacity* project will also be reviewed briefly in relation to their methodological structures. Neudoerffer et al. (2006) (see also Neudoerffer et al., 2005) describe a study of tapeworm infection in dogs in the city of Kathmandu, Nepal. The work in Wards 19 and 20 of the city started out as an epidemiological study. It evolved by incorporating an ecosystem approach to human health. As the researchers note, ''A rich picture of our ecosystem started to emerge when we were able to group actors and activities, not by stakeholder groups, but by ecosystem issues, such as water, food and waste'' (Neudoerffer et al., 2006, p. 24). Consistent with using an ESH approach, the social, political, and economic systems of the urban landscape were seen as embedded in the ecological system of the Bagmati and Bishnumati River Valley watershed. This watershed is located in the Kathmandu Valley, in the Mountain Ecological Zone in the country of Nepal. Key variables of ecosystem health included water availability, water quality, and improper garbage management. ''Hence, the water and food and waste systems formed our team's entry point for understanding the local ecosystem'' (Neudoerffer et al., 2006, p. 24). Central to the analysis was the relation between the health of the ecosystem and the activities, concerns, and needs of the primary actors embedded in the ecosystem.

The next case, developed by Henson and Mitullah (2006), centers on the livelihoods associated with the Nile perch fishery of Kenya. Starting in the late 1980 s, the Lake Victoria fishery expanded dramatically, including a growth of fishers and vessels, and the rapid development of an export industry that fundamentally changed the entire fish supply chain. From a livelihoods perspective, ''Key questions include the nature of the economic and social transformations that take place when the focus of fish supply chains shifts from local to global and the distribution of the returns from potentially lucrative export markets. That is, to what extent do local fishing communities

Table 1. Guiding Questions Applied to Mountain Pine Beetle Epidemic Case

Ecosystem Health (ecological systems)		**Sustainable Livelihoods** (social systems)
Systems thinking	**Worldview**	Systems thinking
Complex adaptive systems	**Theoretical framework(s)**	Complex adaptive systems
Impacts of the mountain pine beetle epidemic on the forest	**Primary issues/context**	Expected loss of employment and income from forest sector
Social well-being, ecological integrity	**Guiding principles**	Economic well-being, economic diversification
Forest as a resource	**Goals**	Maximize economic benefits of forests, minimize economic impact of epidemic
Health	**Concepts**	Livelihoods
Lodgepole pine forest ecosystems	**Unit(s) of analysis**	Timber supply areas
Functionality	**Variables**	Commercial value, forest income dependency, amenity values
Area of land infested, volume of trees killed (red and gray attack), species composition, age, class, structure, wildlife habitat fragmentation, hydrology	**Indicators**	Timber value, timber volume, annual allowable cut, jobs, income, recreational access, visual quality

benefit from the growth in fish and fishery product exports and, specifically, who within these communities gains and who loses?'' (Henson and Mitullah, 2006, p. 8). In this case, the livelihood system is the Kenyon Nile perch fishery of Lake Victoria. Key livelihood variables include aggregate and personal incomes, development indicators, volume and value of fish landings, population of districts bordering the lake, and the structure and activities of the fish supply chain at three levels: localized trading along the lake shore and markets within the hinterland; inter-regional trade between Kenya, Uganda, and Tanzania; and extra-regional international exports. Simultaneously, these livelihood variables depend on the health of the Lake Victoria ecosystem. As noted by the researchers, ''there are concerns about the long-term sustainability of the fishery in view of changes to the ecosystem of the lake [water hyacinth; water pollution] and the degradation of the local environs of fishing communities'' (Henson and Mitullah, 2006, p. 8).

Discussion: Synergy of Connections

Given the diversity of perspectives, frameworks, and methods that inform each of the SL and ESH approaches, there are many areas of overlap between them, particularly in relation to overall aims, that are not reflected in methodology. This diversity aside, a significant point of methodological commonality between the two approaches as used in the *Building Institutional Capacity* project is systems thinking. This shared view of reality informs the theoretical frameworks of both approaches. How each approach operationalizes systems thinking creates points of difference, with these differences becoming more clearly defined as one moves from general to more detailed elements of inquiry.

In general terms, the unit of analysis for all applications of complex adaptive systems theory is the ''system.'' And when using a systems-based approach, as Norton (1991) argues, determining boundaries also determines scale and perspective, and vice versa. Herein lies what can be an important difference between the two approaches: How a system is observed (i.e., operationalized) is different for each of SL and ESH. While one may argue that the observed boundary of the system is arbitrary, the boundary can no longer be treated as arbitrary after it is selected, because the boundary is essential to defining what lies inside and outside of the observed system, i.e., what are elements of the system and what is the environment of the system. Even when the empirical boundary of the system is not, or cannot be, clearly defined, the selected set of variables and indicators serves to bound the system, at least for analytical purposes. Selecting variables and indicators effectively defines what is included as elements of the system (i.e., part of the system) and what is outside or external to the system (i.e., part of the system's environment). Likewise, the unit of analysis, variables, and indicators define what is relevant to the observer. In the first case outlined above, the focus is on the mountain pine beetle. From an ESH perspective, attention centers on the impacts of the beetle on the forest. The unit of analysis is the lodgepole pine forest ecosystem. From an SL perspective, attention centers on the impacts of the beetle on the people for whom the forest is an economic asset. The unit of analysis is not the forest per se, but the forest defined as a timber supply area. The unit of analysis also defines the scale of the system. However, the matter of scale raises further questions within systems thinking. Ecological scales might include, for example, individuals, populations, habitats, landscapes, and biomes. Livelihood scales might include individual person, household, household cluster, extended kin grouping, village, region, and nation (Scoones, 1998). Each scale can be considered independent, as well as being part of a larger whole. Furthermore, events at one scale influence events at other scales. Thus, while we may be able to define different observed systems according to units of analysis, variables, and indicators, we might also say that there is no straightforward, objective way to demarcate the boundaries of any particular system. Hence, the importance of using participatory approaches, at the outset of a project in which stakeholders are actively engaged, is in determining management problems and goals, and thereby, also boundaries, scales, and perspectives. Notwithstanding this matter of boundaries and scale, it seems that SL and ESH often deal with different systems.

In addition to helping to observe system boundaries, variables and indicators reveal an interesting relation between SL and ESH. Namely, the dependent variables for one approach can be the independent variables for the other. For instance, people interested in ecosystem health focus on such variables as resource uses, water quality and quantity, nutrient and energy flows, and disease rates. These dependent variables of ESH can be affected by, or depend on, livelihood factors such as patterns of human production and consumption, work, assets, capabilities, and entitlements. From an SL perspective, the relation is reversed: Patterns of human production and consumption can be affected by resource use, water quality and quantity,

and disease rates, for example. The relation between variables is evident in each of the cases described above. In the mountain pine beetle case, the functionality of the forest as a resource is influenced by its commercial value, the dependence of the local economies on forest income, as well as forest-derived amenity values. The reciprocal relation is as follows: The commercial value and other benefits of the forest is influenced by the functionality of the forest, as indicated by the volume of trees killed, forest structure, and hydrology, among others. In the Kathmandu case, the health of the ecosystem depends on the activities, needs, and concerns of the social, political, and economic actors. In the Nile perch case, the livelihoods of fishers depend on the health of the Lake Victoria ecosystem. This interdependence of variables is important because it lends insight to the relation between livelihoods and ecosystems generally. With regard to systems-based SL and ESH approaches, this interdependence is a feature of their underlying structure. As noted above, when dealing with complexity, individual perspectives are always partial and the aggregate of perspectives is never complete. Thus, the question of what is important to the observer, which relates to the purpose of inquiry, must re-enter the analysis. In the field of rural development, participatory research usually relates to three general purposes: policy, program, and practice. Policy concerns any governing principle or set thereof designed to guide program(s); a policy may include required processes or procedures. Program concerns a set of goals and objectives along with prescribed activities (e.g., projects or services) related to specific outcomes. Practice concerns on-the-ground activities required to carry out a program. Each purpose relates to what is important for different points of observation.

To complete the discussion, we can explore how the hierarchy of purposes from policy to program to practice corresponds with the "storyline" from broad issues to concepts to indicators. One possible interpretation of the relationship between the two hierarchies is shown in Table 2. Someone interested in policy is most likely concerned with the primary issues to be addressed, the principles to be followed, and the concepts employed to explain the nature of the issues. Another who is interested in developing programs must operationalize the stated concepts, thus defining the appropriate level of intervention and desired outcomes (variables). In turn, the practitioner must figure out how to deliver the outcomes and collect data that measure whether or not the desired outcomes were reached. Thus, what is important can differ across

Table 2. Relation between Structure and Purpose of Inquiry

Worldviews	Policy
Theoretical frameworks	
Primary issues/context	
Guiding principles	
Goals	Program
Concepts	
Unit of analysis	Practice
Variables	
Indicators	

perspectives. This is not to suggest that any of the policymakers, programmers, and practitioners deal only with one concern; in most cases everyone is concerned with a full range of interests and perspectives. It is through practice, for instance, that programs are addressed and policies can be challenged. The hierarchical relations shown in Table 2 suggests that, for policymakers that deal mostly with issues, principles, and concepts, the methodological differences between SL and ESH are likely to be less significant. At the other end of the continuum, methodological differences may be more significant because one's success depends on how one measures direct impacts. When it comes to evaluation, the general appeal of concepts helps less to explain success or failure.

Conclusion

As a transdisciplinary lens, ecohealth helps us to explore areas of overlapping domains, such as the relation between SL and ESH. The fact that both similarities and differences exist between SL and ESH is not surprising, or very interesting. Of greater interest is how each approach borrows from the other. Herein lays an aspect of transdisciplinarity suggesting that SL and ESH can produce synergy through its connections. In ESH and SL, we have, respectively, ecological scientists who adopted the concept of health, as it has been used with respect for humans, and social scientists who adopted the concept of sustainability, as it had been used with respect for the environment.

The intent of the analysis was to lend insight to some of the methodological relations between SL and ESH. An advantage of the author's experience is that members of the *Building Institutional Capacity* project team accepted complex systems thinking as a shared perspective. In turn, this provided an important methodological link between SL and ESH: an interdependence of variables. The dependent variables of one approach can be the independent variables of the other. While this shared systems perspective

facilitated the analysis presented in this article, it suggests another advantage. By deliberately selecting interdependent variables, it is possible to use this structural relation as a point of collaboration. Furthermore, this interdependence lends insight to the debate about whether livelihoods are embedded in ecosystems, or vice versa. Rather than having to choose one side of the debate, the interdependence of the variables suggests that one's answer depends on which variables one selects. Thus, through a transdisciplinary lens, it is possible to reconcile these competing views without eliminating their differences. Following second-order systems thinking (Luhmann, 1993, 1995), the task at hand is to observe the observer.

The insights from the analysis can be generalized as follows: Concepts cross scales, but indicators do not. This infers that the concepts of health and sustainability can be used to study ecosystems and livelihoods at various scales. That indicators do not cross scales reflects the nature of systems thinking: Indicators, and their corresponding variables, are system-specific. Thus, if we are to understand the similarities and reconcile differences between SL and ESH, then we have an opportunity to engage in discussions that move beyond the general appeal of concepts. Likewise, we can more clearly articulate what it is that we are observing, and the perspectives we use to make sense of human health and well-being.

References

Ashley C, Carney D (1999) *Sustainable Livelihoods: Lessons from Early Experience*, London: Department for International Development

Berkes F, Folke C (1998) Linking social and ecological systems for resilience and sustainability. In: *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, Berkes F, Folke C, Colding J (editors), New York: Cambridge University Press, pp 1–25

Brown HCP (2006) *Conference Report: Sustainable Livelihoods and Ecosystem Health: Informing Policy, Practice and Research*, Guelph, ON, Canada: University of Guelph. Available: http://www.nesh.ca/sl-esh/pdfs/SLESH_Conference_Report.pdf [accessed July 16, 2010]

Burton C, Connell DJ (2005) Boom, bust, and bugs: central interior BC's forest systems under stress. In: *Livelihoods and Ecosystems: Dealing with Complexity in Rural Development and Agriculture*, Guelph, ON, Canada: University of Guelph. Available: http://www.nesh.ca/sl-esh/kit/6E-CaseStudies-Burton.pdf [accessed July 16, 2010]

Canadian International Development Agency (CIDA) (2003) *Promoting Sustainable Rural Development through Agriculture: Canada Making a Difference in the World*, Ottawa: Canadian International Development Agency

Carney D (1999) *Approaches to Sustainable Livelihoods for the Rural Poor*, ODI Poverty Briefing, Brighton, UK: Overseas Development Institute

Carney D (2002) *Sustainable Livelihoods Approaches: Progress and Possibilities for Change*, London: Department for International Development

Costanza R (1992) Toward an operational definition of ecosystem health. In: *Ecosystem Health: New Goals for Environmental Management*, Costanza R, Norton BG, Haskell BD (editors), Washington, DC: Island Press, pp 239–256

Department for International Development (1999) *Sustainable Livelihoods Guidance Sheets*, London: Department for International Development

Farrington F, Carney D, Ashley C, Turton C (1999) *Sustainable Livelihoods in Practice: Early Applications of Concepts in Rural Areas*, ODI Natural Resource Perspectives No. 42, Brighton, UK: Overseas Development Institute.

Haskell BD, Norton BG, Costanza R (1992) Introduction: what is ecosystem health and why should we worry about it. In: *Ecosystem Health: New Goals for Environmental Management*, Costanza R, Norton BG, Haskell BD (editors), Washington, DC: Island Press, pp 3–20

Helmore K, Singh N (2001) *Sustainable Livelihoods: Building on the Wealth of the Poor*, Bloomfield, CT: Kumarian Press

Henson S, Mitullah W (2006) Nile perch exports from the Kenyan shores of Lake Victoria: good or bad for local fishing communities? In: *Livelihoods and Ecosystems: Dealing with Complexity in Rural Development and Agriculture*, Guelph, ON, Canada: University of Guelph. Available: http://www.nesh.ca/sl-esh/kit/6C-NilePerch-Henson.pdf [accessed July 16, 2010]

Hussein K (2002) *Livelihoods Approaches Compared: A Multi-Agency Review of Current Practice*, London: Department for International Development

Lebel J (2003) *In Focus: Health: An Ecosystem Approach*, Ottawa: International Development Research Centre

Luhmann N (1993) Deconstruction as second-order observing. *New Literary History* 24:763–782

Luhmann N (1995) *Social Systems*, Stanford, CA: Stanford University Press

Manuel-Navarrete D, Kay JJ, Dolderman D (2004) Ecological integrity discourses: linking ecology with cultural transformation. *Human Ecology Review* 11:215–229

Neudoerffer RC, Waltner-Toews D, Kay J, Joshi DD, Tamang MS (2005) A diagrammatic approach to understanding complex eco-social interactions in Kathmandu, Nepal. *Ecology and Society* 10. Available: http://www.ecologyandsociety.org/vol10/iss2/art12/ [accessed July 16, 2010]

Neudoerffer RC, Waltner-Toews D, Kay J (2006) Return to Kathmandu: a post-hoc application of AMESH. In: *Livelihoods and Ecosystems: Dealing with Complexity in Rural Development and Agriculture*, Guelph, ON, Canada: University of Guelph. Available: http://www.nesh.ca/sl-esh/kit/6A-ReturntoKathmandu.pdf [accessed July 16, 2010]

Nielsen NO (1999) The meaning of health. *Ecosystem Health* 5: 65–66

Norton BG (1991) Ecological health and sustainable resource management. In: *Ecological Economics: The Science and Management of Sustainability*, Costanza R (editor), New York: Columbia University Press, pp 102–117

Norton BG (1992) A new paradigm for environmental management. In: *Ecosystem Health: New Goals for Environmental*

Management, Costanza R, Norton BG, Haskell BD (editors), Washington, DC: Island Press, pp 23–41

Rapport DJ (1998) Some distinctions worth making. *Ecosystem Health* 4:193–194

Rapport DJ, Böhm G, Buckingham D, Cairns J, Costanza R, Karr JR, et al. (1999) Ecosystem health: the concept, the ISEH, and the important tasks ahead. *Ecosystem Health* 5:82–90

Robinson L, Fuller T, Waltner-Toews D (2006) *Ecosystem Health and Sustainable Livelihoods Approaches—A Synthesis of the Latest Thinking*, Guelph, ON, Canada: University of Guelph

Scoones I (1998) *Sustainable Rural Livelihoods: A Framework for Analysis*, Working Paper No. 72, Brighton, UK: Institute of Development Studies

Scoones I (2009) Livelihoods perspectives and rural development. *Journal of Peasant Studies* 36:171–296

Waltner-Toews D (2004) *Ecosystem Sustainability and Health: A Practical Approach*, Cambridge, UK: Cambridge University Press

Waltner-Toews D, Kay J, Murray TP, Neudoerffer C (2004) Adaptive methodology for ecosystem sustainability and health (AMESH): an introduction. In: *Community Operational Research: Systems Thinking*, Midgley G, Ochoa-Arias A (editors), New York: Kluwer, pp 317–349

Wilcox B, Aguirre AA, Daszak P, Horwitz P, Martens P, Parkes M, et al. (2004) EcoHealth: a transdisciplinary imperative for a sustainable future. *EcoHealth* 1:3–5

Wilcox BA (2001) Ecosystem health in practice: emerging areas of application in environment and human health. *Ecosystem Health* 7:317–325