

Converging Paradigms for Environmental Health Theory and Practice

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Converging themes from the fields of environmental health, ecology and health, and human ecology highlight opportunities for innovation and advancement in environmental health theory and practice. In this commentary we outline the role of research and applied programs that integrate biophysical and social sciences with environmental health practice in order to address deficiencies in each field when taken on its own. New opportunities for environmental health protection and promotion are outlined based on the three converging themes: integrated approaches to research and policy, methodological acknowledgment of the synergies between the social and biophysical environments, and incorporation of core ecosystem principles into research and practice. These converging themes are discussed in relation to their implications for new types of intervention to achieve health gains across different spatial and temporal scales at the interface between biophysical and social environments. *Key words:* determinants of health, ecology and health, environmental health, human ecology, multistakeholder processes, participation, socioecological systems. *Environ Health Perspect* 111:669–675 (2003). doi:10.1289/ehp.5332 available via <http://dx.doi.org/> [Online 23 January 2003]

Over the past century a range of disciplines have provided diverse resources and a rich heritage of knowledge relevant to environmental health theory and practice. In this commentary we briefly review the core themes and generic concepts emerging from environmental health, ecology and health, and human ecology. Through these fields, we can trace various approaches to identifying health differences and strategies for health promotion and protection that can generate health “benefits”—generally measured as decreased morbidity and/or mortality. Environmental health, ecology and health, and human ecology each provides constructs applicable to public health interventions at different scales of temporal, spatial, and conceptual complexity. These constructs are not mutually exclusive, because approaches attuned to deal with complex issues can also provide useful new insights to address more basic problems. The three fields should be seen as complementary approaches to addressing overlapping problem fields in health, environment, and development.

Our commentary highlights the increasingly complementary and converging work of the last two decades and argues for a further conceptual and methodological integration of knowledge and action to ensure comprehensive and sustainable environmental health gains. Our contention is that research and applied programs that integrate biophysical and social sciences with public health practice can go some way toward addressing the deficiencies in each approach when taken on its own. We also propose that reconsideration of more integrated conceptual frameworks as well as methodological choices can enable more comprehensive understandings of the complex ecosystem and social dimensions of multiscaled health problems and potential interventions.

Environmental Health

A broad definition of environmental health encompasses “the theory and practice of assessing and controlling factors in the environment that can potentially affect adversely the health of present and future generations” [World Health Organization (WHO) 1993, p. 18]. As a science, environmental health has traditionally been grounded in medicine, epidemiology, toxicology, chemistry, ecology, and physics, with an associated focus on protection through regulation and standards (Institute of Medicine 2001). Consequently, practitioners of environmental health generally concern themselves with the more direct, biophysical effects of the environment on human health.

The “germ theory” origins of environmental health are well illustrated by the cause-and-effect approach adopted by early practitioners such as John Snow, who was able to abort the 19th century cholera epidemic in London by removing the handle from the Broad Street pump—the major source of contaminating water. Increased understanding of infectious diseases progressed to provide the “agent–host–environment” triad as a basis for conceptualizing environment and health relationships, highlighting complex interrelationships between the triad components that extend beyond linear cause–effect mechanisms. When causal pathways become more blurred, such as those for cardiovascular disease, the injurious agents are often less obvious and their identification requires the “risk factor epidemiology” approach that has been dominant in the evolution of epidemiology in the second half of the 20th century (McMichael 1999; Pearce 1996). Although greater awareness of the importance of human behavior and social processes is

emerging in environmental health practice, the basic approach is still one of health promotion and health protection largely focused on individual risk factors such as exercise, diet, and smoking or preventing hazardous environmental exposures such as microbiological contamination or toxic substances.

Prompted by the agent–host–environment triad approach to infectious diseases, evolution of social epidemiology enabled a primary focus on those factors in the host’s social environment that may influence exposure (and response) to environmental hazards. Through explicit focus on the social environment, social epidemiology has acknowledged the importance of factors such as crowding and social inequalities, drawing attention to both the political economy of socioeconomic factors (e.g., deprivation, poverty) and psychosocial processes influencing health (Krieger 2001).

Although for historical and institutional reasons the theory and practice of environmental health have to some extent remained dichotomized between biophysical and social environments, the intersections between the two are highly relevant and still often overlooked. The importance of these links is perhaps most clearly illustrated by concerns regarding environmental justice and environmental equity (Institute of Medicine 1999; Stephens 1998). Hazards in the physical environment remain disproportionately the burden of individuals, households, and societies that also face inequalities in terms of socioeconomic discrimination and/or psychosocial stress from their social environment (Institute of Medicine 1999; McMichael et al. 2000; Stephens 1998). The roles of social and economic development, as both drivers and mediators of hazardous environmental exposures, and the need for an ecologically sustainable development are increasingly important challenges in environmental health. (McMichael 2002; Shahi et al. 1997; Woodward et al. 2000).

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Furthermore, the theoretical development of eco-epidemiological approaches (Hales et al. 1997; Susser and Susser 1996), a “social–ecological” systems perspective (McMichael 1999), and ecosocial perspectives (Krieger 2001) and the challenge of multilevel epidemiology in both social and environmental context (Blakely and Woodward 2000) are working examples of the demand for advances in theory, research, and practice that can integrate more effectively the biophysical and social dimensions of environmental health.

Important contributions of environmental health to our well-being lie in the provision of safe resources (water, air, food) and a safe environment (home, work, leisure) within which society and individuals can thrive. The inadequacy of the traditional environmental health approach lies in its limited capacity to identify interventions or remedies for problems that are complex and remote in either time or place (or both). For example, literature shows that the recommendation to decrease carbon dioxide emissions is not one that follows easily from observing an increase in the incidence of melanoma, which illustrates why complex contemporary issues such as global climate change have pushed the conceptual limits of the traditional environmental health paradigm [Hales et al. 1997; Intergovernmental Panel on Climate Change (IPCC) 2001; McMichael et al. 1996]. Such indirect linkages are more easily explored by borrowing from the science specifically dedicated to analyzing complex biological relationships, namely, ecology.

Ecology and Health

The science of ecology aims to understand the networks of interactions among individuals, populations, communities, and their environments, often in the context of food webs or energy cycles (Odum 1971). The science can be applied to a number of environmental health issues, for example, gastrointestinal pathogens and other potential hazards in freshwater ecosystems (Adams and Greeley 1996; Weinstein et al. 2000), where relevant knowledge from fields such as limnology, microbiology, hydrology, and geographic information systems are integrated. Public health interventions may then be devised on a broader scale than traditional “end-of-pipe” health protection approaches to preventing exposure to an injurious agent (Weinstein 1997). Case study 1 contrasts traditional environmental health and ecosystem approaches in the case of infection with Ross River virus (RRv).

Case study 1: an ecosystem approach to Ross River virus prevention in Australia. RRv—a mosquito-borne virus circulating in populations of kangaroos and some other animals—can cause seriously debilitating joint pain in humans. The traditional public health intervention for this disease involves

mosquito control: draining or poisoning the waters in which larvae grow, spraying adults, screening houses, and using mosquito coils. Despite these interventions being employed, the number of reported cases of RRv infection in Australia continues to increase.

A major reason for this increase rests with the infringement of urban and agricultural ecosystems on natural ecosystems, thus exposing the human “accidental” host to an otherwise innocuous viral transmission cycle. In addition, it is possible that traditional interventions may exacerbate rather than ameliorate the situation; the reason for this only becomes clear with an ecological analysis of the environment in which transmission is taking place.

It is possible for an outbreak to occur when, under favorable climatic conditions, an area endemic for RRv expands to include a previously nonimmune population (Figure 1A) via the dispersal of infected mosquitoes, kangaroos, and/or people. In such a situation, it is often appropriate to control mosquitoes to reduce case numbers, as described above. However, in the context of expanding populations impinging on natural ecosystems, outbreaks can also result from nonimmune populations entering an endemic area (Figure 1B).

In the scenario shown in Figure 1B, mosquito control may arguably cause more cases of RRv infection than it prevents. Usually children who live in an endemic area are exposed to RRv from an early age, develop immunity to the virus, and never show symptomatic disease. However, if their exposure is delayed by mosquito control, a susceptible cohort of individuals can develop that is likely to experience an outbreak of disease at some later stage. Thus, the very interventions we apply to reduce the incidence of the disease can, in these circumstances, make things worse. Rather than nonspecific mosquito control measures in endemic areas, an ecological approach identifies specifically targeted interventions that would arguably be more appropriate, such as health impact assessment of urban development and mosquito avoidance education for nonimmunes in endemic areas.

By disrupting a stable transmission pattern in a stable ecosystem, we can create the impression of having to deal with an “emerging” infectious disease—a situation that could have been avoided had interventions been applied according to ecological rather than more traditional environmental health principles. Here we see that traditional intervention can even increase health problems, whereas an ecosystem approach uses a broader, interlinked understanding of the populations, health issues, and potential interventions involved.

Other examples of traditional versus ecologically sensitive approaches include the comparison of public health interventions through building water treatment plants and

the alternative of maintaining the integrity of freshwater ecosystems at the scale of river catchment through sustainable land-use practices, keeping stock out of waterways and revegetating riparian zones (Motueka Integrated Catchment Management Project 2001; Parkes and Panelli 2001; Parliamentary Commissioner for the Environment 2000). At a larger scale, an ecology and health approach has proved helpful in analyzing global environmental issues with causal pathways rooted in anthropogenic environmental disruptions; the potential spread of vector-borne diseases with increasing global temperatures and rainfall has been one productive area of such research (Hales et al. 1999; Maelzer et al. 1999). The ecology and health approach tends toward synthesis rather than reduction, enabling multiple points of intervention to be identified in complex systems that affect population health.

In the same way that social and biophysical environments were identified as overlapping within the field of environmental health, we now reach a point in our discussion where the societal stewardship of ecosystems becomes relevant. Broadly speaking, processes of social, cultural, and economic development are often the drivers of ecosystem disruption that, as discussed in this article, can have various potential health effects. The practice of “ecology and health”-based public health must therefore move toward greater acknowledgment and understanding of the relationship between health, environment, and social processes of development that act at many scales, from global environmental change to river catchments or urban and built environments (Parkes and Panelli 2001; Pederson 1996).

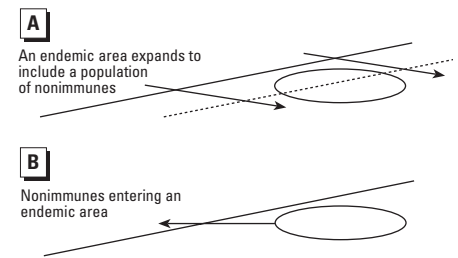


Figure 1. An ecosystem approach encourages improved intervention in response to different scenarios of RRv transmission. (A) An area with endemic RRv (solid line) expands via mosquitoes or carriers such as kangaroos (arrows and dotted line) to impinge on a nonimmune population (oval). (B) A nonimmune population (oval) expands via urban and agricultural development (arrows) to impinge on an endemic RRv area (solid line). Whereas traditional mosquito control may enable a short-term reduction in RRv cases in nonimmune populations, it prevents development of immunity from an early age, increasing vulnerability to future outbreaks. An ecosystem approach would highlight avoidance for nonimmunes and recognize the long-term benefits of developing childhood immunity to RRv. Adapted from Parkes and Weinstein (In press).

The leading contributions of ecology and health to our well-being lie in cementing the linkages between temporally and spatially removed hazards and their indirect health effects. Using this approach, health values can support interventions aimed at sustaining ecosystem services such as clean air, water, and soil and promoting ecosystem conditions that enhance human well-being (Aron and Patz 2001; Cole et al. 1999). The shortcoming in an ecology-and-health approach lies in its tendency toward a biophysical approach that can easily overlook the social, cultural, and economic driving forces that are crucial to understanding anthropogenic ecosystem disruptions and their human health impacts (McMichael 2001). An understanding of a species' ecology includes an analysis of behavior and evolutionary survival strategies; an understanding of ecology and health should include a similar understanding of the species responsible for environmental change, namely, humans.

Human Ecology and Health

Human ecology involves the study of human–environment interactions and extends notions of ecology and health by explicitly traversing boundaries between “nature and culture” and “environment and society.” In keeping with distinctions between the “biophysical” and “social” environment, or environmental and socioeconomic determinants of health, definitions of human ecology are characterized by biophysical and sociological interpretations of the term “ecological.” With origins in the work of Park and Burgess (1924), sociological definitions of human ecology adopt ecological concepts as metaphors for social and organizational processes (Gaziano 1996; Park and Burgess 1924). Sociological approaches emphasize those aspects of human ecology that focus on social processes and relationships within and between individuals and the rest of society, especially exemplified by urban environments. However, when framed as the study of ecosystems that involve humans (Catton 1994) or the relationships between people and their environment (including social systems and ecosystems) (Marten 2001), human ecology can be seen to be particularly complementary to an ecology and health perspective. With an ecosystems approach, the relevance of human ecology is independent of the extent of anthropogenic impact on ecosystems (from urban to pristine environments) and is aligned not only with the science of ecology (Hawley 1944) but also with contemporary understanding of the complexity of, and links between, social and ecological systems (Holling 2001; Waltner-Toews 2001).

By focusing on human–environment interrelationships within ecosystems, human ecology highlights direct and indirect health impacts caused by unhealthy trajectories of development, anthropogenic ecosystem

change, and related social inequities (Follér 2001; Levine and Levine 1994; Marten 2001). Foci on “health” are not always explicit, but human ecology is based on the premise that developmental processes and human health gains are entirely dependent on ecosystem services (Costanza et al. 1997; Daily 1997). Human ecology also has conceptual links with other approaches that recognize human health as being closely coupled with the condition, health, and integrity of ecosystems (Pimentel et al. 2000; Rapport 1997; VanLeeuwen et al. 1999). By investigating the reciprocal relationships among and between humans and their biotic and abiotic environment, human ecology must also engage with the role of social, cultural, and economic development as a driving force behind ecosystem changes at all scales. A human ecology approach to health therefore sees local health patterns within a global context, recognizing links to trends in population growth, resource depletion, and environmental deterioration, and the importance of the cultural and social changes of globalization, free market liberalization, and increasing socioeconomic inequity (Follér 2001; Last 1998; McMichael et al. 1999).

Human ecology draws attention to the synergies between social and physical environment as determinants of health, and the opportunities these synergies create for both health protection and health promotion strategies. The relevance and application of a human ecological perspective are especially evident in research and policy responses to the challenges of adaptation, vulnerability, and resilience in relation to environmental change, including global climate change (Barnett 2001; Ribot et al. 1996; Woodward et al. 1998). Human ecology highlights synergies between social and ecological resilience (Adger 2000; Berkes et al. 1998; Marten 2001) and considers them fundamentally relevant to public health. From a human ecological perspective, social resilience is the capacity of a group or community to cope with external stresses and disturbances resulting from social, political, and environmental change, and ecological resilience is the buffer capacity of ecosystems—arguably enhanced by functional diversity—that enables continued functioning despite severe and unexpected stresses (Adger 2000; Holling 2001; Levin et al. 1998; Rapport et al. 1998). Together, social and ecological resilience are seen as integral, interconnected foundations from which to achieve public health gains.

The strength of a human ecology perspective rests in its ability to highlight the double health inequities of social and environmental disruption, as well as the potential “double dividend” of health benefits by building both social and ecological resilience. The shortfall of a human ecological approach to public health is

that health considerations are often implicit, and because complexity is such that causal attributions are not always clear, certainty of predictions and appropriate interventions may remain elusive. Based on increased understanding of complex socioecological systems, research and policy from a number of contexts are moving toward a level of integration that can enable public health interventions to be based on the synergies between biophysical and social systems. We discuss the implications of these convergences for environmental health theory, research, and practice in the next section.

Complements and Convergence: Future Theory and Practice

Environmental health, ecology and health, and human ecology perspectives have supported diverse activities in academic, policy, and project circles. In the last 15 years this work has developed complementary—and often converging—calls for integration, both in theoretical and practical assessments of health and in strategies for intervention and improved health outcomes. Table 1 illustrates the types of academic, policy, and project work that have developed during this time. A chronology is used to structure this display, demonstrating a cumulative trend in both academic and policy/program initiatives and identifying three core themes that can inform future theory and practice in environmental health.

First, the academic and policy/program arenas in Table 1 show increasing awareness of the complex ecological and social systems underlying environmental health issues. The recognition is accompanied by calls for rigorous and innovative forms of integrated theoretical and/or applied work (Borrini-Feyerabend 1995; Cole et al. 1999; Institute of Medicine 2001; IPCC 2001; Soskolne and Bertolini 1998). Second, effective advances will rest on comprehensive combinations (including multilevel analyses) of both biophysical and social dimensions of environment and health across different temporal and spatial scales (Hales et al. 1997; Krieger 2001; McMichael 1999; Rapport et al. 1998). These composite approaches recognize the importance of intergenerational and interregional issues when health effects of ecosystem change are displaced in time and space (Aron and Patz 2001; Hales et al. 1997). Third, ecosystem principles provide core resources for understanding and responding to complex environment, health, and sustainability challenges—through concepts such as systems interactions, ecological hierarchies, ecosystem services, and the mutually constitutive relations within and among biotic and abiotic influences on health (Kay et al. 1999; Levine and Levine 1994; McMichael et al. 1999; Pimentel et al. 2000; Waltner-Toews and Wall 1997).

By following the chronology of key developments through Table 1, a convergence becomes evident. This convergence consists of an integration of the biophysical and social environment in which environmental health is practiced. Together, these themes highlight the relevance of new conceptual frameworks for responding to current challenges in environmental health research and practice. The convergent themes highlight that it is no longer acceptable or necessary to consider the environmental hazards of ecosystem change in isolation from, or as an inevitable trade-off for, the socioeconomic and public health benefits of development; neither is it appropriate to consider environmental sustainability as a limitation to socioeconomic gains. Rather, innovation is required to optimize environmental health protection and promotion at the interface between environmental and social determinants of health.

An example of environmental health promotion and protection contributions at the “social–ecological interface” is provided by the evolution from a river-catchment–based environmental health research initiative into an externally funded community-catchment forum described in Case study 2.

Case study 2: linking ecosystem and social systems for health and sustainability—ecosystem-based community-oriented research in a river catchment. Attention to the links between environmental and socioeconomic determinants of health was the focus of a health and sustainability project at the spatial scale of a river catchment (Parkes and Panelli 2001). In the Taieri Catchment and Community Health (TC&CH) project, the environmental health issues of concern included the direct health impacts associated with the ecological determinants of water-related disease and the indirect health impacts of catchment management, freshwater ecosystem change, and rural sustainability mediated through socioeconomic determinants of health. Early phases of the TC&CH project identified existing knowledge strengths and deficits regarding catchment and community health issues and established collaborative relationships with community reference groups and co-researchers to note and respond to gaps in understanding and action. Community reference groups involved participation of residents living throughout the 5,650-km² rural river catchment in the southeast of New Zealand’s South Island. Co-researchers included agencies, researchers, and indigenous

organizations involved with science and decision making regarding environment, health, development, and conservation issues in the catchment. The participatory action research process identified participant priorities and concerns regarding freshwater quality and quantity issues. It also facilitated the transition from the TC&CH project through a community–university partnership to the Taieri Alliance for Information Exchange and River Improvement (the TAIERI Trust). This trust represents the move from separate university and community interests to an integrated organization combining the principles and practical implementation interests of community, academic, and agency stakeholders. Capacity and resources for this externally funded community-based catchment forum have been enabled through the multistakeholder participation of the community reference groups and co-researchers in the TC&CH project.

As an inclusive social process, the community-based TAIERI catchment forum has the potential to benefit health not only through its activities relating to the health, safety, and sustainability of freshwater ecosystems but also by fostering empowerment, participation, and social cohesion (Baum 1999b; Cattell 2001).

Table 1. Examples of integration: theoretical and policy/practice cases, 1985–2001.

Key developments in research and theory development	Key developments in international policy, practice, and implementation
Late 1980s/early 1990s: building links between environment, health, and sustainable development	
Population health perspectives (Rose 1985)	The Ottawa Charter for Health Promotion (1986): socioecological approach to “creating supportive environments”
Human ecology and health–environment interrelationships (Boyden 1987)	“Sustainable Development” and the Brundtland Report (World Commission on Environment and Development 1987) as background to the United Nations Conference on Environment and Development (1992); Earth Summit and Agenda 21 (United Nations 1992)
Health and sustainability: health as a sustainable state (King 1990); health–environment–economy relationships (Labonte 1991); environmental limits and sustainability as prerequisites for health (McMichael 1993); health development and the community ecosystem (Hancock 1993)	<i>Our Planet Our Health</i> (WHO 1992)
Mid-1990s: ecological and ecosystem approaches	
Ecosystem footprints and ecosystem services as central concepts for sustainability (Costanza et al. 1997; Wackernagel and Rees 1995)	<i>People and the Environment</i> (World Resources Institute 1994): focused on population and the environment, natural resource consumption, women and sustainable development
Ecological context for infectious diseases (Pederson 1996)	
Ecosystem principles and human health: ecological approach to public health intervention (Hales et al. 1997; Weinstein 1997); primary environmental care as public health action (Borrini-Feyerabend 1995); ecosystem health (Rapport 1997); health as “capacity” within complex socioecological systems (Waltner-Toews and Wall 1997)	<i>Health and Environment in Sustainable Development</i> (WHO 1997) framed by the DPSEE model (driving force, pressure, state, exposure, effects, action) WHO, United Nations Development Programme, and the Rockefeller Foundation: links between environment, development, and health (Shahi et al. 1997)
Late 1990s: integrating social and ecological systems	
Interface between social and ecological systems (Berkes et al. 1998); social, natural, and health sciences (Rapport et al. 1998)	WHO discussion document on ecological integrity and sustainable development as cornerstones of public health (Soskolne and Bertollini 1998)
Linking globalization, environmental change, vulnerability, and health (McMichael et al. 1999; Ribot et al. 1996; Woodward et al. 1998)	World Conservation Union: ecosystem approach to freshwater management (IUCN 1998)
Complex systems and adaptive methodologies for ecosystem sustainability and health (Kay et al. 1999; VanLeeuwen et al. 1999)	3rd WHO Ministerial Conference on Environment and Health (16–18 June 1999, London, UK); environmental health and public participation (Braswell et al. 1999)
Health promotion: framing links between human and ecosystems (Cole et al. 1999); local action toward sustainability (Doris 1999)	World Resources Report 1998–1999 (World Resources Institute 1998): environmental change and human health
Convergences: ecological and social resilience as foundations for protecting and promoting public health	
Integration: environmental and socioeconomic determinants of health (Woodward et al. 2000); ecosocial (Krieger 2001); ecological integrity (Pimentel et al. 2000), ecosystem change and public health (Aron and Patz 2001)	World Conservation Union: co-management of natural resources (Borrini-Feyerabend et al. 2000)
Linking social and ecological resilience at global and local scales: human ecological perspectives (Adger 2000; Marten 2001)	Intergovernmental Panel on Climate Change, Third Assessment Report (IPCC 2001): focused on impacts, adaptation, and vulnerability
Participation as mediator of research innovation and public health gains in the context of both physical and/or social environments (Baum 1999a; O’Fallon and Deary 2002; Parkes and Panelli 2001; Witten et al. 2000)	Canadian International Development and Research Centre, Ecosystem Approaches to Human Health Program (IDRC/CRDI 2000)
	Preparations for the World Summit on Sustainable Development (Johannesburg, South Africa, 26 August–5 September 2002): emphasis on multistakeholder processes and intersectoral action (Hemmati 2001; von Schirnding and Mulholland 2002)

As a community-oriented, ecosystem-based example of environmental health research, the catchment case study illustrates practical opportunities for synergies between ecosystems and social systems that foster a double dividend for public health through the environmental and socioeconomic determinants of health. The project highlights the potential of environmental health research and practice undertaken at the social-ecological interface with ecosystem and social outputs. Environmental health research and practice of this type foster a synergistic double dividend for public health (Figure 2) and point to the need to understand the driving forces of governance, development, and power as well as the specific local realities of people and place.

At the local level, complementary initiatives such as local Agenda 21 and Healthy Cities programs (Dooris 1999) have highlighted both success factors and barriers to operationalizing the socioecological perspective—originally proposed in the Ottawa Charter in 1986 as an approach to promoting safe and healthy environments (Kickbusch 1997; Ottawa Charter 1986). Opportunities for innovation are also found in the convergences toward participation and multistakeholder processes, to enhance stewardship of ecosystems and human health, on one hand (Borrini-Feyerabend 1995; Witten et al. 2000), and as a public health investment through health-promoting and -protecting effects of social cohesion and social capital, on the other (Baum 1999a, 1999b; Kawachi and Berkman 2000).

These overlapping themes support the demand for research and practice focused on enhancing both social and ecological resilience—creating a double dividend of public health benefits. Concentrating research and policy on the adaptive capacity to respond to environmental change at different scales is a challenge evident in the IPCC working group report on impacts, adaptation, and vulnerability to climate change (IPCC 2001). Ecosystem approaches to human health propose theory and practice whereby solutions are based on ecosystem management rather than health sector interventions (IDRC/CRDI 2000; Waltner-Toews 2001). Such approaches reduce vulnerability and improve human health and well-being through interventions that simultaneously enhance ecosystems and respond to local community needs.

Methodologically, participatory action research that enables scientific, policy, and lay interaction emerges as a central approach to future (academic and applied) programs that are responsive to current environmental health challenges (O’Fallon and Derry 2002; Parkes and Panelli 2001; Witten et al. 2000). Principles of multiparty participation, knowledge sharing, and action relevant to

environmental health have been advanced in numerous forms and contexts (Funtowicz and Ravetz 1994; Hemmati 2001; Institute of Medicine 1999; Shahi et al. 1997; WHO 2000). These approaches explicitly acknowledge the importance—and the challenge—of prioritizing processes for effective exchange between the diverse groups implicated by complex environmental health issues. Such processes should emerge as an integral component of future research and practice. Developments in community-based participatory research (O’Fallon and Derry 2002) and community environmental health action plans (Brown et al. 2001) illustrate some ways forward, especially at the interface of environmental and social justice issues. The catchment and community health project described in case study 2 illustrates participatory action research as the basis for a social process that can link ecosystems and social systems within a river catchment to provide benefits for both health and sustainability.

Beyond specific programs, however, our call is made for generic approaches and dialogue that connect the contrasting expertise, power, and experience of institutions, experts, and social groups as they address environmental health agendas from international through local scales. One proposal to integrate the converging paradigms of environmental health is

the prism framework for health and sustainability. The three-dimensional framework is shown in Figure 2 in relation to six interacting axes linking ecosystems and social systems as foundations for health and sustainability. The “prism” of health and sustainability illustrates the implications for the theory and practice when the interrelationships between driving forces, ecosystems, social systems, and health are made explicit. Development, governance, and power are explicitly depicted as drivers of both ecosystem and social change, with converging implications for the environmental and socioeconomic determinants of health that cannot be ignored in 21st-century environmental health research or practice.

The prism illustrates the three converging themes outlined in this commentary: the need for integrated approaches to research and policy, methods that can engage with the synergies between the social and physical environment, and the incorporation of ecosystem principles into research and practice. This framework portrays the spectrum of stakeholders (disciplines, sectors, agencies, and communities) implicated by the “big picture” of environmental health issues. The application of this framework necessitates commitment to multilayered processes of integration (Parkes 2003; Parkes and Panelli 2001). Furthermore, the interactions and

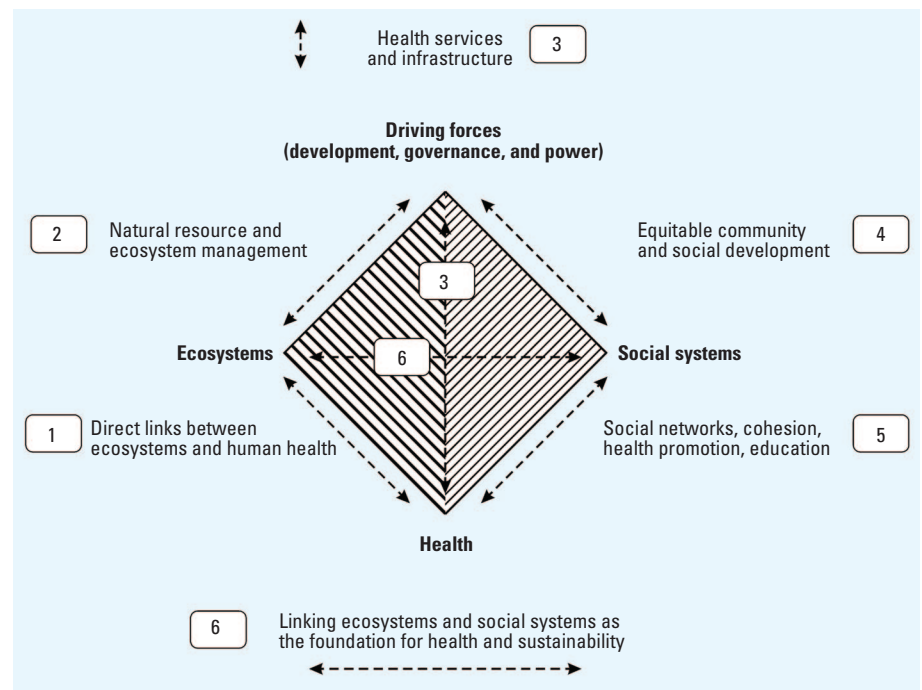


Figure 2. Prism framework of health and sustainability. 1, Direct links between ecosystems and human health (traditional environmental health); 2, natural resource and ecosystem management (including land and water use); 3, health services and infrastructure (including water and sanitation services); 4, equitable community and social development (including socioeconomic determinants of health); 5, social networks, cohesion, health promotion, and education (including social capital); 6, linked socioecological systems (synergies between the environmental and socioeconomic determinants of health can arise when social processes generate health benefits through empowerment, justice, and social cohesion while also enhancing ecosystems). Adapted from Parkes (2003).

reciprocity between the six axes of Figure 2 illustrate that dialogue and integration between diverse stakeholders can make an integral contribution to understanding and responding to a new generation of health and sustainability challenges.

Theory, research, and practice in environmental health have always evolved in relation to topical challenges across the overlapping problem fields of health, environment, and development. Recent trends in environmental health, ecology and health, and human ecology all suggest that the interface between sustainability, ecosystems, social systems, and health is fertile ground for optimizing environmental health interventions and maximizing public health gain. Only with an integration of theory and a complementary methodology that incorporates scientific, institutional, and community players will interventions be devised to permit substantial gains in environmental health.

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