Chapter 17
Human-Environment Research: Past Trends, Current Challenges, and Future Directions

Eduardo S. Brondízio and Rinku Roy Chowdhury

Abstract This chapter reflects on issues and questions underscoring the preceding chapters while providing a brief overview of current and future directions in the study of human-environment interactions. A discussion of future directions begins with recognizing that the challenges of studying complex coupled human-environment systems are not new, although current processes of globalization and climate change render such challenges pressing, and of wider societal relevance. In this brief overview, we highlight questions related to institutions, ecosystem services, health, adaptation to climate change, urbanization, and methodological challenges.

This chapter reflects on issues and questions underscoring the preceding chapters while providing a brief overview of current and future directions in the study of human-environment interactions (HEI). A discussion of future directions begins with recognizing that the challenges of studying complex coupled human-environment systems are not new, although current processes of globalization and climate change render such challenges pressing, and of wider societal relevance.

As we look into the present and future of HEI research, we are challenged with many of the same long-standing questions confronted from a variety of disciplinary angles as in past decades. These challenges pertain to complexity, scale, heterogeneity, governance, and barriers to interdisciplinary bridging, among

E.S. Brondízio (ES)
Department of Anthropology, Anthropological Center for Training and Research on Global Environmental Change, School of Public and Environmental Affairs, Indiana University, Bloomington, IN, USA
e-mail: ebbrondiz@indiana.edu

R.R. Chowdhury
Geography Department, Indiana University, Student Building 120, Bloomington, IN 47405, USA
e-mail: rroychow@indiana.edu

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other themes. Although we are constantly improving upon methodological tools and analytical concepts in human-environment research, a key challenge remains to bridge disciplinary knowledge to the demands of (interdisciplinary) problems we face today. This has been a central concern for the contributors to this volume. Different disciplinary traditions have confronted the question of how local populations interact with larger social, ecological, and economic processes and how we understand complex pathways of change and transitions in HEI systems and their variance across scales. These questions have required the research community to consider the tradeoffs of scaling up (and down) human-environment analysis and confront common yet questionable assumptions about different degrees of social and environmental homogeneity. We have learned that context, units of analysis, and the choices of temporal and spatial scales regarding the questions asked can strongly influence the understanding obtained. Yet, the many challenges of scaling (e.g., how to gain insights into lower-level phenomena from broader-scale behavior or vice versa) continue to define an important conceptual and analytical frontier for the HEI research community and the social sciences in general.

It is important to recognize the evolution of such efforts, as discussed in the introduction to this volume and illustrated in different chapters, as part of the effort put toward interdisciplinary approaches to HEI research. We have come a long way from opportunistic methodological and theoretical borrowing to increasingly interdisciplinary and collaborative research frameworks (Moran 2010; Ostrom 2009). The emergence of social-ecological systems frameworks, as discussed below, illustrates relevant advancements on this front. Progressively, these developments are influencing the training of a new generation of scholars and practitioners equipped with language and skills to address old, new, and pressing questions confronting us today. In these and other frameworks, there is a critical need to detail the historical trajectories of HEI systems in order to generate accurate and robust understanding of their dynamics.

17.1 Global and Regional System: HEI Research for a Changing World

Acknowledging the long history of challenges for HEI research as referred to above does not preclude us from recognizing that we are confronting social and environmental problems at a scale that is unprecedented in human history. As a result of social-economic-political changes intensified during the past 50 years, there are indications that we are beginning a period of global and regional shifts (Lenton et al. 2008; Steffen et al. 2004). The (tele)coupling of climate change, heretofore uncoordinated (or only loosely linked) economic systems, demographic transitions, and sociocultural and political transformations are altering human-environment systems, introducing new patterns of complexity, higher levels of unpredictability, and uncertain outcomes (Rockström et al. 2009). Social and environmental systems in the Global North as well as South are facing critical thresholds and tipping points, and these social-environmental interactions present further surprises. Agreement is growing in the diverse HEI research community that understanding these questions requires more attention to longer temporal scales and to their underlying historical processes (Balsby and Erickson 2006; Dearing et al. 2010). These questions raise opportunities for HEI research and numerous methodological challenges.

No matter which continent, local and regional changes are related to larger national and global historical contexts that pose key methodological and conceptual challenges to HEI research. How can we account for historical differences while also learning from comparative analysis? How can HEI research assess or adjudicate among the path dependencies of human-environment outcomes in different societies? How do problems of scale and governance express themselves in different places? Are there common patterns or “syndromes” (Geist and Lambin 2004; Potschel-Held et al. 1999) of changes in HEI through time and across regions?

Research needs to consider the various historical bases for different social-political-economic processes shaping HEI. Since WWII, development policies and demographic trends have set in motion major regional transformations around the world. More recently, a variety of structural adjustment and economic development programs, trade liberalization policies, and networks of commodity exports have spread and intensified. The social and environmental impacts of structural adjustment programs have been diverse. In some cases, they have been marked by the exponential expansion of large-scale agriculture export, deforestation, and pressure on small-scale producers. In other cases, dependence on imported food has been growing, in parallel to retracting rural economies and aging populations, followed by reforestation. Throughout the world, however, the expansion of urban areas has been striking and marked by significant infrastructural deficiencies, high poverty rates, and various types of links to rural areas. The scope of cultural changes has been equally remarkable. Many regions of the world have seen parallel processes of “de-agrarization” (i.e., diversification in economic activities, income sources, and social identity of rural producers with rural households moving to nonagricultural activities), “de-peasantization” (i.e., relocation of rural families to urban areas with shifts in livelihood basis and social identity), as well as new kinds of ethnogenesis (i.e., reclaiming of indigenous identities frequently associated with land rights, ecotourism, and access to incentives). In parallel to infrastructure and urban expansion, the number and expanse of protected areas for environmental conservation have increased exponentially, which have offered both opportunities and conflicts for different social groups. As illustrated by the preceding chapters, today, infrastructure expansion, commodity production and deforestation, social change and urbanization, and a myriad of new institutional arrangements underlie an evolving matrix of social-territorial complexity worldwide. This is the context defining current and future directions for HEI research.
17.2 Current and Future Directions in HEI Research

As the preceding chapters illustrated, a suite of new questions, themes, and methodological approaches are defining the current and future landscape of HEI research. In this brief overview, we highlight questions related to institutions, ecosystem services, health, adaptation to climate change, urbanization, and methodological challenges.

The diffusion of new institutional arrangements and forms of defining territoriality for the purpose of resource governance is altering social and ecological environments and introducing new configurations of HEI worldwide. The spread of new institutional arrangements extends to resource governance as evidenced in the increase in protected areas and community-based conservation. Also of note is the overlap among government, private, and common-pool arrangements and the risks of compounding institutional failure (e.g., Acheson 2006). Significantly, current shifts in markets and governance globally may increase the connectivity and functional interdependence among different institutional arrangements on one hand and reducing or severing such functional connectivity on the other. For instance, the emergence of new commodity markets has linked local livelihoods as well as ecologies to global economic boom-bust cycles. At the same time, traditional dependencies in local places may be disrupted. Thus, the rise of capital-intensive commodity farming or land tenure “reform” is altering the decision logics of sedentary agriculturalists (such as in East and West Africa) who previously allowed herds owned by itinerant pastoralists to graze their fallow fields while benefitting from the resultant “natural” subsidy to soil fertility. As a result, local forms of use and regulation of resources, although potentially effective at one level, are affected and in some cases overwhelmed by resource use or a shift in a different part of the larger system (Brondizio et al. 2009). Such changes raise important questions for HEI research, such as how different types of management arrangements may help facilitate solutions to intricate cross-level problems.

During the past decade, the concept of ecosystem services has emerged as a way to call attention to human dependence on natural resources and ecosystem functioning. Frameworks for the analysis of ecosystem services, such as that proposed by the Millennium Ecosystem Assessment (2005), have focused on the dependence of human well-being on provisioning, regulating, supporting, and cultural ecosystem services. While the focus on human well-being represents a major advance for HEI analysis, the concept of ecosystem services has been used in particular to highlight the economic value of biodiversity and ecosystem functioning. New research and policy agendas for payment for different types of ecosystem services have emerged and are rapidly creating new forms of institutional arrangements and economic incentives of importance to local populations as well as to national governments. For instance, programs such as Reduced Emissions through Deforestation and Degradation (REDD) are quickly developing, particularly in tropical regions. The effectiveness and social impact of these programs remain to be seen and represent an important dimension of HEI in coming years.

The new United Nations Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) calls for interdisciplinary research very much along the lines of HEI. The research community of HEI is uniquely positioned to contribute to IPBES’s mission of assessing interactions among ecosystem services, biodiversity, and human well-being at multiple levels of analysis, and in ways that include local and indigenous knowledge systems and that are relevant to policy and to different social groups. In this context, land use and cover change continues to be an important theme in HEI, both in terms of understanding trajectories of landscape change and its implication for biogeochemical cycles and biodiversity, as well as in terms of food production systems and local economies. Global climate change scenarios point to environmental shifts in food production areas representing risks and opportunities for local populations. The role of small-scale, decentralized production around urban areas is growing in importance and deserves attention in terms of the contribution to food security and to trajectories of land-use change around urban areas. Similarly, the impact of so-called land grabs on local populations and on land-cover change in different parts of the world, particularly in the tropics, deserves attention from the HEI community. Consumption and changing consumption patterns represent another important linkage to, among other issues, land-use and land-cover change. Changing consumption patterns in rural and urban areas link local to global economic systems through feedback loops with far-reaching environmental and social consequences. Understanding the drivers and outcomes of changing consumption patterns in different parts of the world require new research approaches linking local-level studies to commodity chain and social networks that embed local decisions within wider social and economic networks.

Human adaptation to global climate change represents another major area of research in HEI. Studies of human adaptation to the environment have a long history in anthropology and cultural ecology. New research approaches are developing to study how local adaptive processes are incorporating new types of information and developing an understanding about new climate patterns and uncertainties (Brondizio and Moran 2008). Global environmental changes are affecting the geographic distribution of many vector-borne diseases, leading to increased human health risk (Confalonieri et al. 2007; Gubler 1998). A recent report by the National Research Council (2010) notes that where people live now affects their health more strongly than ever, necessitating spatially explicit approaches to modeling and predicting health outcomes. Malaria and dengue, respectively the world’s deadliest and fastest-growing vector-borne diseases, continue to claim lives in many regions including Africa, Asia, and Latin America. These diseases are borne by mosquito vectors that have complex life cycles and exhibit clear links to temperature, rainfall, and habitat conditions (DeFries et al. 2002; Halstead 2008; Hopp and Foley 2003), which are further linked to land/resource use by managers of different socioeconomic backgrounds and decision strategies (Molyneux 2002; Patz et al. 2004; Vanwanbeke et al. 2007). As the ultimate local agents of land management, households make land-use and related decisions (e.g., migration-related farmland abandonment, extended outdoor field labor, water storage practices) that may strongly affect disease vector exposures and infection risk (e.g., Somboon et al. 2004).
1993; Suwonkerd et al. 2002; Van Benthem et al. 2005). For instance, rural-to-urban migration is expected to change the worldwide distribution of disease and mortality (Harpham 1997). Of great concern is how rapid urbanization, social inequality, and climate variability in the developing tropics are jointly driving shifts in land cover and regional disease burdens.

Worldwide, urbanizing regions represent Earth’s most rapidly changing landscapes, with strong impacts on global biodiversity and biogeochemistry. Despite increasing social and ecological research in urbanizing systems, much remains unknown about their complex dynamics or about their resultant resource demand implications. Given the increasing concentration of the world’s population in urban areas, there is also a pressing need to better understand the connectivity and vulnerability of urbanizing coastal regions and their hinterlands. Patterns of urban development have multiple and significant ecological impacts. Urban sprawl may reflect variable urbanization densities; rates of loss in forests, farmland, and natural wetlands; and increases in impervious surfaces (Hesse and Lathrop 2003; Jantz et al. 2005; Medley et al. 1995). Landscape patterns and edge effects affect urban biodiversity and the connectivity of social processes; increase vulnerability to further landscape fragmentation, fire, drought, and other stressors; and affect regional and global biogeochemistry (Cochrane et al. 1999; Laurance and Williamson 2001; Laurance et al. 2001; Melles et al. 2003; Stein et al. 2005; Stohlgren et al. 1998). Urban design drives the extent and access to urban green space and infrastructure, with implications for environmental justice and human health (Jackson 2003). The determinants and dynamics of urban development and density are a significant focus of urban economics, geography, and planning (Alonso 1964; Alperovich 1982; Craig and Haskey 1978; Kau and Lee 1976; Mills 1970; Muth 1969). At the regional scale, urban expansion has been related to “pull” factors, such as employment and retail clustering, infrastructure, services, amenities, and cheap land, and “push” factors such as crime, taxes, land costs, and pollution (Mieszkowski and Mills 1993). Building densities in North American and European cities are a result of these processes operating over multiple time scales, including the clustering of industries and transportation infrastructure (Antrop 2004; Geyer and Kontuly 1993).

The heterogeneity and dynamics of suburban growth and decline in regions under variable stages of economic development remain arenas for further research. Formal and informal structures (institutions) of landownership/management drive urban land-use change (Bryant et al. 1982). In particular, rural-urban land conversion is a political process: it is embedded in broader sets of power relations mediating land change and entails policy choices designating land values for various uses, e.g., through zoning (Kelly 1998; see also York and Munroe in this volume). Social structures, local decisions, and ecological factors interact in complex ways to shape all urban environments at multiple scales (Roy Chowdhury et al. 2011). Developing urban areas worldwide reflect state, private, communal, and other property ownership structures; however, many urban and suburban landscapes are increasingly under private landownership and residential land use. Understanding these landscapes depends on adequately integrating their multiscalar, social-ecological dynamics, e.g., linking dynamics in social neighborhoods to municipal and state governance, and on integrating both social and environmental aspects. A deeper, integrated understanding is especially critical given the spatial pervasiveness of residential landscapes. The rapid expansion of residential land covers is driven by complex interactions among socioeconomic, political, and environmental factors. Within the United States, as in other parts of the world, losses of agricultural and forested land to urban and suburban uses are among the greatest sources of anthropogenic landscape change in the twentieth and twenty-first centuries, a concern intensified by the large ecological footprints of urban areas as they mobilize resource, commodity, and material flows affecting agricultural, forested, and other non-urban landscapes (Munroe et al. 2005). While expanding residential spaces are embedded with personal and social values (e.g., recreational, aesthetic, property), they also affect ecological structure (e.g., habitat fragmentation) and function (e.g., nutrient flows), creating a “self-imposed burden and hazard” (Pissore et al. 2011; Robbins 2007).

Methodological challenges in HEI research will continue to push the boundaries of disciplinary methodologies. The human-environment relationship at the local level, for instance, is in itself a multilevel process. Local resource users do not operate in a vacuum; they are embedded in systems of resource access and tenure, social-political relations, and external forces and create multilevel alliances and social movements that influence larger political processes. They also adopt and adapt multiscalar influences to foster their own livelihoods, including the way knowledge is developed. The complexity of these social-ecological systems also means that conventional models of causality are limited in capturing the direct and indirect “teleconnections” created by the growing globalization of resource use systems, the interactions created by distant demands for local resources (and vice versa), and the responses of different sectors of society to such demands. These interactions are mediated by social, political, and biophysical conditions that may function across levels (e.g., constitutional arrangements, major infrastructure, macroeconomic processes), while others are level specific (e.g., land tenure systems, resource use technologies). In order to address these challenges, it is important for the HEI research community to build upon proposed frameworks, such as the social-ecological systems framework proposed by Ostrom (2009), which have mechanisms to integrate local-level processes and institutional arrangements into cross-scale assessments. Many ongoing efforts are developing common language, protocols, and frameworks to collect and analyze and compare knowledge about resource management systems in a cumulative fashion.

Reconciling our analytical paradigms and disciplinary contributions with the complexity required to understand societal and environmental change today and in coming decades remains a stimulating challenge for the broader HEI research community. The chapters in this book illustrate a range of productive, collaborative, and inspiring approaches to examine past, present, and future human-environment interactions in different parts of the world. We hope this volume will support and encourage readers to reflect on and to engage with new frontiers of research and practice needed to inform society of more sustainable and equitable pathways for a changing world.
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**Note:** The terms “agriculture,” “Amazon,” “household,” “institutions,” and “land use” appear more than one hundred and fifty times in the text. For these terms, page numbers refer to the first instance of the term in each chapter.

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