CHAPTER 2

Framing Sustainability of Coupled Human and Natural Systems

Jianguo Liu, Vanessa Hull, Neil Carter, Andrés Viña, and Wu Yang

2.1 Introduction

Human–nature interactions have existed since the beginning of human history, but their scope and intensity have increased drastically since the Industrial Revolution, especially in the past several decades. Historically, most human–nature interactions were at the local scale, although some large-scale activities such as migrations and trade did occur. However, human–nature interactions at large scales have become much more frequent and faster than before (Liu et al., 2007a). With more people and fewer resources on the planet, the world has entered the epoch of the Anthropocene (Steffen et al., 2007).

As the human population continues to increase, human impacts have spread to every corner of the earth (e.g., IPCC, 2008, Marsh, 1864, Millennium Ecosystem Assessment, 2005, Thomas Jr, 1956, Turner et al., 1990, Vitousek et al., 1997). Both human and natural systems have become more vulnerable, and the earth has crossed several planetary boundaries (Rockstrom et al., 2009, Steffen et al., 2015). Such consequences have largely resulted from the historical views of human–nature relationships—humans should and can conquer nature (Liu, 2010), or humans can utilize nature without limits (Simon, 1996). Some scholars have recognized that human development is constrained by natural resources (e.g., Meadows et al., 2004) and that humans should maintain harmonious relationships with nature (e.g., in ancient Chinese and Native American cultures; Diamond, 2005, Shapiro, 2001). However, these views were largely downplayed or ignored in practice (Ehrlich and Pringle, 2008). For example, the major development model around the world has been “pollute first and clean up later.” Even though some areas were cleaned up later, improvements were often made at the cost of damaging other areas (Hird, 1993).

How to enable humans to prosper while sustaining natural systems is among the most challenging questions in the world today (Clark and Dickson, 2003, Kates et al., 2001, Matson, 2012). As human impacts continue to rise, more people have realized that the traditional human-dominant views cannot sustain life-supporting systems and new development paradigms are needed. A watershed event took place when the World Commission on Environment and Development published the historic document *Our Common Future* in which sustainable development was proposed (World Commission on Environment and Development, 1987). The research and management communities have widely accepted the concept of sustainable development (meeting the needs of the present society without compromising future generations), but the practice of sustainable development has lagged behind.

A major barrier to effective implementation of sustainable development is the lack of sufficient knowledge on the complex relationships between humans and nature. To help generate such knowledge, an integrated concept—Coupled Human and Natural Systems (CHANS)—has emerged. Coupled systems are those in which human and natural components interact (Liu et al., 2007b), emphasizing reciprocal interactions and feedbacks. These not
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Yang et al., 2013b). Previous literature concluded that the group size effect varies across contexts, which is true but lacks theoretical and empirical guidance for further research and practice (Ostrom 2005). But buttressed by years of work in our model coupled system (i.e., Wolong Nature Reserve), our study depicted the whole picture of a non-linear curve of group size effects on both collective action and resource management outcomes, and confirmed the general hypothetical mechanisms at play (Yang et al., 2013b). These findings from our model coupled system provide strong evidence that while there are many scale-dependent and context-dependent phenomena in coupled systems, there indeed are also generalizable properties (e.g., causal mechanisms) across scales and contexts. While it should be cautious to extrapolate findings from one coupled system to another, the study of model coupled systems can play a crucial role in pioneering new thinking, testing new methods, generating empirical evidence, and guiding research under varied contexts. Ultimately, model systems can help to synthesize empirical data, discover generalizable properties and build robust theories to guide decision-making and management practices.

Analogous to the well-known model organisms and model ecosystems, we have used Wolong Nature Reserve in China (Chapter 3) as a model coupled system since 1996. Our research on this model system seeks to understand the complexity of coupled systems and explore the utility of research results in planning, policy making, and governance. The work in Wolong relies on the conceptual framework (Figure 2.2 or earlier versions of this framework) presented above. Like almost all other frameworks, the one guiding our research has evolved over time with modifications to some specific components, but its core remains the same. Our work also builds on the theories and utilizes the methods we have highlighted above, which are constantly evolving. The model system approach has taught us a great deal over the years about our system in Wolong, and in turn about coupled human and natural systems in general. The rest of this book details our findings. We begin with an overview of Wolong (Chapter 3) and then synthesize various research projects we have conducted in Wolong (Chapters 4–14). We also present highlights of the applications of ideas and methods developed in Wolong to some other coupled systems around the world (Chapters 15–18).

2.8 Summary

The ongoing quest to overcome precipitating threats and to strive for global sustainability requires a sound foundation for understanding the complex ways in which humans and nature affect one another. In this chapter, we introduced one promising answer to this call—the coupled human and natural systems framework. This framework provides a blueprint for analyzing reciprocal interactions and feedbacks between humans and nature. The framework goes beyond previous concepts by being more inclusive of diverse human and natural components, by explicitly emphasizing human–nature feedbacks, and by incorporating interactions with other systems. We demonstrated the application of the framework to understanding human–wildlife interactions in a rural setting by characterizing complex interactions between Local Residents, Wildlife, Forests, Policies, and Contextual Factors. We also showed how the framework builds on and contributes to theories such as niche theory and household production theory. We provided an overview of methods for coupled system research, techniques that bring together individuals from diverse disciplines and backgrounds to analyze and integrate diverse data sets. Examples of cutting-edge approaches include systems modeling such as agent-based modeling. We also put forth the need for intensive, long-term study of model coupled systems similar in depth and breadth to classic studies conducted on model organisms (e.g., *Drosophila*) and model ecosystems (e.g., the Galápagos). The rest of this book illustrates our 20-year study of the model coupled system of Wolong Nature Reserve in China and applications to other coupled systems around the world.

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