



## Multiple dimensions of transitions in complex socio-ecological systems – A case from China

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Transitions in complex socio-ecological systems are intermediate phases between two successive and more stable periods or states and involve various societal, ecological, and biophysical changes that are often non-linear and inter-related. Understanding transitions is challenging but important for managing socio-ecological systems for achieving environmental sustainability and improving human well-being. Long-term and intensive research is warranted to disclose common patterns and mechanisms of socio-ecological transitions and to develop ideas and methods for studying and planning sustainable transitions.

Based on a long-term research on human-nature relationships in Wolong Nature Reserve in China, we studied multiple concurrent social, economic, and ecological transitions during the last 15 years. As a UNESCO biosphere reserve, Wolong lies within a global biodiversity hotspot and a World Heritage site. It contains the largest populations of the world-famous endangered giant pandas and several thousand other animal and plant species. Like most nature reserves in China and many other developing countries, Wolong is also home to many local residents who undertake a variety of activities that involve interaction with ecosystem. For the majority of the 20th century, local people in Wolong lived under poverty line in a closed subsistence-based agricultural economy. Their demands on for wood (as fuel and raw materials) from the natural forests were high and resulted in severe deforestation, habitat degradation, and landslides.

Since late 1990s, a series of major economic (e.g., tourism development) and environmental (e.g., payment for ecosystem services programs) policies have been implemented in the reserve as adaptive strategies to cope with poverty and ecological degradation. Within a decade, we have observed major transitions in land use (i.e. from extractive use to non-consumptive use), economic structure (i.e. from a subsistence-based agricultural economy to an open economy relying on tourism and cash crop), and energy consumption (i.e. decline in biomass fuel by three quarters and tripling in electricity use). We further analyzed their impacts on local people's well-being and discuss the possible explanatory framework for the observed socio-ecological transition as a whole. This study not only has direct implications for sustainability transition in developing countries but also increases our understanding of the complexity of human-nature interactions and their effects on the resilience of complex socio-ecological systems.