

Marrying natural and social sciences for Mother Earth's sake

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No one says marriage is easy – but an international group of 16 natural scientists and social scientists, including three from Michigan State University, are saying the wedding of natural sciences and social sciences is called for.

For the first time, a paper published in the Sept. 14 edition of the journal *Science* synthesizes complex characteristics when humans and natural systems couple up, using six case studies from around the world. To understand the complex world and for good science to transform to good policy, specialization must ease up, according to the paper “Complexity of Coupled Human and Natural Systems.”

“In the past, natural scientists such as ecologists often excluded humans from considerations, while social scientists usually ignored the impact of natural systems on the humans, although humans and natural systems interact with each other as coupled systems,” said Jianguo “Jack” Liu, lead author of the paper and Rachel Carson Chair in Ecological Sustainability at MSU’s Center for Systems Integration and Sustainability. “As the world is becoming increasingly connected in various ways, there is an urgent need to integrate natural sciences and social sciences to understand global challenges and develop feasible policies for effective solutions to complex problems.”

The case studies represent both urban and rural areas; both developed and developing countries; and various ecological, socioeconomic, political, cultural and geographic settings. They provide excellent

information for comparing and contrasting complex aspects of systems in five continents – Africa, Asia, Europe, North America and South America.

All of the example systems are faced with pressing environmental and human challenges: In Kenya, forests give way to croplands, cropland soil degradation causes more poverty, and more poverty leads to more deforestation; in China, tourism, residents and pandas vie for real estate; in Washington State’s Puget Sound, single-family housing crowds rich bird habitats; in Wisconsin’s Northern Highland Lake District, recreation affects sensitive fish habitats; in tropical Altamira, Brazil, crop changes and recent deforestation take a toll; and in Vattenriket, Sweden, land-use choices made several hundred years ago continue to have impact on a wetland of international importance.

The case studies are each turned on all ends, looking not only at landscape patterns, wildlife habitat and biodiversity but also socioeconomics, policies, governance and social networks. They examine complex ecological and socioeconomic patterns and processes over time and across space. They analyze – and look to understand often why policy didn’t produce the expected outcome.

For example, in Wisconsin, where indigenous populations compete with recreation, smelt was introduced as a food source for game fish like walleye. The plan backfired when the smelt gobbled the young walleye, decimating the population.

“Everyone wants to preserve parts of the past, but not the same parts, so people have different visions of the future,” said Steve Carpenter, a co-author of the paper and Stephen Alfred Forbes Professor of Zoology at the University of Wisconsin in Madison. “These differences drive the politics of change in the region. Our research uses the Northern Highland of Wisconsin to understand key aspects of change in a region

where ecosystems and society are closely connected.”

The study of the Wolong Nature Reserve in southwestern China, which is one of the largest homes to the endangered giant panda, found that policies to conserve panda habitat had unexpected effects on people and panda habitat. For example, a natural forest conservation program to prevent illegal forest harvesting spurred many new households to form by splitting existing households into smaller ones since the government’s incentives were provided on a household basis. Generally speaking, more households demand more land for housing and more energy for heating and cooking, and smaller households are less efficient in resource use per person than larger households.

In Brazil, the dynamics of the coupled system in this area are complex, “and particularly informative with regards to how people from different social and environmental backgrounds act in a humid tropical environment,” said Emilio Moran, another co-author of the paper and Distinguished Professor and Rudy Professor of Anthropology at Indiana University.

All the studies show that the path from cause to effect is often not a straight line and in some cases takes decades to emerge. Modern life has raised the stake, Liu said. The global neighborhood is more crowded.

“Even 50 years ago, the world population was only 40 percent of today’s population, humans used fewer resources and didn’t have as much environmental impact as today,” Liu said. “Now resources are getting more and more limited. The number of households is increasing much faster than population size, and the demands for resources and consumption are skyrocketing.

“A lot of things are getting closer to the threshold. If you have a little bit more, the whole system may collapse.”

“Government agencies have recognized for a number of years the need for researchers who can cross the boundaries between the social and natural sciences, because they have to confront real world problems where the ecological and social systems interact,” said Thomas Dietz, paper co-author and MSU assistant vice president for environmental research and director of the MSU Environmental Science and Policy Program. “Some approaches, like those we review in this study, are focused on local systems. Others, like many studies of climate change, compare nations or look at the global system. We need all these approaches.”

“The future of a sustainable environment demands that scientists and policymakers understand the coupling of human and natural systems,” said William Taylor, another paper co-author and chairperson of the MSU Department of Fisheries and Wildlife. “Without such understanding and systems thinking, we are doomed to degrading environments, reduced biodiversity, social instability and an overall decline in the quality of life. I am optimistic that the approach of coupling human and natural systems will provide the road map for enhancing our abilities to develop the needed governance systems to ensure a socially and ecologically sustainable future.”

Source: Michigan State University

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