

Resilience and adaptation in the governance of social-ecological systems

Marco A. Janssen

Center for the Study of Institutional Diversity, Arizona State University
Marco.Janssen@asu.edu

During the last decade there has been increased attention to the study of social-ecological systems (SESs). Social-ecological systems link social and ecological systems (Berkes and Folke 1998). The inherently transdisciplinary field of SES-scholars has focused on resilience of SESs and ways to govern resilience of SESs. Resilience is defined as the ability of a system to withstand perturbations and remain within the same stability regime (Holling 1973). Governance of SESs focuses on enhancing the ability of the system to remain within the desired stability regime, or to create opportunities to move toward a desired stability regime. For example, suppression of forest fires lead to the accumulation of fuel (the trees that are not burned) creating conditions for later fires of such intensity that the soil and seed banks are damaged. This may prevent the forest system from recovering from such a fire. A more appropriate policy is to use small controlled burn to maintain the resilience of the forest system.

The study of SESs was initiated by ecologists who became interested in the social dimensions of ecosystem management (Berkes and Folke 1998). But increasingly we see social scientists adopting an SES approach, taking into account more explicit ecological dynamics of resource systems than earlier social science research. The work of Ostrom (1990) originally focused on the dimensions of the social system of a common resource. In recent work the study of the commons is approached from an SES perspective where natural resources and social systems have equal representation and equal detailed analysis (Anderies et al. 2004; Ostrom 2007, 2009).

In this special issue a series of papers has been collected to further the frontier of the study of the governance of social-ecological systems. The papers are a selection of presentations from the North American Regional Meeting of the IASC, which was held from September 30 until October 3, 2010 at the Tempe campus of Arizona State University (<http://csid.asu.edu/USIASC2010>). The theme of the

conference was “Capturing the Complexity of the Commons.” Approximately 120 people participated in this event, and around 100 presentations were given. The papers that were invited for this special issue addressed the theme of resilience and adaptation in the governance of social-ecological systems.

The study of the governance of SESs has experienced a number of challenges that we see being addressed in the papers from this special issue. The main challenge is how to capture the complexity of SESs, i.e. how to document changes over time at different levels of scale of both social and ecological phenomena. Not only do we not have a widely agreed upon framework to study SESs, but a practical problem is to understand causal relationships. Both Cox (2011) and Pérez et al. (2011) discuss the challenge of causality and the difference between driving causes and more proximate causation.

Can we understand the impact of interventions? This special issue has three studies on the impact of fishery policies in Latin America (Beitl 2011; Gallardo Fernández and Friman 2011; Gallardo Fernández et al. 2011) all of which grapple with the problem of causality since many factors at different levels of scale affect decision-making from fluctuations in global market prices to the specific ecological conditions of the fishing area. York and Schoon (2011) present a study on bottom-up collaboratives of private land-owners in Southeast Arizona that successfully addresses a number of problems at different levels of scale. García-Barrios et al. (2011) discuss a new type of controlled experiment that takes into account the complexity of ecosystem management. They find that most groups are able to reach a sustainable solution and show trusting and supportive attitudes to problem solving.

We will now discuss each paper briefly. Cox (2011) discusses the recent developments in a diagnostic approach of studying SESs (Ostrom 2007). SESs are complex systems and causal relationships are not clearly identified. Given the difficulty of doing controlled experiments in SESs, evidence on the workings of SESs is based on case studies. Since scholars performing and reporting case studies have no common language, comparison between case studies is difficult. An improved diagnostic framework of SESs enables us to provide a better basis for comparison.

The diagnosis mainly includes asking a series of questions of a system at increasing levels of specificity based on the answers to previous questions. After each answer, more specific questions can be asked to further unpack the complexity of a system. This is especially important in approaching multiple levels within SESs and causations that include multiple levels. Although the paper is explorative, it provides clear examples on how to use and advance the diagnostic framework.

García-Barrios et al. (2011) present a game that can be considered a mixture of a role playing game and an experiment. On the one hand, relevant complexity of actual resource problems has been translated into a game with a few simple rules and open space for communication and coordination. On the other hand, the game is sufficiently stylized so that it can be played with rural villagers as well as

graduate students without a statistical difference in the way the game is played. The game focuses on participatory rural land use planning where players need to allocate different land uses and all reach a certain level of productivity to solve the game as a group. The underlying dynamics of the game includes threshold effects and complex interactions of land use in a stylized way. The game has helped researchers and players observe and reflect on the individual coordination strategies that emerge within a group. The majority of the groups are found to have players expressing strategies that are generally trusting and offering. Games like Sierra Springs will enable researchers to derive a better understanding of the decision-making processes that lead to cooperative outcomes in complex coordination dilemmas. Furthermore, as this game is played with stakeholders, it provides researchers with a tool for participatory planning exercises.

York and Schoon (2011) present an in-depth analysis of collaborative natural resource management institutions of rangelands at the border of Arizona and Mexico. Actors in these collaboratives enable actors with diverse interests to come together to solve complex problems by overcoming internal and external threats or disturbances.

There is no one problem the collaborative focuses on, but an ecology of problems that is constantly changing. Originally the collaboratives might be designed to solve a set of concrete problems, but new problems, especially external disturbances caused by large-scale political and economic decisions, events, and processes, emerge regularly.

Using ethnographic and archival data they conduct an institutional analysis outlining the existing and emerging collaboratives, the important actors, and ongoing efforts to cope with the five major challenges identified by the rangeland actors. They trace the development of institutions on the land in the southeast corner of Arizona with a focus on their ability to cope with challenges that are largely within the system – biodiversity, fire, and water management as well as those that are driven externally by actors who are largely absent – border militarization, violence and exurbanization.

This analysis shows that successful ways of addressing the original challenges the collaboratives face enable them to address new challenges in different domains.

Pérez et al. (2011) focus on an increasing problem in a globalized SES. Sustainable local SESs are increasingly vulnerable to the incursion of new resource appropriators. This problem is illustrated by a case study of the irrigation system of the northwest Murcia Region (Spain). Farmers have traditionally used water from springs to irrigate their lands, however, in recent decades, large agrarian companies have settled in this region, using groundwater to irrigate new lands. This intrusion had caused the levels of this resource to drop sharply. In an attempt to adapt, local communities are intensifying the use of resources and are constructing new physical infrastructures; consequently, new vulnerabilities are emerging.

Two papers in this special issue discuss the use of Territorial Use Rights for Fishers (TURFs) for fisheries in Chil. These TURFs were introduced as

management areas (MAs) in the late 1990s. Both papers, Gallardo Fernández and Friman (2011) and Gallardo Fernández et al. (2011) discuss in detail two cases of locations with management areas such as TURFs. The authors use Participatory Rural Appraisal tools, interviews, and reports to collect and analyze the data.

Their results show that MAs' economic benefits are connected to fluctuations in the global market. Adapting to changing world market prices then becomes paramount. TURFs' main goal is ecological conservation, but achieving this seems to depend on meeting the fishers' livelihoods. A failure to meet economic sustainability likely results in failure to meet conservation objectives. The TURFs' system does not pay enough attention to the livelihoods of fishers, which is a serious weakness. However, fisher organizations are empowered by gaining increasing control over the resources.

One of the challenges fishers deal with is access to the resource, the ocean, since land next to the coast is often privately owned by non-fishers. The analysis shows the strong relationship between good economic benefits and social sustainability. Good economic benefits also are reflected in good resource governance. Like behavioral economic experiments, the social fabric in a community seems critical for good governance of ecological and social commons (Castillo et al. 2011). One recommendation of the authors is to strengthen the higher level structure by which the communities are affected. To empower communities to increased volatility of market prices the role of the higher level institutions need to be analyzed in more detail.

In sum, the introduction of TURFs in Chile has mixed consequences as the fishers deal with a multitude of challenges such as access to the resource, restrictions on how to use the resource, challenges with other non-fishing members of the community, higher level institutions and the volatility of market prices. To understand the effects of TURFs one needs to take into account the various other factors in the analysis.

Beitl (2011) focuses on the impacts on the ecological diversity by different types of institutional arrangements for mangrove fisheries in coastal Ecuador. She focuses on the fishery for the mangrove cockle (*Anadara tuberculosa* and *A. similis*), a bivalve mollusk harvested from the roots of mangrove trees. Findings from interviews with shell collectors and analysis of catch-per-unit-effort (CPUE) indicate that mangrove concessions as common property regimes promote community empowerment, local autonomy over resources, mangrove conservation and recovery, higher cockle catch shares, and larger shell sizes. Areas without *custodias* and independent cockle collectors feel further marginalized by the loss of gathering grounds, potentially deflecting problems of overexploitation to "open-access" areas, in which mangrove fisheries are managed weakly by the local government.

The various case studies included in this special issue show the importance of a healthy social fabric in the community. High levels of trust and low levels of inequality enhance the ability of groups to overcome collective action dilemmas. The case studies also show the difficulty of deriving good quality data that enables

us to compare case studies over time. Can case study data be collected by a clear enough standard protocol in various places, or does the attributes of the research team have a big effect on the kind of information collected? This shows the drawback of qualitative studies. Finally, successful local governance needs to be supported by higher level organizations that facilitate the monitoring and enforcement abilities.

The case studies captured the complexity of the commons, but we have a long way to go to unravel this complexity. What is certainly needed is more comparative analysis using multiple methods and a common theoretical framework (Poteete et al. 2010). I hope this special issue provides a modest step in that journey.

Literature cited

- Anderies, J. M., M. A. Janssen, and E. Ostrom. 2004. A Framework to Analyze the Robustness of Social-Ecological Systems from an Institutional Perspective. *Ecology and Society* 9(1):18.
- Beitl, C. M. 2011. Cockles in Custody: The Role of Common Property Arrangements in the Ecological Sustainability of Mangrove Fisheries on the Ecuadorian Coast. *International Journal of the Commons*, this Issue
- Berkes, F. and C. Folke (eds.). 1998. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. New York: Cambridge University Press.
- Castillo, D., F. Bousquet, J. -C. Cardenas, M. A. Janssen, and K. Worrapiumphong. 2011. Context matters to explain field experiments: Results from Thai and Colombian fishing villages. *Ecological Economics* 70(9):1609–1620.
- Cox, M. 2011. Advancing the Diagnostic Analysis of Environmental Problems. *International Journal of the Commons*, this Issue.
- Gallardo Fernández, G. L. and E. Friman. 2011. New marine commons along the Chilean coast – The Management areas (MAs) of Peñuelas and Chigualoco. *International Journal of the Commons*, this Issue.
- Gallardo Fernández, G. L., W. Stotz, J. Aburto, C. Mondaca, and K. Vera. 2011. Emerging commons within artisanal fisheries. The Chilean Territorial Use Rights for Fisheries (TURFs) within a broader coastal landscape. *International Journal of the Commons*.
- García-Barrios, L., R. García-Barrios, A. Waterman, and J. Cruz-Morales. 2011. Social dilemmas and individual/group coordination strategies in a complex rural land-use game. *International Journal of the Commons*, this Issue.
- Holling, C. S. 1973. Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics* 4:1–23.
- Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. New York: Cambridge University Press.
- Ostrom, E. 2007. A Diagnostic Approach for Going Beyond Panaceas. *Proceedings of the National Academy of Sciences USA* 104(39):15181–15187.
- Ostrom, E. 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325(5939):419–422.

- Pérez, I., M. A. Janssen, A. Tenza, A. Giménez, A. Pedreño, and M. Giménez. 2011. Resource intruders and robustness of social-ecological systems: An irrigation system of Southeast Spain, a case study. *International Journal of the Commons*, this Issue.
- Poteete, A. M., M. A. Janssen, and E. Ostrom. 2010. *Working Together: Collective Action, the Commons and Multiple Methods in Practice*. Princeton University Press.
- York, A. M. and M. L. Schoon. 2011. Collective Action on the Western Range: Coping with External and Internal Threats. *International Journal of the Commons*, this Issue.