



Socioenvironmental Pathways to Conservation of Natural Resources & Environmental Betterment

Haiying Feng

Bei Bu Gulf University, Qinzhou, China

ORCID 0000-0003-0594-1187

Victor Squires

Formerly, University of Adelaide, Australia

ORCID 0000-0002-6684-2927

ABSTRACT

This is an analysis of past and on-going 'land and people' management issues in China's extensive rural areas. Both authors draw on more than 20 years' experience derived from working in China's arid northwest and on the 'roof of the world' on the Qinghai-Tibetan Plateau (QTP). Worldwide, communities of people have adapted to hot and dry, cold and arid and hot and humid environments. They have shown their adaptability and have made remarkable innovations that enabled them to survive for centuries. But many of the strategies used now, and those unaltered from the past, are inadequate to cope with the fast-changing situation in modern China. The paper is in several parts. We explain some of the terminology around socioenvironmental thinking and its application to the real world with examples from the Qinghai-Tibetan Plateau – a vast upland in NW China. An attempt is made to show how a better understanding of the interplay of fast and slow variables can help to ensure conservation (wise use) of natural resources and serve the needs of the land users (mainly semi-nomadic herders of yaks, goats, sheep, camels and horses). We suggest that the term 'situation betterment' is a more realistic goal and the 'solving' the manifold problems (ecological, legal, economic, political and logistic) that beset land users, administrators, policy makers and the law makers. An explanation of the systems approach and its relevance to socio-environmentalism is offered.

Key words: fast variables, climate change, conservation, grassland, herders, livestock, degradation, ecological refugees

CONTEXT AND SETTING

Western China is a vast region of about 186 million hectares (ha) of which 105 million ha is classified as degraded, to a greater or lesser extent (Squires and Zhang, 2009, Feng and Squires, 2020). The region is a store house of valuable natural resources such as minerals, petroleum, forests, water sources for China's major rivers (Yangtze and Yellow) as well as a series of important inland endoheic rivers that support large areas of artificial oases devoted to growing food crops. But much of the area is devoid of surface water and is classified as 'cold and arid'. In the more remote areas and in mountain and forest there are wildlife like wild sheep, camels, donkeys, Przewalski horses, Tibetan antelopes, snow leopards and other mammal, bird and

reptile species. The authorities have expanded the area of nature reserves to improve the habitat for these important species. Inevitably, there has been concern about the damage caused by the continued presence of livestock that compete for forage and browse with herbivores like Marco Polo sheep and other endangered ungulate species.



Figure [1a] map of provinces in western China [1b] Mekong (Lancang) river up stream [1c] nine rivers arise in the Qinghai-Tibetan Plateau [1d] the Brahmaputra river up stream

Conservation of natural resources is a mandate taken seriously by the government of China at every level. Some initiatives taken to conserve precious biodiversity has put the herders into direct conflict (Breivik, 2007; Yeh, 2003,2005,2013; Smith and Foggin, 1999; Zhao et al., 2020). In some instances, former herders -- now ecological refugees, were relocated away from areas of sensitive wildlife and wetland habitat in the important Three Rivers (*Sanjiangyuan*) sites in Qinghai where the Mekong river rises along with the Yangtze and Yellow rivers.



Figure 2 The Three Rivers Region of Qinghai [see red line that marks the boundary] is the site of friction over resource use by Tibetan herders and the need to conserve natural resources in the headwater region of major rivers. (Chen et al., 2011)

WHY WE NEED A NEW PARADIGM?

The interplay of ecological, sociological and political factors along with threats caused by climate change, extreme weather events, and the depletion of resources calls for a new approach. An approach that does not necessarily ‘solve’ a problem but one that seeks ‘situation betterment’. There are hazards that impact both human and environmental elements, so we need to explore, analyse and understand the vulnerability of socio-environmental systems. For example, adaptation to climate change as well as sustainable development require a knowledge-based approach and intelligent solutions for the integrated assessment of the state of the environment and society. The new complex approach incorporates studies on environmental impact assessment, human impact assessment, and adaptation to climate change; poverty, the aging of society, environmental threats, and sustainability risk assessment; resilience assessment and mapping, supported by geospatial and artificial intelligence tools. This new approach is called socio-environmentalism.

We believe that it can be a pathway to more rapid and more sustainable conservation of natural resources, especially the renewable ones. A few decades ago, people were expressing concerns about the run-down of natural resources like oil and gas and terms like ‘peak oil’ were invoked. The situation of renewable resources was largely ignored in the false belief that they were self-regenerating and limitless. Concerns about extinctions and loss of biodiversity were played down. But this has changed and much attention is directed at maintaining biodiversity on land in the air and in the waters of the earth. The UN Sustainable Development Goals (SDG) devote a lot of attention to this. The application of the socio-environmental approach to analyse and elucidate the status of efforts by government, by motivated citizenry and others.

A Systems Perspective

Systems theory provides a conceptual framework to understand the dynamics of integrated systems like those that socio-environmentalism addresses. A social-ecological system consists of physical components, including soil, water, and rocks; organisms (plants, microbes, and animals—including people); and the products of human activities, such as food, money, buildings, trash and pollution. A social- ecological system is like a box or a board game, with explicit boundaries and rules, enabling us focus on the main tasks and not be distracted by peripheral matters outside the system boundary. The notion of applying a systems approach to socio-environmental problems was an outgrowth of the development of the General Systems

theory many decades ago and its application to industry from the late 1960s. the systems approach is characterized less by its goals than by its methods. The systems approach is a methodology for dealing objectively, and, as often as practicable, scientifically, with the complexity of systems (Meadows, 2008). A more explicit systems approach can substantially improve efficiency.

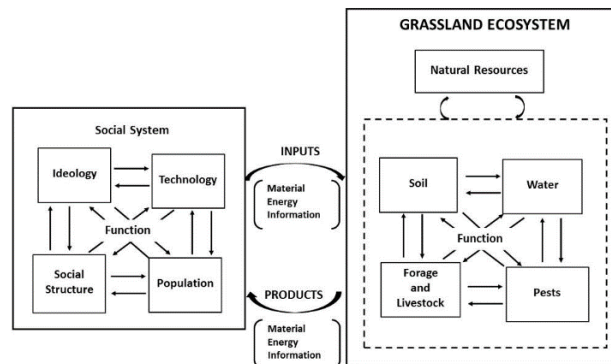


Figure 3. A simplified model of a grassland ecosystem that is used by several different categories of users with different values given to the ecological goods and services produced therefrom. The flow of material, information and energy is important for preservation of livelihood but the continued good stewardship is vital to ensure sustainability

Systems thinking is a way to broaden the analysis in the direction of holism. Systems thinking is characterized by being multi-faceted with respect to the kinds of consequences considered. Instead of limiting the analysis to one sector or viewpoint all aspects influenced by the issue at hand are considered. Systems thinking is a way of broadening the analysis from one-sector thinking to a multi-sector analysis. An approach that looks at a particular socio-ecological problem from many different angles and disciplines is more likely to produce better long-term outcomes because it takes the entire vista into consideration.

The cutting edge of socio-environmentalism is at the boundary. To deal with this we must ask a broader set of questions and change the way we organize ourselves. The major problems, and breakthroughs, will occur at the disciplinary boundaries. We have learned that everything is connected to everything else, therefore we must find a balance between the narrow and the specific, and the broad and the general truths. A systems approach will help accommodate this. It has the advantage of putting all components together so that systems knowledge is primary and the components become a subset of the system. Many of the continuing problems in the socio-environmental arena cannot be solved by a single discipline. The best hope might come from more people embracing a systems approach. There is a big step to be taken, however, between aggregations of multi-disciplinary approaches to problem-solving and holistic or systems approaches.

The systems approach involves approaching problems or situations with a sense of their inter-activeness and wholeness. Ecosystems, such as grasslands grazed by livestock, with their many species of plant and animals (not only livestock) and the individuals whose livelihood depends on them, all interact in a net work of relationships too complex for contemplation by unaided human intellect. The systems approach provides a mechanism whereby complex biological, physico-chemical, social and economic factors can be thought about simultaneously. Systems

thinking is based on the idea of enhancing people's capacity to learn, to improve problem situations (betterment) and to communicate effectively. It draws on the concept of experiential learning and on systems thinking that was honed in engineering and medicine. It involves characterizing and making predictions about complex entities, i.e. systems. It envisages socio-environmentalism as a complex interaction between natural and social phenomena. The systems view represents the dynamic interaction of at least two basically dissimilar systems. It is the interface between people and their environment that exercises our minds (Figure 4). Changes in any part of the system (see below about fast and slow variables) will have repercussions throughout the rest of the system – and often into adjoining ones. Only systems studies provide the framework for prevention of these adverse conditions by concerning themselves the all-important interactions. People/people interactions are also of fundamental importance. Sayer et al., 2013 have elaborated on a variant of the system approach and have opted to call it *a landscape approach*.

Analogous to the ecological subsystem, the social subsystem can be viewed as composed of exogenous controls, critical slow variables, and fast variables (Straussfogel 1997). Figure 4 shows his well-known 'Rectangle'

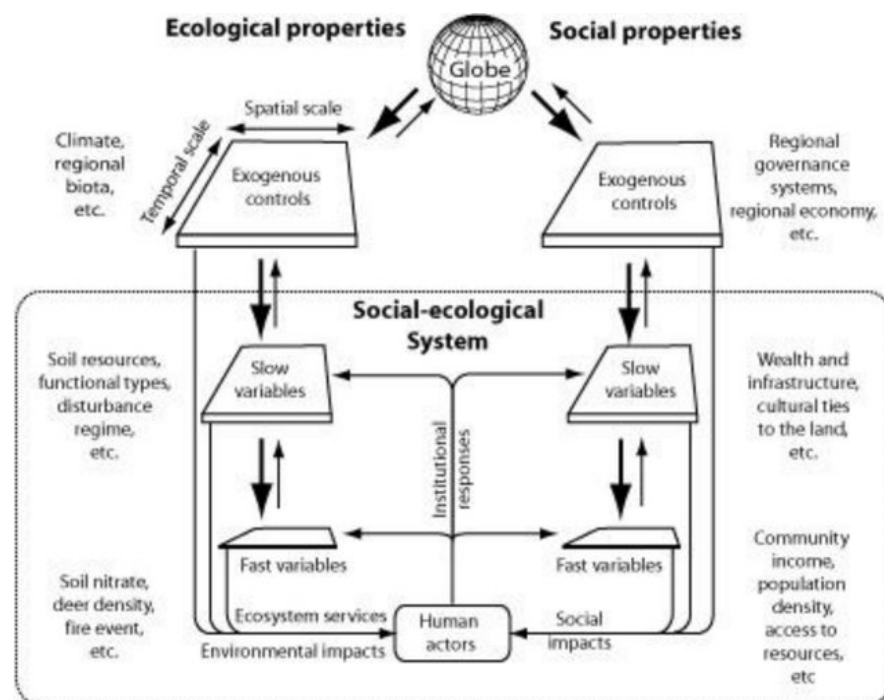


Figure 4 the well-known chart developed by Straussfogel to show the interconnectedness of the ecological and social properties, the influence exerted by exogenous forces on the social-ecological system. Note the significant impact of slow and fast variables

These consist of vertically nested relationships, ranging from global to local, and linked by cross-scale interactions (Ostrom 1999a, Young 2002b, Adger et al. 2005). At the sub-global scale, a predominant history, culture, economy, and governance system often characterize broad regions like NW China. These exogenous social controls tend to be less sensitive to interannual variation in stock-market prices and technological change than are the internal dynamics of local social-ecological systems; the exogenous controls constrain local options.

This asymmetry between regional and local controls occurs in part because of asymmetric power relationships between national and local entities and in part because changes in a small locality must be very strong to substantially modify the dynamics of large regions. Regional controls sometimes persist for a long time and change primarily in response to changes that are global in extent (e.g., globalization of markets and finance institutions), but at other times change can occur quickly, as with the collapse of the Soviet Union in the 1990s or the global financial crisis that wreaked such havoc. As in the biophysical system, a few slow variables (e.g., wealth and infrastructure; property-and-use rights; and cultural ties to the land) are constrained by regional controls and interact with one another to shape fast variables like community income or population density.

Variables that change relatively slowly (i.e., **slow variables**) are often overlooked. Both slow and fast social variables can have major effects on ecological processes (Costanza and Folke 1996, Holling and Sanderson 1996). Systems differ in their sensitivity to different types of changes or the range of conditions over which the change occurs. Slow variables are critical to long-term sustainability, although most management and public attention focus on fast variables, whose dynamics are more visible. There are typically relatively few (often only three to five) slow variables that are critical in understanding. Many of the social and ecological slow variables that determine the long-term dynamics of social– ecological systems act primarily through their effects on human well-being, typical slow variables are slow variables such as climate, property rights, and livelihoods (Turner et al. 2003, Adger 2006).

Soils and sediments are key slow variables that regulate ecosystem processes by providing resources required by **organisms**. Other slow variables include soil fertility, disturbance, and pest populations (like burrowing rodents on the QTP [Box 1] or plagues of grasshoppers).

Box 1 Rodent damage on the Tibetan Plateau

The environmental impacts caused by burrowing rodents (plateau pika and plateau zokor) are obvious on the Tibetan Plateau. The rodents graze on the leaves and roots of grasses on the rangelands, and compete for food with livestock, and dig holes and dump soil on the surface and expose it to wind erosion. It is widely believed that rodents caused the rangeland degradation by assuming a direct relationship between rodents and degradation. Pika and zokor has been labeled as "rangeland pests", and the local government and herders have been fighting to control rodents for more than half a century from the 1970s. As a result, rodents have thus become an indefensible scapegoat for rangeland degradation. But there is evidence that rodents are the result of, not the cause of, the degradation of rangelands on the Tibetan Plateau, and that they are key species in maintaining the integrity of the plateau ecosystem (Smith and Foggin, 1999; Zhao et al., 2020). The outbreaks of rodents are often associated with environmental deterioration and habitat destruction. Rodents are prey for many plateau predator species, have a role in soil nutrient cycling and promoting vegetation succession (Niu et al. 2020). However, one needs to be aware, that the tremendous increase of rodents on the degraded rangeland may trigger severe accelerated degradation by undercutting the protective turf, thus exposing rangeland on the Tibetan Plateau to wind-erosion.

SUMMARY AND CONCLUSIONS

The circumstances under which the social–ecological systems evolved have changed and will continue

to change. Identifying and monitoring slow social and ecological variables is particularly important in the QTP and similar areas in NW China because high variability in fast variables masks the fundamental change forced by slow variables.

Local ecological knowledge is critically important for maintaining the functions and coadaptation of dryland social– ecological systems. This is particularly important in drylands because experiential learning and innovation tend to occur more slowly in these highly variable systems. In addition, there is often less formal research than in mesic regions. Research questions include: What were some of the original sources of resilience in drylands? How have these changed, and how can we restore or generate new sources of resilience under the altered social and climate contexts? In some cases, drylands have undergone dramatic and apparently irreversible degradation. What changes in social–ecological slow variables have caused these thresholds to be exceeded? How can we reduce the likelihood of this occurring in the future?

Finding sustainable solutions usually requires active engagement of **stakeholders** (groups of people affected by policy decisions) who must live with, and participate in, the implementation of potential solutions. Consequently, the development of hybrid scientific and local knowledge systems is vital for local management and regional policy in QTP grasslands and other similar areas in NW China.

ACKNOWLEDGEMENTS

One of us (hyf) was the principal researcher for the national social science fund of china project grassland degradation and herder sustainable livelihood in the qinghai-tibetan plateau (project number:17bmz106)

References

- Adger, W.N. 2006. Vulnerability. *Global Environmental Change* 16:268–281.
- Adger, W.N., N.W. Arnell, and E.L. Tompkins. 2005. Successful adaptation to climate change across scales. *Global Environmental Change* 15:77–86.
- Breivik, I. 2007. The political ecology of grassland conservation in Qinghai province, China: Discourse, Policies and the Herders. Masters thesis, Norwegian University of Life Sciences (UMB)
- Carpenter, S. R., and M. G. Turner (eds). 2000. Special issue on interactions of fast and slow variables in ecosystems. *Ecosystems* 3(6):495–595. <http://dx.doi.org/http://dx.doi.org/10.1007/s100>
- Carpenter, S.R., and M.G. Turner. 2000. Hares and tortoises: Interactions of fast and slow variables for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences* 103:16637-16643
- Costanza, R., and C. Folke. 1996. The structure and function of ecological systems in relation to property-rights regimes. Pages 13–34 in S. Hanna, C. Folke, K.-G. Mäler, and A°. Jansson, (eds). *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment*. Island Press, Washington.
- Crépin, A.-S. 2007. Using fast and slow processes to manage resources with thresholds. *Environmental and Resource Economics* 36:191–213. <http://dx.doi.org/10.1007/s10640-006-9029-8>
- Feng, H. and Squires, V.R. 2020 Socioenvironmental dynamics of alpine grasslands, steppes and meadows in the Qinghai-Tibetan Plateau: A commentary. *Appl. Sci.* 10: 06488
- Holling, C.S. 1986. The resilience of terrestrial ecosystems: local surprise and global change. Pages 292–317 in W.C. Clark and R.E. Munn (eds). *Sustainable development of the biosphere*. Cambridge University Press, Cambridge, UK.

- Holling, C.S., and Sanderson, S. 1996. Dynamics of (dis)harmony in ecological and social systems. Beijer Discussion Paper 81.: *Beijer Discussion Paper Series*.
- Liao, Ch, Sullivan, P.J, Barrett, C.B and Kassam, K.A.S 2013. Socioenvironmental Threats to Pastoral Livelihoods: Risk Perceptions in the Altay and Tianshan Mountains of Xinjiang, China. *Society for Risk Analysis* 2013 1-16
- Meadows, D. H. 2008. *Thinking in systems—a primer*. Chelsea Green Publishing, White River Junction, Vermont, USA.
- Niu, Y., Yang, S., Zhu, J., Chu, B., Ma, S., Hua, R. and Hua, L. 2020. Cyclic formation of zokor mounds promotes plant diversity and renews plant communities in alpine meadows on the Tibetan Plateau. *Plant and Soil* 446;65-79
- Ostrom, E. 1999. Coping with the tragedies of the commons. *Annual Review of Political Science* 2:493–535.
- Sayer, J., Sunderland ,T., Ghazoul, J..... Buck, L.E 2013 Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land use. *Proceedings of the National Academy of Sciences* 110(21):8345-8348 DOI: 10.1073/pnas.1210595110
- Smith, A.T. and Foggin. J.M.1999.The plateau pika (*Ochotona curzoniae*) is a keystone species for biodiversity on the Tibetan plateau." *Animal Conservation* 2, 235–240.
- Squires, V.R., Lu Xinshi, Lu Qi, Wang Tao and Yang Youlin (eds), 2009 Degradation and recovery in China's Pastoral Lands. CABI, Wallingford, UK
- Squires, V.R , Hua Limin, Zhang Degang and Li Guolin (eds) 2010. Towards Sustainable use of Rangelands in north west China. Springer, Dordrecht
- Squires, V.R. and Zhang, K. 2009. The context for the study of rangeland degradation and recovery in China's pastoral lands. pp.3-14 in; Victor R Squires, Lu Xinshi, Lu Qi, Wang Tao and Yang Youlin (eds) Rangeland Degradation and Recovery in China's Pastoral Lands. CABI, Wallingford, UK
- Squires, V.R., Dengler, J., Feng, H. and Hua, L. Grasslands of the World: Diversity, Management and Conservation. CRC Press, Boca Raton
- Straussfogel, D. 1997. World-systems theory: Toward a heuristic and pedagogic conceptual tool. *Economic Geography* 73:118–130.
- Turner, B.L.II, Kasperson, R.E., Matson, P.A., McCarthy, J.J. Corell, R.W.et al. 2003. A framework for vulnerability analysis for sustainability science. *Proceedings of the National Academy of Sciences* 100 (14)8074-9
- UN (United Nations). 2007. *The Millennium Development Goals Report*. United Nations, New York
- Walker, B. H., Carpenter, S.R., Rockstrom, J., Crépin, A-S and Peterson, G.D. 2012. Drivers, "slow" variables, "fast" variables, shocks, and resilience. *Ecology and Society* 17(3): 30.
<http://dx.doi.org/10.5751/ES-05063-170330>
- Yeh, E.T. 200 Tibetan range wars: spatial politics and authority on the grasslands of Amdo. *Development and Change* 34(3):1-35
- Yeh, E.T. 2005. Green governmentality and pastoralism in western China 'converting pasture to grasslands' Nomadic Peoples NS2005 9(1-2):9-30
- Yeh, E.T. 2013. The politics of conservation in contemporary *Journal of Peasant Studies*, 40:6, 1165-1188, DOI: 10.1080/03066150.2013.859575
- Young, O.R. 2002. *The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale*. MIT Press, Cambridge, MA
- Zhao, X., Zhou, L., Xu T., and Xu, S. 2020. The plateau pika has multiple benefits for alpine grassland ecosystem in Qinghai-Tibet Plateau. *Ecosystem Health and Sustainability* 6(1)
DOI 10.1080/20964129.2020.1750973