

Rangeland Degradation, Poverty, and Conflict: How Can Rangeland Scientists Contribute to Effective Responses and Solutions?

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Abstract

In many developing countries where rangelands are a dominant land type and critically important in livelihoods of a significant portion of the population, severe rangeland degradation and/or conflicts over rangeland use can create significant social, economic, and environmental problems. In this paper, we review rangeland degradation in the developing world, its impacts and causes, discuss problems in applying rangeland science to improve rangeland conditions, discuss the role of rangeland scientists, and discuss our approach for enhancing rangeland science in international development. We suggest range scientists can provide valuable input and direction on issues of rangeland degradation (including state changes and impacts on ecosystem goods and services), provide guidance in methods and realistic opportunities for rangeland improvement to local users, government, and development organizations, and work to provide pastoralists with adaptive management in variable ecosystems. Conflict and poverty can create situations where a long-term goal of sustainable rangeland use is overwhelmed by short-term needs of safety and food security; however, providing science and training on sustainable management can make a difference where conflicts are not too severe and can help promote societal stability. Negative perceptions about aid are widespread, but the needs for improved conditions associated with multiple values of rangelands, and the needs of people utilizing these areas, are great. Conducting planning and projects with transparency and accountability will help promote more inclusive participation and successful projects. To be effective, a project needs to consider the needs of the people utilizing the project area but also provide to these communities information on values of the rangelands to other stakeholders (ecosystem services). Sustainable projects will require accountability and enhance self-reliance to allow community empowerment and adaptability to changes.

Resumen

En una muchos países en vías de desarrollo donde los pastizales son el tipo de área que domina y que tienen una crucial importancia en los medios de subsistencia de la población, la severa degradación de los pastizales y/o conflictos sobre el uso de los pastizales pueden crear problemas sociales, económicos y medioambientales significativos. En este artículo nosotros revisamos la degradación de los pastizales en el mundo en vías de desarrollo, sus impactos y causas, discusión de problemas en ciencia de pastizales aplicada para mejorar las condiciones, discutir el rol de los científicos en el área de pastizales y nuestro acercamiento para mejorar la ciencia de los pastizales en el desarrollo internacional. Nosotros sugerimos que los científicos en el área de los pastizales pueden hacer una valiosa aportación y dirección con respecto a los problemas de la degradación de los pastizales (incluyendo cambio en su estado y el impacto en los bienes y servicios proporcionados por estos ecosistemas), aportar una guía en métodos y oportunidades realistas para el mejoramiento para usuarios locales, gobierno y el desarrollo de organizaciones, y trabajo para proporcionar científicos con manejo adaptativo en un ecosistema variable. Los conflictos y la pobreza puede crear situaciones donde una meta a largo plazo de uso sustentable de pastizales es impedida por necesidades a corto plazo de seguridad y seguridad alimentaria, sin embargo, proporcionando ciencia y entrenamiento en manejo sustentable se puede crear diferencia donde los conflictos no son tan severos y puede ayudar a promover estabilidad social. Las percepciones negativas acerca de la ayuda se han generalizado, pero las necesidades para mejorar las condiciones asociadas con los múltiples valores de los pastizales, y las necesidades de la gente para utilizar estas áreas, son enormes. El llevar a cabo planes y proyectos con transparencia y responsabilidad ayudaría a promover más la participación y el éxito de estos proyectos. Un proyecto necesita considerar las necesidades de la gente utilizando las áreas del proyecto para ser efectivo, pero también debe proveer a estas comunidades de información acerca del valor de los pastizales para otras partes interesadas (servicios ambientales). Los proyectos sustentables requerirán la rendición de cuentas y la autosuficiencia para favorecer a la comunidad y la adaptabilidad a cambios.

Key Words: applied science, causes, impacts, international development

INTRODUCTION

The early development of systematic range management approaches in the United States was largely an outcome of a concern over the influences of livestock grazing practices on western rangelands beginning in the late 1800s (Holechek et al. 2010). Following significant degradation of public lands

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associated with free access to grazing lands and policies that exacerbated the problem, the ecological condition of both public and private rangelands in the United States since the 1930s has generally improved (Box 1990; US Department of Interior, Bureau of Land Management 1990). A recent assessment indicated that approximately 80% of nonfederal lands were in relatively healthy conditions (US Department of Agriculture, Natural Resources Conservation Service 2010). However, issues of concern certainly exist (e.g., noxious weeds, shrub encroachment, riparian health, loss of rangeland to other uses such as urbanization, etc.). Parallel successes in rangeland science, education, and management have occurred in other developed countries, but in many developing countries where rangelands are a dominant land type and critically important to the livelihoods of a significant portion of the population, severe rangeland degradation and/or conflicts over rangeland use create significant social, economic, and environmental problems. Many questions could be asked regarding our role as range scientists in improving rangelands and rangeland management globally. Here, we review the problem of rangeland degradation in developing countries and examine why it has become a significant threat in many countries where pastoralist livestock grazing systems permitted sustainable use until recent times. We then ask: Has the range management profession provided the input necessary for improved rangeland management or rangeland conditions? Can range scientists assist in improving rangeland conditions while working in conflict zones (e.g., Afghanistan and Sudan)? We discuss our approach as rangeland scientists in advocating for improved range management in international development projects.

RANGELAND DEGRADATION IN THE DEVELOPING WORLD

Rangeland degradation is of concern for a vast area of the world's rangelands and their value for ecosystem services including food, water, and livelihoods for many of the world's poor. For example, dryland biomes, encompassing much of the area where pastoral livestock production is a major land use, cover 51% of the earth's land area but support 78% of the global grazing area (Asner et al. 2004). Livestock provide food and income to the majority of the 1.2 billion people living on less than \$1 per day (Food and Agricultural Organization [FAO] 2008), and livestock demand is rising to unprecedented levels (Delgado et al. 1999; de Haan et al. 2001; FAO 2008). Pastoralists utilizing degraded rangelands generally suffer from poverty and food insecurity. These poor communities often lack medical, education, and market opportunities, leading to more isolated conditions and discontent. The causes of rangeland degradation in many developing countries are complex, but we stress that it can be both a cause and a result of open conflicts.

The extent of degradation in developing countries is difficult to quantify because of the lack of monitoring, but certainly, concern exists that the human population is exerting significant pressure on rangeland ecosystems. It is also stressed that no general concept of land degradation exists that is uniformly applicable to all situations because it is necessary to define the factor being degraded (Reynolds et al. 2003). However, in general, degraded rangelands are characterized by sustained

reduced biological and economic productivity associated with improper or unsustainable human land uses and the impact of this unsustainable use on hydrology, soil processes, and vegetation composition.

Livestock grazing is the largest geographic land use and is broadly associated with alterations in ecosystem structure (Asner et al. 2004). Reynolds et al. (2007) estimated that some 10% to 20% of drylands have been severely degraded, and the literature is replete with cases of overgrazing and other causes for it (e.g., Hess and Holechek 1995; Middleton and Thomas 1997; Ayoub 1998; Dregne 2000; Eswaran et al. 2001; Teketay 2001; Asner et al. 2004; Rosales and Livinets 2005; Wilcox and Thurow 2006; Wilcox 2007). In addition, a recent Millennium Ecosystem Assessment (2005) determined that ecosystems have been altered more in the past 50 yr than during any other time in history. With a continued increased use of primary production by humans (Vitousek et al. 1986), continued growth in human population, reduced grain yields associated with climate change (Lobell et al. 2011), and expansion of cropland into rangelands to meet food security needs (Butt et al. 2005) and biofuel production (Lapola et al. 2010), a strong need exists for understanding how rangelands can continue to provide goods and services. To maintain and improve ecosystem services from rangelands, we must understand the direct and indirect causes of rangeland degradation, the interest by diverse groups in society to improve rangeland conditions, what role range scientists play in these issues, and why rangeland science has apparently been unsuccessful in "heading off" the problem in many developing countries.

RANGELAND DEGRADATION CAUSES IN DEVELOPING COUNTRIES

The causes of rangeland degradation are complex in time and space and associated with interactions between pastoralists, governance and policy, and environmental factors. The extent is often debatable, as are the causes and potential solutions for improvement. The interaction between climate- and human-induced decline is often difficult to separate. There is little doubt that instances have occurred in the past where rangeland scientists or policymakers considered livestock to be the primary cause of degradation when severe droughts were actually the cause. In fact, it has been hypothesized that the productivity of arid and semiarid vegetation is controlled primarily by the highly variable rainfall that exists in these regions and that vegetation is rarely affected by livestock grazing and rangeland management (Behnke and Scoones 1993; Ellis 1994; Scoones 1995). In nonequilibrium rangeland systems, livestock are not expected to have a long-term effect on vegetation productivity. Illius and O'Connor (1999), however, argued that livestock grazing could impact nonequilibrium rangelands, and others have demonstrated a significant impact of livestock on long-term vegetation productivity (Muller et al. 2007; Wessels et al. 2007).

The proximate causes of rangeland degradation include overgrazing, unsustainable fuel wood (including shrubs) use, mining, and plowing of rangelands with subsequent loss of soil productivity. The ultimate drivers, however, are typically associated with policies, socio-economic changes, or interac-

tions of socio-economic and governance factors with climatic stressors such as drought. Our experiences have shown that poverty and rangeland degradation are often associated with societies in transition, especially where land tenure/land use has been significantly altered. For example, with the collapse of the Soviet Union, rangelands in Mongolia (as well as other Central Asian states) became mostly “free-access” with a loss of controls over timing of grazing or animal numbers (Mearns 1996; Fernandez-Gimenez 1997; Humphrey and Sneath 1999; Bedunah and Schmidt 2004). Changing land-use policies altered land tenure and control throughout most of western China, resulting in a loss of traditional management (Williams 1996; Banks 1999, Ho 2000; Banks 2001; Bedunah and Harris 2005).

It is not possible here to review every instance where policies associated with changing land use and tenure resulted in dramatic changes to pastoral systems, but in general, these changes result in a loss of resource rich grazing areas or a loss in the ability to access pastures that provided pastoralists with different grazing resources. For example, herders have lost productive sites to cultivation, urbanization, or border creation (national borders and exclusionary Protected Areas) that in the past allowed for winter or dry season grazing. Alden Wiley (2008) stressed that many of the conflicts we see today are associated with a failure of governments to recognize the rights of nomadic or transhumant pastoralists to customary property in national laws. She stressed that as a consequence of being treated as public lands, governments have not reallocated land control to individuals, groups, or enterprises that can generate serious grievances over who has grazing rights. Conflicts over collective assets such as communal grazing lands may appear to occur because of interethnic and religious differences, but often the more fundamental conflict is between people and their governments associated with rights and powers over property (Alden Wiley 2008). Where conflicts occur, or where free-access is the major problem, rangeland managers need to provide input into policy-making and may be directly or indirectly involved in conflict resolution in order to improve rangeland management. The complexity of these problems has often limited development successes in countries with poverty, and poor or corrupt governance.

HAS RANGE SCIENCE IMPROVED RANGELAND MANAGEMENT IN DEVELOPING COUNTRIES? WHY OR WHY NOT?

We believe that rangeland science has helped to improve rangelands in developed countries. However, this is not clearly the case in many developing countries. Degraded rangeland conditions often lead to direct conflicts between users thereby making it difficult for rangeland managers to provide support based on an improved understanding of rangeland ecology. In some instances, range specialists are asked to help in areas where conflicts are prominent (e.g., Afghanistan), and one must ask if range managers can really make a difference in conflict zones. We ask: has the range management profession improved rangeland conditions in such cases and if not, why? Has there been adequate support or interest in rangeland conservation by the world community (and if not, why)?

For the most part, the answers to these questions are highly speculative because many causes of failed international development programs targeted at improved environment and livelihoods could be enumerated. There is little doubt, however, that range management problems in many developing countries continue to grow, and we concede that some past failures are associated with the paradigms used in development. For example, past development activities have advocated a “western ranching” model stressing efficiency of resource use and an equilibrium-dynamic paradigm that did not fit areas with strongly nonequilibrium conditions and/or where community property was a strong component of pastoral systems. Likewise, the value of traditional pastoral systems and traditional ecological knowledge were often discounted. Fences and water developments, without adequate livestock control, significantly increased land degradation in parts of Africa and Mongolia (Bedunah and Miller 1995; Walker and Janssen 2002). In other cases, the periods of funding for development projects were insufficient to assess the ecological impacts properly or to allow full institutionalization of the program. Furthermore, the economic benefits of the implemented program are often highlighted as a measure of success rather than ecological and ecosystem service benefits because the latter are harder to measure. As rangeland managers, we must therefore strive to understand the historical context in which previous management approaches were introduced (Sayre and Fernandez-Gimenez 2003) in addition to examining whether particular management approaches fit or favor a particular system. Moreover, the advantages, disadvantages, and potential alternatives to these approaches must be clearly presented to decision makers.

Livestock development projects with rangeland components have often not received favorable consideration due to a perception that livestock use is inherently damaging to the environment. We suggest this perception has been common with some environmental non-governmental organizations (NGOs), as well as some government development programs, therefore reducing the ability of rangeland scientists to participate in programs that could improve rangelands. Perhaps the view is partially associated with Marsh's (1864) influence in shaping early ecological thought in western societies. Marsh wrote, “Wherever he (man) plants his foot, the harmonies of nature are turned to discord.” This view has undoubtedly influenced some early and contemporary conservationists to disregard the significance of historic anthropogenic disturbances in shaping current ecosystems (for example, see Bird et al. 2008). A perception that humans are separate from ecosystems may result in loss of traditional grazing within protected areas established to protect biodiversity values that have existed with livestock and pastoralists for centuries, if not millennia. Subsequently, the loss of traditional livestock grazing may result in the loss of cultural values in the protected area (Bedunah and Schmidt 2004). The more recent theories on interrelationships between humans and ecosystems, nonequilibrium environments and state and transition models, and the importance of ecosystem resilience and stability in understanding threats to rangelands provide improved management paradigms for consideration in rangeland development.

Negative perceptions about development aid abound, but certainly, the need for improved conditions are great, especially

associated with multiple values of rangelands, and improved livelihoods of the world's poor. Failed policy and governance (and often corruption) creates structural and social problems that make rangeland development programs extremely difficult. For example, projects developed without considering the local context and indigenous culture, or without commitment from local groups, are not likely to exhibit positive impacts nor gain sustainability. Projects and planning must be transparent and open to provide impetus for inclusivity of communities and to build enhanced self-reliance and accountability to improve the potential for long-term sustainability. However, we stress that "going back" to historic grazing patterns is often not possible because of expanding human populations, changes in land-use, and borders restricting livestock movements (many Central Asian countries and African countries have seen relatively recent border changes). A focus on the past in a changing world will often not result in current solutions for improved management, although, certainly the past and traditions must be considered in developing solutions. Many previously nomadic groups want modern conveniences that restrict their movements. With globalization and economic intensification, increasing human population and climate change, the sustainable use of rangelands will continue to be a challenge. Rangeland scientists must continue to advocate for multiple-uses and values of rangelands and provide information on threats to sustainable use and their impacts on different users through time.

WHAT IS THE ROLE OF RANGELAND SCIENTISTS IN RANGELAND DEGRADATION ISSUES?

Rangeland scientists are key players in determining the causes and degree of rangeland degradation, the potential impacts of degradation on future ecosystem services, and potential solutions and costs. We also need to play a role in collecting, understanding, and commenting on different definitions of degradation used by different stakeholders as degradation can be defined both culturally and scientifically. In some cases, we must determine if present rangeland conditions are associated with recent changes in use or those in the more distant past. Certainly, the interactions between environmental factors (e.g., severe drought) and land uses often make the degree of human-caused degradation difficult to assess. However, we believe rangeland professionals are well trained to recognize the complexity of the interactions between ecological and human systems and to examine these issues.

Models of vegetation dynamics associated with equilibrium and nonequilibrium paradigms (Briske et al. 2003) provide rangeland professionals with theory and conceptual models of rangeland dynamics to help policy makers and rangeland users with information to better understand potential vegetation change and altered ecosystem services associated with degradation. Ecological resilience is the capacity of a system or state to absorb a disturbance without fundamental changes to its characteristic processes and feedbacks (i.e., does not change "state"; Holling 1973). The feedback between human decision-making and ecological processes ultimately determines ecolog-

ical resilience, but triggers or thresholds resulting in ecosystem change are often poorly understood.

Rangeland scientists can help pastoralists and policy makers understand the threats from state changes in terms of both ecological and societal factors. They can emphasize ecosystem processes rather than stressing products (livestock) as a means to identify when an ecosystem is threatened with undesirable state changes. Improved understanding of triggers/thresholds and impacts of state changes is another area where rangeland scientists can help educate land users and guide policy and regulation. Pastoralists may not be able to determine when thresholds are being approached that leads to degradation because the change is gradual and their knowledge of ecosystem ecology may be poor or different from our understanding as rangeland scientists. Livestock early warning systems (Stuth et al. 2005) can provide policy makers and livestock producers with assistance in determining current and forecast forage conditions that should improve decision-making processes. Rangeland specialists can stress that in many systems, the changes that occur when the resilience of a system is exceeded can lead to an undesirable but highly resilient state that is difficult and costly to reverse (Allen and Holling 2010). Implementation of rangeland health monitoring programs (Herrick et al. 2005; Damdinsuren et al. 2008), when coupled with livestock early warning systems, can provide a means for necessary feedback between human decision-making and ecological processes needed to potentially avoid irreversible degradation.

Human uses have always affected rangelands, and it is up to the rangeland specialist to determine the roles of different impacts. Asian and African rangelands that were grazed sustainably by domesticated livestock for centuries, if not millennia, were grazed in a manner similar to that of the native fauna, with nomadism emulating the seasonal migrations of wild ungulates (Walker and Janssen 2002). Changes in markets and livestock policies (including taxes and fees), altered land uses (e.g., greater areas of crop production), the development of watering points, improved health (vaccinations, parasite control, etc.), and providing structures and hay for wintering animals have allowed for greater livestock numbers and more intense use in many areas. Thus, changes in policies and technologies can often be the ultimate cause of rangeland degradation, and rangeland scientists are well trained to determine the causes and potential solutions.

Although we suggested earlier that the role of rangeland specialists is likely underappreciated, opportunities and active roles for rangeland specialists certainly exist in international projects within NGOs (e.g., conservation organizations such as the Wildlife Conservation Society, Nature Conservancy; nonprofit aid-development groups such as Winrock International, Mercy Corps, Oxfam, Heifer International, Ford Foundation, The Bridge Fund, and Aga Khan Foundation), international development banks such as the World Bank and Asian Development Bank, government-based development arms (e.g., US Agency for International Development), and multinational organizations such as the United Nations that have various conservation and development programs. The total dollar value of all development and/or conservation projects with rangeland components is unknown; however, the rangeland component is likely underfunded considering global

rangeland area and the importance of the livestock sector for many of the world's poor. With that said, the amount of money budgeted since 1991 for the Global Environmental Facility (GEF), a UN-based financial mechanism promoting international cooperation and protection of the global environment, is in the multibillions of dollars. For example, the Land Degradation, Biodiversity, and Climate Change focal area projects¹ since 1991 had total project funds (GEF plus cofinancing) of \$1.8 billion, \$7.6 billion, and \$20.0 billion, respectively (GEF 2011). The Land Degradation and Biodiversity focal areas have more projects with rangeland components, but in the future, it is likely that many more climate change projects will have rangeland components requiring rangeland scientist participation.

OUR APPROACH TO ENHANCING RANGELAND SCIENCE IN INTERNATIONAL DEVELOPMENT

In international development projects with a rangeland component, there is almost always the perception of significant rangeland degradation by the donor(s) and often conflict over rangeland uses. We work with pastoralists and government agencies directly involved with pastoral issues, as well as other sources of information (i.e., literature and research), to determine the threats to sustainable rangeland use, the degree of degradation, and potential solutions. We can contribute to policy, law development, and information and education needs when we have a solid understanding of how rangeland users are organized, how they traditionally used rangelands, current and past methods of conflict resolution/mediation, and other social norms for group interaction. Without community (i.e., all user-communities) support, resource-use laws may increase conflicts and tensions. Our approach is to stress the need for rangeland communities to be intimately involved in planning but also stress that even in areas where extensive livestock production is the primary land-use, development policies and reforms must also consider issues of health care, education, research, land use and governance, and cultures to allow for sustainable use of rangelands. Recently, many development specialists have echoed the mantra "No Development without Peace, No Peace without Development" (see Brenk and van de Veen 2005) as crucial when considering multiple stressors and interactions associated with international development. Although we stress planning, we recognize that planning alone will not result in successful projects. Ultimately, it is the affected communities, at different scales, that must adapt and solve the conflict and/or rangeland degradation. However, as rangeland specialists, we can provide guidance on rangeland ecological issues and the potential for improvement, or demonstrate the continued loss of values associated with increased degradation.

¹The GEF separates projects into six focal areas: biodiversity, climate change, international waters, ozone depletion, land degradation, multifocal areas, and persistent organic pollutants. The multifocal area may also have a rangeland component, and this focal area has a total project fund of \$5.8 billion.

MANAGEMENT IMPLICATIONS

In many areas of the developing world where rangelands are the major land type, land degradation and conflicts regarding land use are, or should be, prominent issues facing policy makers. Pastoralist communities are often marginalized compared to state concern with mining or cropping or the state has an agrarian "mind-set." Range practitioners can provide valuable input and direction on issues of rangeland degradation (including state changes and impacts on ecosystem goods and services), provide guidance in methods and realistic opportunities for rangeland improvement to local users, government, and development organizations, and work to provide pastoralists with adaptive management strategies in variable ecosystems. Rangeland practitioners recognize that rangelands, pastoralists, and governments are linked in a complex human environmental system and can help policy makers and users to understand these complex interactions to maintain ecosystem services. Rangeland practitioners can help local communities and local/regional/national policy makers by actively engaging them in the development of better land use management planning, including the importance of good policy and institutional reforms and funding mechanisms that can empower people to work for sustainable resource management. At the local level, this will require grassroots organization and engagement with the local communities and stakeholders to develop resource use plans that minimize conflict, monitoring protocols to assess rangeland health, risk management planning, and potentially working together to restore degraded rangelands. Planning and conducting projects with transparency and accountability will help promote more inclusive participation, self-reliance, and sustainability.

Engagement with policy makers should focus on working with them to develop infrastructure, personnel, and funding mechanisms to provide guidance and facilitation for community-based planning and monitoring for sustainable resource management. It is stressed that when projects are designed without considering the local context and indigenous culture, or without commitment from local groups, development aid will show few positive impacts nor gain sustainability. Enhanced self-reliance and accountability must also be built into the project to improve the potential for long-term sustainability of development projects. Rangeland practitioners can also work with regional/national governments for policy development to reduce rangeland degradation through strategic use of safety nets (e.g., livestock price support or transport during drought), early warning systems to reduce the likelihood that thresholds are crossed that can lead to irreversible, degraded states, advise on inappropriate policy choices that will affect pastoral areas and peoples, and provide experience from application of concepts from other countries and situations. For rangelands that are in ecological states that are not productive, rangeland scientists need to work with communities and governments to develop innovative and inexpensive ways to restore these areas to more stable and productive states. There is no doubt that conflict and poverty can create situations where a long-term goal of sustainable rangeland use is overwhelmed by short-term needs of safety and food security; however, providing science and training on sustainable management can make a difference where conflicts

are not too severe and can help promote societal stability. In many instances, land tenure concerns (e.g., who owns the land or who has the right to use or benefit from the land) are historic factors, often related to current conflicts and degradation, which must be examined. We stress that even in areas where extensive livestock production is the primary land-use, development policies and reforms must also consider the issues of health care, education, and land use and governance to allow for sustainable use of rangelands. In some cases, conflicts can be so severe or laws so weak that natural resource issues are overwhelmed by other issues or concerns. In these cases, rangeland practitioners must work with others in conflict resolution to allow for shared governance or other agreements to allow for secure land use. With the specter of continued human population growth, economic intensification, and climate change, the ability to maintain biodiversity as well as other critical ecosystem services will be challenging, especially in developing countries. There is no doubt that the development community will need to take an integrated approach to solve these problems. Development organizations, including NGOs, development banks, government aid organizations, and multiple national organizations will need well-educated staff and contract professionals to solve environmental problems, ensure ecosystem services are not threatened, and improve social equity that will improve livelihoods. Nowhere is the challenge greater than in rangeland ecosystems. Rangeland scientists need to be the advocates of sound rangeland management and policy to ensure the maintenance of ecosystem services and values for future generations.

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