Chapter 2
Better Land Stewardship: An Economic and Environmental Imperative, If There Is to Be Sustainable Development

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Abstract This chapter attempts to get to grips with the concept *of land stewardship* and its links with sustainable development (SD) in the context of the Central Asian region (CAR as defined in Chap. 1). The idea is to convey clarity to the concept by elucidating the principles and practices which can make it work, particularly in rangeland-based production systems and the respective local rural populations. However, the diversity of rangeland-based agriculture and livestock raising systems throughout the CAR, especially in the five Central Asian "stans," Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, makes it rather difficult to characterize the consequences of a successful transition from Soviet style to more sustainable farming systems and the adoption of an attitude of land stewardship among the rural community and those who attempt to regulate its use (policy-makers and other government officials).

SD is a concept that people know about, but opinions differ as to what it means in concrete term actions. The key question is: "What do we want to maintain, for what purpose and for whom?" Many possibilities exist. These are elaborated in this chapter and elsewhere in the book as is some examination of the relationship between SD and land stewardship and what being a land steward really means.

Keywords Sociocultural • Intergenerational equity • Ecology • Economics • Rangeland-based industries • Ecological goods and services • Stewardship priorities • Interconnectedness • Land tenure systems • Farming systems • Sustainable land management • Biosophysical approach • Landlessness • Geobotanic survey • Land degradation • WOCAT • Land users' views

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Key Points

- In its broadest sense, land stewardship is the recognition of the collective responsibility to retain the quality and abundance of land, air, water, and biodiversity and to manage this natural capital in a way that conserves all of its values, be they ecologic, economic, or sociocultural. Stewardship is a journey, and the commitment that comes with being good land stewards takes time and effort.
- There is nothing new in the quest by humankind for permanent ways of using the land entrusted to them. The intent of this book is to identify which players, policies, and procedures can best contribute to a more sustainable way of living of the CAR (rural) societies and ensure that land is used in a way that will allow future generations to enjoy the benefit stream that can flow from land that is used in a sustainable way. This gives rise to the concept of *intergenerational equity.*
- Sustainability of land use systems should be a high priority in all countries of the CAR because agriculture (including animal husbandry) is the cornerstone of the economic health and well-being of all them. The meaning of sustainability presents problems, its meaning "in theory" is commonly intuited, but "in practice" it is seldom really explained or understood. Likewise, there are the ongoing responses to periodic changes in population density, weather patterns, competing land uses, alternative economic uses, and natural condition of resource base for each rangeland site. Perhaps what is more appropriate is "more adaptable and sustainable ways of living for the CAR societies."
- Maintaining the productive quality of and its resources for continued future use is one of the most important challenges directly confronting the rural population in CAR, but the problems also impact on the wider society of all these countries.
- The first priority in all CAR rangelands is to maintain and restore the ecological sustainability of the watersheds and rangelands for present and future generations. To achieve and maintain the ecological sustainability of the rangelands while balancing the diverse economic and social needs of rangeland inhabitants along with conserving rangeland biodiversity and watershed values is a major challenge. The wider societies in CAR countries—both rural and urban—have an enormous stake in fostering progress toward profitable, environmentally friendly farming systems.
- Regardless of how we define sustainable use of land, it is ultimately the land user who must establish practical, sound practices. So the land users' point of view of what constitutes sustainability is the most important perception of all. There is a clear need to bridge the gap between production and income objectives of the land users on the one hand and the long-term objective of preserving natural resources on the other.

1 Introduction

The maintenance of land and its resources for continued future use are the most important environmental problems directly confronting the rural population in Central Asia, but the problems also impact on the wider society of all these countries

(see below). Even defining the problem and deciding which outcomes are best is fraught with difficulties, confusion, and conflict (Brown et al. 2008; Kreutzmann 2012). In this chapter, there is an attempt to get to grips with the concept *of land stewardship* (and of sustainability) and convey it with clarity, elucidating the principles and practices which can make it work, particularly in rangeland-based industries and related rural populations. Stewardship is defined by Worrell and Appleby (2000) as the responsible use (including conservation) of natural resources in a way that takes a full and balanced account of the interests of society, future generations, and other species, as well as of private needs, and accepts significant answerability to society. In a farming context, stewardship refers to the notion that farmers are stewards of the land and that farming is a way of life that places implicit responsibility on farmers to look after the land for future generations. Stewardship has relevance to aspects of land tenure and property rights, which makes it applicable across a wide range of fields of resource use. Stewardship is important in addressing land tenure, which is one of the major contributors to land degradation, mainly in developing countries, where land tenure systems limit the possibility people have to take full responsibility for the land (see below).

In its broadest sense, stewardship is the recognition of the collective responsibility to retain the quality and abundance of our land, air, water, and biodiversity and to manage this natural capital[1] in a way that conserves all of its values, be they environmental, economic, social, or cultural. Although the definitions are almost limitless, there really are two clear and fundamental elements of "stewardship"—*awareness* and *action*. That means:

1. Recognizing the collective responsibility to retain the quality and abundance of our natural resources.
2. Putting that awareness into action by making the appropriate decisions for how to best use and manage these resources not only for today but for future generations as well.
3. But implementation of decisions and monitoring outcomes are also required as the steward needs to periodically adapt improvements or changes to emerging conditions in response to past and ongoing interventions/actions.

Being or becoming a good land steward implies:

- Understanding the concept of giving *value to ecological goods and services*. We depend on ecological goods and services everyday for our health, social, cultural, and economic needs. Ecological functions are the base resources that sustain our lives. The sustainability of communities and economies depends upon an ability to maintain or restore the ecological functions of both urban and rural landscapes. *Ecological goods* are the products of the processes and interactions of natural systems. The natural world provides us with the essential services we require for life. These services are called *ecological services*.

[1] They are the resources and benefits provided by the ecosystem that are essential for human survival and economic activity. See discussion on ecological goods and services.

- Recognizing important *stewardship priorities*. CAR is a region of diversity—socially, culturally, and ecologically. Ecologically, this vast region is blessed with unique and distinct landscapes (Maselli, Chap. 1). Each has its own unique natural features: of which climate is one important shaping factor, and each supports its own distinct species of animals and plants. Over the past century, these landscapes have been intensely impacted by human development. Long-time residents of an area can pinpoint the visible and dramatic changes that have occurred in their local natural landscapes (Kurbanova, Chap.7). In highly populated areas of the country, native grasslands, aspen-dominated parkland, wetlands, and other natural features have been virtually eliminated. Natural resource exploitation (including mining and urban and infrastructure development) is increasing exponentially and continues to significantly impact remaining natural landscapes.
- Learning from those who provide good stewardship examples. This is where stewardship begins.
- Applying key *stewardship principles* in all our land and resource use decisions. Effective stewardship helps maintain and restore the function of the natural resources (air, land, water, biodiversity); we rely on to produce the goods and services we depend. There are four guiding principles of environmental sustainability:

1. *Caring for the system as a whole*—Adopting an ecosystems' holistic resource management approach includes understanding the fundamental roles and values of natural systems, building up biological fertility in the soil, incorporating an understanding of the ecological cycles on the landscape (water, energy, nutrients), and how land-use practices can either benefit, be in harmony, or negatively impact these cycles and other land-users' flora and fauna.
2. *Conserving resources*—Maximizing efficiency and striving to reduce the consumption of renewable and nonrenewable resources and long-term optimization versus short-term maximization of production.
3. *Maintaining and enhancing stability in nature*—Sustaining and encouraging natural biological diversity and complexity and maintaining natural areas and functions on the land (i.e., wildlife habitat conservation).
4. *Applying cultural values*—Caring for the health of the land for future generations and long-term economic stability, the link between civilization (urbanization) and the land-base and ecosystems that are vital to survival, and the intrinsic value and right of all life on Earth to exist.

The resource base for agriculture, including animal husbandry on rangelands, unless husbanded carefully and replenished continually, will dwindle in its capacity to produce at levels required to meet the demands of burgeoning population and changed market demands from an increasingly urbanized society. Farming systems collapse or are forced to change when they become unprofitable to the farmer or when they impose on farm families, neighbors, or rural communities (or perhaps whole nations) excessive indirect costs or burdens. These indirect costs arise, for example, from increased frequency and severity of natural disasters such as floods or landslides that are attributable to poor land management.

There is nothing new in the quest by humankind for permanent ways of using the land entrusted to them. The challenge of this book is to identify which players, policies, and procedures could contribute to a more sustainable society and ensure that land is used in way that will allow future generations to enjoy the benefit stream that can flow from land that is used in a sustainable way. This gives rise to the concept of *intergenerational equity*.[2]

The topic of sustainability of agricultural land *sens lat*. (including rangelands) should be a high priority in all countries of the CAR, especially the higher altitude areas (Kreutzmann 2012) because agriculture (including animal husbandry) is the cornerstone of the economic health and well-being of all them. There is no more important question than that of the sustainability of agricultural ecosystems. Desertification, deforestation, and accumulation of chemicals in soils and waters are of increasing concern in many ecosystems in most countries in the CAR. Many definitions of sustainability have been presented, and this is as it should be. The word sustainable may imply a steady state.[3] If one sees a steady-state situation, one must look over horizons to some distant goal. A careful reading of the development literature reveals as many ideas about direction as there are authors, so consensus on an equilibrium point would be impossible. A workable definition is *"an agriculture that can evolve indefinitely toward greater human utility, greater efficiency of resource use, and balance with the environment that is favorable both to humans and to most other species"* (Harwood 1990).

This definition is heavily value-laden but is consistent with the parameters of an emerging social and political agenda for agricultural development. It is also very generic. To understand the process by which it is translated into substance in any national setting, some sense is needed of political agendas, the translation of these agendas into policy, and the roles, the agenda, and the policy in national development. Quite clearly, there are differences between the various countries that make up the CAR.

Several scenarios for sustainable land use have been articulated, and most stress the following:

- The interconnectedness of all parts of a farming system, including the farmer and his family
- The importance of the many biological balances in the system
- The need to maximize desired biological relationships in the system and to minimize use of material and practices that disrupt these relationships

Sustainability involves the complex interactions of biological, physical, and socioeconomic factors and requires a comprehensive approach in order to improve existing systems and develop new ones that are more sustainable.

[2] It means that we inherit the Earth from previous generations and have an obligation to pass it on in reasonable condition to future generations.

[3] Sustainable development (SD) means not a steady state as such but can/should imply the increase of ecologic, economic, and sociocultural capital.

The notion of sustainability presents problems; its meaning "in theory" is commonly intuited but "in practice" is seldom really explained or understood, especially whenever the prevailing condition of a given rangeland is not inherently productive and whenever an alternative form of land use is far superior in a given case. Likewise, there are the ongoing responses to periodic changes in population density, weather patterns, competing land uses, alternative economic uses, and natural condition of resource base on each rangeland site. Perhaps what could be agreed upon in the context of this book is "more adaptable and sustainable ways of living for the Central Asian societies."

Sustainable land use should involve the successful management of resources to satisfy changing human needs while maintaining or enhancing the natural resource base while avoiding environmental degradation. The emphasis in CAR countries is on rural income, and employment and trying to handle environmental problems, or instilling a land ethic (land stewardship) by the passing of laws against land degradation simply will not work:

- Key constraints hampering the sustainable use of pastures/rangelands in CAR. Weak infrastructure in many of the countries is a major constraint to a higher productivity/rentability and transporting and marketing crop and livestock products.
- Financial and administrative systems are often biased toward urban consumers.
- Land tenure systems can discourage land users from conserving natural resources and investing in future productivity.
- Most countries in the CAR lack laws to protect forests and rangelands from indiscriminate exploitation, and the implementation is also a problem.

2 Society's Stake in Better Land Stewardship

What are the expectable/desired benefits of more widespread adoption of responsible land stewardship in CAR countries? To answer this question requires some sense of where rangeland-based farming and animal husbandry is now, relative to more sustainable land use, and how it might change as progress is made in adopting cropping patterns and grazing management systems more consistent with the principal features of sustainability previously identified.

First, here are some general points regarding the sustainability of agriculture at the present time. The economic scorecard is well known and clearly not good in several key respects. The CIS countries[4] generally have low GDP and low scores on human development index (HDI). Many rural people are on or below the poverty line, and the continuation of the overall contribution of rangeland-based production systems (including livestock) to national economic activity and long-term prospects is problematic (Kurbanova, Chap. 7; Lerman, Chap. 8; Sedik, Chap. 9).

[4] Commonwealth of Independent States – former member countries of the Soviet union

Second, the problems faced by rangeland-based industries (Strong, Chap. 10) that could undermine sustainable land use differ greatly by region, both in degree and character. Many, if not most, farming systems currently practiced in CAR are unsustainable. Adjustments in livestock husbandry and cropping practices and technologies surely will be needed for most farming systems to remain viable, even for subsistence level outputs. The transition to sustainable production systems leads to development of diversified (and more specialized) producers whose enterprises capture the comparative advantage of the rangeland resource and location in relation to markets for their outputs.

The cost of these practices to land users to move toward more sustainable systems will not be great and generally can be spread over a variety of agronomic and ecological benefits such as moisture and nutrient retention *in situ*, improved soil, and higher forage yields. An exception could be on the more steeply sloping land that will require terracing or other costly structural practices to keep soil erosion in check.

Third, sustainable farming systems and practices will be adopted when, and only if, they offer farmers a convincing opportunity to earn higher profits than from any other systems.

Finally, we must remember that current systems often are used because they were used the year before, are proven, reduce short-term risk, and require modest investment and a low level of management skill and equipment.

The diversity of rangeland-based agriculture and livestock rising throughout CAR makes it difficult to characterize the consequences of a successful transition to more sustainable farming systems and the adoption of a sense of land stewardship among the rural community. Nonetheless I will try. If we assume that sustainable agricultural and animal husbandry practices (including adoption of better grazing management) will be incorporated into specialized farming systems, this trend would greatly facilitate the arrest and reversal of land degradation. By fostering spring deferment of grazing, rest rotation grazing, use of crop rotation, minimum tillage, early weaning, better winter housing, improved management of hayfields, and so on so productivity rises and incomes increase.

The principal benefits to society from arresting and reversing land degradation will be higher household incomes, increased productivity of farming systems, conservation of biodiversity, increased carbon sequestration, and fewer floods and landslides. Wildlife habitat will be improved (Jackson, Chap. 15), and over time, new recreational opportunities and tourism opportunities will arise. Over time, the economic value of these benefits, while difficult to quantify, surely will exceed several billion dollars each year.

The wider society in CAR countries (both rural and urban) has an enormous stake in fostering progress toward continuously productive farming systems. The two most dramatic near-term benefits from such progress will involve, first, improved economic performance and increased household incomes, made possible by increased offtake from livestock. Higher benefits that will flow from development of more specialized farming system. For example, highlands can focus on breeding and

lowland farmers can take the younger livestock for fattening and finishing to meet the market demand for meat, milk, and other livestock products, and from the burgeoning urban populations (Leake, Chap. 18).

3 Sustainable Resource Management, for Whom?

The "ecosystem stewardship" approach proposed by Chapin et al. (2010) integrates three strategies for sustainable development: reducing vulnerability to expected changes, fostering resilience to sustain desirable conditions in the face of perturbations and uncertainty, and transforming from undesirable trajectories when opportunities emerge. Each of these is applicable to sustainable land management (SLM) in the pastures and rangelands.

Sustainability is a concept that most people know about, but opinions differ as to what it means. *Sustainable development* means "development to meet the needs of the present, without compromising the ability of future generations to meet their own needs." Sustainable development assumes the alignment of development decisions with environmental considerations. The key question is just "what do we want to maintain?" Many possibilities exist. Do we want to maintain:

(a) The rural population and community structure at existing levels?
(b) The biological and ecological integrity of the region?
(c) The financial viability of farmers and herders?
(d) The culture and traditions of the farmers and herders?

Once a decision is made as to which of these (singularly or in combination) is the main aim, then the action taken to achieve this aim can be specified.

The impact of people on the land resources depends on a number of "pillars":

- Values and beliefs
- Cultural norms
- Knowledge generation and transfer
- Research and development
- Business and financial institutions' social and other service systems
- Legal and justice systems
- Civic and political institutions

A program for the sustainable development of the rangelands can be seen through three strategic approaches, each of which is supported by selected programs of activity, summarized in Table 2.1.

Approach 1 covers essential institutional support. The most important being land tenure initiatives. *Approach* 2 addresses livestock and rangeland development. Livestock production is the key economic driver that will underpin any sustainable support needed for the rangelands. The rangelands require appropriate support for

Table 2.1 Three strategic approaches in a program to develop sustainable land use

Approach 1	Approach 2	Approach 3	
Institutional/policy development	Livestock and rangeland development	Diversification	
		3.1 Nonlivestock agricultural production	3.2 Nonagricultural production
1.1: Land tenure	2.1: Fodder production	3.1.1: Agroforestry	3.2.1: Review employment opportunities/ regional and district plans
1.2: Policy	2.2: Veterinary services		3.2.2: Other investment/ business opportunities
1.3: Farmer/community organizations	2.3: Capacity building FFS[a] for improved husbandry		3.2.3: Capacity building—vocational training
1.4: Capacity building	2.4: Pasture management		
1.5: Legislation	2.5: Feeding/nutrition		
1.6: Rural finance	2.6: Land degradation		

[a]FFS Farmer Field Schools—farmer-led, farmer-organized training in the field

land degradation remedial measures to ensure continued viability of the land that the livestock sector depends on. *Approach* 3 covers nonlivestock production activities. These are highly relevant if livestock economic pressures on the rangelands are to be relieved, to aid recovery.

Central Asian societies, especially rural societies, are deficient in a crucially important ingredient. The missing ingredient is an understanding by the majority of the population of:

- Sensitivity and interdependence of living systems
- The place of humans in nature
- Relations between cultural and natural processes

Correcting this deficiency is essential for attaining an ecologically sustainable society which is at the same time satisfying in terms of quality of life. Such an attainment will require a *biosophysical*[5] approach to priority-setting and decision making throughout society. The challenge to today's generation is how to devise land use systems that will maintain the productive capacity of the land for the benefit of both present and future generations.

[5] *Biosophy* is the science and art of intelligent living based on the awareness and practice of spiritual values, ethical-social principles, and character qualities essential to individual freedom and social harmony.

4 Sustainability and Change in the Natural Environment

There is a tendency to consider the earth's ecosystems as constant and unchanging when left to natural processes, but clearly this is not so. Time series photographs and the results of geobotanic surveys document the changes in ecosystems as evidenced by loss of woody plants that were cut for fuelwood and loss of forage species as a result of overutilization. As the changes in the pattern and intensity of rainfall and slowly rising temperatures over the past 20 years or so have shown, the biophysical environment is changing (Fig. 2.1).

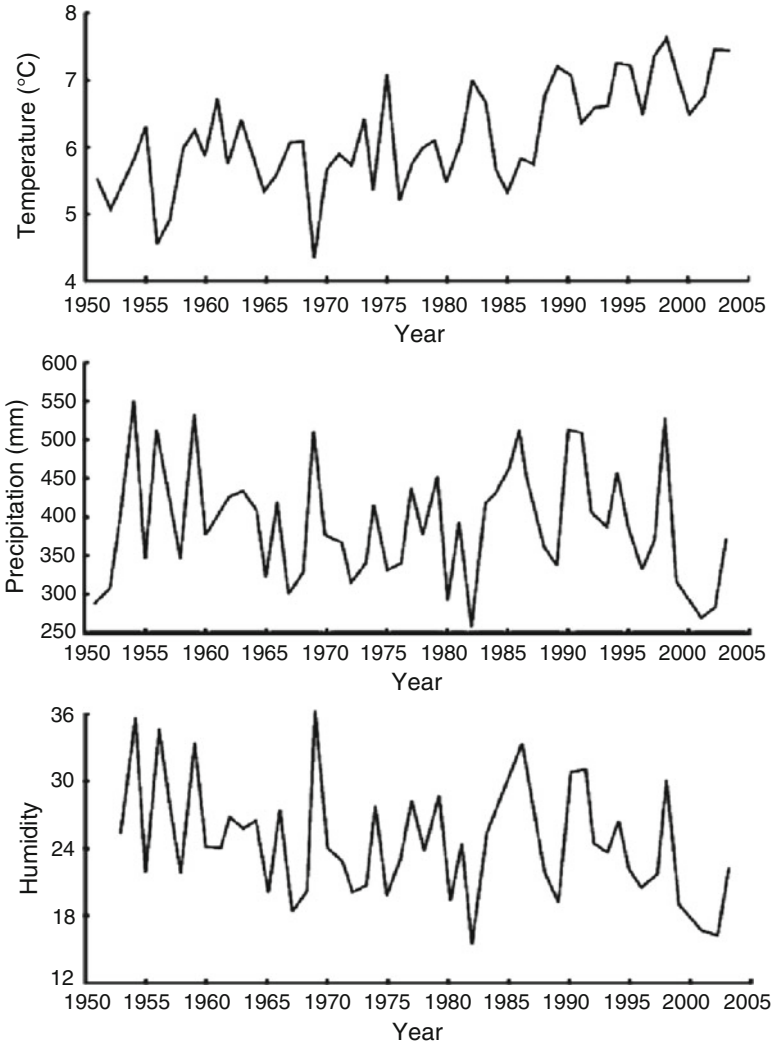

Fig. 2.1 Time series data from Junggar Basin, Xinjiang in western China over a 50-year period showing variability in temperature, rainfall, and humidity

As people strive for a better life, there has been a tendency to see development as synonymous with economic growth and wealth in monetary terms. Both capitalist and socialist systems are based on the quest for economic growth, which in turn is recognized as the mark of progress—the measure by which a nation's well-being has been gaged. The long-term implications of this approach has come to the fore as ecological disasters such as the Aral Sea crisis in western Kazakhstan have become more widely known.

The ideal now is sustainable development (SD). This ideal is a concept that combines two conflicting visions of social change. The ideal originates from environmental concerns rather than financial considerations and is largely based on the conviction that present economic practices, especially those applied in the countries of Central Asia, cannot preserved the Earth's productive potential for future citizens. Thus, policies aimed at satisfying short-term economic and social needs have conflicted with the need to account for what has become known as "*intergenerational equity.*" It has been argued by several commentators that sustainable land use can be achieved without destroying the environment while improving the livelihood of low-income people, but CAR presents special challenges.

In the great majority of cases, the rural poor in the CAR countries have only two options: remain as landless laborers suffering chronic poverty and malnutrition (Kurbanova, Chap. 7) or take the opportunity to occupy marginal grazing and croplands. With most of the good agricultural land concentrated in the hands of an elite class of landlords, the redistribution of land becomes critical both to social justice and to the sustainability of societies (Kurbanova, Chap. 7; Halimova, Chap. 13).

The importance of human–environment interactions to the condition of land compels attention to adaptive management. In order to reconcile concerns and agendas at a higher strategic level, identification of synergies, conflicts, trade-offs, interconnections, feedbacks, and spillover effects among multiple objectives, drivers, actions, policies, and time horizons is crucial. Once these issues are transparent, coordinated action can be put into place (Cowie et al. 2011).

But what does sustainable development mean in practice? It means inter alia using the land in ways that do not degrade it. A consensus definition of sustainable land management (SLM) has proven elusive. Adapting the well-known definition of sustainable development devised by the World Commission on Environment and Development (UN 1987) to the case of land, we consider SLM to be "the management of land to meet present needs without compromising the ability of future generations to meet their own needs." There are now in use a number of different labels for sustainable land use, but the term regenerative agriculture is the term I prefer. In my opinion, enhanced regeneration of natural resources is essential to the achievement of a sustainable form of land use. Other aspects will contribute to sustainability, but regeneration is the component of sustainability that is most important. The term "regenerative" can become part of the language of renewal, reconstruction, and permanence of rural people (and ultimately urban people as well).

There is a need to develop production systems that maximize positive synergies between the various elements of a specific system. SD is commonly defined through

the three "pillars" consisting of ecological, economical, and social components. Essentially, sustainable development (SD) comprises a set of strategies and tools to:

- Integrate biodiversity conservation and ecosystem structure and function with economic development
- Maintain ecological integrity of the rangeland system so as to conserve biodiversity and carbon sequestration capacity
- Ensure satisfaction of basic human needs such as food, shelter, and security
- Achieve equity and social justice
- Provide for social self-determination and cultural diversity

Land degradation (LD) is a major problem for most of CAR's rangelands (Gintzburger et al. 2003). Accelerated soil erosion in all of its forms (gullies, sheet and rill erosion, slumping, and in some places wind erosion) is widespread. Hence, there is a clear need to tackle the root *causes* of LD and not just to deal with its *consequences*. Most efforts in the past have been aimed at "solving" minor problems such as "how to get more forage per hectare" rather than at dealing with the underlying causes of low productivity such as insecure land tenure, unclear boundaries for the assigned grazing user rights (Halimova, Chap. 13), or lack of clear policy on how to balance livestock numbers and feed supplies (Michalk et al. 2010). There is need to raise awareness among both land users (herders and farmers) and the technical staff at all levels (from national to village [*kishlak*] level) of the keys to sustainability and the realities of the market economy. Many LD problems have their origin outside of the agriculture sector. They arise from legislation and policies developed in the cities and from pressures exerted by market forces—including international ones that affect trade and world commodity prices.

The policy approach of the government of each of the CAR countries toward rangeland degradation and farmer/herder livelihoods cannot be viewed in isolation of policy developments and operation in other parts of society. In the transition from a centrally planned to a more market-oriented economy, the types of policies, the mix of policies, and the broader policy and institutional setting have all undergone dramatic changes. The rural sector has not been immune from the general reforms and changes occurring elsewhere in society.

5 Challenges Faced in Reversing Land Degradation

- There have been successful examples of reversal of land degradation as detailed in the book "Where the Land is Greener" (WOCAT 2007). Similarly, useful work on soil erosion control has been done by the Soil Science Research Institute of Tajikistan and doubtless by other research agencies in other CAR countries. More needs to be done to replicate these proven practices and approaches and both replicate them and facilitate scaling-up. A deeper insight into the mechanisms and processes of recovery and restoration of degraded lands has been provided by Tongway and Ludwig (2010).

- Economies in CAR, especially in the five "stans," are in transition toward a market economy at a time when GDP is still the lowest of the CIS countries. This imposes considerable constraints on government spending and presents a number of serious challenges. Low relative incomes and the incidence of poverty are pervasive in rural areas and a major challenge for all levels of government.
- There has been a massive increase in livestock numbers and a more intensive use of the forage resource. This intensive use has led to severe degradation and lower productivity as well as massive reductions in carbon sequestration potential and in biodiversity.
- Some of the key issues and challenges confronting the pastoral lands and their users include increasing human population, excess grazing pressure, increasing land degradation, more intensive use of the rangelands, and the link between livelihoods, ecological services, and degradation.
- Growth of livestock industries is constrained by the availability and cost and availability of feed inputs. Another key input is labor. Population growth in pastoral areas has exceeded that in other parts of each country. There is a high proportion of the male population involved in work as migrant labor. For example, many of the able-bodied men from Tajikistan between the ages of 18 and 50 years have gone to work in Russia. At the same time, the relative scarcity of capital in the poor areas has constrained growth in the pastoral region.

There are six major focus areas in rural development in CAR that impact on any attempt to adopt and promote SD. These are:

Managing structures (fragmented and chaotic structures, overlapping mandates, and economies of scale)
Managing policies (lack of comprehensive rangeland management policy framework; inconsistency in planning, legislation, and programs; coordination with other policies)
Managing institutions (powers and responsibilities, capacity to carry out tasks, coordination, facilitative vs. interventionist approaches)
Managing people (structural adjustment of pastoral and agricultural industries, settlement policies, population policies)
Managing livestock (livestock industry development, technology [feed, breeding, grazing management])
Managing markets (price determination and macrolevel management of markets, microlevel management of markets)

The major challenges to be addressed in the rangelands include:

- The need to improve information on extent and state of the rangelands, and how they are changing over time.
- The need for rangeland technicians to refine existing models of rangeland ecology and to work with economists, livestock specialists, and pastoral development experts to design appropriate management systems for livestock production.

- Linkages between the ecological aspects of conserving the biodiversity and watershed values of the rangelands and the economic benefits and goals of sustainable development. The problems of the region's pastoral areas need to be more clearly articulated.
- Need to better integrate the mainstreaming of biodiversity conservation programs for the rangelands with other development and environment activities.

For the rangelands, the first priority in all CAR rangelands is to maintain and restore the ecological sustainability of the watersheds and rangelands for present and future generations. Restoring and maintaining the ecological sustainability of the rangelands while balancing other needs is a challenge. Diverse economic and social needs of rangeland inhabitants, along with pressure to conserve rangeland biodiversity and watershed values, add to the difficulties faced. Meeting the challenge requires that there is a move away from a focus of sustaining livestock outputs from the rangelands to one of sustaining ecological processes and a wide variety of goods, services, conditions, and values. Many rural people face a downward spiral of decreased grazing land, of increased crop encroachment, and spiraling firewood requirements. These forces contribute to the impoverishment of the rural population and to accelerated land degradation. The trend is being exacerbated by recurring drought, and vulnerability to drought is one of the main indicators of long-term environmental and social sustainability of these farming systems (Squires 2011).

Within rangelands,[6] ecological sustainability requires maintaining the composition, structure, and processes of the rangeland ecosystem. The concept of *ecological sustainability* provides a foundation upon which the management of rangelands can contribute to the goals of economic and social sustainability. Implementation of ecological sustainability into development plans for rangeland areas is not a precise process; there are many unknowns and risks that cannot be controlled. Therefore, planning for rangeland sustainability should acknowledge the following features of rangeland systems:

- The dynamic nature of ecological systems
- The significance of natural processes
- The uncertainty and inherent variability of ecological systems
- The impact of cumulative effects (including climate change)

When developing actions to reverse LD and improve livelihoods and conserve biodiversity, there is a need to:

- Leave options open by not preempting future actions
- Conserve habitat for native species of plants and animals
- Raise productivity of ecological systems
- Reduce uncertainty through adaptive management and continuous learning

[6] See Squires 2011, for a fuller discussion of rangeland, including widely accepted definitions and the goods and services that derive from it.

Since rangelands vary considerably across the CAR, development programs need to be focused at local community levels. This requires improved community participation and the development of sustainable participatory mechanisms for community-based natural resource management (Kurbanova, Chap. 7). There is a clear need to bridge the gap between production and income objectives of the land users (Michalk et al. 2010) on the one hand and the long-term objective of preserving natural resources on the other.

There is recognition now too of the fact that there are few management options available to the land users. Those that do exist fall into two categories:

Reduce total grazing pressure (from livestock, from mammalian competitors such as rodents and wildlife, and from grasshoppers and other invertebrate pests) by reducing herd/flock sizes through heavier culling and through adoption of precision management to cull unproductive animals. Breed improvement also falls into this category as a longer term strategy, but it is not a panacea. Improved breeds will not perform well unless they get better feed.

Increase feed supply and/or utilization efficiency (by planting sown pastures and fodder crops; by utilizing crop residues in a better way, e.g., urea treatment; by conserving fodder as hay or silage). Better ration formulation for penned animals helps to make better use of the available feed and allows the tailoring of the ration to the specific animal's need. Of course reducing the competition from rangeland pests like rodents and grasshoppers should be part of the strategy to reduce grazing pressure.

Increased attention to livestock–environment interactions is therefore of critical importance in maintaining the CAR rural resource base. An integrated approach is required to reverse the present downward trend in rangeland productivity. The objective is not simply to revegetate the degraded areas by means of reseeding or imposition of grazing bans, but rather, it involves the management of livestock (the majority of which are owned and controlled by village-based households).

This management involves more than adjusting the grazing pressure. It calls for adjustment of the animal husbandry system and greater understanding of the linkages between grazing livestock and the rangeland on which they depend, including the impact of abiotic elements such as climate. This last point is particularly important in terms of the impending impacts of global climate change (Oxfam 2009). Many CAR countries, especially Tajikistan, are ill-prepared for climate change (Fig. 2.2).

6 Climate Change Impacts Are Complicated by Environmental Management Weaknesses

Environmental problems, independent of climate change, have presented serious challenges to most of the CAR countries although not every country has the exact same suite of problems. Many countries lack management practices needed to protect the natural resource base on which economic activity depends. Shortcomings

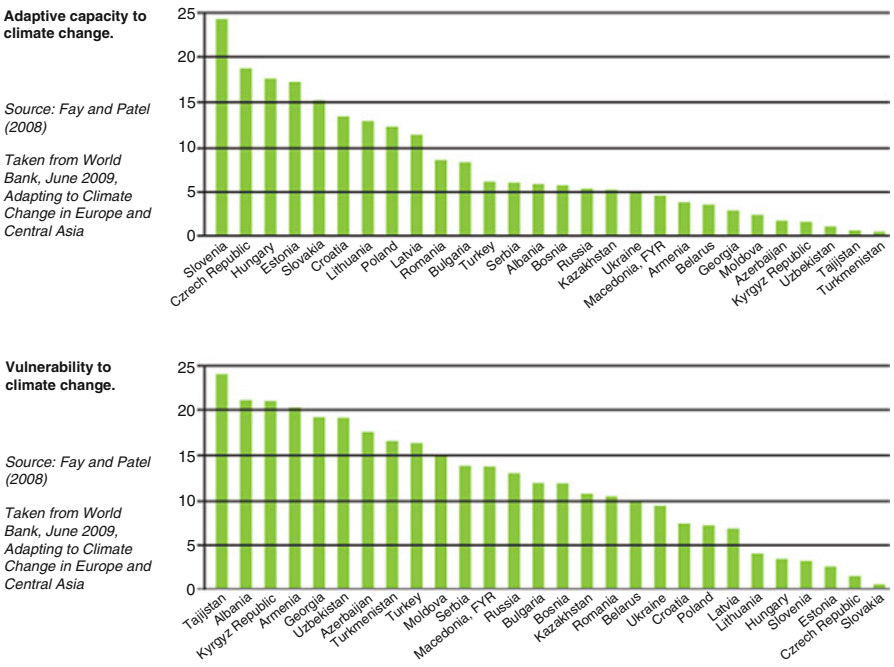

Fig. 2.2 Tajikistan is the country most vulnerable to climate change in the eastern Europe and central Asian bloc, but Kyrgyzstan, Uzbekistan, and Turkmenistan are also vulnerable. Many central Asian nations have low adaptive capacity to cope with climate change

are evident in management of soil fertility, water use, forest management, and illegal logging. Projecting current management practices into an era of accelerating climate change raises concerns. Worries about not only about social and economic setbacks in farming and forestry but also impacts on ecosystem stresses, including biodiversity loss and damage to watersheds and rural landscapes.

Failure to address land degradation problems is particularly worrisome because climate change could make today's problems worse through a pattern of alternating droughts and intense rainfall. Institutional and management weaknesses stem mainly from the complex transition from centrally planned communist-era governance models (Rahimon, Chap. 3). Though the most difficult decades have passed, a legacy of distorted specialization and rigid, poorly-funded institutions remain (Squires, Chap. 12).

Vulnerability to climate change will be dominated by socioeconomic and legacy issues (Fay et al. 2009). Resilience to a changing climate—whether to a climatic shock or to changing averages—depends heavily in the state of the system that it impacts, whether human, physical, or ecological. Thus, a short drought may be manageable for a farmer coming out of a prosperous year but ruinous if it follows another dry year that drained household savings or reduced herd/flock size.

Decades of mismanagement and neglect have diminished CAR countries' natural resistance. Under the socialist system, economic growth was pursued in blatant disregard for prevailing natural conditions.

Land users' ability to adapt to a changing climate depends on the elements of well-functioning farming systems. Such elements include:

- Locally relevant agricultural research in techniques and crop varieties and animal genotypes
- Training in new technologies and knowledge-based farming approaches
- Private enterprises, or public or cooperative organizations, for inputs such as seeds and machinery, and access to affordable rural finance for such inputs
- Physical infrastructure and logistical support for strong, transporting, and distributing farm products
- Strong links with local, national, and international markets for agricultural products
- Timely access to climatic and forecasting information and the skills needed for their interpretation and application

Rangelands grazed by livestock support a forage crop capable of intercepting and storing large amounts of solar energy and, consequently, support livestock production at low cost, if managed properly. There has been slow realization that livestock are *tools* for managing the rangeland vegetation resource and marketing its forage and that livestock are *not an end in themselves*.

There is still a lot to learn about how to manage rangelands for higher energy interception. Vegetation is the central variable in the rangeland system which is externally affected by the amount and timing of precipitation and other weather factors such as wind, freezing conditions, and drought. Severe LD also prevents vegetation from regenerating (Squires et al. 2009).

The grazing subsystem is driven by external factors—*vegetation productivity* which in turn is dependent on other factors (see above). Livestock's domination in grazing systems limits the opportunity for rangeland ecosystems to recover and is the driving force in rangeland degradation. Another important driving force in the rangeland ecosystem is the human dependence on livestock as the main source of income.

7 The Land User's View of Land Stewardship

Regardless of how we define sustainable use of land, it is ultimately the land user who must establish practical, sound practices. So the land users' point of view of what constitutes sustainability is the most important perception of all. Farmers and herders seek first a reasonable financial return on their capital and labor. They seek efficient production techniques that do not demand too much physical effort (labor), personal time, or capital. Financially they aim to operate farming and livestock raising methods that can adapt to risk and changes in markets and weather. Personally and socially, they prefer a farming method that keeps their customs alive, meets

their peer groups' expectations in land stewardship, and gives their offspring a sound resource base for future family prosperity. In working toward these goals for the family farmers, we must be mindful of the fact that land users cherish the freedom to act independently, to operate their farming/livestock enterprise, and to work with minimum regulation and interference. They value the right to seek information and assistance when and from whom they choose and to decide for themselves how best to manage the land.

One of the forces affecting the way land users manage their resources (soil, water, vegetation) is their security of land tenure. Clearly, people with insecure tenure and annual (may be renewable) leases will be less concerned about the long term than someone who has lifetime land use tenure (Kurbanova, Chap. 7; Halimova, Chap. 13). The attitude of the land user has a critical bearing on the significance of "sustainability." One of the aims of good land stewardship is to use the resources in a way that leaves something of value to the coming generations. The idea of intergenerational equity would have no meaning if government policymakers avoid all responsibility to ensure secure tenure and equitable division of land resources.

The idea of stewardship is based on landholders regarding themselves as temporary custodians of the nation's resources or as end users of the land. This long-term unselfish view brings with it a respect for the landscape and the humility associated with frugal living and an appreciation of nature. It is the essence of a personal worldview based on sustainability.

8 Summary and Conclusions

It is clear that for CAR countries, with all of their complexity and their dwindling resource base, widespread poverty, and burgeoning populations, better land stewardship is an ecological and economic imperative.

A national action plan for the rangeland should be developed by each country to systematically address the real problems of rangeland degradation in ways that have a long-lasting impact on halting and reversing the trend of rangeland degradation. A long-range, logically structured action plan needs to be developed to ensure that efforts being made to stabilize and improve rangeland ecosystems are focused and coordinated. The government needs to provide the necessary policies and institutional support to ensure that technical solutions have an enduring and positive impact on the rangelands. The action plan must impact a wide range of institutional, regulatory, financial, educational, and physical forces if it is to be effective in halting and reversing rangeland degradation. A big part of this is to change the mind-set of the primary land users (farmers and herders) and foster the development of a land ethic based on land stewardship. An ethic of stewardship for rangeland aims to promote sustainable land use and to develop sustainable communities. The importance of working with local communities is elaborated elsewhere in this book (Kurbanova, Chap. 7; Hua, Chap. 14).

To promote ecological sustainability of CAR's rangelands, the ministry concerned with nature protection should begin to play a more active role in rangeland research, monitoring of the rangeland environment, and engaging in policy dialogue on environmental sustainability of the rangelands. Such ministries do not have the livestock production orientation of the Ministry of Agriculture (or local equivalent) and should help shape the research, policy, and development agenda to ensure that ecological sustainability of rangeland ecosystems is pursued.

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