Chapter 15
Conclusion: Environmental Futures of the Upper Yellow River Basin

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We won't have a society if we destroy the environment.
Margaret Mead

Abstract The distinctive geography, ecology and history of the Upper Yellow River Basin have created a suite of unique, irreplaceable environmental and cultural values. However, significant development pressures present an all-too-familiar example of the challenges faced in achieving sustainability goals. This chapter pulls together various threads of enquiry explored in this book to scope prospective environmental futures of the Upper Yellow River. A socio-ecological systems approach to environmental management demonstrates how landscape approaches can provide a useful tool to negotiate trade-offs between competing social, economic and environmental objectives. Research needs and prospective management approaches to address threats to environmental and societal well-being are outlined. The chapter challenges the proposition that effective environmental protection and conservation can be achieved through a 'reserve' mentality applied independently from lifestyle values of people who live in the area. Participatory practices that frame human activities as part of nature, not separate from it, are required to support 'whole of landscape' approaches to ecosystem

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management that give due regard to social, economic, cultural and environmental considerations. Future prospects for the Upper Yellow River basin are shown to be far from a 'doom and gloom' situation.

Keywords Socio-ecological systems · Environmental management · Environmental protection · Biodiversity management · Ecosystem management · Regional development · Sustainability · Ecosystem services · Environmental history · Environmental futures · Conservation · Restoration/rehabilitation · Resilience · Sanjiangyuan National Nature Reserve

15.1 Introduction

The distinctive geography, ecology and history of the Upper Yellow River Basin have created a suite of unique, irreplaceable environmental and cultural values (see Brierley et al. 2016, Chap. 1). The global significance of the region is a product of its geologic and climatic setting, its ecosystems and resource base, and its cultural associations. However, significant development pressures present an all-too-common example of the difficulties faced in achieving sustainability goals and conservation planning (see Economy 2004; Goodman 2004; Liu et al. 2012; Shapiro 2012). We have a collective responsibility to look after the source zone—for local people, for China and for the world. What is the legacy we leave behind for those that follow?

Because of their history, isolation and variability of habitat, mountain regions are treasure chests of biodiversity and are rich in endemic species and genotypes (Hamilton and Macmillan 2004). Distinctive ecosystems have developed in response to the pronounced altitudinal belts in these areas. However, high-altitude terrains are especially susceptible to human-induced damage, and many elements of these fragile environments are vulnerable to accelerated rates of climate change. Habitat fragmentation and isolation have led to biodiversity losses. Around 18 % of the total number of species in the Sanjiangyuan is threatened (Chen et al. 2007). This is much higher than the world average of 13 %. Numbers of Tibetan antelope, white-lipped deer, red deer and snow leopard have decreased significantly, while alpine musk deer are almost extinct (see Brierley et al. 2016, Chap. 1).

In this chapter, we argue that while environmental protection is a vital consideration in the source zone of the Yellow River, effective conservation cannot be achieved through a 'reserve' mentality that views landscapes and ecosystems as 'museums' that are 'locked in time and space' (cf., Chan et al. 2007; McShane et al. 2011; Ran et al. 2016, Chap. 14). Rather, due regard must be given to the priorities of people who live, work within and shape these living socio-ecological systems, recognizing that these landscapes provide multiple values and services to diverse interest groups (e.g. Lawrence 2010; Sayer et al. 2013). Spatial segregation of protection and production functions of land does not provide a sustainable basis for environmental management. Many local environmental and sociocultural values are vulnerable to development pressures and associated government policies (see Ran et al. 2016,

Chap. 14). We contend that visions for an ecologically sustainable future should seek to integrate proactive biodiversity management programmes with coherent strategies that promote regional development and natural resource management.

We feel that future prospects for the Upper Yellow River Basin are far from a 'doom and gloom' situation. Regional water resources remain plentiful and are an exceptionally valuable asset (Huang et al. 2016, Chap. 4). Tourism numbers are booming as infrastructure developments create increasing opportunities for visitors to experience the stunning landscapes and ecosystems of this region. Climate change presents new opportunities for agricultural and land use developments. In an age of increasing concern for food security, there are significant prospects to expand organic farming techniques that build upon traditional lifestyles.

This chapter pulls together various threads of enquiry explored in this book to scope prospective environmental futures of the Upper Yellow River. The chapter is structured as follows. First, a socio-ecological systems approach to environmental management is outlined, viewing human endeavours as part of natural systems. A landscape frame offers an integrating basis to assess prospective social and environmental futures. The second section of this chapter considers steps to support ecosystem management in the region. The third section provides a summary of threats to environmental and societal well-being in the Upper Yellow River Basin. The chapter concludes by identifying steps that can be taken to address these concerns.

15.2 Landscapes and Ecosystems as Socio-Ecological Systems

The mindset with which we see the world fashions our actions. Approaches to environmental management, and the priorities that we place on these measures, reflect societal choice and opportunity. The choices we make reflect our needs, values and perceptions, as we frame recreational, aesthetic and cultural connections in relation to consumptive needs. Choices reflect the values we think matter—what we seek to achieve in our relationship to the natural world and to each other. Opportunity refers to what it is possible to achieve through management efforts and lifestyle choices. Unfortunately, confronting images of degraded ecosystems across much of the planet remind us of the choices we have made to date. In a sense, environmental health can be viewed as a measure of the health of our society.

15.2.1 Humans and Nature: How are we Living with this Planet?

With each passing day, the human imprint upon Planet Earth increases. Humanity is quickly encroaching upon the finite limits of the biosphere. As the global population continues to increase and our technological capacity becomes forever

greater, we exert an increasingly profound influence upon the world around us. The Anthropocene is already a living reality. Humankind has become a dominant force of nature, exerting unprecedented pressures on the planet's resources and pushing the Earth's biophysical system far outside of its historic operational range (Steffen et al. 2015). Human impacts upon Earth's life support systems have become so profound that they threaten many of the ecological services that are essential to society (Chapin III et al. 2011). The exponential growth of human activities is raising concern that further pressure on the Earth System could destabilize critical biophysical systems and trigger abrupt or irreversible environmental changes that would be deleterious or even catastrophic for human well-being.

Nature supports our lives. Healthy socio-ecological systems are self-sustaining and resilient. However, unsustainable lifestyles and levels of consumption threaten the viability of these systems, and hence our own well-being. A sustainable world is one in which concerns for socio-economic development and environmental protection are balanced in an equitable manner, such that people live in harmony with ecosystems. At present, this is not the case. Pervasive degradation of environmental systems is testimony to the non-sustainable lifestyles that we live—the choices made by society to date. Recognition of this situation is a critical first step in efforts to reform societal outlook and practice. The goal of Earth Stewardship is not to protect nature from people; rather, it is to protect nature for human welfare (Chapin III et al. 2011).

Sustainability should not be viewed simplistically as a negotiated trade-off. Half a habitat is not a viable option. Ecosystems are either sustained and are sustainable, or they are not. 'Business as usual' will not work. In many instances, societal choice reflects economic circumstance: what is affordable? As noted by Mahatma Gandhi, '*Poverty is the greatest polluter*'. Sustainability questions will always play a secondary role in the immediate quest for survival. Ultimately, however, environmental security is also a prerequisite for human survival. Moves towards sustainability require that we recognize immediately what we cannot afford NOT to do. The cost of environmental protection is cheaper, and more effective, than notional cures.

Proactive approaches to the sustainable management of environmental futures build upon rational plans that assess what to protect where, how to target rehabilitation initiatives and how to engage society in meeting these aims. These are social, economic, cultural, spiritual and attitudinal issues as much, if not more, than they are technical, scientific or technological issues. As yet, there are few indications that these threads are being meaningfully appraised in a coherent (collective) sense in the Yellow River Source Zone.

Efforts to protect and enhance biodiversity and support the intrinsic value of nature are required to ensure ongoing provision of ecosystem services (e.g. improved water quality, fertile and stable soils, drought and flood buffering, genetic diversity and carbon sequestration) that enhance human quality of life (e.g. clean water, food security, enhanced health and effective governance; de Groot et al. 2013; Suding et al. 2015). 'Thinking like an ecosystem' promotes a perspective in which the environment is not 'out-there'—rather, it recognizes explicitly

that we live 'within-it'. Both technically feasible goals and scientifically valid goals require social acceptance. Major conservation and rehabilitation efforts will not be successful unless society approves the goals and objectives. Ultimately, environmental protection and repair are collective responsibilities that require appropriate visions, effective implementation and societal 'will' to improve environmental health and societal well-being. Unless applications are 'owned' by the communities involved, prospects for long-term, sustainable environmental health are likely to be compromised. Involving people through multiple avenues—from participation to consumption of ecosystem services to cultural renewal—can promote public engagement and stewardship of local ecosystems.

Environmental degradation and loss of biodiversity affect all of us, though some are affected more than others. Healthy and sustainable environmental systems will not be achieved by passively waiting for someone else to 'fix' the problems. How will we know, before it is too late, that we are approaching the limits to ecosystem viability? Coherent approaches to environmental management are conceptualized and operationalized at the landscape scale.

15.2.2 A Landscape Approach to Environmental Management

Landscape approaches help to negotiate trade-offs between developmental and environmental concerns, providing tools and concepts for allocating and managing land to integrate competing social, economic and environmental objectives. Sayer et al. (2013) define a landscape as an area delineated by an actor for a specific set of objectives. This definition extends beyond notions of landscapes as merely physical spaces. Rather, they are arenas in which physical, biological and social entities interact and change over time. Desirable changes in one component of the landscape may have unintended and undesirable repercussions. Landscape approaches therefore demand an open-minded view of outcomes and acknowledgment of the trade-offs likely to be involved in any system change. As land use and resource policies shape both social and environmental outcomes, clarifying and negotiating competing land use rights and responsibilities has now become a core role of resource management agencies across much of the world. Increasingly, engineering-style command-and-control approaches to resource use and environmental management are being replaced by community facilitation and negotiation between stakeholders (Sayer et al. 2013).

Landscape approaches to environmental management recognize that biological diversity is inextricably linked to the variety of landscapes and land-forming processes in any ecoregion (Wiens 2002; Wohl et al. 2005). The term 'geodiversity' can be considered to represent the diversity within components of the nonliving world (i.e. diversity within the geosphere, as opposed to the biosphere; Parks and Mulligan 2010). The evolutionary processes that generate and maintain biological diversity are constrained by environmental processes that reflect

landscape patterns and connectivity within a particular area. Patterns of resource availability are structured in space and time by these patterns of geodiversity (Parks and Mulligan 2010). A more varied landscape consisting of diverse habitats offers broader and more varied niche space available for species to fill (Dufour et al. 2006). Associations and habitat uptake vary over time, whether as a consequence of short term (e.g. diurnal or seasonal) variation, or longer term variation through climatic cycles and stochastic events. Thus, conserving geodiversity also conserves the biological processes that generate and maintain biodiversity, ensuring that the foundations for functioning ecosystems will still exist even if the current occupants (species) do not. Inevitably, prospects for recovery are inhibited if source populations are missing, regardless of the management actions we take.

Effective management practices aim to establish systems that are self-sustaining and resilient in a manner that is appropriate for the environmental context and landscape setting (Higgs 2003; Hobbs et al. 2011; Suding 2011). Recognizing explicitly that there are too many species to save them one at a time, extensive landscape-scale endeavours are required to maintain and/or enhance the resilience of ecosystems, supporting capacity for species to disperse, migrate, forage and reproduce. Ecosystems that are structurally and functionally diverse are more likely to be durable and capable of adapting to future challenges of climate change, introduced species and land use change (Suding et al. 2015).

In spatial terms, measures of geodiversity are typically framed in relation to landscape heterogeneity, considering types of entities and assessing how they are interlinked (i.e. their juxtaposition, pattern and connectivity). Not all landscapes and ecosystems are complex—some may be remarkably simple (Fryirs and Brierley 2009). Some boundaries are inherently impermeable; others induce significant constraints upon the operation of particular processes and the range of species (i.e. many landscapes are naturally disconnected; Fryirs and Brierley 2009). If a landscape is naturally disconnected, efforts to increase connectivity 'work against' nature. Conversely, management actions such as fencing programmes and dam construction artificially disconnect (fragment) landscapes and river systems. This impacts upon faunal migration pathways and inhibits prospects that species can reach their dispersal destinations, such that they are forced to live in habitats that are not large enough for their survival as they are unable to achieve genetic exchange. In general terms, decreased variability in habitat availability induces biodiversity loss.

In temporal terms, appraisals of landscapes as dynamic templates emphasize concerns for the range of variability of any given system, recognizing that responses to disturbance are the 'norm'. Hence, adjustments around an equilibrium condition are not always expected (Brierley and Cullum 2012). In this light, assessments of system sensitivity and resilience must be framed in relation to the expected 'range of behaviour', recognizing that surprises are inevitable, and particular combinations of circumstances may trigger unique (not previously experienced) outcomes. Such framings must consider the emergent and uncertain nature of prospective future adjustments, considering risks and threats to public health and safety in an open-ended, non-prescriptive manner.

Ultimately, the use of a landscape template emphasizes the primacy of place as a critical component of environmental management. How readily can lessons learnt at one locality be transferred elsewhere (Brierley et al. 2013)? Given the steep environmental gradients and proximity of different altitudinal zones in mountainous regions, with significant opportunities for biotic adaptation to environmental changes, large areas must be protected to support the adaptive capacity of these systems, giving species the opportunity to migrate to new habitats. Such considerations are particularly important given the large environmental changes that will accompany global climate change in coming decades.

15.2.3 History Provides Clues to the Future: The Importance of Evolutionary Trajectory

Environmental histories provide important guidance with which to inform environmental management. Much can be learned by looking to the past to inform the future, as evolutionary analyses provide fundamental understandings of causes and triggers of change, tipping points and bifurcations in evolutionary adjustment, and contingencies that fashion future adjustments. This helps to guide analyses of the range of potential future states and associated behavioural regimes (Fryirs et al. 2009; Surian et al. 2009). Inevitably, these situations are entirely contextual—they reflect local circumstances alongside broader-scale drivers and pressures for change, and limiting factors which may constrain the future range of variability. Modelling applications can be used to generate insights into the likelihood that a given state will be attained over a given time frame, taking into account prospects for lagged and offsite responses. Assessment of the likelihood of prospective future states/trajectories, alongside appraisals of their desirability, can define 'what is achievable' in relation to 'what is desirable/acceptable' in the management of environmental futures.

However, historical understandings are just that—interpretations of what landscapes and ecosystems used to be like. Although historical knowledge, in its many forms, provides insight into how ecosystems functioned in the past, the unprecedented pace and spatial extent of anthropogenic changes may create conditions that depart strongly from historical trends (Hobbs et al. 2011). Thus, history often serves less as a template and more as a guide for determining appropriate management goals (Balaguer et al. 2014; Higgs et al. 2014). Analyses of past conditions can only provide partial insights into prospective environmental futures. Socio-ecological systems are complex systems, wherein what has gone before does not necessarily provide a complete and reliable picture of prospective future conditions. In a no-analogue world, the emergence of novel ecosystems is inevitable (Hobbs et al. 2006, 2009, 2013).

Recent transitions in management practice emphasize concerns for process-based analyses of evolutionary trajectories as a basis to assess likely future states, rather than framing activities in relation to specific reference conditions that reflect past states. Associated management efforts incorporate future variability through the use of flexible, open-ended and dynamic goals (e.g. Hiers et al. 2012; Hughes et al. 2012). Target

conditions that guide adaptive management practices can be viewed as stepping stones along evolutionary trajectories (Brierley and Fryirs 2015). As surprises are encountered and lessons are learned, both the targets and the management activities that aim to achieve these targets are adapted. Such flexibility flies in the face of command-and-control approaches that are often difficult to unpick and reframe, since built infrastructure and path dependencies impose significant constraints upon future management options. Learning to live with variability and complexity requires that we accept and embrace uncertainty. It is impossible to 'know' what the future will bring.

15.2.4 Growth with Safeguards: Balancing Development and Environmental Protection

Efforts to safeguard the future in West China face great challenges in balancing economic development and societal well-being while promoting environmental protection and restoration in the face of climate and land use change. Preventing future deterioration of environmental assets is a critical first step. Importantly, a wide range of landscapes and ecosystems in the upper basin of the Yellow River remain in good condition and continue to provide a host of environmental services. These values underpin prospects for socio-economic development of the region and therefore warrant effective environmental protection. Hence, it is vital to safeguard land and water resources by promoting sustainable land use.

However, what values are we trying to protect in ongoing management efforts in the Upper Yellow River Basin? How consultative are decision-making processes, especially in relation to those who live on (and off) the land? Is there a genuine commitment to participatory practice, remembering explicitly that conservation cannot be sustained through management of 'reserves' or 'parks' independent from people (see Ran et al. 2016, Chap. 14)? This situation is all the more untenable in the light of the grazing-adapted ecosystems shaped by human endeavours over thousands of years in this region (Li et al. 2016a, Chap. 7; Han et al. 2016, Chap. 8; Tane et al. 2016, Chap. 13). Rangelands continue to provide for the livelihoods of local herders. A viable pastoral society is vital to ensuring the sustainability of the prevailing socio-ecological system.

Having said this, rangelands are being degraded due to overgrazing, policy changes and climate change (Li et al. 2016a, Chap. 7; Tane et al. 2016, Chap. 13; Wu et al. 2015). The development of sustainable land use practices needs to draw upon both indigenous knowledge of grazing and rangeland management, as well as modern, more technical methods. Social transformations and economic changes are required to strengthen public participation and cooperation with all types of institutions to formulate appropriate policies and improve public services (Wu et al. 2015). A deep commitment to social and environmental justice underpins the likely effectiveness of such transformations in practice (Westley et al. 2011).

Managing for resilience requires integrative planning from the outset, not ad hoc strategies and actions. Iterative, flexible and ongoing processes of negotiation, decision-making and re-evaluation, informed by science but shaped by human

values and aspirations are required (Sayer et al. 2013). We need a clear and shared statement of what we are trying to achieve (vision and goals), what we need to do to get there (strategies to achieve them), prioritization of actions to achieve goals and monitoring programmes to assess the effectiveness of these practices (and implement appropriate responses to lessons learnt). Given inherent complexities and uncertainties, management processes cannot be unduly prescriptive—they must be flexible and adaptive. A clear evidence base is required to support decision-making, identify assets and threats, and establish clear and measurable objectives for desired future states. Support tools are required to:

- Generate a clear understanding of what a sustainable world may look like
- Use foresighting exercises to prepare ourselves for likely futures, identifying circumstances under which changes in system state may occur
- Provide guidance on the steps that must be taken in working towards a sustainable world.

A landscape approach provides a framework to support consideration of choices in the setting, discussion and negotiation among options for environmental futures. In framing these deliberations, differing scenarios can be tested in terms of development, population pressure, climate change, land use, soil and water resources, environmental limits (boundaries), evolutionary traits, thresholds, etc. Environmental modelling applications can support analyses of eco-environmental dynamics, appraising pressures and threats in relation to cumulative impacts, thereby enabling foresighting and scenario-setting exercises to appraise prospective responses to management applications. Environmental Impact Assessments are required to facilitate proactive, precautionary management, using efficient and effective monitoring programmes to measure progress and develop responsive management strategies that learn from experience.

Throughout such endeavours, it must be remembered that the weakest link in any system (whether scientific/technical understanding, socio-economic and/or cultural associations, or managerial/governance issues) limits the performance of the system as a whole.

15.3 Management Responses to Pressures and Threats upon Environmental Values and Societal Wellbeing in the Upper Yellow River Basin

> The dependency of local livelihoods on the services provided by ecosystems is greater in drylands than in any other ecosystems, rendering their inhabitants exceptionally vulnerable to land degradation. Current approaches to managing drylands to mitigate land degradation often fail to produce significant improvements because local knowledge is often undervalued and the complexity of underlying processes leading to land degradation is still not well understood.
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> Mueller et al. 2014, p. 1.

In some ways, biophysical constraints place significant limits upon development prospects in the Upper Yellow River Basin. For example, although various dam projects will be developed to exploit hydropower resources, there is limited agricultural potential to be gained through irrigation schemes because of altitudinal and climatic constraints upon the short growing season and the limited (often depleted) soil resources with low inherent fertility.

Global climate change is the fundamental natural cause of ecological deterioration in the region. Glacier retreat, ascending snow lines, drying up of wetlands and degradation of alpine permafrost have impacted upon hydrological resources, groundwater reserves, run-off relationships and vegetation patterns. Concerns for water security are also directly tied to land use practices. Reduced run-off has forced herders into other areas, increasing grazing pressure and further degrading grassland areas (Chen et al. 2007). The warming trend has impacted upon agricultural prospects, affecting plant growth, yield and community structure in alpine meadow ecosystems (e.g. Chen et al. 2014; Zhang et al. 2015). Intensified human activities and overgrazing have brought about extensive grassland and wetland degradation in recent decades (see chapters by Qiao and Duan 2016, Chap. 6; Li et al. 2016a, Chap. 7; Li et al. 2016b, Chap. 9; Gao 2016, Chap. 10; Tane et al. 2016, Chap. 13).

Recent changes have markedly decreased primary productivity associated with animal husbandry, threatening people's livelihood. The yield per unit area of grassland, the percentage of elite forage species and vegetation cover have decreased, while the percentage of toxic plants has increased (Fu et al. 2007). Grassland areas are becoming increasingly fragmented, characterized by reverse succession from alpine meadow to degraded alpine meadow to desert in some areas. Biological and ecological changes are increasing susceptibility to invasions by exotic species and rodent irruptions, enhancing soil erosion and salinity problems (Li et al. 2016a, Chap. 7). Forms and rates of degradation vary markedly on differing topographic surfaces, reflecting factors such as sediment thickness, water/nutrient movement, soil fertility/health (e.g. relationships between soil microfauna (bioturbation) and differing hydrological, texture and nutrient properties of soils on differing surfaces), vegetation communities (including weeds) and pica distribution. These relationships, in turn, are influenced by land use practices, especially cultivation and animal management (see Tane et al. 2016, Chap. 13).

Complex ecogeomorphic interactions are clearly exemplified in those areas of the Upper Yellow River that are being subjected to grasslandification, wherein wetlands are drained and modified for use as pasture (Shang et al. 2013). Ultimately, resulting environmental transitions in abiotic and biotic terms are driven by social and economic processes, alongside climate change. Additional research on these relationships is required if concerns for vulnerability, resilience and associated management responses are to be appropriately addressed. Critically, key drivers and underlying processes of degradation must be understood at local/regional scales, building upon situated field-based understandings (see Li et al. 2013). Also, process-based understandings are critical in appraising the likely suitability and effectiveness of rehabilitation initiatives. For example, sustainable stocking rates must be determined for differing types of grassland at differing stages of degradation.

Incorporating local knowledge is fundamental to these endeavours—in environmental, socio-economic and cultural terms. As noted by Mueller et al. (2014, p. 4): '… current approaches to manage drylands to mitigate land degradation often fail to produce significant improvements because local knowledge is often undervalued and not included in land-management approaches, and furthermore, the complexity of underlying processes leading to land degradation is still not well understood'. A landscape approach based on ecogeomorphic principles provides an important basis to address this shortcoming, emphasizing concerns for coupled ecological–geomorphological systems (Mueller et al. 2014). Essentially, local voices must be heard and acted upon, building upon the kind of research outlined in this book and elsewhere (e.g. Shang et al. 2014; Su et al. 2015; Tang et al. 2015; Wang et al. 2015; Zhang et al. 2013, 2015). Ecological degradation and biodiversity losses in the Upper Yellow River region will continue unless human developments are managed appropriately (Foggin et al. 2006).

Environmental protection has emerged as a major issue alongside economic development in China in recent years. The emergence of the Ministry for Environmental Protection marks recognition of the extent of degradation and the priority given to environmental repair. However, ongoing problems such as air and water quality, biodiversity loss, food security and land degradation are indicative of the relative ineffectiveness of measures taken to date.

As economic circumstances improve and aspirations grow, societal expectations for healthy and fulfilling lifestyles and well-being are also likely to increase. Unlike most of the country, and despite some concerns for the degradation of landscapes and ecosystems in the face of climate and land use change (especially in the face of development pressures), environmental conditions remain in a good state in the Yellow River Source Zone. Hence, the primary focus of management efforts in this area is able to emphasize maintenance of environmental health rather than interventions that promote environmental repair. For now, the primary management issue is the protection of key landscapes and ecosystems in the region, such that future generations can enjoy the wonderful values and experiences of this remarkable place (see Brierley et al. 2016, Chap. 1).

Socio-economic programmes are fundamental to future societal and environmental well-being. The remarkable beauty, ecological attributes and sociocultural mix of the region, alongside low levels of industrial and agricultural pollution, present significant opportunities for regional growth, with considerable prospects through ecotourism, organic agriculture and high-value local products (traditional medicines, yak and sheep products, etc.). Working with herders to develop locally owned businesses will enhance retention of resources and profits within the region. Moves towards a win–win 'green economy' aim to protect the environment while improving farmer's income. Recent steps to support such prospects include efforts to develop more intensive industries and training programmes to improve labour skills (Ran et al. 2016, Chap. 14). These include modernization of the animal husbandry industry (including enhanced livestock processing), development of regional grassland industries, production of new Chinese and Tibetan medicines and promotion of ecotourism opportunities.

However, the prevailing Chinese development model seems to adhere to classical modernization theory, embedded in an authoritarian approach. This is similar to the collectivization phases in the Soviet Union and the People's Republic of China, when Stalinist- and Mao Zedong-inspired models were implemented under autonomy and sedentarization regimes (Kreutzmann 2013). Unfortunately, conservation values, policies and practices are not well-integrated in China, with systematic barriers such as weak rule of law, unclear land tenure, top-down government authority and disconnects between scientific research and management implementation (Grumbine and Xu 2011). China's centralized approach to biodiversity conservation, with limited local participation, creates an inflexible and inefficient approach because of conflicts between local communities and national administrators (Zheng and Cao 2015). More effective moves towards an environmentally secure future may ensue if traditional Chinese environmental values are combined with contemporary science and international management practices. Locally based initiatives supported by bridging organizations are required to facilitate community-based approaches to environmental management that incorporate understandings from traditional Tibetan culture using a knowledge co-production approach (Shen and Tan 2012).

Sustainable futures in pastoral regions will not be achieved without adequate participation of stakeholders. Rather than simply legislating for desired behaviours, working towards common goals with local communities as key partners through co-management arrangements is required. Working directly with Tibetan pastoralists offers prospects to enhance societal and economic well-being while protecting cultural values, thereby promoting more sustainable, equitable and economic measures for long-lasting development and environmental conservation in the region, simultaneously meeting local development goals and national conservation goals (Foggin 2011; Foggin and Torrance-Foggin 2011). Conservation-oriented government policies such as ecological migration (*shengtai yimin* in Chinese) threaten not only local pastoralists' livelihood and community structure, but also regional stability, as quota-driven resettlements are married with high levels of unemployment and loss of hope (Du 2012; Foggin 2008, 2011).

15.4 Closing Comments: Managing for the Future

> Harmony with land is like harmony with a friend; you cannot cherish his (her) right hand and chop off his (her) left.
>
> Aldo Leopold

Ultimately, resource and environmental management is not about managing the environment per se, it is about managing people and their relationships to natural resources. People-friendly environmental management practices are required to avoid the tragedy of the commons, where no-one takes responsibility for environmental outcomes. Efforts to think big and long term are most likely to achieve intended and sustainable outcomes when they emphasize concerns for

sociocultural connections through inclusive and flexible governance arrangements, moving forward collectively through ongoing commitments to achieve sustained social, economic and environmental improvements into the future.

Working directly with managers within appropriate governance arrangements that support local communities is the key to effective environmental management (Rogers 2006). Fundamental transitions in societal and governance arrangements are required if the quest for sustainable environmental futures is to build appropriately upon the scientific and technical guidance outlined in this book. The quest for sustainability frames environmental condition in relation to socio-economic and cultural considerations—both now and into the future. The only way in which these aspirations and requirements can be met is when the local citizenry, the people who live on (and off) the land are respected as the true custodians of the land. The combination of value to nature and value to community gives rehabilitation activities the capacity to enhance participatory politics and practices. Capacity building at local levels is vital in efforts to support a harmonious society, ensuring that efforts are locally owned and enacted. Effective interventions build upon co-produced knowledge that incorporates local understandings alongside socially situated science and management.

In a similar vein, management initiatives must be sufficiently flexible to enable them to be adapted when the system behaves (or responds) in unexpected ways. An adaptive management approach recognizes explicitly that we do not always know what the consequences of our actions are going to be and we are not always going to get things right. However, if an appropriate commitment to experimentation and documentation is in place, we should learn from experience and respond accordingly in the design and implementation of future measures. In this light, coping with uncertainty becomes a goal of management processes, rather than attempting to remove it or using it as an excuse for inaction (Clark 2002; Hillman and Brierley 2008). In many ways, threats to long-term ecosystem health are most pronounced when management responses seek to protect human values and assets from natural variability. Endeavours not to over-react in times of crisis are critical to the success of such ventures. It is often extremely dangerous to resort to conventional ‘controlling’ measures that we know are unsustainable in the long term. Ultimately, how we live with risks and hazards reflects the values and importance we give to ecosystem relationships.

In some parts of the world, a ‘tide of change’ towards restoration and environmental improvement (protection) reflects a new societal accommodation with nature. Widely based societal movements towards environmentally conscious lifestyles reflect increasing recognition of our environmental footprint—the food, energy, water and other resources that we consume. Green economies, green infrastructure, green jobs and green farming are symptomatic of increasing awareness of the consequences of our actions and concerns for future lifestyles and well-being. These movements take different forms in different areas, embracing the diversity and variability of a given place, rather than striving to ‘make landscapes or ecosystems the same’ (see Tadaki et al. 2014).

Several key principles emerge from this book in efforts to engender sustainable environmental futures in the Yellow River Source Zone. First, we must create a sense of what a sustainable environmental future looks like—one that society desires and owns. Second, strategic plans of action must carefully consider the range of options, at the same time remembering that getting started is more important than waiting for the perfect plan. Defining assets and threats is a key starting point, working out what to protect, and what threatening processes must be addressed in a proactive manner (addressing the causes not the symptoms of change). Hopefully, findings from the book go some way to achieving this. In summary terms, three key principles have emerged:

(a) Frame human relationships as part of nature, not separate from it.
(b) Adopt visionary 'whole of landscape' approaches to ecosystem management, giving due regard for social, economic, cultural and environmental considerations, emphasizing concerns for integrity and resilience over reactive, short-term, issues-based agendas.
(c) Remember that environmental management affects all of us, both now and into the future, such that effective measures and programmes engage effectively with local communities through participatory practices. The adage 'hope inspires, fear paralyses' provides a timely reminder of the fundamental importance of the collective commitment that is required for sustainable practice.

One thing is clear: the pace of change ensures that the Yellow River Source Zone will be a very different place in coming years.

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