HABITAT AND RIPARIAN MANAGEMENT IN RANGELAND ECOSYSTEMS

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Summary

The role of rangeland habitats and the future of watershed ecosystems are connected in ways few people appreciate. Water security has emerged as crucial to the whole concept of sustainable development, thus rangelands have become the most important watersheds in nearly every country around the world, carrying huge responsibilities for harvesting, storing, distributing and supplying fresh clean water to sustain all living communities.

Rangeland watersheds are natural water farms supplying surplus water through underground aquifers, groundwater mounds, seeps and springs; and via surface streams, rivers and lakes. Like an iceberg at sea, more than 90% of the water is below the surface in the regolith. When springs surface to form streams that overflow into rivers and lakes, the water is usually clean and fresh; at least it is in healthy watersheds. How this happens is a complex game between habitats, regoliths and their living communities. Rangeland ecosystems consist of above and below ground habitats, riparian zones and the many communities they support. These include human habitations and herds of domestic animals. In a world of multicultural diversity it is surprising to find there are only two cultural paradigms for rangeland management: these are the *watershed storage* and *catchment drainage* paradigms. Each depends on unique cultural ethos and distinct environmental perspectives. Recognizing the role played by cultural ethos in the management of rangelands is an important first step. The second is recording how communities and their cultural heritage are reflected in the nature of watershed habitats and the condition and health of riparian ecotones.

Cultures relying on the *watershed storage* paradigm are commonplace in the Asia-Pacific realm. Traditional habitat farming cultures consider all aspects and parts of nature to be connected: living together as one extensive compound organism. Over millennia, most traditional Asia-Pacific cultures have evolved mechanisms based on community cultural intelligence for developing their settlements. Relying mainly on ecographic maps and analogue models to represent watershed habitats, long experience has proved that functional riparian zones and rangeland ecosystems are essential for their farming systems.

Watershed management in pastoral agricultures which relies on the *catchment drainage* paradigm tends to assume that rangelands and their ecological processes can be transformed to suit the needs of pastoral grazing and related settlement infrastructures without affecting the performance of watershed ecosystems. The evidence does not support this. When it comes to critical watershed habitats like aquifer springs, terraqueous meadows and riparian ecotones, the cumulative ecological effects of grazing with hard hoofed animals can be profoundly destructive, fatally compromising water resources and environmental health.

Whether human habitations are ultimately destructive or productive in rangeland

ecosystems is a matter for ecological assessment and watershed audits, preferably through participatory community programs. From sustainable development and environmental protection perspectives, the environmental health of rangelands is primarily a product of their ecological performance as watersheds. Because watershed habitats, riparian habitats and rangeland ecosystems connect strategically to control the ecological performance and the environmental health of rangeland ecosystems, it is absolutely necessary to protect their ecological functions from cultural activities which compromise them.

1. Introduction

1.1 Geographic Perspectives

Rangeland is a generic description of *chain-of-mountain* landscapes commonly found at the upper reaches of watersheds. They are geographic landscapes made up of more or less continuous mountain ranges and their hills, foot slopes and valleys. Defining boundary conditions for rangelands is a challenge that involves reconciling differing cultural perceptions of these geographic landscapes.

Figure 1a. Rangelands with similar geographic landscapes from very steep mountains to strongly rolling spurs and footslopes illustrating the characteristic habitats, riparian zones and ecosystems developed by watershed and pastoral cultures. (Watershed village community farming on the northern slopes of the Qinling range in Shaanxi Province, China. The photo shows habitat farming sequences from watershed food forests on steep lands, and in riparian gullies, to terrace crops edged by and fruit and berry orchards on moderate sloping habitats; with near surface aquifers, seeps and springs).

In the USA and other pastoral cultures there is an alternative, pastoral meaning of rangeland not always found in English dictionaries. In these pastoral cultures, rangeland is a term with unique cultural meanings describing large tracts of public land providing

open pasture where livestock may graze freely, tended by cowherds, goatherds or shepherds. This specific cultural meaning is intended when reference is made to *pastoral rangelands*. There is a common feature connecting the two cultural meanings of rangelands. Rangelands are usually unfenced open landscapes (Figure 1). When privatized, subdivided and fenced, rangeland becomes enclosed farmland. The change from open rangeland to enclosed farmland can be gradual taking several centuries. Often however it is rather sudden, occurring within a single generation or even less as examples from various countries will show in the sections that follow.

Being defined by broad geographies and beset with cultural overtones, there is usually no clear natural boundary between rangelands and adjacent landscapes. This makes mapping and modeling rangelands a challenging exercise in which cultural imperatives are often stronger than ecological perspectives. Even more challenging are situations where groups from pastoral and watershed cultures attempt to co-exist as they do in some rangeland areas of Nepal and New Zealand.

Figure 1b. Rangelands with similar geographic landscapes from very steep mountains to strongly rolling spurs and footslopes illustrating the characteristic habitats, riparian zones and ecosystems developed by watershed and pastoral cultures. (Pastoral rangelands in the Waitaki Basin watershed New Zealand on the southern slopes of the Two thumbs Range: British colonials introduced open grazing of rangeland watersheds in the 19th century reducing habitat biodiversity and employing burning and grazing to maintain grasslands in forest environs. The power pylons are more recent hydro power developments. Hydro development led to riparian fencing to protect critical floodplain habitats and riparian zones).

1.2. Cultural Ethos

Cultural ethos sets the enabling framework for science and then empowers technology

in culturally specific ways, sometimes neither rational nor logical. Expansion of pastoral cultures particularly during the modern colonial age (17-20th centuries), transformed forested watersheds around the world into pastoral rangelands. The environmental impacts of deforesting rangelands and the introduction of domestic herds of hard hoofed animals over such large areas has been chronicled for centuries without changing the situation or the underlying culture. Perhaps exceptions are to be found where crises over water resources or energy issues demanded action.

Human nature honed for millennia by a particular culture, develops an entrenched cultural ethos; a powerful force that engenders the habit of only recognizing self-empowering knowledge-based paradigms. Selective knowledge is the result, which in turn empowers technological advances compatible with retaining the prevailing cultural ethos. Like the *rock-scissors-paper* game, the *culture-knowledge-technology* order is not readily reversible. In the context of an empowering cultural ethos, scientific knowledge is rather impotent when it comes to changing cultural attitudes and perspectives.

From the cultural perspectives of geography, landscape ecology and environmental psychology we learn that rangeland cultures do not necessarily share similar environmental perceptions or watershed values with their neighbors. Perhaps nowhere are the consequences of cultural attitudes and perspectives better illustrated than by the lengthy history and heritage of Chinese rangelands. The Great Wall was commenced, built and maintained at an enormous cost in human lives, as well as financial and other resources, to separate conflicting farming and pastoral cultures. In both cultures, fences were considered unacceptable intrusions, fragmenting and frustrating their natural farming or pastoral grazing systems. Both cultures occupy rangelands but their activities are mutually incompatible.

By comparison, in western cultures converting rangelands to fenced farmlands were events characterized by open hostilities and cultural conflicts chronicled in history books and comic operas. Cultural conflicts and even range wars over enclosing and fencing rangelands may seem strange in modern times, at least until the broader context of cultural attitudes and perspectives are taken into account.

During the highland clearances of Scottish rangelands during the 17th and 18th centuries, at a time when science was ascending to dominant paradigm status, village farming communities in the Scottish highlands were deliberately destroyed and replaced by sheep and cattle estates. In these wars between conflicting religious cultures, science had little or no say in how this happened or whether the environmental consequences would be beneficial. The story of the Scottish highlands is a salutary lesson in the power of pastoral cultures, illustrating how entrenched they become even when faced with prolonged ecological degradation and economic depression.

The ecological consequences of the Scottish clearances were not fully documented until the 20th century, when they revealed a legacy of watershed degradation, environmental destruction and declining population. Nowadays in Scottish rangelands, called highlands by local folk, sheep and cattle grazing activities are being replaced by watershed forestry and salmon farming with remarkable results that includes the

restoration of streams, rivers and riparian ecotones. For the first time in centuries, population and employment in the Scottish highlands are rising again, following close on the heels of successful restoration of rangeland ecosystems.

1.3. Environmental Health

With rangelands containing many of the world's most important mountain watersheds, the quality and reliability of water resources produced by these rangelands are overall indicators of environmental health. From a sustainable watershed perspective, the environmental health of watersheds is primarily a function of the performance of rangeland ecosystems. From an environmental health perspective, the main role of rangeland watersheds is storing and supplying fresh clean water. To be able to do this reliably, it is necessary to maintain the ecological functions of stream floodplains to accommodate and facilitate flooding. How rangelands do this is explained in the following sections.

Seasonal and periodic floods are necessary for maintaining the integrity of riparian habitats, floodplain ecosystems and watershed aquifers. Floodplains allow floods to be accommodated beneficially without causing serious hazards or environmental damage. Rather, the water is slowed down and spread widely to where flood waters can be stored in subterranean suites of aquifers. Through seasonal flooding sequences and rainfall cycles, floodplain aquifers are continually recharged and refreshed so they can reliably discharge fresh clean water fit for food production and human consumption. Flood surges also provide the energy for distributing water to higher elevated wetlands and other terraqueous habitats.

Flooding provides multiple benefits for flora and fauna. Seasonal flood surges trigger breeding cycles among wildlife communities; seeds are dispersed in flood debris and deposited on floodplains to germinate. The ecological functions of floodplains, terraqueous habitats and riparian ecotones identify them as critical environmental management zones with overriding importance.

Viewed in this way, the main role of rangeland watersheds is the harvesting and storing of water in the ground, in addition to refreshing and cleansing, distributing and supplying fresh, clean water to springs, streams, river and lakes. From the watershed perspective, the more water that is stored in the ground and the more terraqueous habitats that are linked through the landscape, the better. This is traditional knowledge in watershed cultures where community cultural intelligence promotes the paramount importance of the water dragon as the traditional guardian of aquifer springs, stream and river systems and the *living* water flowing within the landscape that supports them all (Figure 2).

Figure 2 shows a traditional wood carving from East-Asia illustrating through cultural iconography that the iconic water dragon representing living water takes priority over the horse dragon representing hard hoofed animals. Shown on either side is a traditional representation of fertile landscapes with healthy plants sustained by living water. In western pastoral cultures, the opposite is the case, for St George on his horse slays the water dragon with his sword. From the perspective of cultural iconography, the English

legend of St George and the dragon can be interpreted as catchment infrastructure overwhelming watershed ecostructure (reproduced with permission of WSF)

Figure 2. Cultural iconography from Asia showing the subservient role of hard hoofed animals

Open farming without fences is commonplace in mountain rangelands among traditional farming communities in the Asia-Pacific realm. The absence of fences in Asia-Pacific rangelands generally indicates watershed farming cultures where the grazing of hard hoofed animals is culturally unacceptable. Traditional cultural restrictions protecting watershed habitats, riparian ecotones, springs and streams are common in Asia-Pacific cultures Here the water dragon, a traditional iconic symbol of living waters residing in the landscape, reins supreme over the horse dragon representing hard hoofed grazing and browsing animals (Figure 2).

The absence of fences requires that communities willing to cooperate in developing their farming systems rely on watershed storage principles. There are huge benefits to the community; because capital and maintenance costs for fencing farmland are avoided, allowing more time and money to be invested in improving productivity. When infrastructure costs and impacts of fencing are considered and the ecological consequences of segmenting and enclosing landscapes are taken into account, it becomes apparent that the rationale for fencing rangelands is based on other criteria.

Assessing environmental health of rangelands can be a contentious issue for some stakeholders, notably those inclined to place more importance on particular interests in specific resources, rather than in the overall health of rangeland watersheds. In pastoral rangeland cultures like those found in the Australian outback or New Zealand high country, it is commonly assumed that the presence of pastoral livestock is beyond question, regardless of their environmental impacts on critical resources such as soil and water. Correspondingly, in cultures placing high values on environmental health or seeking to restore the ecological functionality of watersheds, like those found in the Gan River rangelands of Jiangxi, or the loessial rangelands of Shanxi, China, open grazing of pastoral livestock is usually proscribed and prohibited from rangelands.

Restoring and protecting the environment is a key objective of international law for sustainable development contained in the 27 key principles of UN Agenda 21. In practice however, audits of the health of environmental systems and rangeland resources are typically dependent on the cultural attitudes and ecological perspectives held by those directing or undertaking the audits or assessments. Audits of the environmental health of rangeland watersheds are usually conducted as reconnaissance field surveys of watershed habitats and regolith aquifers. More detailed benchmark studies of the ecological and hydrological processes that link them are made and the nature of aggrading and degrading rangeland ecosystems are investigated as important indicators of environmental health.

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Biographical Sketch

Haikai Tane is a Koorinesian elder from the Eora-Waiora community in south western Oceana. He graduated with BA Honors in Geography 1967, (ANU Canberra Australia); LLB Distinction International Law 1968 (ANU Canberra Australia); and MSc in Ecology and Planning 1972 (UBC Vancouver Canada). Haikai is a geographer, ecologist and planner with 40 years experience as a professional practitioner and field researcher. An expert in mapping, modeling and auditing watersheds, his main field of study is the sustainable development of rangeland watersheds.

With extensive practical experience in Asia-Pacific countries, he has audited rangeland watersheds in Canada, USA, India, China, Australia and New Zealand. As Principal Planner with the Murray Darling Basin Commission Canberra, he was responsible for coordinating planning and development of the River Murray watershed from 1990-1995. In recognition of professional achievements, in year 2000 he was inaugurated New Zealand's first Professor of Sustainable Development with adjunct status, allowing him to continue his R&D programs as Director of the Watershed Systems Field Research Station in the Waitaki Basin.

Prof Tane is a member of the NZ Planning Institute and Adjunct Professor of the Chinese Academy of Sciences's Lushan Botanic Gardens, a mountain research station located in the Lushan World GeoPark, Jiangxi Province. In 2002 his collected writings were collated and published in Chinese by Shanxi Forestry, Science and Technology. In 2004 he was awarded the prestigious Chinese Lushan Prize for outstanding contributions to China in the field of science and technology for sustainable development.