Global Range Resources: a perspective on their use

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**Introduction**

Rangeland is usually defined as uncultivated land that will provide the necessities of life for domestic and wild grazing and browsing animals, this includes grasslands, savannas, shrublands, woodlands, wetlands and deserts ----Allen et al. 2011

Rangelands have a variety of additional functions, including tourism, hunting, fishing, forestry and natural resources protection.
• Rangelands supply nearly three quarters of the world’s energy requirement.

----World Resources Institute 2000

• Since range management has become much more intensive during the last 50 years, “rangeland” often includes pastureland and integration with sown forages in China.

• Both rangelands and grasslands are terms often used for the same ecosystems. We will use a broad definition in this paper.
Content

- Rangeland functions
- Rangeland types and resources
- Rangeland management perspectives
The importance of Rangeland to Humans

• Land Area and Forage Production
• Production of Animal Products
• Wild life
• Water
• Recreational Products
• Plants Products
• Wood and Minerals
• Open Space
Rangeland Multi-Functions

- Habitat, greenhouse mitigation, water quality, carbon sequestration
- Forage, livestock production, fiber, bioenergy crop, medicinal or edible value plants
- Ecosystem diversity, human health, socio-economics
Production of Animal Products

India has the largest percentage of the world's cattle population, China has the largest percentage of the world’s goat population, Australia and China have the highest percentage of sheep. The United States is the leading producer of beef, China leads in mutton production worldwide. Australia is the leading producer of wool.
Plant and wild Animal Products

Rangelands produce a wide variety of plants that could be very important in meeting our future needs.

*Glycyrrhiza* Linn

*Cordyceps sinensis*
Tourism and Hunting

Habitat and Biodiversity

habitat for many rare and unique plant and animal species.
Soil Erosion Control and Water purification
Recreational Products

Hiking, camping, trail biking, picnicking, hunting, fishing, and rock bounding are some of the important recreational uses of rangelands.
Some rangeland types and resources

- Grasslands are the most productive rangelands in the world when forage production for wild and domestic animals is the major consideration.
- Grasslands are typically free of woody plants (shrubs and trees) and are dominated by plants in the family Gramineae (grasses).
Precipitation
Grasslands generally occur in areas receiving between 250 mm and 900 mm annual precipitation. This precipitation generally occurs as frequent light rains over an extended period (90 days or more).

Figure 4.5 Abiotic factors determine the type of ecosystem that can develop in an area. (From Nebel 1981.)
Soils associated with grasslands are usually deep (over 2 m), loamy textured, high inorganic matter, and very fertile. These characteristics make them highly suitable for cultivation.

In sandy arid areas (less than 300 mm of annual precipitation), soils (less than 600 mm deep) often support grassland, while deeper soils on the surrounding area support shrubland.
Steppe and Prairie

In temperate areas, extended light rains during the summer favor grassland over shrubland because the shallow, fibrous roots of grasses use moisture near the soil surface more efficiently than do the long, coarse roots of trees and shrubs.

Steppe soil profile
Savanna (Tropical grassland)

During the summer dry period, the long, coarse roots of shrubs and trees can use moisture stored deep (over 1m) in the soil profile more efficiently than the shorter, fibrous grass roots.
Steppe

- Annual precipitation 60-120 days
- Usually without trees or large shrubs
- Net annual forage production 400-4000 kg/ha
- Meadow steppe, typical steppe, desert steppe

- Widely distributed from Europe to east Asia, and some parts of north and south America
- Several management models and livestock production systems
Grazing systems and main challenge

• **Legume-based grassland –livestock systems** (Europe)
• **Rotational grazing systems** (New Zealand, Australia, UK, Japan, France, etc)
• **Poor animal production, over-grazing** (Mongolia, central Asia and parts of Africa)
• **Degradation is a major problem in China**
Prairies

- Relative moist climate, fertile soils, loamy in texture
- Dominated by perennial grasses, Canada and USA have most areas
- Attractive for cultivation
• Fire is very important in prairie management
• Modern grazing systems, sustainable management, community-based
• Ranchers, governments, and researchers experienced in management
• Complete laws protecting the lands, and regulate the stocking rate
• Energy dependent

Figure 2. Cattle number and recommended stocking rates on Canadian grazing grasslands from 1860 to present. Actual stocking rates from 1955 to the present were summarized from six large grazing leases in southern Alberta (Adams et al. 2004). Feedlot appearance after 1961 largely reduced grazing pressure on grasslands.

----Wang et al. 2014
Savannas

• Distributed near the equator
• Annual temperatures are 15-35 °C, 300-1500mm rainfall, 80-90% in 2-4 months
• C4 grasses commonly in advance
• Major ecosystem type in Australia and Africa

• Savanna Structure: The savanna is mainly composed of scattered trees and tall uniform grasses that are taller than one metre. There is a wide range of grasses but an area is usually dominated by one to two types of grasses.
• Heavy grazing usually results in loss of the understory grasses and an increase in the density of the trees and shrubs.

• Conservative stocking with year-round grazing, or a grazing system that includes some wet-season resting

• Rotational grazing systems

• Savannas used for beef cattle, breeding animals, and finished on better pastures elsewhere or feedlots or Asia

Table 2. Herbaceous biomass and botanical composition of study sites at the start of the experiment before treatments commenced.

<table>
<thead>
<tr>
<th>Site</th>
<th>State</th>
<th>Biomass (kg ha⁻¹)</th>
<th>Botanical composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Decreaser perennial grasses</td>
<td>Increaser perennial grasses</td>
</tr>
<tr>
<td>Site A</td>
<td>I</td>
<td>2,920</td>
<td>93.3</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>340</td>
<td>61.8</td>
</tr>
<tr>
<td>Site B</td>
<td>I</td>
<td>3,280</td>
<td>71.8</td>
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<tr>
<td></td>
<td>II</td>
<td>450</td>
<td>35.3</td>
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<tr>
<td>Site C</td>
<td>I</td>
<td>1,790</td>
<td>24.5</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>1,050</td>
<td>12.7</td>
</tr>
</tbody>
</table>

Figure 1. A state and transition model for tropical grasslands (adapted from McIvor and Scanlan 1994). Solid lines indicate transitions that can be achieved through management, and dashed lines indicate transitions that are unlikely or will be difficult to achieve.

Figure 2. Effect of resting on changes in biomass and frequency of decreaser perennial grasses in plots with 25% utilization at three State II sites (mean and SE). The treatments are 25% utilization with no rest (R−), and 25% utilization with rest (R+).
Rangeland management perspectives

• **Goal:** Sustainable management of resources and optimize livestock production
  - Rangeland is a renewable resource
  - Provide food and fibre at lower cost than farmland
  - Rangeland productivity is variable and determined by climate, soil, topography
  - Rangeland provide many products and services
  - Rangeland management involves social, economic, cultural and technical factors
Grassland Production Industries

1. Extensive rangeland of low productivity with common grazing

2. Low to medium productive rangeland in more advanced economies

3. Highly intensive rangeland-livestock industries
1. Extensive rangeland of low productivity with common grazing

- Maximize survival of animals, achieve enough production of food
- Over-grazing risk is high or already applied
- Typical regions 1 ha only supports 1-2 sheep unit (Mongolia, Saudi Arabia, Syria, Algeria, China (desert steppe))
- Degradation or even desertification is common

Community based rangeland management has been proposed in some countries, however, there is no firm conclusions (like Mongolia)
2. Low to medium productive rangeland in more advanced economies

- Maximize output of saleable products (Canada, USA, Australia)
- Increase animal production per head, and lower stocking rates
- Semi-arid rangelands in China, Australia, USA, and South Africa are taken the concepts to give livestock a better option

- Reduce any possible damage to rangeland
- Sustainable balance between forage supply and animal demand
3. Highly intensive rangeland-livestock industries

- Achieve near maximal livestock production per head (milk, meat)
- Developed countries (Europe, America, New Zealand, parts of Australia)
- Forages and crops are sown to supplement; additional energy supplements
- New Zealand, 2000 sheep units/ha to eliminate any selectivity, short graze periods (12-48h), long rest periods (30-120 days), stocking rates increase 25%

- Pastures have been converted to highly productive Lolium perenne / Trifolium repens swards.
Rangeland utilization

• Manage the plant/animal system
• Maintain the desirable plant species, define the appropriate level of utilization
• Rules can be set whereby the state of plants can be used as an indicator of system ‘health’.

System Management
Global warming and rangelands

Good rangeland management is important for carbon sequestration

Fig. 1. Global distribution of soil C sequestration potential, from improved grazing management in the world’s grazing lands (rangelands and pasturelands combined).

----Henderson, 2015
The financial optimum stocking rate is around the range at which individual animal productivity is 60% to 75% of the maximum per-head production possible.

---Kemp et al. 2013

Fig. 3. Sheep growth rates per head (circles and solid fitted line; \( y = 0.092 + 0.047x - 0.024x^2; R^2 = 0.74 \)) and derived values per hectare (dashed line) continuously grazing over 5 y. Data are only for summer, when grass was green. Data for lamb growth rates on neighboring farms over 2 y (2004 and 2005) is shown (triangles).
Herbage mass > 1t DM/ha in summer, more desirable species, 400 sheep units days/ha yr (China);

Fig. 1. Diet composition of sheep grazing on the (a) LP and (b) HP in June, July, and August.
Fig. Partial redundancy analysis (RDA) of field data in axis1 (52.3%) × axis2 (16.3%) ordination planes constrained by the five treatments.
Rangeland utilization

- In northern Australia, an alternative approach (Ash et al. 2011) has been to estimate the proportion of herbage that can be sustainably utilised through the 9-month dry season. The amount actually eaten by cattle may only be half of that i.e. 10-15%.

- The typical steppe study mentioned found that the utilisation rate, at the optimum sheep grazing days, was about 20% i.e. the about 40% of the forage would be removed as another 20% would be lost through senescence, micro and meso-herbivore activities etc.

- In the New Zealand, case outlined above the amount of forage utilised could be 70-80% depending upon pasture growth rates.

- **In general,** it seems that a sustainable utilisation rate would decline as the productivity of a rangeland declines, due to a buffer need to maintain cover through dry periods, though this is likely to also vary depending upon seasonality of growth and if utilisation refers to the growing or non-growing season.
Legume plays a key role for both production and diversity of protection.

Alfalfa import from US
Value of Recreation increasing

The importance of open space, scenery, and aesthetic values from rangelands is difficult to quantify. However, price of hotels in summer in grassland region of China is often twice or triple comparing to other seasons.
Range management is the manipulation of rangeland components to obtain the optimum combination of goods and services for society on a sustained basis.

Range management has two basic components:
(1) Protection and enhancement of the soil and vegetation complex;
(2) Maintaining or improving the output of consumable range products, such as meat, fiber, water and wildlife.

---Range Management- principles and practices.
By Holechek, Pieper and Herbel.
Grassland management intensification weakens the associations among the diversities of multiple plant and animal taxa!!!

The form of intensification was also important; increased fertilization and mowing frequency typically weakened plant–plant and plant–primary consumer correlations, whereas grazing intensification did not.
Acknowledgement

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