Management and Policy Options for IMAR Grasslands: A Social-Ecological Perspective

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Photo: Y. Bai

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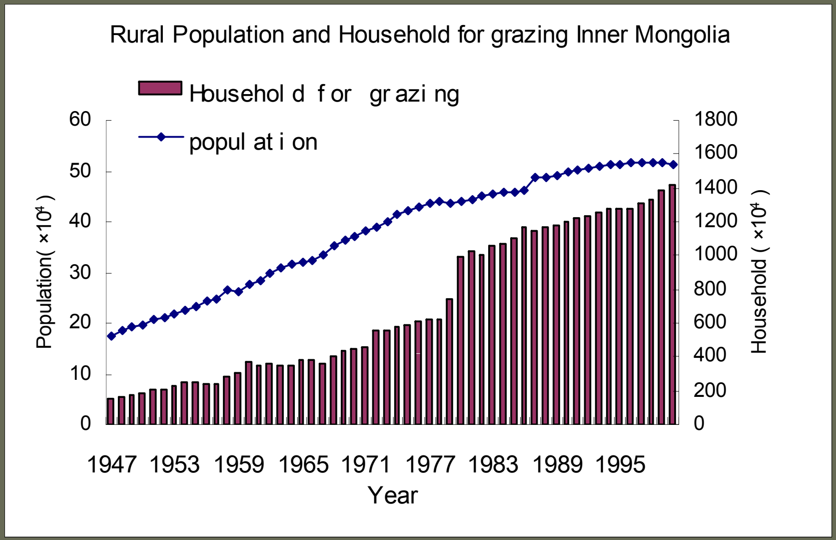
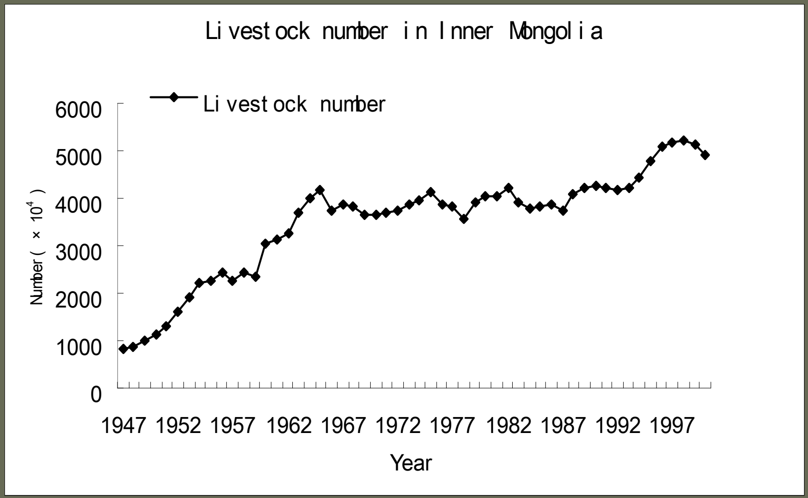
Human and Livestock Trajectories for IMAR

Human Population



Livestock Numbers



Land use patterns jeopardize resilience and provisioning of ecosystem services for 23 M people in IMAR.

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Consequences of Degradation


Soil Erosion


Sand Storms


Desertification


Human Poverty

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Resilience-based Ecosystem Management

- ***Ecological resilience*** **-** change required to transform a system from being maintained by one set of mutually reinforcing processes and structures to a different set of processes and structures.
  - Can the system withstand current land use patterns?

- ***Thresholds*** **-** conditions sufficient to modify ecosystem structure and function beyond the limits of ecological resilience.
  - What is the potential of catastrophic ecosystem change?

- **Resilience-based indicators** – structural variables serving as surrogates of ecological processes to assess resilience.
  - Is it possible to anticipate and prevent catastrophic change?

Briske et al. 2008

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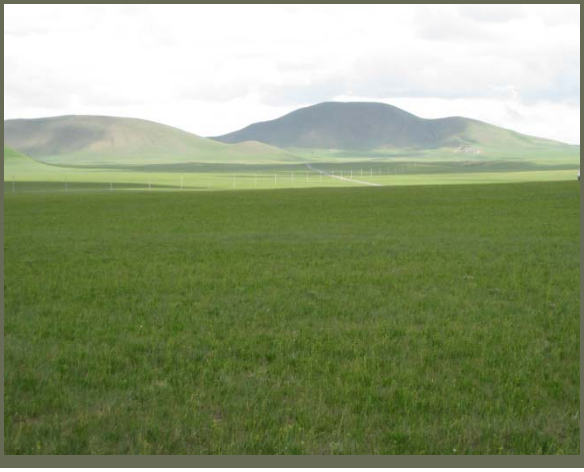
Presentation Objectives

- Evaluate alternative strategies to maintain and improve grassland resilience in IMAR
- Define major controls on grassland resilience
- Recommend strategies with greatest potential to promote resilience of both social and ecological system components



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Controls on Grassland Resilience

- Evolutionary grazing history
- Grassland climatic regime
- Social-ecological systems
  - Government policies
  - Market and economic forces
  - Traditional knowledge and values
- Climate change projections

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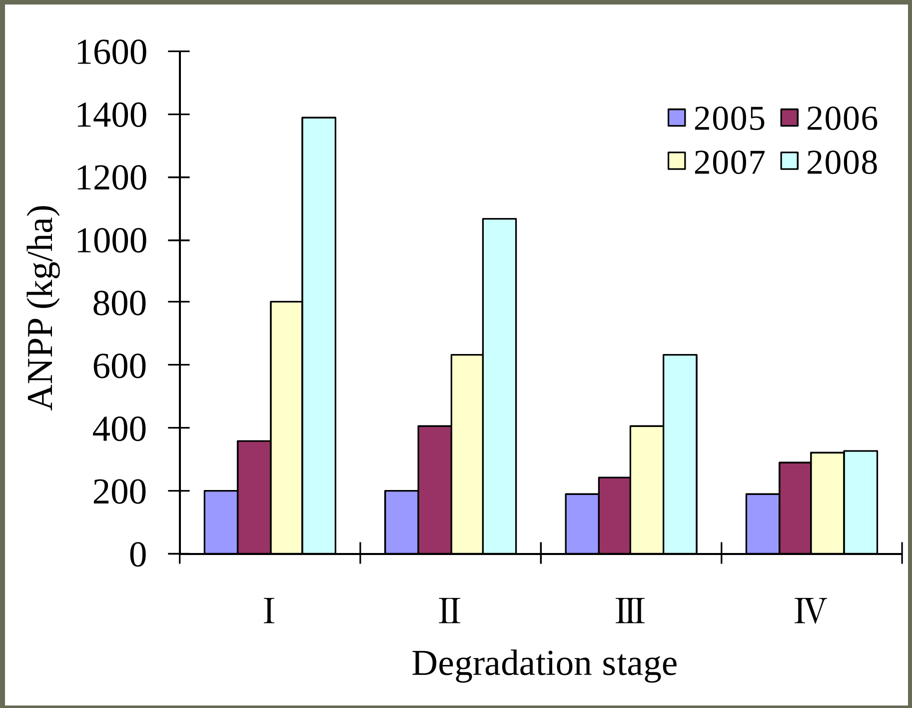
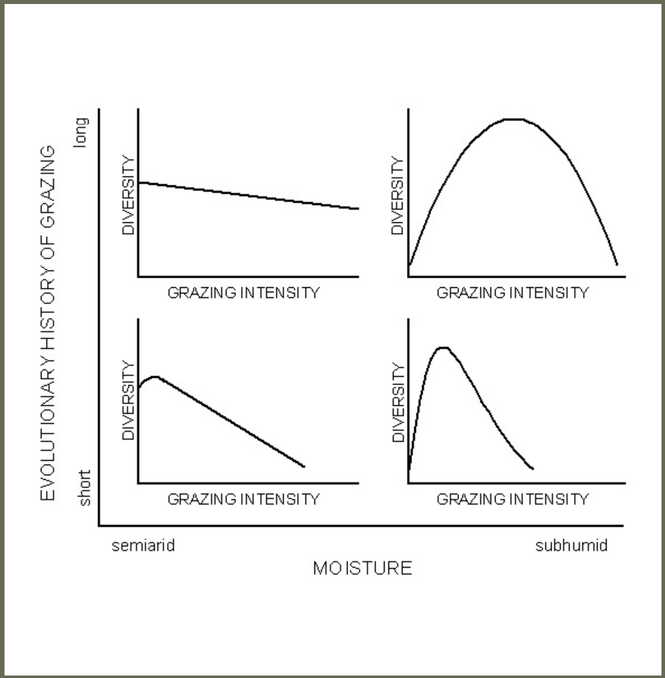
IMAR Grassland Resilience

Recovery Potential



Wang Zhongwu et al. unpubl.

Generalized Grazing Model



Milchunas et al. 1988

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Resilience Window

- 46.7 M ha degraded
- 60% total grassland in IMAR
- 50% in NPP last 50 yrs
- Severe grazing primary driver
- Stage I 47%, Stage II 35%, Stage III 17%

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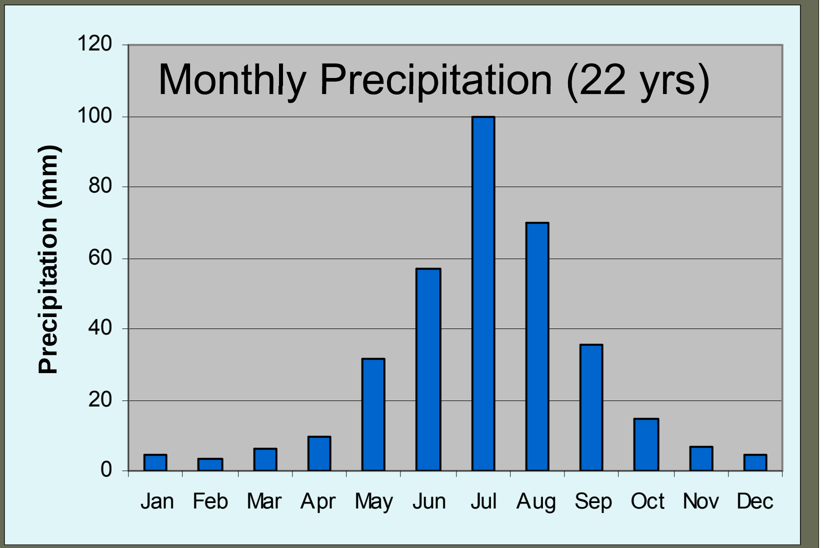
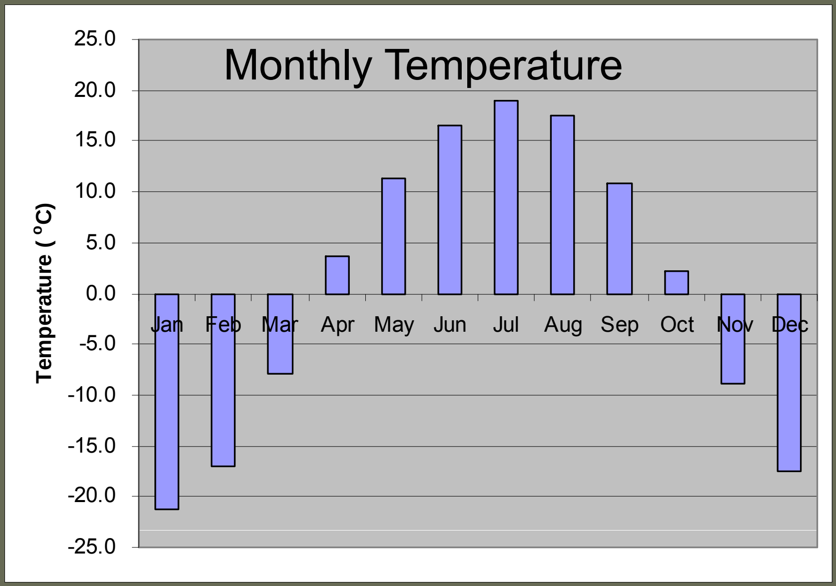
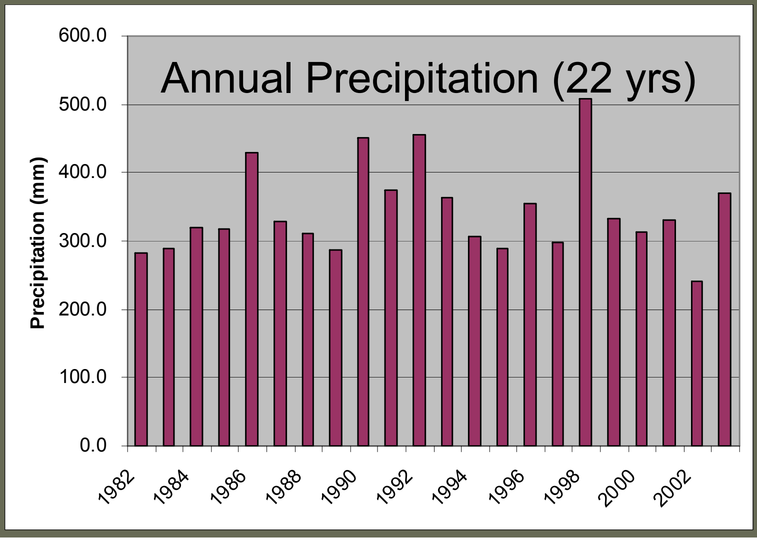
Xilinhote Climate Profiles

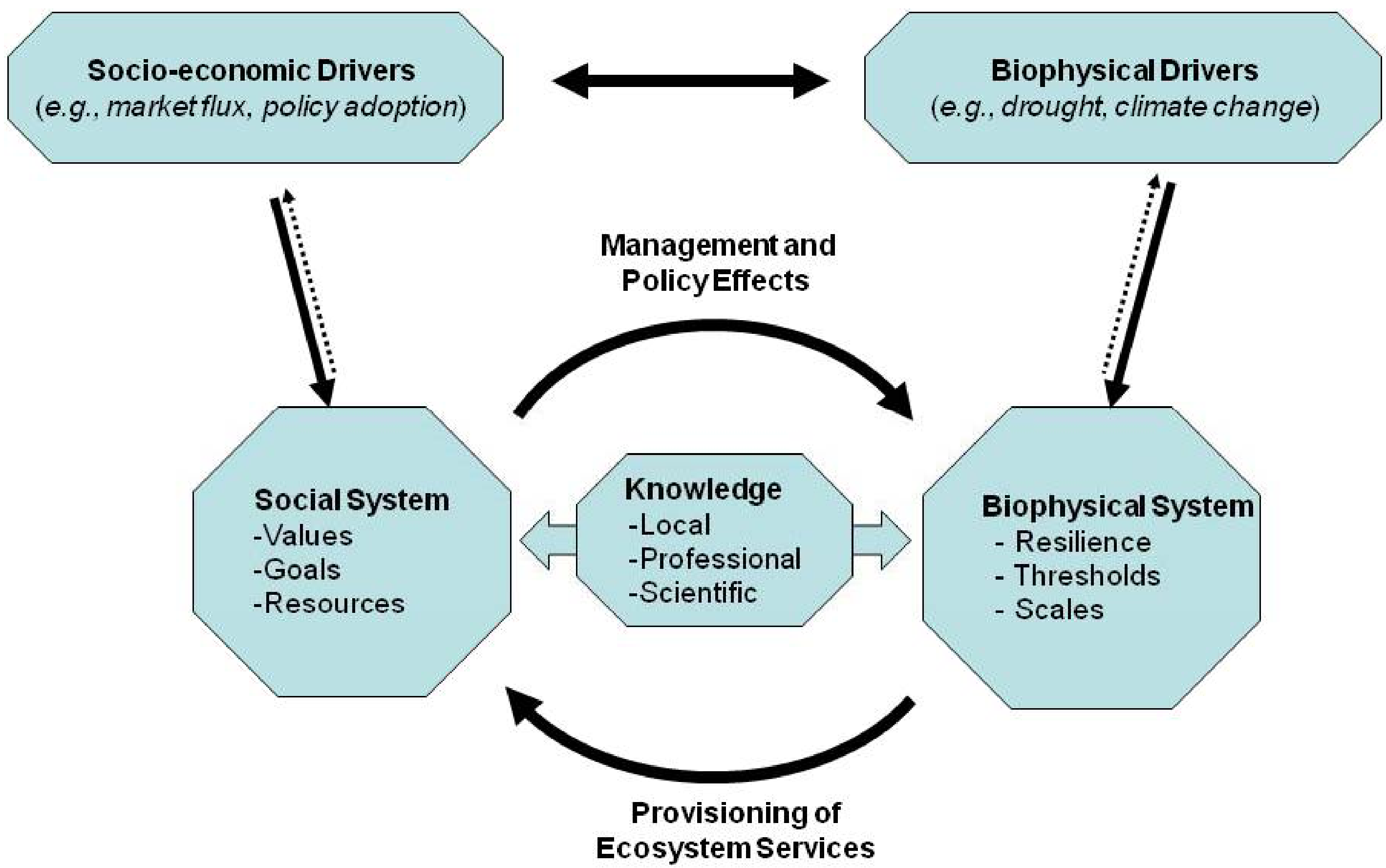






CAS Data

Social-Ecological Systems



Modified from Stafford-Smith et al. 2007

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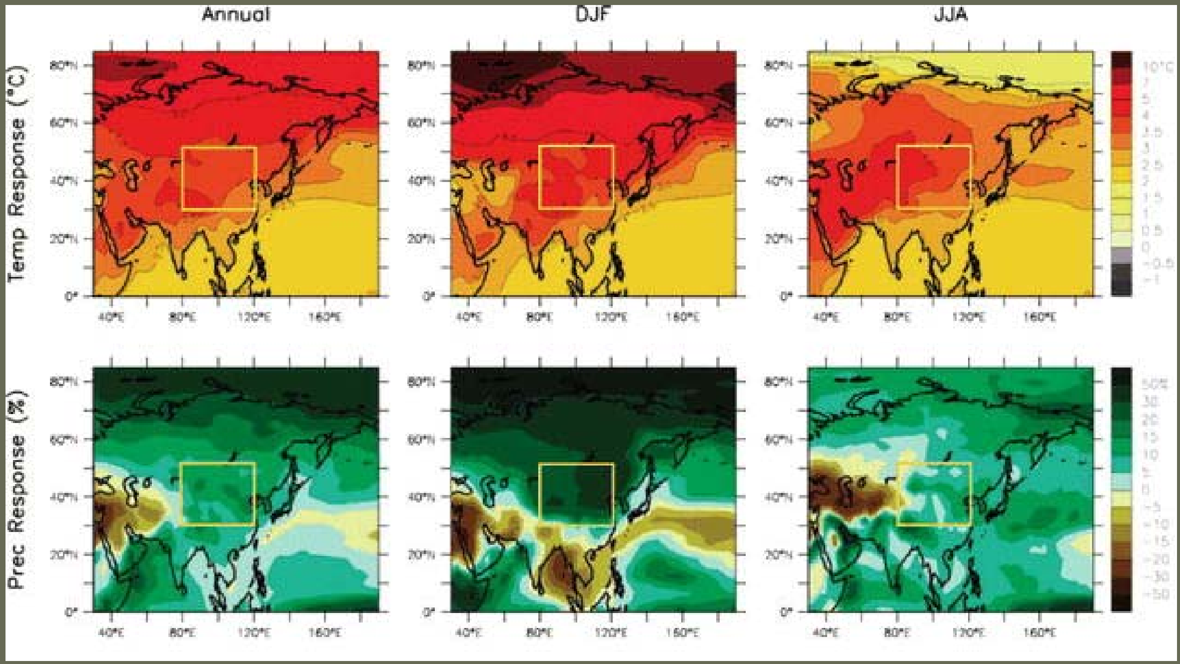
Climate Change Projections



Temperature increase 2.5 - 5.0C; both winter and summer.

Winter precipitation increase; summer decline west, slight increase east.

- More frequent and prolonged droughts are likely.
- Decrease in soil water to decrease NPP and soil cover.
- Range decreases in current steppe types and increase in desert.
- Novel warm, temperate shrub steppe may develop.

Angerer et al. 2008

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Current Resilience Assessment

- Continued degradation and desertification indicate current land use is unsustainable
- Unsustainable grazing widely considered to be the primary driver
- Ecological solution: remove 30-50% of the existing 70 M head of livestock
- Social solution: maintain or increase income of herder households with fewer livestock

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Potential Resilience Strategies

- Intensified Livestock Production Systems
  - Grazing systems
  - Forage systems
  - Supplemental feeding
- Improved Livestock Production Efficiency
  - Cull inefficient animals
  - Drought/winter management and forecasting
- Diversify Income Sources
  - Value added (quality) to livestock products
  - Market value for ecosystem services

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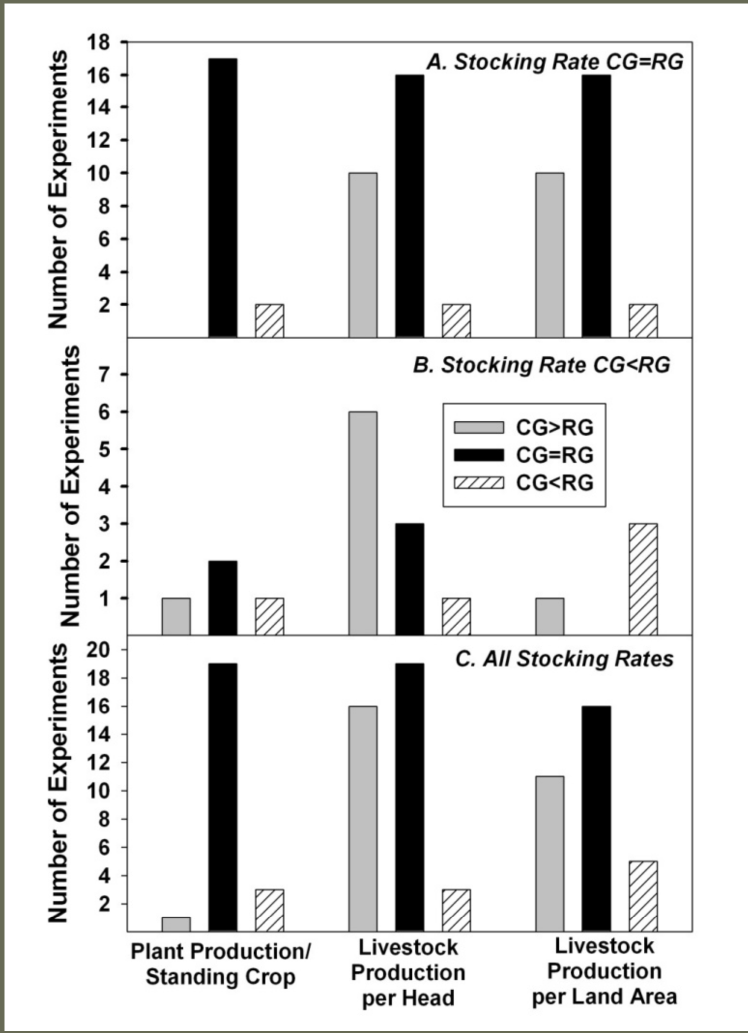
Rotational Grazing Systems



Briske et al. 2008

- Subdivide grazed area in multiple units that are successively grazed to produced alternating intervals of grazing and deferment (Stoddart et al. 1975).
- Majority (84-92%) of experiments show no advantage of rotational grazing for plant and animal production (n=35).
- This does not include seasonal livestock migration over large regions to track rainfall and NPP (Holechek et al. 2001).

Grazing Systems IMAR

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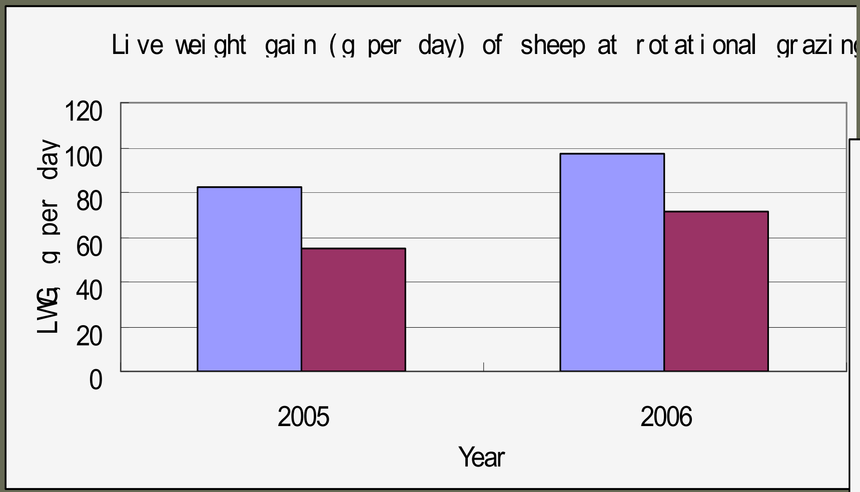
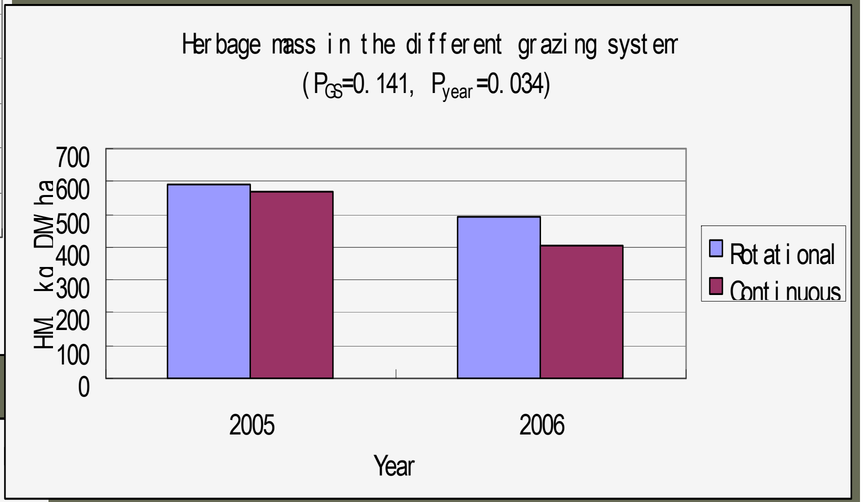
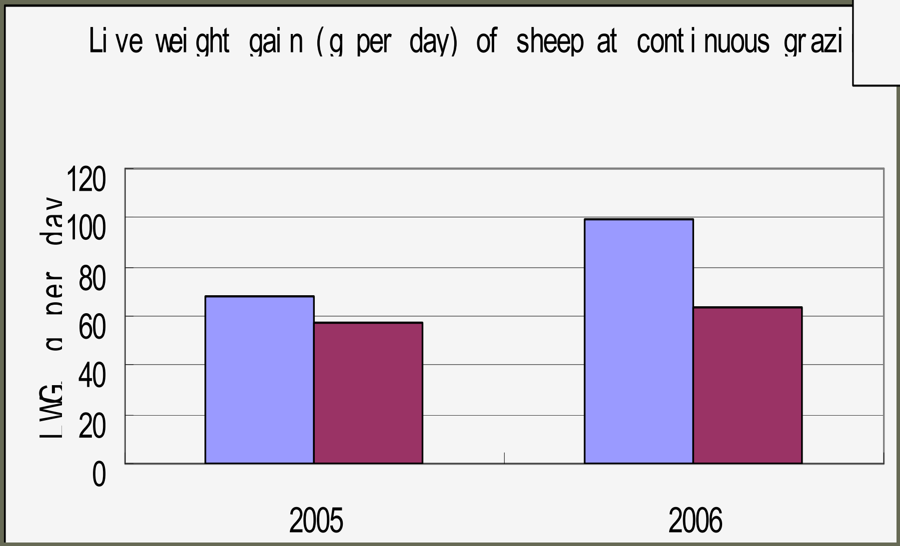
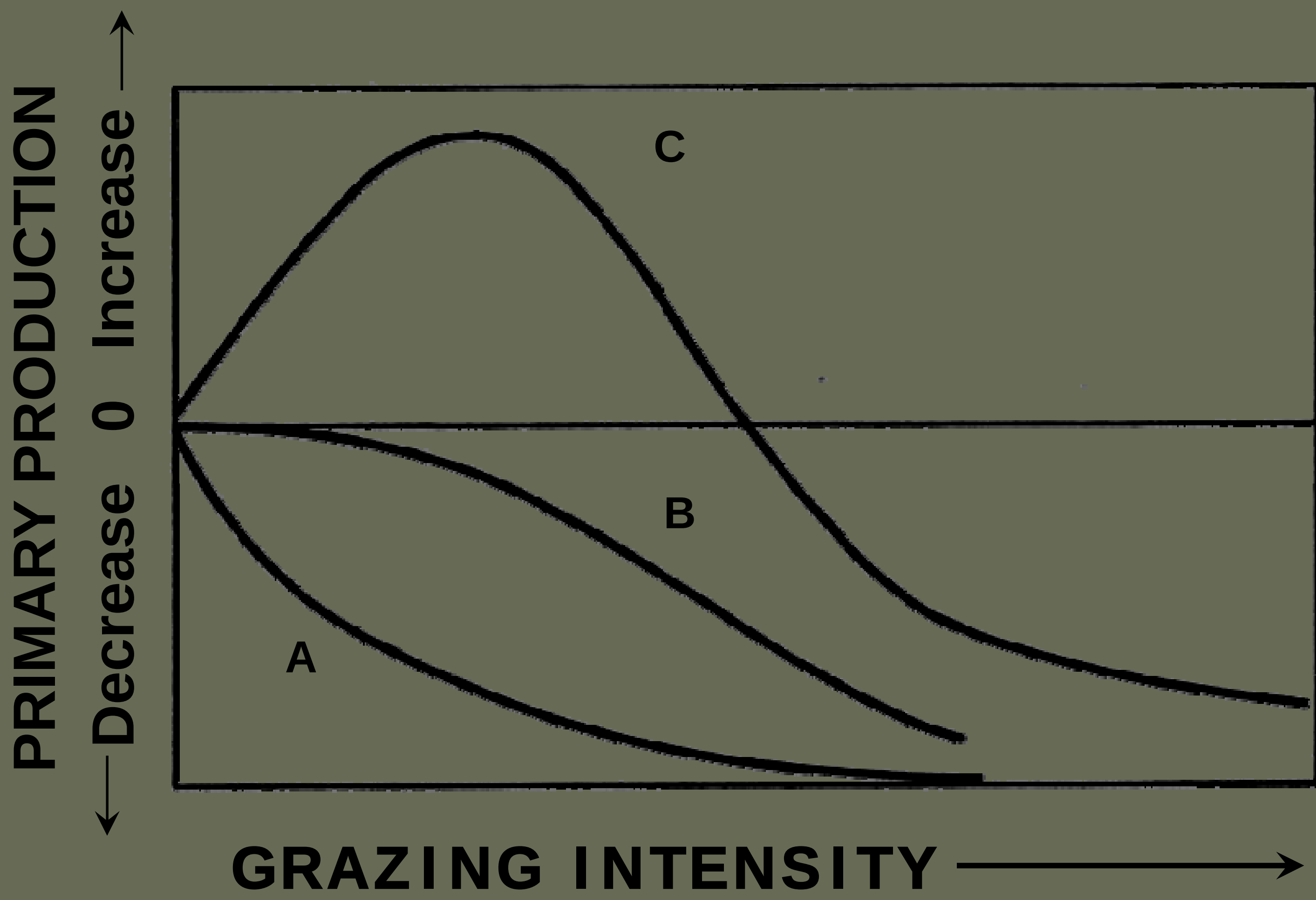






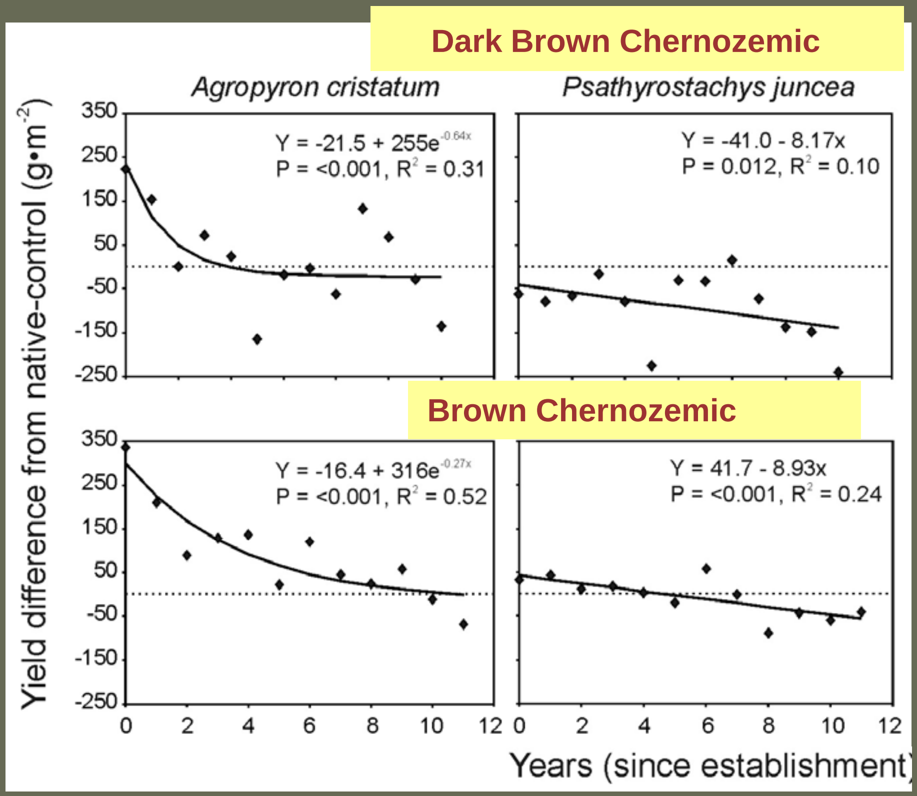
Wang et al. 2009

Grazing Optimization Hypothesis



McNaughton 1979

Forage Production Systems



Willms et al. 2008

- No comparable IMAR data
- Risks associated with seeding in semiarid areas
- Costs incurred similar to biofuels program
- Supplemental feed can increase grassland degradation
- Can winter feed be reduced with sustainable grazing?

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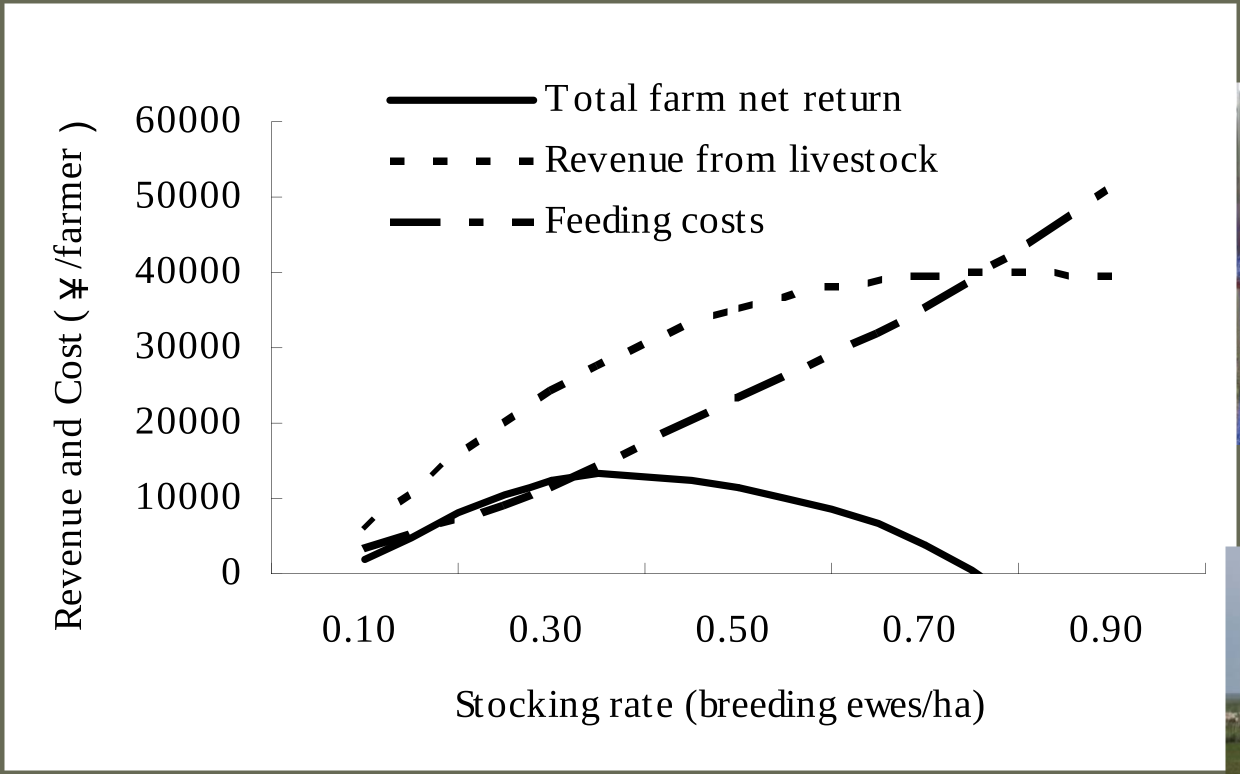
Increase Production Efficiency

- Cull less-profitable animals
- Improve animal care and herd genetics
- Specialize production systems i.e., breeding vs. finishing, milk, meat and fiber.
- Establish herder associations to increase economies of size
  - Market timing and purchasing power
  - Ship products directly to market
  - Greater financial and human capital
  - Improved management flexibility

Household Income



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Diversify Income Sources

- Ecotourism – national tourism is popular
- Value add livestock production
  - organic and lean meat, milk and cheese products
- Medicinal plant production
- Market ecosystem services (subsidies)
  - C sequestration, soil and watershed protection, biodiversity maintenance


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Recommended Resilience Strategies

- Intensified production systems not viable
  - Minimal evidence to support their value
  - Current livestock numbers unsustainable
- Production efficiency and diversification most viable strategies
  - Maintain income with fewer animals
  - Lessen livestock impacts on grassland systems
- Increase awareness of ecosystem services
  - Effective grassland management equates to sound economics and sustainability
  - Modest investment within 'resilience window' is more efficient than large scale restoration practices later.

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Management & Policy Recommendations

- No level of grazing management can maintain resilience with current livestock numbers
  - Future climate warmer and drier (summer) with potential for more severe drought.
  - Traditional knowledge of grazing management minimized with new land tenure and systems.
  - Increasing population density and urbanization following fossil fuel and wind energy development.
- Socio-political solution is required simultaneously with viable long-term grazing management and restoration.

Based on Angerer et al. 2008

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Herder Income Offsets Following Destocking

- How can household income be maintained with sustainable livestock numbers (30-50%↓)?
- Potential offsets to herder income:
  - Livestock production efficiency – 25%
  - Income diversification – 10%
  - Markets for ecosystem services – 15%
  - Off household income sources – 10%
- Herder associations likely critical to the effectiveness of this approach.

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Fundamental Challenges

Herder Adaptability

- No cases known where policy has led to voluntary reduction in livestock numbers to achieve sustainability.
- Successful examples have required high enforcement costs.

Land Tenure Policy

- Carrying capacity concept has not proven successful for sustainable grazing management in IMAR
- Can this be corrected or does HRPS need to be challenged?

Li et al. 2007

Integrated Framwork

Grassland Policy Decisions

Promote reduction in animal numbers

Grazing Management Strategies

Increase grassland resilience

Herder Socioeconomic Concerns

Production efficiency & diversify incomes

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