

Vulnerability of Great Plains Grasslands, Beef Production and Rural Economies to Climate

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Protecting nature. Preserving life.

Presentation Objectives

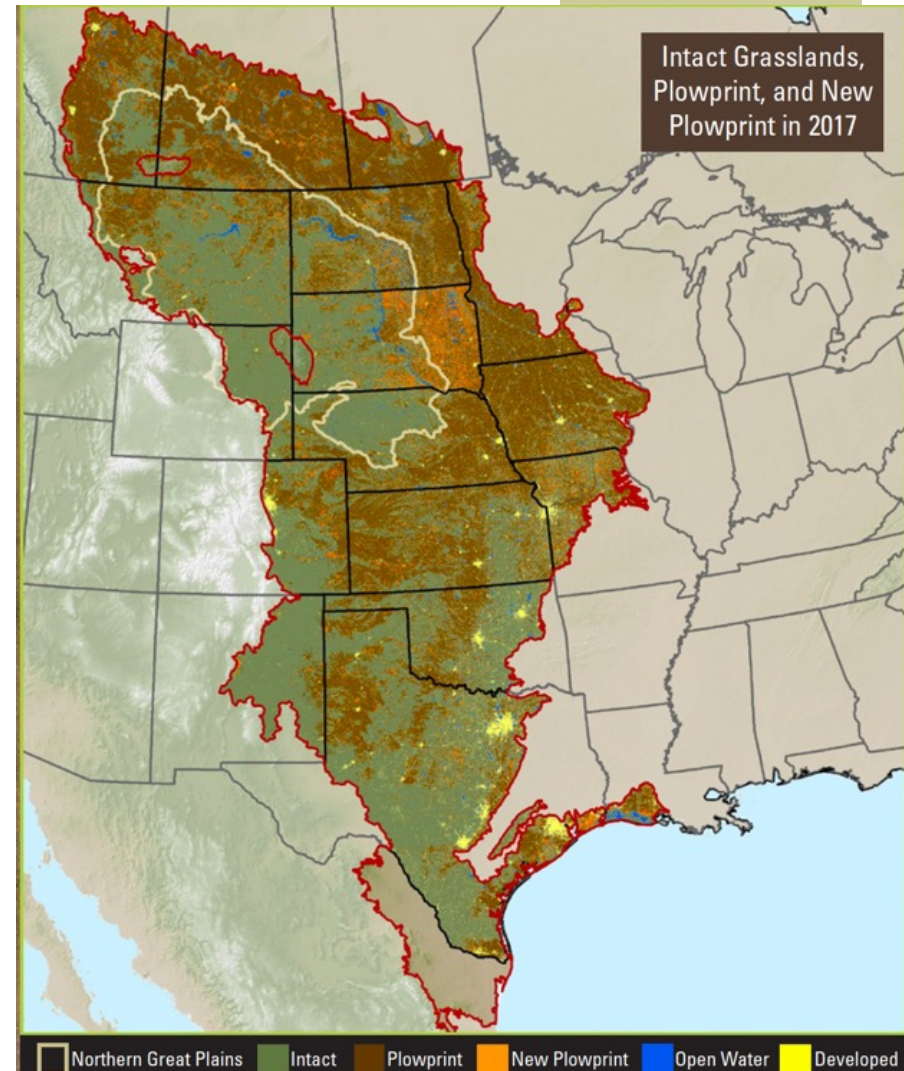
- Increase awareness of regional vulnerability to future climate and accelerate adaptation planning.
 - ✓ Increasing climate variability
 - ✓ Vulnerability of grassland beef production
 - ✓ Implications for grassland conservation
 - ✓ Translational adaptation to sustain beef and grasslands
- Stimulate discussion regarding assumptions, consequences and solutions.

U.S. Great Plains

18% conterminous U.S., but only 12% of population.

Population increasing in metro counties, decreasing in rural counties.

Largest tracts of remaining grasslands



Agricultural Economies

- Grasslands privately owned
- Region contains 50% of national beef cow herd (16 M animals)
- Generated revenue of \$43B in 2017
- Land use subject to economic and policy considerations
- Rural economies dependent on agriculture



Projected Climate Variability

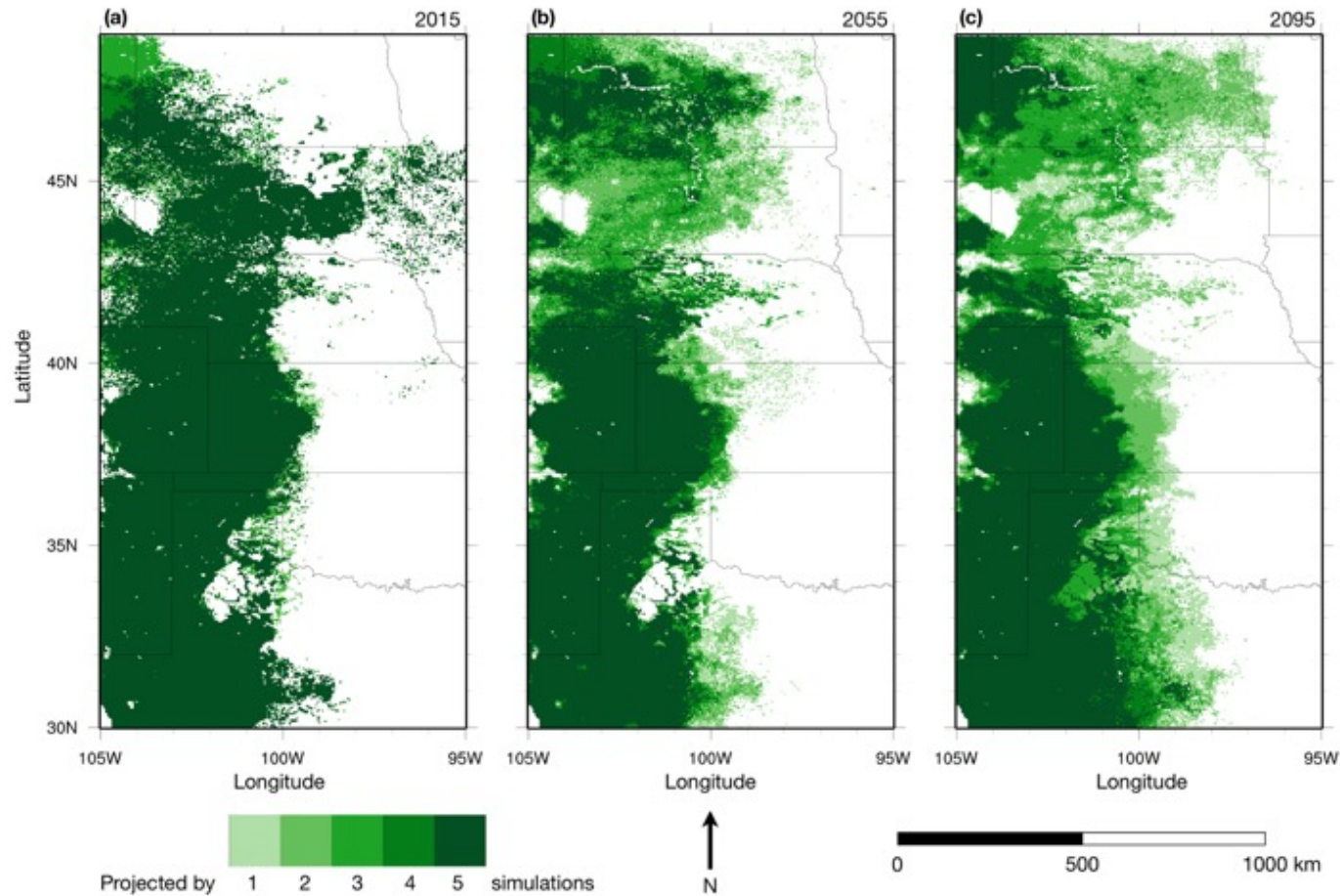
Evidence indicates that 21st century climate will differ from that of the 20th century.

- 1) increasing interannual precipitation variability
- 2) accelerated atmospheric warming and drying.
- 3) extreme drought 'megadrought'.

Central and Southern plains anticipated to experience more severe conditions.

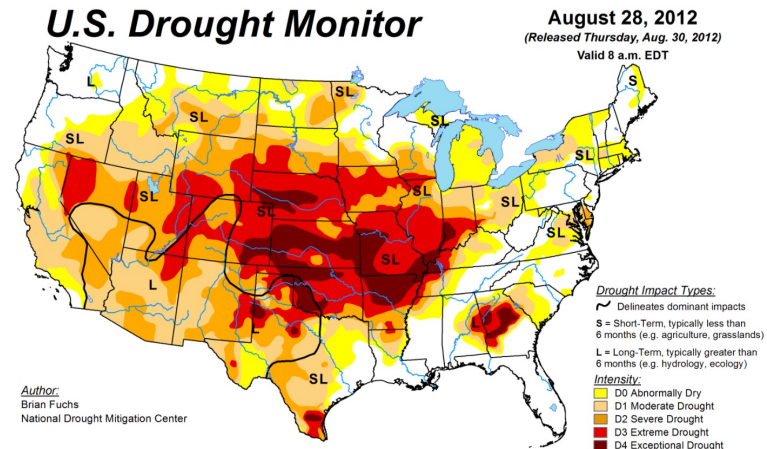
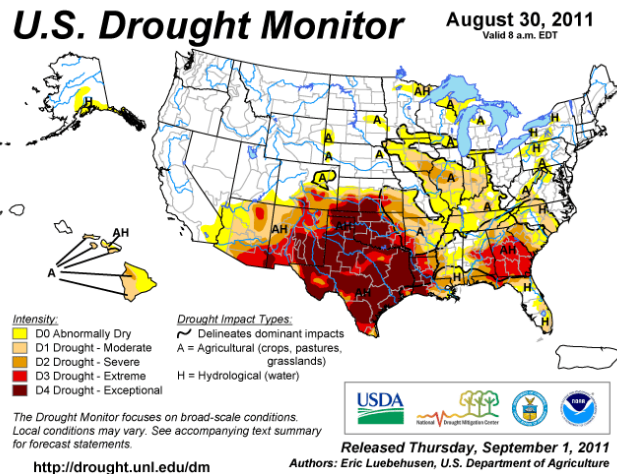
Klemm et al. 2020

Potential Natural Vegetation



Future Vulnerability

Interdependent system climate – grasslands - beef cattle production, and the rural economies they support are vulnerable to future climate.

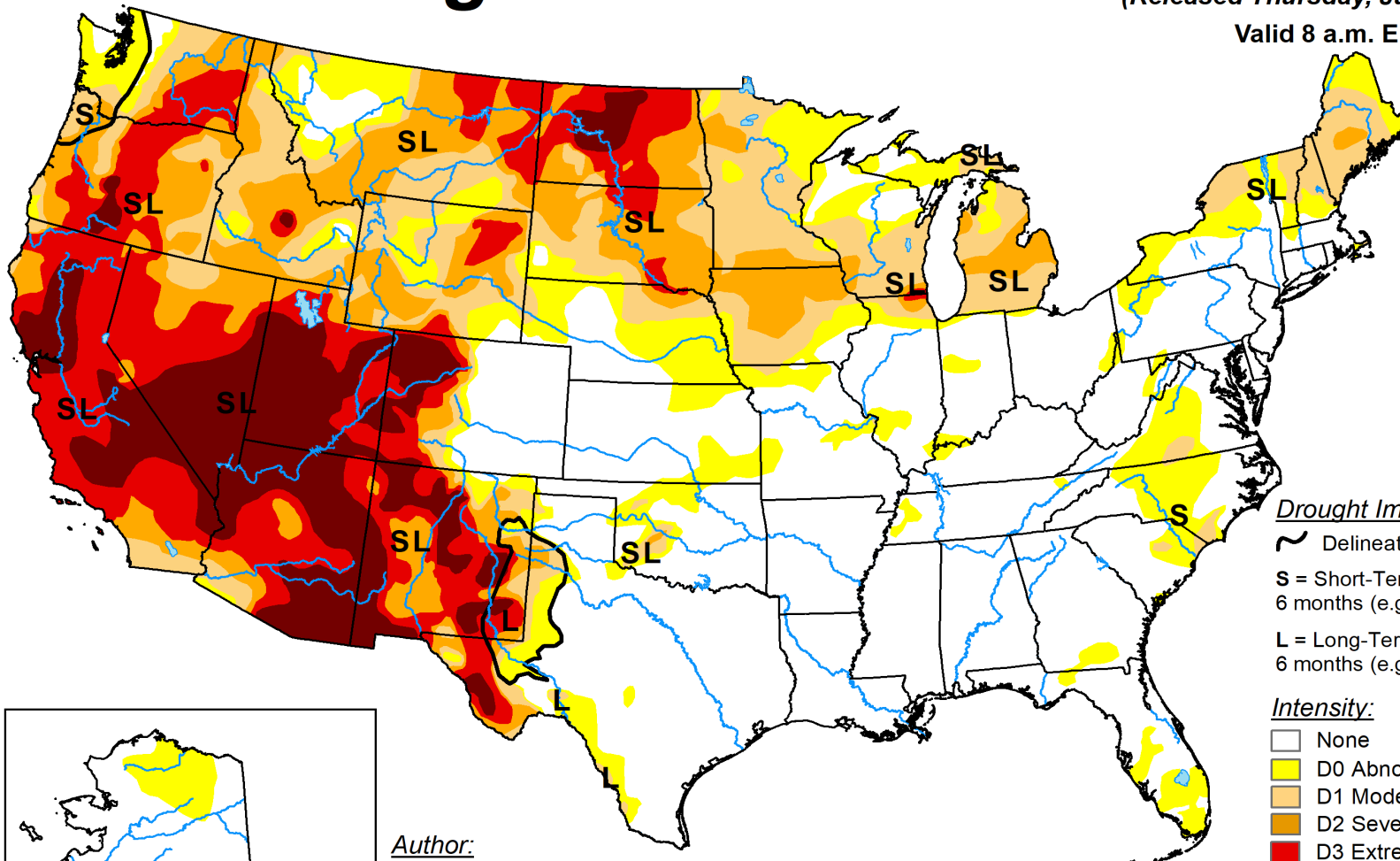


U.S. Drought Monitor

June 22, 2021

(Released Thursday, Jun. 24, 2021)

Valid 8 a.m. EDT



Drought Impact Types:

~ Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

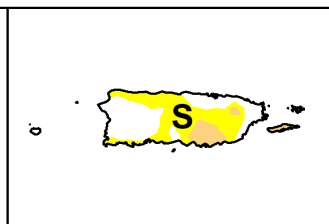
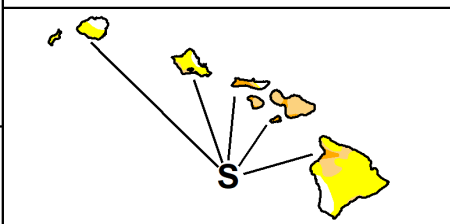
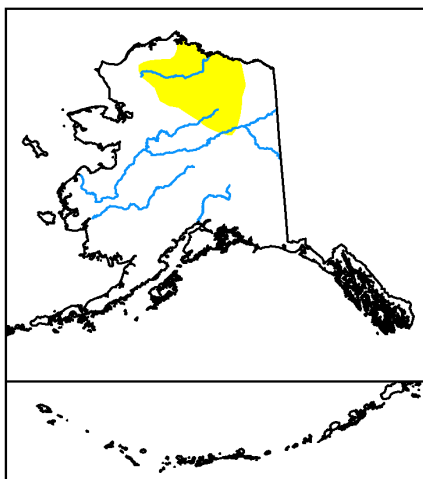
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Author:

Curtis Riganti
National Drought Mitigation Center



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>



droughtmonitor.unl.edu

Impacts on Beef Production

- Variable forage production
- Reduced forage quality
- Modified species composition
- Invasive species expansion
- Reduced animal nutrition
- Disease and ectoparasites
- Increased wildfire potential
- Drying riparian systems

Polley et al. 2013 REM



Heightened System Vulnerability

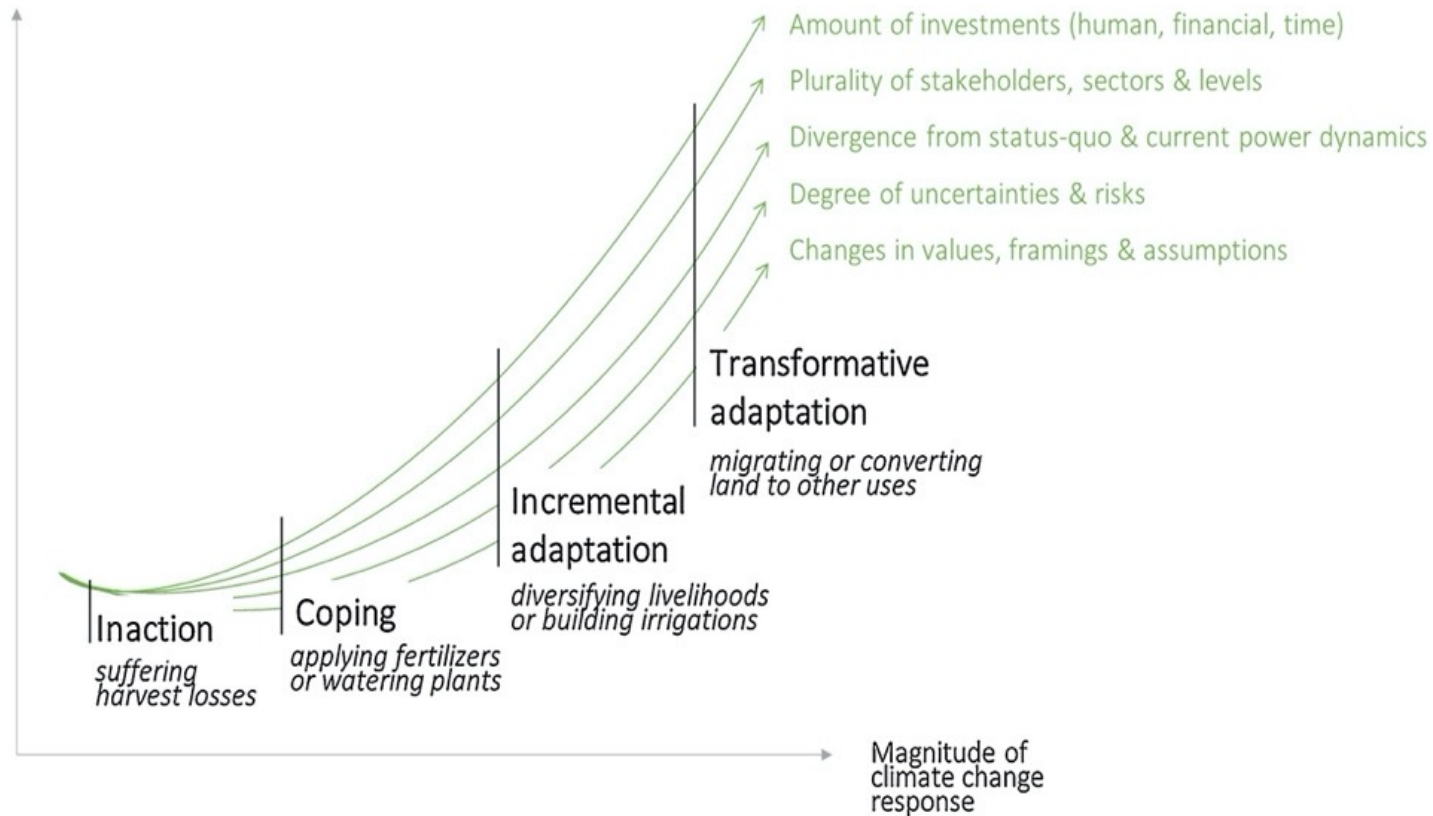
- Direct dependence on climate to provide forage resources
- Modest profit margins minimize financial buffers and adaptive capacity
- Insufficient adaptation to current climate variability “adaptation deficit”.
- Consequence of advanced age, insufficient resources, limited technical knowledge, excessive optimism, and climate skepticism.

Incremental Adaptations

- Drought planning
- Grass banking
- Flexible stocking strategies
- Livestock breeds and species
- Ectoparasite control
- Fire – fuel management
- Income diversification



Adaptation Continuum



Transformational Adaptation

- Incremental adaptation is *no longer sufficient* to maintain viable beef cattle production.
- Current social-ecological system becomes *unsustainable*.
- *Alternative system* with different livelihoods and management strategies needed.
 - ✓ When is a system no long sustainable?
 - ✓ What alternative systems exist?
 - ✓ Who makes and implements these decision?

Klemm et al. 2020

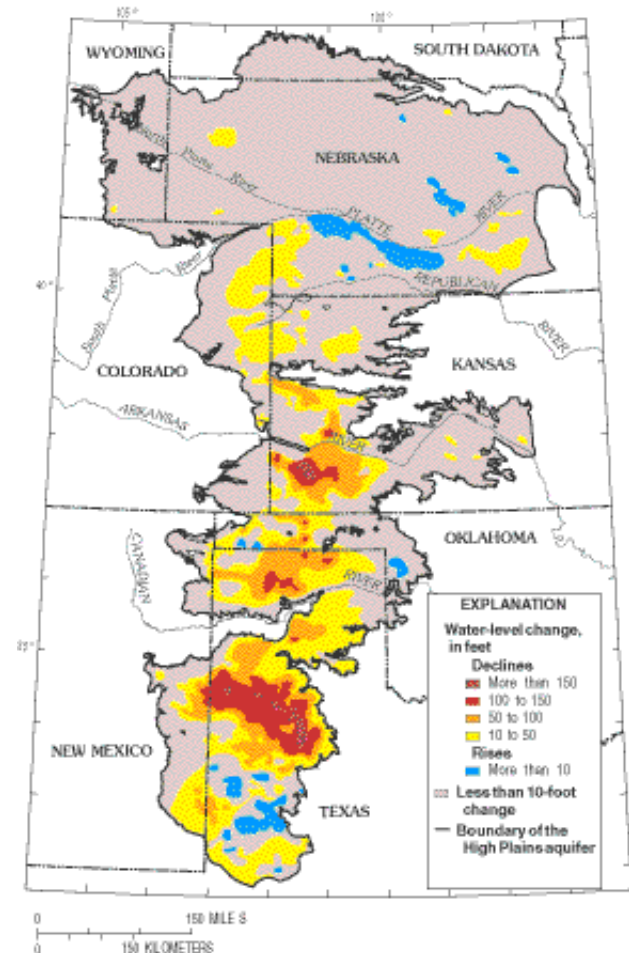


Transformation: Texas High Plains

- Recharge minimal – playa lakes
- Rapid depletion since 2000
- 100 m decline since 1950
- Some areas depleted by 2030
- Dryland crops vs. grassland

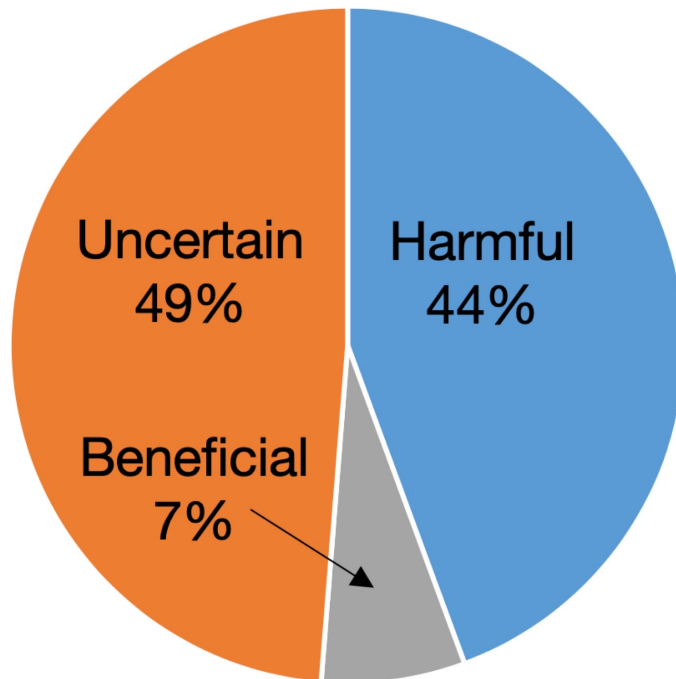


Ogallala Aquifer

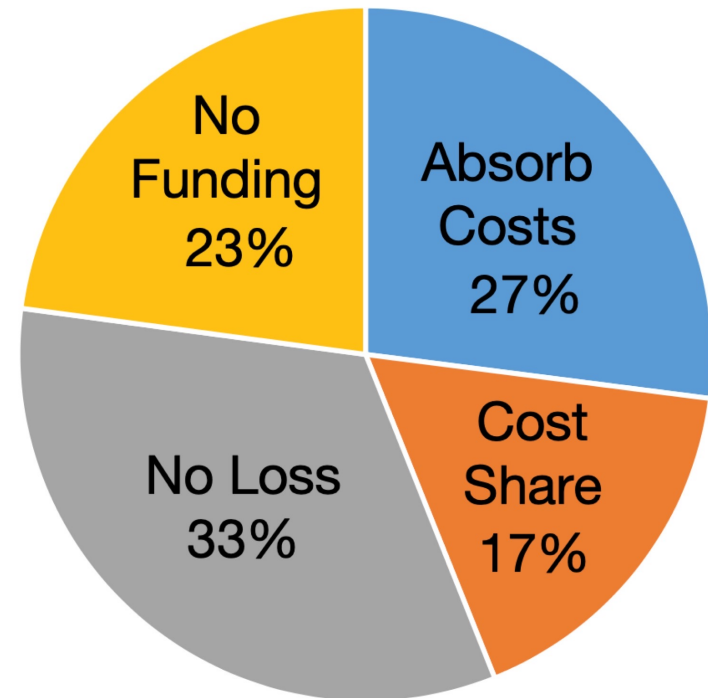


Beef Producer Perceptions

(a) Impact of Climate Change



(b) Adaptation Affordability



Most Pressing Challenges

- Ranch foreclosure in response to repeated destocking and restocking cycles.
- Grassland overgrazing in response to climate variability and economic hardship.
 - ✓ Long (1.5-3 yr) production cycles over which climate anomalies can disrupt the production.
 - ✓ Production cycles are not easily stopped and started as in crop systems.

Klemm et al. 2020



Cascading Series of Events

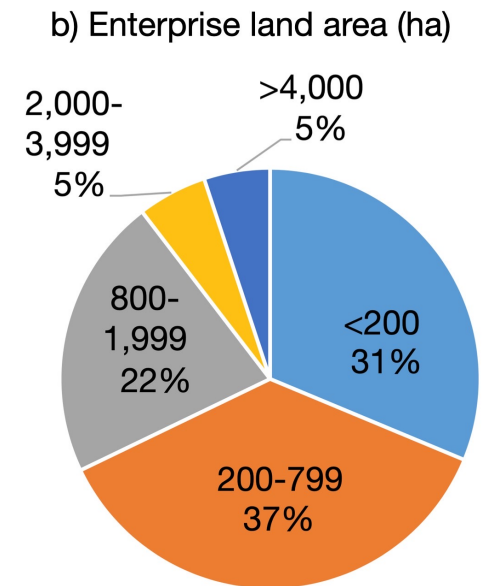
What is the most sensitive phase of the beef production system?

Which category of beef producers are most vulnerable?

How may land ownership, use and value change?

How may these rural social-ecological systems respond?

Beef Producer Characteristics



Campbell et al. 2019

Buffalo Commons Revisited

JOURNAL ARTICLE

The Buffalo Commons: Metaphor as Method

Deborah E. Popper and Frank J.
Popper



Geographical Review
Vol. 89, No. 4 (Oct., 1999),
pp. 491-510 (20 pages)

Published by: Taylor &
Francis, Ltd.



Grassland Conservation

- Current threat is cropland conversion, especially in Northern Plains.
- Future climate may slow or reverse agricultural intensification.
- Future climate may decrease economic viability of grassland beef cattle production.
 - ✓ Potential consequences/trajectories?
 - ✓ Can they be managed?
 - ✓ How and by whom?



Potential Grassland Trajectories

- Consolidation into larger properties
 - ✓ Production oriented e.g., working landscapes
 - ✓ Amenity oriented e.g., financial investments
- Conversion to alternative land uses
 - ✓ Exurban development near metro centers
 - ✓ Renewable energy development
- Other conservation strategies
 - ✓ Payment for ecosystem services
 - ✓ Conservation easements



Transformational Adaptations

Regional grass banking and cattle relocation

- Private – government partnerships
- Private cooperatives for economies of scale
- Greater integration of cattle and crop systems

Production chain investment in cow-calf production

- Consistent beef supply for production efficiency

Flexible financial instruments

- Buffer weather dependence on market price

Further enterprise diversification

Transformational Programs/Policy

Shift 'disaster payments' to 'climate preparedness'

Redirect NRCS EQIP to climate adaptation

Reduce perverse incentives i.e., marginal land crop insurance, crop subsidies

Payment for ecosystem services

- Biodiversity, soil conservation, GHG mitigation, watershed value, recreational opportunities
- Climate smart beef certification

Expansion of protected areas



ELSEVIER

Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha



Reconceptualising adaptation to climate change as part of pathways of change and response[☆]



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Protecting nature. Preserving life.



**National Cattlemen's
Beef Association**

Climate adaptation pathways enable stakeholders to assess possible futures, evaluate diverse adaptations, and sequence them through time.