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A review of strategies for dealing with climate change in North American Rangelands

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INTRODUCTION

Climate change has greatly impacted rangeland systems. Changes in rangelands are having dramatic effects on both social and ecological systems. Increased greenhouse gases in the atmosphere have contributed to a 1° C increase in average global temperature since the industrial revolution (ca. 1750). Models indicate that by midcentury the average global temperature could increase by another 1° C. Increased temperatures have both direct and indirect effects on rangelands. Direct effects include modified precipitation patterns and increased frequency of severe weather events. Indirect effects include altered distributions of many plants and animals including some agricultural pests.

Joyce et al. 2013 offers three broad options for addressing the social-ecological changes in rangeland systems that will result from an altered climate. These strategies include mitigation (changing management practices to increase carbon sequestration and reduce greenhouse gas emissions), adaptation (changing practices to reduce the negative impacts of climate change), and transformation (considering alternative land uses and introducing new social structures). The authors emphasize the role of social learning in the process of confronting climate change.

MITIGATION

An effective mitigation program will consider a rangeland's ability to sequester carbon and contain plans to reduce greenhouse gas emissions as well as include opportunities to reduce greenhouse gas emissions associated with management. The success of mitigation is highly variable between locations. A mitigation strategy's success is tied to land characteristics (such as soil type, vegetation type, water content, and soil and water quality) and management practices (herd size, grazing regulations, and manure management). The interactions between greenhouse gas reducing measures and measures to improve carbon sequestration should be considered, as one may reduce the effective-

ness the other. This interaction could impact the overall success of a mitigation plan.

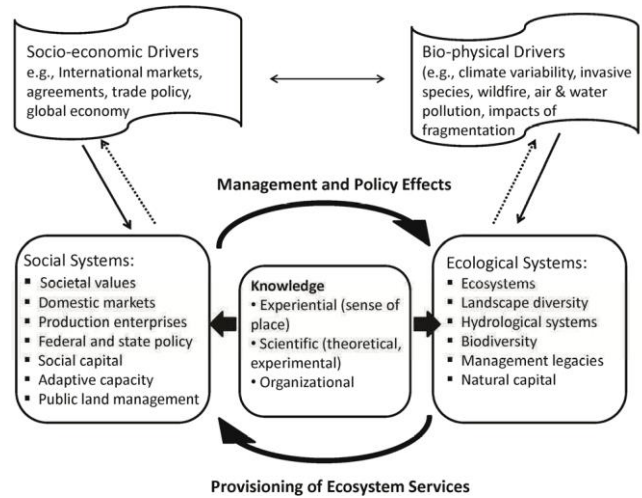


Figure 1. Adaptation to climate change must be developed within the framework of the rangeland social-ecological system as influenced by experiential, scientific, and organizational knowledge and social-economic and biophysical drivers. *Reprinted with permission from L. Joyce, Rangeland Ecology and Management, Allen Press Publishing Services.*

Per unit land, the potential carbon sequestration ability of US rangelands is about half that of US croplands. However, improved carbon sequestration is considered valuable due to the large amount of rangeland and the link between desired ecosystem services and a healthy rangeland. Options for improving carbon sequestration include converting cropland into rangeland, improving the quality of degraded rangeland, and improving management practices. However, it is generally agreed that the best strategy is to protect existing rangelands as carbon sinks.

Mitigation by reducing greenhouse gases is a complex issue, making development of a general greenhouse gas manage-

ment strategy difficult. The effects of a greenhouse gas reduction strategy can vary widely depending on location. Some strategies that could be considered include improving forage quality, supplementing livestock feed, adding legumes to rangelands, and reducing herd size. Joyce et al. 2013 note that mitigation for carbon sequestration does not appear economically viable. The effectiveness of a strategy should be evaluated before implementation in rangeland.

ADAPTATION

Adaptation is the behavioral, social, economic, or cultural changes made to adjust to climate change. This involves identifying what aspects of our social-ecological systems are vulnerable to climate change and implementing measures to enhance the adaptive ability of the system. The objective of an adaptation strategy should be to increase resilience. Resilience is a system's ability to change with disturbance but still maintain the same function. In order for an adaptation strategy to be feasible it must remain flexible and undergo frequent evaluations of effectiveness. The most effective plans will involve short term and long term adaptation strategies as well as a system for evaluation.

Adaptation can come in many forms. Possible strategies include - but are not limited to - adjusting grazing management practices as rangeland ecosystems change, shifting to livestock breeds or species that are more tolerant of heat, or changing forage types. In order for an adaptation strategy to work it will require a great deal of educational opportunities and training programs for local groups. Knowledge of climate science and the consequences of climate change need to be readily available to local groups when forming adaptation strategies. Social learning will be necessary so that all members of a community understand the impacts of climate change. Social learning will lead to increased cooperation within communities, resulting in more effective adaptation strategies.

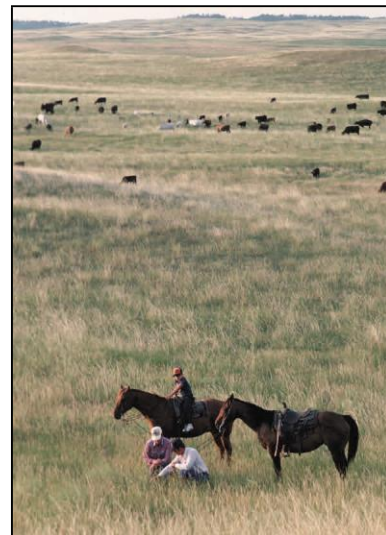


Figure 2. Photo by Tim McCabe
Courtesy of USDA Natural Resources Conservation Service.

TRANSFORMATION

In some cases adaptation may not be enough to preserve the original function of a rangeland. When this is the case it will become necessary to transform our social-ecological systems that rely on that rangeland. Transformation will require the abandonment of old systems and the adoption of unique programs that will emphasize new functions of social or ecological system. These new systems will have to encourage the use of new ecosystem services that will become important with climate change. An example of this would be to allow hunting on lands where expansions of woody vegetation due to climate change makes grazing less feasible.

In order for transformation to work communities need to be aware of the needed changes and have the flexibility and resources needed to make the change. This will require in depth experimentation to find viable options and community cooperation to implement the changes. In many cases resources and financial capital may be limited constraining a community's ability to effectively transform.

CONCLUSION

Research has focused on understanding and predicting effects of climate change on ecological systems, but the changes in how human systems (e.g., social values, economic, policy, land management) interact with ecological systems (e.g. rangelands) will be critical to understand. Research and outreach efforts targeting social-ecological issues will assist landowners in developing climate change adaptation strategies. While climate change alters ecosystems, enterprises that are dependent on specific land uses such as ranching will also need to change to survive and in fact, ranchers may provide leadership on the adaptation process. Adaptation such as changes in grazing strategies and market development must be flexible and the development process iterative to be successful. Outreach to ranchers will support their transition to resilient systems and ultimately benefit the land. Evaluation of emerging adaptation strategies is important to success.

REFERENCES

[Joyce, L.A., D.B. Briske, J.R. Brown, H.W. Polley, B.A. McCarl, and D.W. Bailey. 2013. Climate Change and North American Rangelands: Assessment of Mitigation and Adaptation Strategies. *Rangeland Ecology and Management* 66: 512-528.](#)

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