



# Future Directions for Usable Science for Rangeland Sustainability

WORKSHOP PROCEEDINGS



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# Future Directions for Usable Science for Rangeland Sustainability

## WORKSHOP PROCEEDINGS

A workshop held June 2-5, 2014

The Samuel Roberts Noble Foundation Conference Center  
Ardmore, Oklahoma

**Workshop organized by:**

Sustainable Rangelands Roundtable  
The Samuel Roberts Noble Foundation  
University of Wyoming Department of Ecosystem Science and Management  
Arizona State University Center for Science and Policy Outcomes

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National Cattlemen's Beef Association	USDA Agricultural Research Service
National Grazing Lands Coalition	USDA Forest Service
Oklahoma State University	USDA National Institute for Food and Agriculture
Sand County Foundation	USDA Natural Resources Conservation Service
Texas A&M University	USDI Bureau of Land Management
The Nature Conservancy	US Geological Survey
University of Arizona	
University of Nevada – Reno	





# Future Directions for Usable Science for Rangeland Sustainability

## W O R K S H O P P R O C E E D I N G S

### Introduction

This report summarizes outcomes of a workshop on the future directions of usable science for rangeland sustainability held at the Samuel Roberts Noble Foundation Conference Center in Ardmore, Oklahoma, June 2-5, 2014. As funding for rangeland research becomes scarcer, researchers and funding organizations must ensure information needs of public and private land managers are met. Coupled with rangeland research funding constraints are ever-expanding environmental, financial, and societal pressures on land owners and managers. Given these challenges and a funding future that likely will remain quite competitive, great value can be gained by more closely aligning on-the-ground scientific information needs with topics being considered by university and agency rangeland researchers, and major research funding organizations. In an emerging era of budget constraints, usable science that involves the intended end users throughout the scientific enterprise and gives rise to improved outcomes on the ground should be highlighted. Therefore, the Sustainable Rangelands Roundtable and the Samuel Roberts Noble Foundation partnered to bring together university and agency researchers, public and private land managers and producers, non-governmental organizations, and representatives of funding agencies and organizations to initiate the process of charting a research agenda of usable science for rangeland sustainability. (See appendices 1-3 for participants, agenda, and sponsors).

### Workshop Objectives and Goals

The four goals of the Usable Science Workshop were:

1. Define and discuss the concept of usable science (science developed with the end-user in mind) as it pertains to rangeland soil health and sustainability with consideration of perspectives of agencies, funding organizations, land managers, producers, non-government organizations, and academics;
2. Identify current and emerging issues facing rangelands and their sustainable management along with potential geographic (regional) variations and important stakeholders for each;

3. Develop a portfolio for funding organizations and research/management government agencies of recommendations for future directions of usable science for rangeland sustainability incorporating stakeholder input to address soil health, water, plants, animals, and socio-economic aspects of sustainable rangelands and the varied ecosystem goods and services that intact, functioning rangeland systems provide; and
4. Identify timeline, tasks, and responsibilities for dissemination of information generated during the workshop through conference workshop proceedings, peer-reviewed journal articles, general interest articles, executive summaries, and briefing activities for thought leaders and decision makers.

A forward thinking research agenda is also needed because research that meets users' needs is often not emphasized with much effort and money supporting research that is less relevant to management.

To address these goals and create a research agenda for usable science for rangeland sustainability, workshop participants used a process that involved five groups with different areas of expertise. The groups were animals, socio-economic, soil health, vegetation, and water.

## **Sustainable Rangelands Roundtable - Rangeland Sustainability Principals**

The Sustainable Rangelands Roundtable (SRR) has been involved in projects that focus on the socio-economic and ecological aspects of rangeland sustainability. Below is a description of a few of the products SRR has developed:

### **Criteria and Indicators for Sustainable Rangelands Management**

The goal was to determine what data was needed, not to determine whether rangelands are sustainable. There are three ecologically based criteria and two social and economic-based criteria. These criteria are broad statements that are immeasurable. Under these criteria, 64 indicators are categorized to address how specific things should be measured.

### **Sustainable Rangeland Ecosystems Goods and Services**

This project created a booklet that determined what monitoring and assessment was important for providing current and future ecosystem goods and services.

### **Sustainable Ranch Management Assessment Guidebook**

This project was a Western Sustainable Agriculture Research and Education (SARE)-supported effort looking at how to use national-level indicators. A grant was received to develop a guidebook and train rangeland professionals. The SRR created a monitoring plan to complement ranchers' business plans. This process offers one way to verify sustainable beef production.

### **Assessing Sustainable Rangelands' Contribution to Food Security in the U.S.**

The USDA is very focused on food security. The goal was to estimate red meat production from rangelands; it is the first attempt at looking at food security from a rangelands standpoint. The assessment was done in 17 western states. SRR worked with the National Agricultural Statistics Service to obtain data. The next step is to determine how red meat

production changes in the face of climate change, wildfires, and land fragmentation.

### ***Ecological - Framework for Comparing Ecosystem Impacts of Developing Unconventional Energy Resources on Western U.S. Rangelands***

This would look to see if the indicators detect above ground, at ground, and below ground impacts.

### ***Social - Climate Change Effects on Rangelands: Affirming the Need for Monitoring***

This project compares the climate changes models for Northern Great Plains and the Southwest. Looking at precipitation scenarios for the Northern Great Plains, more precipitation and warmer temperatures are expected, while the desert Southwest will be hotter and drier. With this project the interest lies in applying models to conceptual framework by drawing on the implications of the effects of climate change on trends in the indicator data.

### ***Economic - Ranch-Level Economic Impacts of Altering Grazing Policies on Federal Land to Protect the Greater Sage-Grouse***

SRR is looking at the impacts that Greater Sage-Grouse conservation efforts may have on ranching. SRR worked with Dr. Allen Torell (New Mexico State University) and Dr. Neil Rimbey (University of Idaho) to look at the economic impacts on the ranching operation. They approached it as doing the re-do analysis to determine what will happen to ranching in the western U.S. Biologists' recommendations included evaluated turning livestock out a month later, removing livestock a month later, or possibly doing both. Analyses were conducted on all these scenarios (paper is available on the University of Wyoming website). SRR is also looking at adapting the ranching guidebook to sage-grouse issues and potentially endangered species in general to identify issues, management options, and define what needs monitored.

## **Defining Usable Science**

Much money is spent on research and development in the U.S. each year; however, this research is often not readily available to users and gets lost in a “vat of knowledge” and forgotten because it does not meet the needs of potential users. This leads to allocation challenges procedural challenges, and political challenges, compounded by a tendency to use a linear model of science-user interaction to pull information out of the “vat.”

How do we decide what science to use? One option is by operationalizing this definition of usable science: science that best meets the needs of decision makers when those needs are considered through institutions, policies, and processes of decisions about science. Criteria for usability and social outcomes are also crucial to managing science. The biggest myth about usable science is that it is synonymous with applied research. Usable science has the end-user/decision maker in mind but may be basic or applied research. For usable science, information needs to be assessed relative to decision context as opposed to discipline context. To produce science for decision-making, we need to recognize the differences between researchers. Understanding the demand for science is crucial as well. Usable science needs to

be approached using a circular model rather than a linear model. Knowledge users should be part of all aspects of knowledge creation from identifying research questions to implementing the outcomes of research. For this to happen, challenges like institutional gridlock need to be met and opportunities need to be made for usable science.

## **Perspectives on Usable Science**

The perspectives on what usable science is differ between potential user groups. At the workshop, participants heard from six different user groups on what opportunities, needs, and challenges were associated with usable science. This allowed everyone to hear what science was needed for these different groups and how they could interact with one another to contribute toward usable science. The six groups included producers, NGOs, researcher/scientists, government agencies (USDA Forest Service, Agricultural Research Service, Natural Resources Conservation Service, and USDI Bureau of Land Management), funding organizations (USDA National Institute of Food and Agriculture), and grazing coalitions.

### **Producer Perspectives**

Producer perspectives were offered by the National Cattlemen's Beef Association Director of Sustainability Science, who also works with the Beef Checkoff Program. The main goal of the Beef Checkoff Program is to communicate information about the beef industry to the consumer and influencer. The Beef Checkoff Program is mandated by law to collect a dollar for each head of livestock sold for beef. This dollar goes to help pay for research and marketing of the beef industry. Research areas of the Beef Checkoff Program include human nutrition, safety, and new product development.

Producers need usable science to help promote a sustainable beef industry and illustrate credibility and effectiveness of the practices they are using to make every stage of the beef lifecycle more sustainable. A large piece of the puzzle is missing as the industry tries to tell the complete story of beef production on rangelands. We need to think about connecting the sustainable rangeland story to the sustainable beef story. Ranchers also need a way to have production agriculture funding; currently only 0.5 percent of net funding goes back into production agriculture.

### **Interested NGO Perspectives**

The major NGO at this workshop was the Samuel Roberts Noble Foundation. Members recently reorganized and created a mission statement highlighting the importance of outcomes from their science and not science for the sake of science. To make their science more usable, they have clustered their scientists to address sustainable models for the future and have integrated these clusters to become more market driven. They have developed projects such as Forage 365, which looks at using native forage. They also are creating the Center for Land Stewardship, which will look at stewardship activities that could be offered to producers and other interest groups.

The foundation seeks to make research regional, national, and global, with more collaboration with different groups across the country. Ag-informatics is needed as well as bio-infor-



matics. The Noble foundation identified opportunities to enhance usable science by having more private and public land funding available. Tax reform could also expand usable science by making more dollars available to researchers. A recent project that puts usable science into practice is the Soil Renaissance effort, which hopes to build a baseline plan for how we look at soil health in the U.S. Along with the opportunities, challenges are also faced in the Noble foundation and other NGOs. These include the lack of agriculture scientists, data management, which is costly and requires personnel, and the political environment.

## **Researcher/Scientist Perspectives**

The key question raised by the research/scientists participants was, “How did we get into a situation where we are rewarded for doing research that pays little attention to how it can be usable?” The response focused on internal dynamics of the social system in which researchers work. There is prestige in publishing in journals and doing science pleasing to other scientists rather than to potential users of science. The biggest challenge is trying to step out of this box. Training the next generation of researchers/scientists to think about usable science is another necessity. Scientists need to be able to translate their work into terms understood by those intended to use it and also find ways to involve and engage those users in the complete scientific process. Scientists realize there are places they need to progress to make this happen. Working on legislators is a start. Progress would be made by talking to the users of science and seeing what information they need and then designing the tool around what is needed rather than engaging science users after the tool has been completed without their input.

## **Agency Perspectives**

The government agencies represented at the workshop included the USDA Forest Service, Agricultural Research Service (ARS), Natural Resources Conservation Service (NRCS), and USDI Bureau of Land Management (BLM). The agencies need usable science for management decisions. Presently, there is a distance between science and management. Management needs science that can be measured so the effects of that management practice can be seen. Agencies are large producers and large consumers of data. Often, agencies have the usable science but perhaps pertaining only to one aspect of sustainability (ecological information without social or economic aspects). Cross-disciplinary research at the local and regional scale would be useful, as well as synthesis articles that combine research in the ecological, social, and economic sectors at all scales.

## **Science Funding Organizations**

One of the major science funding organizations present at the workshop was the USDA National Institute of Food and Agriculture (NIFA). The NIFA representative suggested behavioral changes need to be made between the educator and the stakeholder to have research outcomes become usable science practices. Because of this realization, NIFA has made stakeholders and sociologists involvement in the research process a requirement for funding to be given. However, to have this work correctly and efficiently, there needs to be trust between the stakeholders and researchers. Research dollars for rangelands to not come in large pack-

ages, instead, small funding amounts are combined for larger projects. Academics need to become better at communicating their information and following up on research progress. Funders need to see the results of usable science projects and need the information on how a project is successfully answering specific questions if they are going to provide future funding. Keeping funding agencies and policy makers informed allows for better future decision making.

## **Grazing Coalition**

Grazing coalition representatives brought up discussions on the disconnect between usable science and politics, along with how usable science has helped/will help them as producers. There needs to be an understanding of usable science that has political backing for management purposes. People not only need to understand the ecological side of science but also the social and economic aspects to understand all that is being affected. Producers believed the range scientists who came out to their ranches and explained the science helped them develop and improve efficient production. The science needs to be presented in a way that is understandable, especially to teach producers who are new to the industry.

## **Usable Science for Rangeland Sustainability in a Geographic Context**

Making science relevant to society has always been a challenge. In the academic and political arenas, discussion of usable science has gone on for a long time. Usable science demands publicly and privately funded research to meet the needs of science users along with a recognition of research needs to guide policy intervention in a rapidly changing world. There are three attributes of usable science:

- Pertinence - understanding the needs and attitudes of those affected,
- Quality - the extent to which communities and cultural values are integrated,
- Timeliness - if/when results will be available in time to inform decision making.

So, as a researcher, how do you make your research more demand driven? Start by responding to the problem, finding equity in research priorities, imagining solutions for future change, and fostering knowledge co-creation. Knowing the scale of the information needed also is requisite to making science usable to the end user, as is incorporating users from the appropriate scale and region in the co-production of knowledge.

## **Workshop Process**

The workshop process began with two facilitators describing what was expected from the five resource working groups (animals, socio-economic, soil health, vegetation, and water). Each group was assigned a leader and a student note-taker.

The first step for groups was brainstorming ideas, issues, and challenges confronting sustainable rangelands. These ideas were recorded for discussion in the working groups. Some of the ideas were specific to the resource-working group, while other ideas were based on rangelands as a whole. After this step was complete, the large group reconvened, and all the identified topics were listed on flip charts around the room and numbered. There were 142

priorities facing rangelands itemized by the five groups (Appendix 4). Participants individually went through all the items and rated them using a scale developed by facilitators. Participant worksheets were collected, and the facilitators collated responses to create a comprehensive, prioritized ranking of issues.

With these ranked issues, the individual resource groups met to further flesh out the prioritized issues and determine which they believed should be addressed in the near term. A worksheet was filled out for each issue the group selected. The worksheet asked specific questions to provide a complete picture of each issue (Appendix 5). Once this was done, a set of research questions were developed for each of the issues, and a separate worksheet was filled out for each research question (Appendix 5).

After issues and research questions were developed, the full workshop reconvened, and each small group gave a report on their issues and research questions. The floor was then open for discussion to ensure nothing was left out. The small groups recorded comments from the audience and incorporated them into their ideas. The issues and research questions will form the foundation for each of the small groups to write a peer-reviewed journal article.

## Workshop Outcomes

Results and conclusions from this interdisciplinary workshop reflect 20 hours of dialogue among contributors. Outcomes are categorized according to the five resource groups. Usable science considers the needs of its users throughout the basic to applied scientific enterprise, in this case to ensure rangelands continue to provide a desired mix of economic, ecological, and social benefits to current and future generations. Ecological drivers identified as influencing socio-economic aspects included climate change, drought, flooding, fire, and invasive species. The highest priority research questions developed address: restoration of abandoned cropland; using a landscape perspective for rangeland management; assessing resilience of rangeland systems to extreme events; integration of agricultural production and wildlife habitat conservation; effects of spatial pattern of plant communities and soils on livestock production, wildlife habitat, and water quality; understanding the role of space and time variability; determining effects of invasive species on rangeland ecosystem goods and services; developing methods to rehabilitate degraded soils, recover from wind erosion, and deal with soil stabilization; and costs benefit analysis of restoring forage crops.

Below is a description of the issues each resource group developed and a list of potential research questions that could start addressing these issues. Content was extracted from the Usable Science Issues and Research Question worksheets. The unedited worksheets can be found in Appendix 4.

## Animals

**ISSUE 1: Proactive drought planning.** The reason this issue is important was for management preparedness and flexibility, better-informed science, potential collaborative decision-making, and profitability/economic planning. Proactive drought planning is important to livestock producers, consumers, land managers, communities, and many others. Policy makers, county commissioners, producers, traders/market, managers, extension agents, and

conservation counties and districts would benefit from this. Tools and knowledge to develop site-specific drought management plans are needed for these benefits. The kinds of research activities that might best address the issue of proactive drought planning include better prediction skills that are more site specific, as well as case study demonstrations and successful qualitative data collection and analysis.

### RESEARCH QUESTION

What are the appropriate rangeland management decisions to make land more drought resistant and what are effective (before, during, and after) drought and weather variation indicators, triggers, and actions that will help optimize management of sustainable working lands?

**ISSUE 2: Matching production and management systems to the resource.** This issue is important to optimizing resources (land, water, animals, etc.). Land managers, interested groups, producers, other land users, agencies and others believe this issue is important. The main benefit would be optimization of sustainability across all identified users to assist consumers, local communities, new incoming agency specialists, producers, and ranch managers. The types of research activities that might best address this issue would be geo-spatial meta-analysis, quality control data base analysis, clearing house/portal for successful approaches by resource/region/variable, and case studies/descriptions.

### RESEARCH QUESTIONS

1. What are the major resource characteristics that drive production system options?
2. How do we properly match animals to the resource base (species, breed, class, nutrition)?
3. How do we demonstrate and implement the benefits of stocking rate flexibility based on available knowledge?
4. How do we exploit knowledge of animal behavior, distribution, and stockmanship to achieve rangeland management and production goals?

**ISSUE 3: Data mining, synthesis, gap analysis, effective communication of livestock impact on rangelands.** This issue is important to land and livestock managers to identify opportunities and research related to the use of domestic livestock for vegetation management. Livestock producers, industry organizations, agencies, and conservation organizations might be advocates for this research. The types of research activities for this issue might be to target synthesis and literature review through theses, dissertations, and “gray literature.”

### RESEARCH QUESTION

Is there information and data about the effects of domestic livestock (positive, negative, and neutral) on rangelands and associated natural resources and how can it be used effectively?

## Socio-economic

**ISSUE 1: How to get the right kinds of information to knowledge users in a form they can use.** This issue is important because tremendous amounts of knowledge are generated every day but often it does not get to potential users when needed and in a useable form. Industry and producer groups, universities, government entities, policy makers, NGOs, and consumers would benefit from research on this issue. Users of this research would be information creators and distributors. Extension agents, agencies, NGOs, and industry groups would be advocates for this research. The types of research activities that would best address this issue would include multi-disciplinary, multi-focused research appropriate to the scale of the question, this should include an evaluation of strengths and weaknesses of extension programs and ways to build on the former while suggesting reforms to address the latter.

#### **RESEARCH QUESTION**

Who needs what information and what are the barriers and opportunities for information transfer?

**ISSUE 2: Improve the desirability and profitability for new generations to make a living in rangeland agriculture and associated environmental benefits.** This issue is important because without a continued supply of landowners and land managers, sustainability of rangeland agriculture is at risk. Conservationists, state agencies, ranchers, and the public that values intensive agriculture, open space advocates, and NGOs would benefit from research on this issue. They would benefit through maintenance of small enterprise and community stability (socially and economically). Community economic development and municipal services as well as land-grant universities, agriculture and economic agencies, and individual families would be users of research on this issue, along with being advocates for the research. Multidisciplinary, multi-focus research activities would best address this issue.

#### **RESEARCH QUESTION**

What are the barriers and opportunities for new people to enter and persist in rangeland occupations and how can we use that information to increase the number of adults who choose such careers?

**ISSUE 3: Understanding and managing for variability (climate, drought, fire), adaptation, and recovery.** This issue is important because of increasing environment variability, market unpredictability, and demographic change. This issue is important to everyone at every scale (local, regional, national, international). Everyone would also benefit from research on this issue but different products will benefit different audiences at different scales. The research will be used by policy makers to form policy decisions, livestock managers from a ranch level model, and community leaders from adaptive government entities. Advocates of research on this issue include land managers, communities (fire department, municipal and utility services), community-to-regional scale planning and development, state and federal agencies, natural resource researchers, industry-related entities (e.g., oil and gas), global NGOs, and marketers. Research activities that would best address this issue would be multi-disciplinary, multi-focused research appropriate to the scale of the question asked.

## RESEARCH QUESTION

How do rural communities best prepare for, adapt to, and/or recover from impacts of increased environmental and socioeconomic variability?

**ISSUE 4: Understand and create incentives for improving land stewardship across boundaries (geographic and political) to address water, invasive plants, wildlife (special status species), fire, etc.** This issue is important because issues such as invasive species, water, wildlife, and fire need to be applied to scales larger than individual properties and jurisdictional entities so production capacity can be increased. The benefits would be at the community level and the community, NGOs, and individual landowners would be users of research on this issue. Multi-disciplinary, multi-focused research appropriate to scale would best address this issue.

## RESEARCH QUESTION

What motivates landowners to cooperate across boundaries for environmental stewardship and how do we use that information to create and/or improve incentives and reduce disincentives?

## Soil Health

**ISSUE 1: ESD States/Soil Health Status.** This issue is important to ensure all management practices benefit soil health. This issue is important to land planners (owners, consultants, etc.) and land managers. Advocates for research on this issue would be the National Grazing Land Coalition, NRCS, NCBA, other associations, and informed producers. The kinds of research activities that would best address this issue would be identifying soil attributes (among states within individual ESDs) that indicate the status of the soil to determine what manageable/economical practices or inputs can alter or improve productivity and to identify soil attributes in each ecosite as they relate to thresholds between states.

## RESEARCH QUESTIONS

1. Characterization of soil health indicators
2. What are the indicators/attributes of soil health? Can we detect different levels of importance that vary among states within the ecological sites?
3. What are the sensitivity levels that affect threshold changes and what management practices influence the indicators in a cost-effective, positive, or negative way?
4. Spatial analysis and determination of efficiency of soil sampling for soil health to identify indicators.
5. Synthesis paper on soil responses to land management, soil microbiology is an unknown.

**ISSUE 2: Relevance of soil survey ESD.** This is an important issue to complete data sets and fill in missing information. This issue is important to the NRCS, extension services, public land managers, and private individual managers. Those who would advocate for research

on this issue would be those in areas without soil surveys (north and west parts of the states), those that have not had surveys updated, and the NRCS and other extension services/consultants. The kinds of research activities that would best address this issue would be to identify soils in many parts of the country that have not been identified and ensure all current research is accurate, including evaluation of the potential for remote sensing.

## RESEARCH QUESTION

Completion and updates of soil surveys

**ISSUE 3: Soil mitigation: prescribed fire versus wildfire.** This issue is important to educate the public and prevent wildfires that occur due to fuel build. Also to reduce smoke (which is less from prescribed). Those for whom this issue is important include land/fire managers, Forest Service, BLM, public, and policy makers so they can explain reduced heat, smoke, soil movement, and carbon effects. These are the same people who would advocate for research on this issue. Research activities that would best address this issue would be to assess accumulated brush piles and the effects of burning.

## RESEARCH QUESTIONS

1. What are the soil responses to vegetation treatment disposal? Effects of various ignition methods on post woody plant material on soils? (piling vs. standing vs. scattered burning)
2. What are the soil nutrient responses to prescribed fire (in terms of seasonality, regional aspects, and frequency) compared to non-fire?
3. Influence a wildfire has on soil nutrients as compared to non-fire (and later prescribed fire) (look at intensity of wildfire)
4. Synthesis of current research that identifies soil responses to range management practices and effects on climate change

## Vegetation

**ISSUE 1: Develop landscape perspective for rangeland conservation and management.** This issue is important because the scale of science needs to be matched to the scale of the question. This impacts all stakeholders in rangeland management. Advocates of this research would include federal land management agencies and The Nature Conservancy. Work would need to be done to engage broad groups of private landowners. The types of research activities needed for this issue would include algorithms for scale, determination of the role of spatial pattern, edge effects, patch dynamics (shape and size), and how animals use landscapes.

## RESEARCH QUESTIONS

1. How to determine the resilience of rangeland landscapes to extreme events such as fire, drought, flooding, invasive species, etc.
2. Understanding the motivations of different groups to implement landscape level planning

3. How do you have agriculture and wildlife habitat on the same landscape?
4. What are the effects of spatial pattern of plant communities and soils on livestock production, wildlife habitat, water quality, etc.?
5. Understanding the role of variability of space and time in rangelands
6. Develop monitoring concepts for a landscape perspective
7. Determine effects of invading native and exotic species on ecosystem services

## Water

**ISSUE 1: Transfer of knowledge to land managers, increase support of rangeland programs and extension, harmony: community-based conservation versus commodity-based conservation.** This issue spans all resource groups.

**Issue 2: Drought.** This is an important issue because rangeland is characterized by drought. It is important to anyone making decisions such as the governor, land management agencies, land managers, Secretary of Agriculture, climate service providers, water utilities, irrigation districts. Advocates for research on this issue would be state climatologists, agricultural producers, ranchers, agricultural economists, commodities, and agencies. The kinds of research activities that would best address this issue would be drought economics and determining stability, resilience thresholds.

### RESEARCH QUESTIONS

1. Better monitoring tools, prediction tools, better technology (applies to monitoring, prediction, and preparedness)
2. Building adaptive capacity and resilience. How to build adaptability to long-term droughts? (Plant, animal, communities, stakeholders)

**ISSUE 3: Proactive watershed management and protection of high-quality rangeland watersheds.** This is important to municipalities, water utilities, water foundations, The Nature Conservancy, anyone who wants intact environments, ranchers, sportsmen, the public, conservation groups, and bird watchers. The same would advocate for research on this issue. The kinds of research activities for this issue would be policy, geography (acres, subsurface, sensitive areas), geologic mapping, LIDAR, community-based watershed management, and conservation easements (ease of implementation).

### RESEARCH QUESTION

Understanding rangeland water budgets

**ISSUE 4: How to productively move cropland to rangeland. This is important to any farmed cropland on marginal landscapes, farmers and ranchers among the Southern Plains and Western states.** The American Lung Association, EPA, and USFWS would be advocates for research on this issue. Research activities that would address this would be restoration ecology, wind erosion and soil surface stabilization, public awareness with outreach,



wind breaks/plant materials, and restoring subsoil/sand/degraded soils.

## **RESEARCH QUESTIONS**

1. Restoration of abandoned cropland
2. Cost/benefit analysis-what are the costs to society of restoring forage crop? Or not?

## **Next Steps**

The next steps to continue building on the outcomes of this workshop include a peer-reviewed journal issue, a poster presentation of results and recommendations, brown bag presentations/discussions (USGS, NIFA, others?), a review session at Society for Range Management meeting in Sacramento 2015, and a briefing session for thought leaders and decision makers. Other literature and presentations may arise in the future.



# Appendix 1

## Workshop Participants

**J.K. "Rooter" Brite, Jr.** - JA Ranch, National Grazing Lands Coalition

**Joel Brown** - Natural Resource Conservation Service

**Mark Brunson** - Utah State University

**Bill Buckner** - The Samuel Roberts Noble Foundation

**Netra Chhetri** - ASU Consortium for Science Policy and Outcomes

**Greg Clary** - The Matrix Assessment Group (facilitator)

**Alix Cleveland** - USDA Forest Service

**Justin Derner** - USDA Agricultural Research Service

**Jim Dobrowolski** - USDA National Institute of Food and Agriculture

**Theo Dowling** - Public Lands Council

**Alex Echols** - Sand County Foundation

**Chad Ellis** - The Samuel Roberts Noble Foundation

**Quincy Ellis** - The Matrix Assessment Group (facilitator)

**Dave Engle** - Oklahoma State University

**Sam Fuhlendorf** - Oklahoma State University

**Amy Ganguli** - New Mexico State University

**Lori Hiding** - Arizona State University

**Chris Hise** - The Nature Conservancy

**Lynn Huntsinger** - University of California-Berkeley

**Sherm Karl** - USDI Bureau of Land Management

**Urs Kreuter** - Texas A&M University

**Bree Lind** - University of Wyoming (note taker)

**Kristie Maczko** - Sustainable Rangelands Roundtable, University of Wyoming

**Paul Meiman** - Colorado State University

**Pat Pfeil** - National Grazing Lands Coalition

**Gary Price** - 77 Ranch

**Frank Price** - Frank and Sims Price Ranch

**John Ritten** - University of Wyoming

**Bill Sproul** - Sproul Ranch

**Kim Stackhouse-Lawson** - National Cattlemen's Beef Association

**Chuck Stanley** - USDA Natural Resources Conservation Service

**Tamzen Stringham** - University of Nevada-Reno

**John Tanaka** - Sustainable Rangelands Roundtable/University of Wyoming

**Doug Tolleson** - University of Arizona

**Leticia Varelas** - University of Wyoming (note taker)

**Evan Whitley** - The Samuel Roberts Noble Foundation

**Gary Ziehe** - USDA Forest Service

## Appendix 2

### Future Directions of Usable Science for Rangeland Sustainability

June 2-5, 2014

*The Samuel Roberts Noble Foundation Conference Center  
Ardmore, Oklahoma*

#### Workshop Objectives:

1. Define and discuss the concept of usable science (science developed with the end-user in mind) as it pertains to rangeland soil health and sustainability with consideration of perspectives from agencies, funding organizations, land managers, producers, non-government organizations, and academics.
2. Develop for research funding organizations and research/management government agencies a portfolio of recommendations for future directions of usable science for rangeland sustainability, incorporating stakeholder input to address soil health, water, plants, animals, and socio-economic aspects of sustainable rangelands and the varied ecosystem goods and services intact, functioning rangeland systems provide.
3. Consider current and emerging issues in sustainable rangeland management and potential geographic (regional) variations throughout development of the research portfolio for usable science for sustainable rangelands.
4. Identify timeline, tasks, and responsibilities for dissemination of information generated during the workshop through conference workshop proceedings, peer-reviewed journal articles, general interest articles, executive summaries, and briefing activities for thought leaders and decision makers.

#### Monday, June 2, 2014

*Travel to the Samuel Roberts Noble Foundation, Ardmore, OK*

- 5:00pm** Reception, Meet n' Greet- Noble Foundation Conference Center Lounge/Living Room, with remarks from Noble Foundation *President Bill Buckner*
- 6:30pm** Dinner - Noble Foundation Conference Center Dining Room

**Tuesday, June 3, 2014:**

- 7:30am** Breakfast (*on site guests only*) - Noble Foundation Conference Center Dining Room
- 8:30am** Workshop welcome and opening plenary - Noble Foundation Pavilion, *Dr. John Tanaka, University of Wyoming*
- Overview expectations for workshop (peer-reviewed journal special issue)
  - Review agenda content for 2.5-day workshop
- 8:45am** Self Introductions
- 9:00am** What is “Usable Science?”- Concept and Examples, *Lori Hiding, Arizona State University, Consortium of Science and Policy Outcomes*
- 9:30am** Summary of rangeland sustainability principles - social, economic, and ecological aspects with examples of possible directions for usable science - *Dr. John Tanaka, University of Wyoming*
- Sustainable Rangelands Roundtable First Approximation Report: Criteria and Indicators for Sustainable Rangelands Management
  - Sustainable Rangeland Ecosystem Goods and Services
  - Sustainable Ranch Management Assessment Guidebook
  - Assessing Sustainable Rangelands’ Contributions to Food Security in the U.S.
  - *Ecological* - Framework for Comparing Ecosystem Impacts of Developing Unconventional Energy Resources on Western U.S. Rangelands
  - *Social* -Climate Change Effects on Rangelands: Affirming the Need for Monitoring
  - *Economic* - Ranch-level Economic Impacts of Altering Grazing Policies on Federal Land to Protect the Greater Sage-Grouse
- 10:15am** Break – Noble Foundation Pavilion
- 10:35am** Participant perspectives and thoughts on usable science needs, opportunities, and challenges. What would represent meaningful progress?
- Producer perspectives - Dr. Kim Stackhouse-Lawson, NCBA
  - Interested NGO perspectives - Mr. Bill Buckner and Mr. Chad Ellis, Noble Foundation
  - Researcher/scientist perspective - Dr. Mark Brunson, Utah State University
  - Agency perspectives - Dr. Gary Ziehe, FS, Dr. Sherm Karl, BLM, Dr. Justin Derner, ARS, Dr. Joel Brown, NRCS
  - Science funding organization perspectives - Dr. Jim Dobrowolski, NIFA
  - Others

**11:35am** Usable Science for Rangeland Sustainability in a Geographic Context: Accounting for Regional Variability - *Dr. Netra Chhetri, Arizona State University*

**12:05pm** Lunch - Noble Foundation Conference Center Dining Room

**1:20pm** Begin work group process (Ellis, Clary)

- **What are expected outcomes?**
- **How can I add value to the process?**
- **What's in it for me?**
- **What are the steps of the process?**

Introduce resource-based structure from which small groups work will proceed. Review small group assignments (using name tag markings), participants, and breakout room locations (*boardroom, living room, loft, dining room, and pavilion*).

Begin resource group brainstorming (instructions, identify leaders and recorders) (Ellis, Clary)

- **Soil Health**
- **Water Resources**
- **Vegetation**
- **Animals**
- **Socio-economic Aspects**

**3:10pm** Afternoon break - Noble Foundation Pavilion

**3:30pm** Reassemble as whole group for small group reports; whole group provides additional input, prioritize all items, and assign each item to its most appropriate resource group for further development (Ellis, Clary)

**5:30pm** Adjourn Workshop Day 1

**5:30pm** Cocktail Hour - Noble Foundation Conference Center Lounge/Living Room

**6:30pm** Dinner - Noble Foundation Conference Center Dining Room

## Wednesday, June 4, 2014:

- 7:30am** Breakfast (*on site guests only*) - Noble Foundation Conference Center Dining Room
- 8:30am** Small groups reconvene to add details to and further develop prioritized issues from Day One and identify related research questions. Consider adding the following elements to issues and research questions (*breakout locations will be boardroom, living room, loft, dining room, and pavilion*). (Ellis, Clary)
- **Why is this issue important and to whom?**
  - **Who will benefit and how, from creating knowledge to address this issue?**
  - **To whom will products be usable (if they will indeed be usable)?**
  - **Who might advocate for research on this issue; who are proponents of this work?**
  - **What kinds of research activities will best address this issue?**
  - **What research question(s) will best address this issue? (use one research worksheet per question)**
- 10:40am** Break - Noble Foundation Pavilion
- 11:00am** Small groups continue discussions and product development, transitioning from issues to usable science research questions.
- **What priority is this research question (high, medium, low) and why?**
  - **What is the spatial scale (local, regional, national, international) needed to address this research question?**
  - **Would you expect results on this research question in the long-term (10+ years), mid-term (5-10 years), or short-term (1-2 years)?**
  - **What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**
- 12:00pm** Lunch - Noble Foundation Conference Center Dining Room
- 1:15pm** Small groups continue discussions and product development for usable science research questions.
- 2:15pm** Small group reports: results of deliberations and thoughts on how usable science issues and research questions might be addressed; comments and suggestions from whole group to each resource group (Tanaka) (20 min. each max.)
- **Soil Health**
  - **Water Resources**
  - **Vegetation**
  - **Animals**
  - **Socio-economic Aspects**
- 3:45pm** Break - Noble Foundation Pavilion

**4:05pm** Document progress: small groups reconvene to incorporate suggestions made during reports to the whole group and finalize summary for workshop proceedings (*breakout locations will be boardroom, living room, loft, dining room, and pavilion*). (Clary)

- **Soil Health**
- **Water Resources**
- **Vegetation**
- **Animals**
- **Socio-economic Aspects**

**5:30pm** Adjourn Workshop Day 2

**5:30pm** Cocktail Hour - Noble Foundation Conference Center Lounge/Living Room

**6:30pm** Dinner - Noble Foundation Conference Center Dining Room

**Thursday, June 5, 2014:**

**7:30am** Breakfast (*on site guests only*) - Noble Foundation Conference Center Dining Room

**8:30am** Whole group discussion to identify workshop accomplishments, necessary next steps, suggestions for future workshops, symposia, etc., and plans for future work:

- Articles for a special journal issue based on workshop outcomes
- Schedule for journal article drafts and submission with lead authors identified and committed.
- Workshop proceedings, executive summaries, and general interest articles.
- Gauge interest/potential for briefing sessions
- Sustainability Assessment Matrix (Ellis, Clary)
- Other suggestions? *Led by Dr. John Tanaka, University of Wyoming*

**10:30am** Optional Noble Foundation Research and Facility Tour(s) - TBD

**12:00pm** Workshop participants depart



## **Appendix 3**

### **Special Thanks to Our Workshop Sponsors**

#### **Facilities and Meeting/Reception Refreshments**

The Samuel Roberts Noble Foundation

#### **Monday Evening Dinner**

University of Wyoming, Department of Ecosystem Science and Management

#### **Participant Travel**

Arizona State University, Consortium for Science and Policy Outcomes

Colorado State University

National Cattlemen's Beef Association

National Grazing Lands Coalition

Oklahoma State University

Sand County Foundation

Texas A&M University

The Nature Conservancy

University of Arizona

University of Nevada – Reno

University of Wyoming

Utah State University

#### **Government Partners**

USDA Agricultural Research Service

USDA Forest Service

USDA National Institute for Food and Agriculture

USDA Natural Resources Conservation Service

USDI Bureau of Land Management

US Geological Survey

## Appendix 4

### Rangeland Sustainability Issues and Prioritization Order

1	Forward-looking drought predictors
2	Complete water budget
3	Who gets the water
4	Proactive watershed management
5	Protecting high-quality rangeland watershed (in contrast to mitigation/storage)
6	Increased creativity of scientists' thought processes on how to fund long-term research
7	Water and increased woody biomass issue (soil resources, wildlife habitat, production ag, watershed)
8	Drought indicators that are more sensitive on a regional level
9	Producer acceptability
10	Harmony: Community-based conservation vs. commodity-based conservation
11	Water made available through brush management
12	Optimal timing for riparian area grazing
13	Rangeland resiliency in the context of evolving demand and supply
14	Change culture of exploitation to conservation
15	Building management structure to encourage positive outcomes (incentives not regulations)
16	Interrupting plow-out/set aside policy
17	Multiple stressors of water (climate change as additional stressor)
18	Technological innovations in water management
19	Uncertainty and ambiguity about decision-making
20	Sensitivity of rangeland issues to decision makers
21	Public institutions' organization of knowledge
22	Transfer of knowledge to land manager
23	Increase support of rangeland programs and extension
24	Understanding water price as a driver for conservation (beyond basic needs)
25	Define and implement drought preparedness
26	What are the economic implications to drought after the drought has left

27	Better coordination among research projects
28	Do we need a national water policy
29	Better adoption of water conservation policy (e.g., irrigation technology)
30	How to productively move cropland to rangeland
31	Soil carbon Rx fire vs. wildfire vs. mob grazing
32	Optimize microbial activity (litter cover, infiltration)
33	Soil condition rating
34	ESD states/Soil health states
35	relevance of soil survey ESD
36	Livestock micro activity to soil micro activity
37	Soil/Plant Interaction
38	Integration of soil data and interpretation (tying data together)
39	Soil erosion (wind/water, climate change predictability) (Predictive models-regional)
40	Soil microbial induced for designer communities
41	Soil mitigation Rx fire vs. wild
42	Soil cryptobiotic crusts
43	Targeted conservation programs/practices for soil resources on landscape and post-fire
44	Dust PM10
45	Vegetation more than just forage (e.g., habitat)
46	Consider industrialization of rangelands
47	Understand role of heterogeneity
48	Embrace climate change science
49	Understanding plant community adaptability/plasticity in the face of change
50	Improve mechanisms for communication/cooperation among diverse stakeholder groups
51	Consistent and well-understood descriptions of current and "desired" conditions
52	Tools to encourage critical thinking about vegetation's dynamics across scale
53	Acknowledge variability in space and time vs. the mean
54	Focus on magnitude and risk of change
55	Understand tradeoffs in forage quantity and quality and fuel load
56	Understand fire effects

57	Consider extreme events
58	Using terminology understood by all
59	Scale down vs. scale up
60	Focus on multiple objective management
61	Core data sets that are shared
62	Consider multiple scales
63	Landscape change in the face of increasing urban population
64	Understanding importance of diversity
65	Learning from drought
66	Understanding impacts of neighbors
67	Understand role of fragmentation on important ecological processes
68	Importance of stocking rates/density
69	Understand other sources of income from range
70	Consider full range of invasive species issues
71	Engage woody plant encroachment as dominant
72	Alterations of disturbance regimes
73	Understand perception of vegetation change
74	Understanding the role of plants water holding capacity during drought
75	Effects of livestock on rangeland
76	Effects of wildlife/livestock interaction
77	Stocking rate flexibility
78	Proactive drought planning
79	Animal nutrition monitoring
80	Collaborative range monitoring
81	Education/experience of next generation
82	Invasive species
83	Recreation impacts on natural resources and agriculture
84	NEPA
85	Animal impact on rangelands
86	Stockmanship
87	Lack of effects of livestock
88	Unintended consequences of "sustainable" diets
89	Matching animals to the resource
90	Match production system to resource
91	Impacts of special status species upon livestock producers
92	Feral horses

93	Empower landowners with knowledge
94	Communication between neighbors
95	Protection of property rights
96	Definitions of property rights
97	Grazing management not grazed v. ungrazed
98	Animal behavior
99	Animal distribution
100	Breed adaptability to intensive grazing
101	Stockmanship/animal handling
102	Enterprise/profitability
103	Education of non-ag community
104	Aligning incentives and outcomes
105	Metrics of sustainability
106	Recruitment of producers and expertise
107	Information for decision support
108	Communication of complexity of food system
109	Efficiency of inputs
110	Optimize resources: land/water/animals
111	Building social capital to enhance adaptive management (trust, reciprocity, and networks)
112	Need better measures of social indicators of sustainability
113	Social definitions of sustainability
114	Restoring and integrating rangeland habitat in tame systems
115	Increased improved outreach education and advocacy
116	Policy and management decisions should be widely considered fair
117	Understanding mental models of woody plants and the role of fire in rangeland ecosystems
118	Helping communities better adapt to social, economic, environmental, or political change
119	Good understanding of biophysical systems at various scales (temporal and spatial scale triggers, trade offs, and certainty)
120	Quantitate the value of rangeland and protein production
121	Implement measures of research to facilitate positive ag message to consumers
122	Reducing the role of implicit, untested assumptions in decision making
123	Understand and create incentives for improving land stewardship across

	bounding
124	Identify and measure broad costs and benefits of renewable energy production
125	Reconcile messages across disciplines
126	Recognize and evaluate rangelands in the eastern states
127	Multi-disciplinary, multi-focus research
128	Develop management and policy for anthropogenic ecosystems to maintain ecosystem services
129	Finding common ground for industry groups (i.e., oil and gas)
130	Improve desirability and opportunity for new generations to make a living on the land
131	Understand land managers' motivations (profit vs. lifestyle)
132	Understanding and managing for variability (climate, drought, fire)
133	Market-based demographic emphasis to research and demonstration
134	How to people react and respond to risk
135	Identify factors driving the motivations of extraordinary producers from a conservation perspective (above-average vs. average producer)
136	Improve recovery from natural disasters
137	Encourage and promote involvement of younger generations in agriculture
138	How do you incorporate diverse knowledge into decision-making
139	Maintaining affordable water supplies from aquifers in the face of climate change
140	Document stated intention to behave vs. actual behavior in terms of land management
141	Too focused on livestock
142	How to get "right" kinds of information to knowledge users in a form they can use

## Appendix 5

### Usable Science Evaluation Worksheet - Issues

**Group:** Animal

**Issue:** Proactive Drought Planning

**Ranking score:** 416 list of 3 (out of big list) total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- **Why:**
  - Management preparedness/flexibility, better informed science-based decisions, collaborative decision-making, and profitability/economic planning.
- **Who:**
  - Livestock producers, consumers, land managers, communities, etc.
- **Benefits:**
  - Who: Policy makers, county commissioners, producers, traders/market, agency managers, extension agents, conservation counties and districts
  - How: tools and knowledge to develop site-specific drought plans

**Who might advocate for research on this issue; who are proponents of this work?**

- Landowners/managers, local/regional/state technical advisors, production associations, natural resource interest/user groups, government agencies, municipalities

**What kinds of research activities will best address this issue?**

- Local scale water group?
  - Better prediction more site specific
  - Case study result demonstration - also include economic value
  - Successful qualitative data collection/analyzing
- Notes:
  - Sherm's Question - Some indicators and targets for going back in
  - Tamzen's Point - Rainout shelter and?? to see what happens to warriors app of plants

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- What are the appropriate drought triggers and actions?
- Optimize decisions and actions at various scales
- Prove value to land managers around drought resilience

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

- Collaborative range monitoring
- Empower landowners



## Usable Science Evaluation Worksheet - Research Questions

**Group:** Animal, Drought Planning Issue

**Research question:**

- What are the appropriate rangeland management decisions to make land more drought resistant and what are drought and weather variation indicators, triggers, and actions effective (before, during, and after drought) that helps optimize management of sustainable working lands?

**What priority is this research question (high, medium, low) and why?**

- 416 (high) ever-present concept effecting rangelands

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local research and application
- Local and regional

**Would you expect results on this research question in the long-term (10+years), or short-term (1-2 years)?**

- Indicators, triggers, and actions could be developed in the short-term and undergo continued calculation
- Drought resistance management will require long-term research

**What level of funding would this research require, and what groups would be likely funders (university, government, NGO, private)?**

- Abundant funding sources are available with potential research ranging in scale and cost
- Shorter term - inexpensive (relatively) work on trigger and indicators (\$100-\$150k) from university, NGO, and private funding
- Longer term - more expensive work on drought resistance and optimize management of working landscapes; government, NGO, university partnerships for funding

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Issues

**Group:** Animal

**Issue:** Match production/management systems to resource

**Ranking score:** 377 on list of 15 (of big list) total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Why:
  - Optimizing resources - land, water, animals, etc.
- Who:
  - Land managers, interest groups, producers, other land users, agencies, etc.
- Benefit:
  - How:
    - Optimize, sustainability, across all identified users
  - Who:
    - Consumers, local communities, new incoming agency specialists, new producers, ranch managers

**Who might advocate for research on this issue; who are proponents of this work?**

- Environmental/conservation NGOs
- Trade associations/industry
- Decision/policy makers
- Local governments

**What kinds of research activities will best address this issue?**

- Geospatial meta analysis
- Quality control data base analysis
- Clearing house/portal successful approaches by resource/region/variable
- Case studies/also description

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- Stocking rate flexibility
- Genotype/environmental interaction
  - Breed/class/life stage, etc.
- Animal nutrition
- Case studies
- Developing indicators resource available
- Animal behavior/distribution
- Stockmanship
- Wildlife/livestock interaction
  - Ex. Feral horses

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

- Decision support
- Empower data
- Systems approach to management of resource
- Collaborative range monitoring
- Empower landowners

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Animal, match production and management systems to resource

**Research question:**

- What are the major resource characteristics that drive production system options?

**What priority is this research question (high, medium, low) and why?**

- High

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local and regional ~ localized research, extending to regional level when resource environment is large

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short and mid-term research and implementation with review and evaluation over the long term

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Short term - relatively costs increases as size and scope diverse funding organizations increase or as time extends that support working lands

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Animal, match production and management systems to resource

**Research question:**

- How do we properly match animals to the resource base?
  - Species
  - Breed
  - Class
  - Nutrition

**What priority is this research question (high, medium, low) and why?**

- High

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local and regional scales addressing specific management areas

**Would you expect results on this research question in the long-term (10+years), or short-term (1-2 years)?**

- All

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Shorter term - relatively less expensive (i.e., single landowners/experiment station)
- Longer term - relatively more expensive (or broader scale)

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Animal, match production and management systems to resource

**Research question:**

- How do we demonstrate and implement the benefits of stocking rate flexibility based on available knowledge?

**What priority is this research question (high, medium, low) and why?**

- Medium

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local application to specific resource base, extend information availability to regional scale

**Would you expect results on this research question in the long-term (10+years), or short-term (1-2 years)?**

- Principally short term, with long-term evaluation and review

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Cost can range from \$0 for willing landowner to higher costs required to reach a broader scale and influence legal policy

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Animal, match production and management to resource

**Research question:**

- How to exploit knowledge of animal behavior, distribution, and stockmanship to achieve rangeland management and production goals

**What priority is this research question (high, medium, low) and why?**

- Medium

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Localized, site-specific research producing results that can be applied to similar ecosystems regionally or even globally. Literature review would be national.

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short-term results of literature review covering “already knowns”
- Mid-to-long term for results of implemented or experimental research

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Governmental or educational organizations could provide lower funding for smaller projects or literature review.
- Larger research projects would require larger funds

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Issues

**Group:** Animal

**Issue:** Data mine, synthesis, gap analysis, effective communication of livestock impact on range

**Ranking score:** 3.26 on list of 55 total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Important to land and livestock managers to identify opportunities and research needs related to use of domestic livestock for vegetation management.

**Who might advocate for research on this issue; who are proponents of this work?**

- Livestock producers, industry organizations, agencies, conservation organizations

**What kinds of research activities will best address this issue?**

- Target synthesis and literature review intentionally targets theses, dissertations, and “gray literature”

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- What are the effects of domestic livestock (+, -, and neutral) on rangelands and associated natural resources, and how can it be used effectively?

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else that is relevant to this issue!**



## Usable Science Evaluation Worksheet - Research Questions

**Group:** Animal, data mine, synthesize, gap analysis, effective communication of livestock impact on rangelands

**Research question:**

- Is there information and data about the effects of domestic livestock (positive, negative, and neutral) on rangelands and associated natural resources and how can it be used effectively?

**What priority is this research question (high, medium, low) and why?**

- High - 1 degree peer-reviewed literature is full of grazed and ungrazed studies and after the “grazed treatment” does not represent management used by most producers

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- National

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short-term

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Relatively low cost - funding for 1-2 graduate students on 2-3 year programs
- Might be funded by universities, industry organizations, NGOs, private, or some mix

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Issues

**Group:** Socio-Econ

**Issue:** #142 How to get the right kinds of information to knowledge users in a form they can use (115)

**Ranking score:** 11 on list of 142 total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Why:
  - Tremendous amounts of knowledge are generated every day and often does not get to potential users when needed and in a usable form
- Who Benefits:
  - Industry and producer groups, universities, government entities, policy makers, NGOs, consumers
- Users:
  - Information creators and distributors

**Who might advocate for research on this issue; who are proponents of this work?**

- Extension, agencies, NGOs, and industry groups

**What kinds of research activities will best address this issue?**

- Multi-disciplinary, multi-focus research appropriate to the scale of the question! Should include an evaluation of strengths and weaknesses of extension programs and ways to build on the former while suggesting reforms to address the latter.

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- Who needs what information and what are the barriers and opportunities for information to transfer?

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Socio-econ

**Research Question:**

- Who needs what information and what are the barriers and opportunities for information transfer?

**What priority is this research question (high, medium, low) and why?**

- High
- Increasingly small proportions of population are knowledgeable about agriculture and natural resources. Information is readily available, but consumers may not be able to gauge the quality of information, and the most reliable info may not be most accessible and in useable form. As a result, people make decisions with incomplete or unreliable information.

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local, regional, national

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short to medium, up to five years

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- NCBA, SARE, EPA, energy industries, NSF, other federal agencies,
- 2 million total - 4 locations, at 0.5 million

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Issues

**Group:** Socio-econ

**Issue:** 130 Improve desirability and profitability for new generations to make a living in rangeland agriculture and associated environmental benefits (137)

**Ranking score:** 19 on list of 142 total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Why:
  - Without a continued supply of landowners and land managers, the sustainability of rangeland agriculture is at risk.
- Who benefits:
  - Conservationists, state agencies, ranchers, a public that values intensive agriculture, open space advocates, NGOs
- How they benefit:
  - Maintenance of small enterprise, community stability (social and economic)
- Who will use:
  - Community economic development and municipal services, land-grant universities, agricultural and economic agencies, individual families

**Who might advocate for research on this issue; who are proponents of this work?**

- Beneficiaries listed above, corporate agriculture, industry organizations, students
- 

**What kinds of research activities will best address this issue?**

- Multidisciplinary, multi-focus research activities (work with water group to explore opportunities to restore “go back land” as an incubator for new ranch managers)

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- What are the barriers and opportunities for new people to enter and persist in rangeland occupations and how can we use that info to increase numbers of adults who choose such careers?

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Socio-economic

**Research question:**

- What are the barriers and opportunities for new people to enter and persist in rangeland occupations and how can we use that info to increase numbers of adults who choose such careers?

**What priority is this research question (high, medium, low) and why?**

- Very high. Without a future generation of operators and processors, agricultural production will shift to other regions and nations

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- National, by study region

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short to mid-term for research
- Long-term for implementation

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Could be millions

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Issues

**Group:** Socio-econ

**Issue:** 132 Understanding and managing for variability (climate, drought, fire), adaptation and recovery (118, 111, and 136)

**Ranking Score:** 1 on list of 142 total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Why:
  - Increasing environmental variability, market unpredictability, and demographic change
- To whom:
  - Everyone at every scale (individual landowner to global)
- Who benefits:
  - Everyone benefits, but different products will benefit different audiences at difference scales
- How:
  - Policy makers from policy decisions, livestock managers from ranch-level models, community leaders from adaptive government entities

**Who might advocate for research on this issue; who are proponents of this work?**

- Advocates and proponents - land managers, communities (fire department, municipal and utility services), community to regional scale planning and development, state and federal agencies, natural resource researchers, industry-related entities (e.g., oil and gas), global NGOs, and marketers

**What kinds of research activities will best address this issue?**

- Multi-disciplinary, multi-focused research appropriate to the scale of the question (work with animal and water groups on drought)

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- How do rural communities best adapt to/recover from environmental and socioeconomic variability?

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Socio-econ

**Research question:**

- How do rural communities best prepare for, adapt to, and/or recover from impacts of increased environmental and socioeconomic variability?

**What priority is this research question (high, medium, low) and why?**

- High, because the world is changing in ways that have no prior models for comparison, and the people who live here have no family knowledge to draw upon

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Regional and up, research will be conducted and applied at a local level and be aggregated at national level

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- The problem is not static, so there will be short-term results along with long-term results from longitudinal studies

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- A million dollars per community per three years for five locations, five million in total
- USDA, NSF, NIH, private industries, NASA, EPA star grants

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## Usable Science Evaluation Worksheet - Issues

**Group:** Socio-econ

**Issue:** 123 Understand and create incentives for improving land stewardship across boundaries (geographic and political); water, invasives, wildlife (special status species), fire 131 and 135

**Ranking score:** 10 on list of 142 total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Why:
  - Issues such as invasive species, water, wildlife, and fire need to be applied at scales larger than individual properties and jurisdictional entities; productive capacity can be increased.
- Who benefits:
  - Community level benefits
- Who uses:
  - Community entities, NGOs, individual landowners

**Who might advocate for research on this issue; who are proponents of this work?**

- Beneficiaries as described above

**What kinds of research activities will best address this issue?**

- 127, 131, and 135. Multidisciplinary, multi-focused research appropriate to scale

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- What motivates landowners to cooperate across boundaries for environmental stewardship and how do we use that information to create and/or improve incentives?

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**



## Usable Science Evaluation Worksheet - Research Questions

**Group:** Socio-econ

**Research question:**

- What motivates landowners to cooperate across boundaries for environmental stewardship and how do we use that information to create and/or improve incentives and reduce disincentives?

**What priority is this research question (high, medium, low) and why?**

- High, resource problems increasingly cross jurisdictional and property boundaries. Impact of actions on one property often affect conservation or production on adjacent properties. Land ownership is becoming increasingly fragmented.

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Watershed and ecosystem

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short-term in identifying motivations, mid-term to devise, test and implement incentive programs

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Phase 1 - \$300,000 - testing and development
- Phase 2 - \$7.5 million - implementation
  - Foundations focused on conservation, NGOs, USDA farm programs, CIG grants

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Water

**Research question:**

- Restoration of abandoned cropland

**What priority is this research question (high, medium, low) and why?**

- High - feedback loop with drought and aquifer depletion competing uses of water

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local to regional

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Midterm - due to potential soil loss and severity of rehab need. Use last of the irrigated water to reestablish rangeland plants - level of compensation (level)?

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- USDA, NRCS, ARS, NIFA
- Seed cost, private funding, Monsanto
- Tie it to climate change
- CRP? Not a research question
  - \$600 million
- Diverse native?
- Plot level research \$10 million three regions

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

- Prioritizing native species compared to invasive/exotic species

## Usable Science Evaluation Worksheet - Issues

**Group:** Soil

**Issue:** Relevance of soil survey ESD

**Ranking score:** 2 on list of 14 total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- To complete data sets and fill in missing information
  - NRCS
  - Extension service
  - Public land managers
  - Private individual managers

**Who might advocate for research on this issue; who are proponents of this work?**

- Those in areas without soil surveys north and west part of the states
- Those that haven't had surveys updated
- NRCS and other extension services/consultants

**What kinds of research activities will best address this issue?**

- Many parts of the country have not been identified; make sure all current research is accurate.
- Potential for remote sensing

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- Can we more efficiently use "conduct more" existing research?

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

## Usable Science Evaluation Worksheet - Issues

**Group:** Soil

**Issue:** Soil mitigation: prescribed fire vs. wildfire

**Ranking score:** 3 on list of 14 total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- To educate those against it and prevent wildfires that occur due to fuel build up. To reduce smoke (which is less from prescribed).
- Land/fire managers
- Forest Service and BLM
- Public
- Policy makers who can explain reduced heat, smoke, soil movement, and carbon effects

**Who might advocate for research on this issue; who are proponents of this work?**

- Extension services/consultants
- Conservation groups trying to mitigate wildfires
- Policy makers
- Forest Service/BLM
- Public

**What kinds of research activities will best address this issue?**

- Accumulated brush piles and effects of burning
- Compare and contrast the effects of prescribed fire and wildfire on soil
- How do you dispose of excess vegetation after removal (burning of brush piles) without destroying soil underneath

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- Soil carbon responses to prescribed fire (Timing, intensity, etc., characteristics that affect it)
- Compare and contrast the effects of prescribed fire and wildfire on soil
- How do you dispose of excess vegetation after removal (burning of brush piles) without destroying soil underneath

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestion please feel free to add anything else relevant to this issue!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soil

**Research question:**

- Spatial analysis and determination of efficiency of soil sampling for soil health to identify indicators

**What priority is this research question (high, medium, low) and why?**

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soil

**Research question:**

- Synthesis paper on soil responses to land management \*soil microbiology is an unknown\*

**What priority is this research question (high, medium, low) and why?**

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soil

**Research question:**

- Characterization of soil health indicators

**What priority is this research question (high, medium, low) and why?**

- High, in order to make the best use of the land

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local and regional

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short-medium term on pre-examined soils
- Long-term on areas that do not currently have ESDs

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- NRCS
- NRI
- ESD development
- Network platforms
  - NEON
  - LTAR
  - LTER

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soil

**Research question:**

- What are the attributes (indicators) of soil health, can we detect different levels of importance that vary among states within the ecological sites?

**What priority is this research question (high, medium, low) and why?**

- High
- Land management decisions
- Placement of conservation practices
- Efficiency in gathering pertinent information on soil health

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local and regional
- Would be completed on a national level, but the study would focus on the differences between regions and ESD states.

**Would you expect results on this research question in the long-term (10+years), or short-term (1-2 years)?**

- Regional differences = mid-term (3-5)
- Collection of attributes = short to mid-term identifying MLRAs with soil differences (start with ESDs)
- Measuring thresholds and monitoring changes = long-term

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- NIFA
- Innovation grants
- NRCS
- NGO
- Private

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soil

**Research question:**

- What are the sensitivity levels (of each indicate) that affect threshold changes and what management practices influence the indicators in a cost-effective positive or negative way?

**What priority is this research question (high, medium, low) and why?**

- High

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local and regional, but more local

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Long-term and mid-term
- Mid-long term based on existing knowledge of and history of sites

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- NIFA
- NSF
- Gates Foundation
- GLCI-advocate
- SRR

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soil

**Research question:**

- Completion and updates of soil surveys

**What priority is this research question (high, medium, low) and why?**

- High
- There are areas that don't currently have soil surveys/ESDs

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Regional
- Northwest U.S.

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short and mid-term

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- In-house NRCS

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soil

**Research question:**

- What are the soil responses to vegetation treatment disposal? Effects of various ignition methods on post-woody plant material on soils (piling vs. standing vs. scattered burning)

**What priority is this research question (high, medium, low) and why?**

- Medium and low

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short - mid-term
  - If info is out there a compilation paper could be done

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- University

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soils

**Research question:**

- What are the soil nutrient responses to prescribed fire? (in terms of seasonality, regional aspects, and frequency) \*Synthesize what has been done

**What priority is this research question (high, medium, low) and why?**

- High - in Great Plains

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local and regional
- Eastern Tallgrass Prairie

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short-term if we utilize areas that have been burned

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Forest Service
- University
- Government
- NGO
- Private

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soil

**Research question:**

- Influence a wildfire has on soil nutrients as compared to non-fire (and later prescribed fire) (look at intensity of wildfire)

**What priority is this research question (high, medium, low) and why?**

- High

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local - individual fires

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short-term
  - Use existing burned sites

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Joint Science/Fire Program (JFS)
- NIFA
- BLM/Forest Service
- Foundations
- D.O.D.

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Soils

**Research question:**

- Synthesis of current research that identifies soil responses to range management practices and effects on climate change

**What priority is this research question (high, medium, low) and why?**

- High

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Regional and national

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short-term

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- University
- Agency specific

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## Usable Science Evaluation Worksheet - Issues

**Group:** Vegetation

**Issue:** Develop landscape perspective for rangeland conservation and management

**Ranking score:** \_\_\_\_\_ on list of \_\_\_\_\_ total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Importance:
  - The scale of the science is matched to the scale of the question
- Whom:
  - Impacts all stakeholders in rangeland management

**Who might advocate for research on this issue; who are proponents of this work?**

- Proponents:
  - Federal land agencies, The Natural Conservancy
- Work to get broad groups of private landowners

**What kinds of research activities will best address this issue?**

- Algorithms for scale
- Role of spatial pattern
- Edge effects
- Patch dynamics (shape, size)
- How animals use landscapes
  - How humans use landscapes

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- How do you have agriculture and wildlife habitat on the landscape?
- How do you get groups of landowners to come together to do landscape-level projects?

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Vegetation

**Research question:**

- Determine resilience of rangeland landscapes to extreme events such as fire, drought, flooding, invasives, etc.

**What priority is this research question (high, medium, low) and why?**

- High priority
  - Economic necessity
  - Limited funding and threats to rangeland suggest to focusing to priorities
  - Health-related factors
    - Human

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local to regional

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Results expected at all levels

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Depending on project, all levels of funding could be required university, government, NGO, and private funders.

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**



## Usable Science Evaluation Worksheet - Research Questions

**Group:** Vegetation

**Research Question:**

- Understanding the motivations of different groups in order to implement landscape level planning

**What priority is this research question (high, medium, low) and why?**

- High
  - Implementation
  - Understand goals for success

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- All spatial scales

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Results in all categories

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- All levels of funding
- All groups would be funders

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else that is relevant to this question!**

- How do you develop a landscape plan??

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Vegetation

**Research question:**

- How do you have agriculture and wildlife habitat on the same landscape?

**What priority is this research question (high, medium, low) and why?**

- High
  - It is a question that everyone has
  - Integrates across disciplines
  - Economic diversification
  - Indicator

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local to regional

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Yes, expect results in all these categories

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Multiple sources of funding and funders
- Government, NGO, private
- (\$100,000-millions for funding)

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Vegetation

**Research question:**

- What are the effects of spatial pattern of plant communities and soils on livestock production, wildlife habitat, water quality, etc.?

**What priority is this research question (high, medium, low) and why?**

- High
  - Core data layer
  - Fundamental question for agencies

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local to regional

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- All, would expect results in all categories

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Multiple sources of funding and funders
- Government, NGO, private

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Vegetation

**Research question:**

- Understanding the role of variability of space and time in rangelands

**What priority is this research question (high, medium, low) and why?**

- High
  - Fundamental to managing variability in space and time

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- All spatial scales

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Results at all levels

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- Not likely to get much private funding (might need private participation)
- High level of funding

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## Usable Science Evaluation Worksheet - Research Questions

**Group:** Vegetation

**Research question:**

- Develop monitoring concepts for a landscape perspective

**What priority is this research question (high, medium, low) and why?**

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Vegetation

**Research question:**

- Determine the effects of invading native and exotic species on ecosystem services

**What priority is this research question (high, medium, low) and why?**

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Issues

(Spans all groups)

**Group:** Water

**Issue:** #22 transfer of knowledge to land managers; #23 increase support of rangeland programs and extension; #10 harmony: community-based conservation vs. commodity-based conservation

**Ranking score:** \_\_\_\_\_ on list of \_\_\_\_\_ total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

**Who might advocate for research on this issue; who are proponents of this work?**

**What kinds of research activities will best address this issue?**

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

## Usable Science Evaluation Worksheet - Issues

**Group:** Water

**Issue:** Drought

**Ranking score:** \_\_\_\_\_ on list of \_\_\_\_\_ total items (#132, #78, #1, #8, #25)

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Rangeland is characterized by drought
- Anyone making decisions: the governor, land management agencies, land managers, Secretary of Agriculture, climate service providers, water utilities, irrigation districts

**Who might advocate for research on this issue; who are proponents of this work?**

- State climatologists - anyone interested in drought predictions
- Ag producers/ranchers
- Ag economists
- Commodities - buyers/sellers - markets
- Agencies: state and national legislators

**What kinds of research activities will best address this issue?**

- Drought economics
- Stability, resilience, thresholds

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- Better predictive tools
- Better monitoring tools
- Better technology (applies to monitoring, prediction, preparedness)
- How to build adaptability to long-term drought (plants, animals, humans, economics)
- Resilience questions
- Community self-organization to respond to drought
- And institutional

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**



## Usable Science Evaluation Worksheet - Research Questions

**Group:** Water

**Research question:** Drought - better monitoring tools, prediction tools - better technology (applies to monitoring, prediction, and preparedness)

**What priority is this research question (high, medium, low) and why?**

- High - pressing issue across the West and Great Plains; visibility and pervasiveness of drought impacts

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local, state, regional
- Basin - water supply (national, international)

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Short-term - tool development (e.g., remote sensing)
- Mid-term - testing the tool; interface
- Long-term - extending to users

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- NIFA funds it now (RFA NIWQP)
- \$660K for 3-5 year project total \$4.5 million
- NIFA, AFRI water for agriculture, \$6 million in FY14
- NSF-NIFA water; NOAA
- Google Drought; large cities and states

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Water

**Research question:** Drought - building adaptive capacity and resilience, how to build adaptability to long-term droughts? (Plant, animal, communities, stakeholders, economics)

**What priority is this research question (high, medium, low) and why?**

- High - pressing issue across the West and Great Plains, visibility and pervasiveness of drought impacts

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- All scales
- Also link these scales (cross-scale dynamics)
  - Example: stream gauges across basins that cross borders down-scaling of models loses dependability

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Medium
- Long-term

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- \$20 million over 3-year period, NIFA
- \$6 million per year, \$750k/project
- ARS - climate hubs, LTAR, plant materials, arid land research (Maricope)
- NGOs
- Business - seed companies

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

## Usable Science Evaluation Worksheet - Issues

**Group:** Water

**Issue:** Proactive watershed management and protection of high-quality rangeland watersheds

**Ranking score:** 6 on list of 142 total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Municipalities, water utilities, water foundations, The Nature Conservancy, anyone who wants intact environments, big ranch/keep it as a park, sportsmen, general public, conservation groups, bird watchers

**Who might advocate for research on this issue; who are proponents of this work?**

- Municipalities, water utilities, water foundations, The Nature Conservancy, anyone who wants intact environments, big ranch/keep it as a park, sportsmen, general public, conservation groups, bird watchers
- Soil conservation districts and state associations, federal agencies

**What kinds of research activities will best address this issue?**

- Policy, geography, acres, subsurface, sensitive areas
- Geologic mapping, LIDAR
- Community-based watershed management, conservation easements and their ease of implementation

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

- Hydrology question - water budget and brush conversion/water productive questions

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

- Includes issues with vegetation management (brush conversion)

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Water

**Research question:** We need to understand rangeland water budgets

**What priority is this research question (high, medium, low) and why?**

- High - climate change is a drought driver

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Watershed - local to regional

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Mid-term - models can be short-term e.g. century model; validation is mid-term?

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- \$3 million per project for 3 years; 4 projects
- NSF, NOAA, USDA-NIFA, USGS, DOE, EPA, USFWS, GB LLC, NASA

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

- Includes issues with vegetation management (e.g., brush conversion) and hydrogeology

## Usable Science Evaluation Worksheet - Issues

**Group:** Water

**Issue:** how to productively move cropland to rangeland

**Ranking score:** 3.06 on list of 142 total items

**Why is this issue important and to whom? Who will benefit and how, from creating knowledge to address this issue? To whom will products be usable (if it will indeed be usable)?**

- Any farmed cropland on marginal landscapes - farmers and ranchers among the Southern Plains states and West; safety and human health issue (dust)
- Benefits: general public, landowners, maintain some productivity

**Who might advocate for research on this issue; who are proponents of this work?**

- American Lung Association, EPA, State Environmental, USFWS for habitat regions

**What kinds of research activities will best address this issue?**

- Restoration ecology, wind erosion and soil surface stabilization, public awareness with outreach, wind breaks/plant materials
- Restoring subsoil/sand/degraded soils

**What research question(s) will best address this issue? (Create one research worksheet per research question)**

**This is not necessarily an exhaustive list of questions prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this issue!**

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Water

**Research question:** Restoration of abandoned cropland

**What priority is this research question (high, medium, low) and why?**

- High - feedback loop with drought and aquifer depletion - competing uses of water

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Local, regional

**Would you expect results on this research question in the long-term (10+years), or short-term (1-2 years)?**

- Mid-term - due to potential soil loss and severity of rehabilitation need. Use last of the irrigation water to re-establish rangeland plants - level of compensation (level?)

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- USDA-NRCS, ARS, NIFA, seed companies, private funding, Monsanto
- Tie it to climate change
- CRP? Not a research question
- \$6 million
- Diverse native? Plot level research \$10 million 3 regions

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

- Prioritizing native species compared to invasive/exotics

## Usable Science Evaluation Worksheet - Research Questions

**Group:** Water

**Research question:** Cost/benefit analysis - what are the costs to society of restoring a forage crop? Or not?

**What priority is this research question (high, medium, low) and why?**

- Fundamental analysis - should we do the research?
- Regionally driven - high-medium

**What is the spatial scale (local, regional, national, international) needed to address this research question?**

- Dust is international
- But in U.S. local, regional

**Would you expect results on this research question in the long-term (10+ years), or short-term (1-2 years)?**

- Turn it out in 1-2 years
- Need a probability distribution - maybe longer
- Go back land in Oklahoma is about 20 million acres, so the issue is relevant today! Has to be a new owner.

**What level of funding would this research require and what groups would be likely funders (university, government, NGO, private)?**

- \$5 million native vs. exotics? Will relate to economics
- New farmer cover crops or rancher program incremental planning
- USDA-ERS, RMA, NIFA, BLM, USFS, congressional,
- Landowners to do it themselves (part farm bill priority of equipment)
- Change owner and subsidize new start with livestock given a deed restriction

**This is not necessarily an exhaustive list of question prompting information the group may have additional observations and suggestions please feel free to add anything else relevant to this question!**

- Sedimentation leading to downstream hypoxia
- Policy analysis about conservation programs and crop insurance (why are they farming there?)
- Effect of water supply with dust on snow - Southwest
- Present generation is subsidizing disaster of the next generation?
- What does it take to move policy analysis to a change on the land?