# Transdisciplinary research in practice: lessons from participatory, folklore and community-supported approaches in the greater American West

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## Abstract

Rapid social and ecological changes on global rangelands amplify the challenges to achieving biodiversity conservation, rural economic viability and social well-being, and rangeland sustainability. These dynamics create a need for transdisciplinary science that is inclusive of ecological, sociological, and participatory approaches in order to rebuild meaningful working relationships between scientists, ranchers and managers, and other rangeland stakeholders. In real application, however, transdisciplinary science faces numerous social, ethical, and logistical challenges, including the question of how the work might benefit rangeland stakeholders. Our objective is to advance rangeland researchers' toolbox for meaningful engaged research by describing three lessons from transdisciplinary projects in the rangeland contexts of the United States. These include the need for 1) ranch-scale, long-term participatory management experiments; 2) folklore and oral history methods and 3) community-supported social-ecological research that creates credible science that can be communicated out to non-ranching decision-makers. These examples illustrate the nuances of transdisciplinary research, reciprocity, and useable knowledge creation in complex rangeland social-ecological contexts.

## Introduction

Producing food in ways that sustains biodiversity and quality of life is a complex challenge that requires tools for transdisciplinary knowledge development and exchange. Rangeland-based livestock (largely cow-calf, yearling, sheep, and bison) production systems in the US West have the potential to help sustain biodiversity while supporting rural communities and food systems across the region. However, managers here are challenged by multiple, interacting drivers of change stemming from climatic, ecological, social, and economic systems. Rangeland scientists and managers are increasingly recognizing the value of transdisciplinary collaborations, inclusive of ecological, sociological and local knowledges, to successful solution-oriented science. Such efforts depend upon methods that effectively engage and value our partners' knowledge and management contexts. This paper expands working land researchers' toolbox for meaningful, engaged research by describing lessons from three approaches (Table 1): 1) ranch-scale, long-term participatory management experiments; 2) folklore and oral history methods; and 3) community-supported social-ecological research. These approaches represent tools that encompass or can be used within larger transdisciplinary projects. Drawing from our experiences, we summarize potential applications, benefits, and limitations of these approaches to inform future projects and partnerships across rangelands and agroecosystems generally.

## Three tools for transdisciplinary engagement in rangelands
### Ranch-scale, long-term participatory rangeland management experiments

Our first approach is participatory research conducted at large spatial and long temporal scales. On the semi-arid shortgrass steppe ecosystem of eastern Colorado, USA, the USDA-Agricultural Research Service (ARS) Central Plains Experimental Range (CPER) is a ~6,000 ha research station which has traditionally produced research to inform ranch, conservation, and USDA-Forest Service managers, especially on the nearby Pawnee National Grassland. Here, a ten year, ranch scale (2,600 ha) participatory grazing experiment brings researchers and agriculture producers, conservation interests, public agency professionals, and outreach experts together to advance our knowledge of trade-offs and synergies among beef profitability, drought resilience, biodiversity, and social learning objectives. The Collaborative Adaptive Rangeland Management (CARM) experiment tests the hypothesis that a collaborative team can use experimental data together with local and professional knowledge to manage a herd of yearlings on 10, 130 ha paddocks for multifunctional outcomes more effectively than those realized by a second herd of (the same number) yearlings grazing 10 ecologically paired paddocks in a system similar to the local "business as usual" season-long, continuous

grazing system (Wilmer et al., 2018). Cattle graze during the growing season (mid-May through October), and participants make decisions about the project objectives, cattle stocking rates and grazing systems, and use of prescribed fire. As part of a larger-scale network of research sites in the USDA- ARS Long-Term Agroecological Research (LTAR) network, CARM management practices and outcomes are monitored extensively at multiple scales by an interdisciplinary group of rangeland, animal science, social science, hydrology, modelling, and economics researchers.

While results of the first eight have been reported elsewhere (Augustine et al., 2020), the "CARM team" has recognized key qualities of the project that enhance the effectiveness of the collaboration. First, the project takes place in the local ecosystem near, and in partnership with, working ranches and land managers. This enables immediate relevance to private and public land managers. Second, unlike many plot-scale experiments, CARM operates at the ranch scale, and thus better reflects the decision-making context of real-life management. Critically, the project includes a ranch-scale control ("business as usual") treatment, which enhances analytic power and enables the team to interpret treatment and weather effects. The decade-long time frame enables sufficient time for treatment effects, learning, relationships, and variable weather patterns to emerge. The timeframe also demonstrates commitment to partner groups and individual participants. Limitations of this approach include the logistical complexities, expense, time commitment and complexity, which require additional interdisciplinary collaboration.

Table 1: Three tools to enhance transdisciplinary approaches in ranching and rangeland-based contexts.

|  | Ranch-scale, long-term experiments | Oral history | Community-based social-ecological research |
|---|---|---|---|
| **Case location or ecosystem** | Shortgrass steppe | Western US rangeland-based communities (Carr Childers, 2013) | Ecotone between mixed-grass prairie and sagebrush steppe |
| **Management challenges** | Sustainable ranch management for multifunctional goals | Ranching community vitality, knowledge transfer, and public perceptions of rural peoples | Resilience to weather/climate, conservation, social, economic challenges |
| **Key qualities to enhance engagement** | Experiments conducted at spatial and temporal scales relevant to real-life management; control treatments enhance analytical power | Format honors rural cultures and traditions, documents individual history and place-based ecological knowledge | Collaborative research question identification, cross-checking, outward-facing science, and quantification |
| **Methods considerations** | Requires time and funding commitments, and access to large experimental stations or ranches may be needed. | Digital, travel and transcription funds needed. Historians can collaborate with local museums. | Community trust, consent, and participation require ongoing negotiation. Build in reciprocity. |
| **Pairs well with** | Long-term experimental projects, University Extension efforts, network-scale science | Science synthesis and digital outreach programs | Efforts to manage across multiple land tenures and/or worldviews (e.g. management of public lands grazed by private ranchers) |

### *Folklore and oral history methods*

In ranching and rural communities, oral storytelling is an important form of cultural reproduction, meaning-making, and identity formation. A second tool, oral history, engages the humanities in a novel approach to respecting and integrating local managers' experiences on the land, and ecological and business knowledge into the broader body of knowledge informing rural community and rangeland sustainability. A model for this approach is found in the Nevada Test Site Oral History Project at the University of Nevada, Las Vegas. Between 2003 and 2008, historians collected the oral histories of those involved with and affected by the nation's nuclear testing program. Simply put, "oral history collects memories and personal commentaries of historical significance through recorded interviews" (Ritchie, 2015). Oral history can be used in communication and collaboration with rangeland science synthesis, co-production, or ranch-based projects to improve communication, learning, and place-making.

Funded by the US Department of Energy, the project initially captured the institutional knowledge of how nuclear testing evolved between 1945 and 1992. However, project director Mary Palevsky expanded its

scope to include those living in the rural areas surrounding the test site, particularly ranchers. Though located on the geographic and intellectual periphery of the project, these interviewees became central to understanding the changes nuclear testing wrought on the land and in the lives of those living in proximity to the text site. They also demonstrated how science and safety communication about nuclear testing was predicated on the creation of relationships with radiation monitors sent to these areas (Carr Childers, 2013). The shared authority model inherent in oral history production creates buy-in from community members by elevating work of non-scholars. In the participatory framework of shared authority, oral historians work *with* narrators to produce interviews rather than producing them *for* the communities in which narrators live (Frisch, 1990). The difference between *producing with* and *producing for* is the difference between giving and taking.

In recent years rangeland science has increasingly recognized the inextricable links between social and ecological processes (Hruska et al. 2017). Oral histories help round out the stories of the past by augmenting documentary and photographic records with unwritten recollections. They also reveal how individuals and communities have experienced the forces of history, particularly in the case of the less formally educated and less powerful, and how the past links to the present. However, it is important to remember that oral history interviews reflect individual perspectives, are predicated on the conversation between the interviewer and the interviewee and are grounded in the moment in time in which they are collected. For oral history interviews conducted with rancher narrators, it is critical to include those whose multi-generational ranching families have operated on the land over a long period of time to garner the depth of knowledge and connection they have to ecosystems and landscapes.

### Community-supported social-ecological research

Our third example comes from the Thunder Basin Ecoregion of northeastern Wyoming, an ecotone, or ecological boundary zone, between grasslands of the Great Plains and shrublands of the Intermountain West. Here, various interest groups pursue ranching, conservation, energy development, and other land use goals. The Thunder Basin Grasslands Prairie Ecosystem Association (TBGPEA), a landowner-led non-profit organization, has worked for 20 years to "Develop a responsible, common sense, science-based approach to landscape management within the five northeast Wyoming counties." Under this mission, TBGPEA collaborates with researchers to solve problems related to ecology, climate, grazing, wildlife conservation, economics, and social science.

The collaborative effort uses several key methods. The first is co-design. TBGPEA collaborates with researchers and other partners to identify research questions and approaches. Transforming real-world problems into research projects is difficult, and substantial front-end effort is needed to ensure that the results of a research project will feed back into relevant results that help solve the problem on the ground. Second, we use cross-checking, or regular interaction among partners. This ensures research results can be continually evaluated against local knowledge of the social-ecological system. When results don't match up, a key approach is to give equal weight to scientific and local knowledge. This leads to fruitful discussions around why discrepancies might exist, and what additional information might be needed to resolve or explain differing findings (multiple truths, Cote and Nightingale, 2012). This approach contrasts with a typical manager-scientist dynamic in which each group regularly assumes that their understanding of the system is "more correct". Sometimes, discrepancies cannot be resolved. More often than not, however, these discussions lead to additional investigations or analyses that produce a deeper or more complete understanding of the system.

Third, we enhance the benefit to the community by producing outward-facing science that communicates local knowledge to the outside world in a credible, objective format. As stated above, research results do not always match up perfectly with local knowledge. However, in many cases research winds up saying with scientific confidence what many people already knew to be true. In these cases, research can help the community by creating peer-reviewed, scientifically acceptable literature that supports local understanding of how things work. Fourth, science can help solve problems by quantifying trade-offs or synergies within the system (Duchartdt et al. 2019). For example, science can help people move from statements such as "prairie dogs reduce livestock weight gains" to "prairie dogs reduce livestock weight gains by X%, corresponding to a reduction of ranch revenues by \$Y". The latter statement opens up avenues for action (e.g., payment for ecosystem services) that are not available without quantification of the problem. Quantification can benefit the local community and also act to reduce conflict by clarifying the costs and

benefits of different approaches. Community-supported social-ecological research hinges on researchers' ability to prioritize community relevance over scientific impact. Managers, in turn, can expect to sacrifice some real-world complexity due to the constraints of research study design. All partners benefit from recognizing that scientific findings will not always support the community's worldview, preferred management style, or policy agenda. All partners need to go into the work with the clear-eyed recognition that results are unknown and research is held to high ethical standards.

## Discussion

Rangeland-based food systems are unique places where many types of land users, forms of biodiversity, and complexity interact. It is thus appropriate that rangeland researchers and stewards seek creative and boundary-spanning methods for engagement, knowledge production, and social learning. Above we describe specific approaches to conducting scholarship with communities in order to offer researchers, ranchers, and other practitioners tools to advance transdisciplinary solutions to sustainability problems, to better understand one another, and to respond to real management contexts. There are several limitations of the tools, including that they may be more time, resource, and emotionally demanding than conventional ecological or grazing research. Additionally, they require additional thinking about ethics, risks to participants, and benefits to communities. However, our experiences suggest that key aspects of the tools are especially helpful, including that they engage deeply with communities and practitioners with cultural competency, and in forms and spatial and timescales that matter to specific historical, cultural, and place-based contexts. As researchers increasingly recognize the importance of engaging practitioners and communities in our work, it is also important that we integrate a methodological consideration of culture, place, and process in our methods.

## Acknowledgements

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