



# Infusing ‘*long-term*’ into social science rangelands research

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## On the Ground

- Social science rangelands research has advanced substantively in the last few decades as a multidisciplinary endeavor, and notably through increased capacity to integrate with ecologically centered approaches.
- The diversity of social science-related contributions to rangelands research continues to expand with both breadth and depth of approaches, perspectives, and backgrounds of participating scholars.
- The USDA Long-term Agroecosystem Research (LTAR) Network advances a unique long-term and large-scale effort to incorporate social science research into a long-term “common experiment” across multiple sites within varied rangelands contexts of the United States.

**Keywords:** social science rangelands research, Long-term Agroecosystem Research (LTAR) network.

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During the 20th century, the natural resource sciences increased awareness of and acknowledged connectedness between human and ecological systems. Now a more widely accepted and developed concept, we tend to view environmental problems as often having more complexity, rather than in isolation from the social and economic settings in which they occur.<sup>1</sup> Increasingly, research focuses on changes in the interrelationships among ecosystems and human well-being.<sup>2</sup> Changes in one part of a social-ecological system have repercussions on other parts of the system, creating continual feedback loops<sup>3</sup> with the potential for unintended consequences to both human well-being and ecosystems.

Similarly, the rangelands research community has continued to increase scientific attention toward the connectedness of human and ecological systems, and therefore, sought to ad-

dress the complex social-ecological issues facing rangelands.<sup>4</sup> This special issue, prompted from an agency-sponsored symposium at the 2020 annual meeting of the Society for Range Management, highlights selected contemporary convergence and advancements of that activity. Within this introductory paper, we highlight historical context to this trend as well as a set of current examples related to multiple scales and support occurring within the USDA Agricultural Research Service (ARS) Long-Term Agroecosystem Research (LTAR) network.

## Historical context

To introduce the spectrum of social science rangelands research, we illustrate what it means to analyze human interaction about rangelands, primarily focused on, but not exclusive to North American contexts. Here, we define social science as the study of human relationships. Related, we broadly emphasize concepts of social well-being, defined here as a construct to indicate communion, justice, tolerance, communication, and collective action among groups.<sup>5</sup> In this context, social science rangelands research focuses on how social relations manifest in the rangelands we study.

Early domestic social science rangelands research often had a strong economic emphasis. Some of the earliest economic research related to rangelands included recognizing the “common pool” aspects of the early open range and the resulting resource degradation. This research included the development of policy recommendations related to publicly owned rangelands to address these issues.<sup>6</sup> Early economic efforts, however, also identified critical issues and complexities of rangelands management. These included the low productivity of rangelands and the associated private and social costs of distance and space, high risk, and land tenure including private use of public lands. This early social science rangelands research resulted in differing management objectives, provision of public goods including habitat and feed for wildlife and game animals, and erosion and water quality effects.<sup>7</sup> Despite recognizing these multiple, complex rangelands management issues, early economic research often focused on the costs and production benefits of rangelands improvements,

targeting the issues of low productivity and remediating damages that had occurred with previous management.<sup>8</sup> Regarding rangelands production systems, economic research has advanced the development and use of analytical methods to further understand the complexities of human and economic systems relating to rangelands management.

Other range economics topics have analyzed how to assess the evolving breadth of ranch values in order to consider consumptive amenities, why grazing permits (not always the livestock) add value to ranches, economic effects of expected increases to precipitation variability, and more recently, long-term effects associated with declines in public grazing permits.<sup>9-10</sup> These studies often analyzed net returns and economic utility for ranches, yet also revealed a pattern that economic models do not always fully explain observed behavior. Recognition of these limitations led to the elaboration of ongoing economic analyses that begin to integrate broader theoretical concepts.<sup>11</sup>

Further advances to social science rangelands research incorporated social science theories including producers' motivations and perceptions to shape the adoption of new management practices and contributed to general theories about diffusion of innovation<sup>12</sup> and planned behavior.<sup>13-14</sup> Related, Didier and Brunson<sup>15</sup> applied innovation adoption theory to ranching research and outreach, using range livestock producers' perceptions to integrate novel components into the theoretical framework. Their work highlighted the role of ranch spatial factors and political-legal constraints as barriers to adopting ranch management innovations. An analysis by Gosnell et al.<sup>16</sup> documented effects from land ownership changes, capturing shifts in traditional rangelands uses associated with human migration hotspots of the West. Reid et al.<sup>17</sup> provided contemporary evidence of how community-based pastoralist systems can move rangelands management toward social well-being objectives. Wardropper et al.<sup>18</sup> have demonstrated how climate services can assist in ranch-based decision-making, especially under co-production of knowledge contexts. And Fanok et al.<sup>19</sup> demonstrated rangelands stakeholders may organize for managing drought resilience through social connections and cohesion.

Collectively, these studies advanced knowledge that agency personnel, program planners, Extension, and other stakeholders can use to increase adoption of management innovations and program participation, such as with conservation easements or cost-share programs. In addition to these advances to social science rangelands research, integrated approaches have begun to further address the needs of all, especially historically underserved communities, as well as those who represent an array of operations in the supply chain contributing to service delivery for all individuals, communities, and societies who depend on rangelands.<sup>20</sup>

### Advancing into social-ecological contexts

Social-ecological approaches in rangelands systems encompass vibrant cultures, address cases of politically marginalized societies, and imperiled hotspots of global biodiversity.<sup>21</sup>

With the social sciences gaining more standing in the analyses of complex social-ecological systems, "[t]here is an opportunity to more fully integrate and centrally locate the social science into the more holistic study of rangelands" (p. 181).<sup>20</sup> Social-ecological rangelands research continues to evolve and integrate how social factors—such as culture, well-being, and multiple ways of knowing—influence management decisions.<sup>22</sup> Furthermore, Bruno et al.<sup>20</sup> reviewed indexed journal articles using a systematic mapping approach and highlighted the dominant focus to date of social science rangelands research in North America on ranchers. This work identifies an opportunity to engage more diverse rangelands communities and stakeholders, as the research directions continue to expand and advance.<sup>20</sup> As rangelands science engages more stakeholders, we posit that the significance of such social factors (e.g., culture and power) and social identities (e.g., race, gender, and sexual orientation) on management decisions will come into greater focus.<sup>23-24</sup>

### Contemporary approaches in social science rangelands research

As our study populations diversify and inquiry expands to include socio-cultural factors, social science rangelands research will continue to expand intersections with related disciplines focused on human-environment interactions, including human ecology, human geography, and political ecology. Previous research has added diverse value to approaches in how we conceptualize the community of scholars in social science rangelands research.<sup>25-28</sup> As social science rangelands research delves deeper and wider into examining complexities of rangelands social processes, it also engages underrepresented groups. This proposed shift will position scholars to increasingly contend with systemic issues, such as climate change and inequity.<sup>29</sup> Further, these issues often occur at large scales, can have transboundary effects, and may remain chronic over spatiotemporal scales.<sup>30</sup>

Given earlier eras of rangelands science did not focus on social structures and challenges within human communities, per se, core social science concepts such as trends in demographic diversity, inequity in access, and conflict between groups, remain fruitful, intellectual, and practical challenges for the social-ecology of rangelands. Recent scholarly review of the field also highlights the need to continue support of a broader array of epistemological approaches.<sup>20</sup> For example, existing Indigenous voices in the field<sup>31</sup> remain arguably underrepresented in our attempts to describe these trends and how they apply to rangelands research. Enabling support for diverse and alternative approaches creates engagement opportunities often still lacking even when we have attempted social-ecological integration in natural resources research, including rangelands cases.<sup>32</sup> For instance, rangelands research has identified the significance of gender roles within rangelands management decisions.<sup>33-34</sup> These findings indicate an opportunity and need for rangelands scholars to pursue more

equitable and inclusive contributions, including engagement with the traditions and scholars of feminist geography and critical development, which have long focused on understanding and advancing women's roles in agricultural spaces.<sup>35-37</sup> While not simple, interdisciplinary collaborations often show vitality for examining and addressing such "wicked problems" as poverty and climate change<sup>38</sup> that lie at the social-ecological interface of social science rangelands research.

## Diversifying inquiry

As the social science rangelands research field of inquiry evolves, integrating new and emerging research methods to match the expanding inquiry will unfold, especially attending to micro-social processes. Bruno et al.<sup>20</sup> found that 52% of North American rangelands social science applied survey methods. As discussed above, survey research has routinely illustrated the easily quantifiable and often economic-centric dimensions of ranching. However, research has also found that motivators of rangelands management extend beyond profit-driven economic factors and include nonmarket factors such as family, tradition, and "way of life."<sup>39</sup> For instance, research that increasingly has used mixed-methods approaches, has started to illuminate the significance of socio-cultural factors, such as community identity,<sup>40</sup> self-identity,<sup>41</sup> social-ecological services,<sup>42</sup> and sense of place,<sup>43</sup> among others, to rangelands management. The diversification of methodological approaches in social science rangelands research also expands ways of knowing within the broader community of rangelands scholars, practitioners, and operators.

These and similar studies have advanced our understanding of social factors in rangelands systems, while also highlighting the complex phenomenon of rangelands management that remains dynamic and an area of ongoing study. In 2004, Sayre<sup>44</sup> advocated that rangelands social science needed more qualitative research to fully identify and understand rangelands social-ecological dynamics unaccounted for in previous quantitative research. Moreover, Sherren and Darnhofer<sup>32</sup> also advocated for expansion of mixed-method approaches and "to give voice to land management practitioners" (p. 545).

Continuing to broaden the understanding of rangelands as integrated systems inclusive of human dimensions will promote the opportunity to better understand rangelands complexity through holistic inquiry. For instance, will long-term monitoring of community well-being yield patterns of sustainable conservation practices that enable drought adaptation in rangelands settings? One of the pathways toward expanding social science rangelands research in social-ecological contexts will emphasize efforts to scale-up integrated research over time and space. The next section highlights a contemporary infusion into social science rangelands research that does just that. The LTAR network encompasses an effort for further integration of social science rangelands research with more bio-physical science at the continental level and expectations to design broader analytical timeframes.

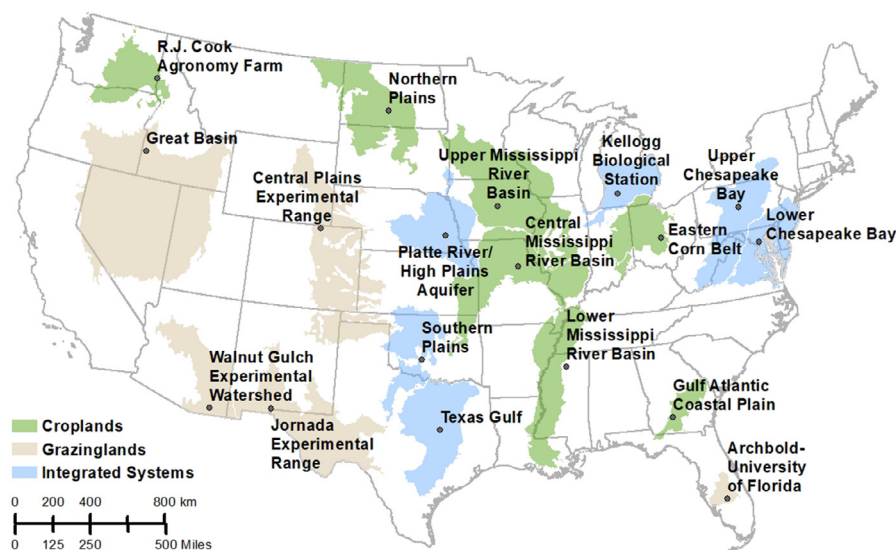
## LTAR and a long-term, large-scale frontier for social science rangelands research

As noted, rangelands science has made great advances to integrate connections between the environmental aspects of rangelands health and social processes pertinent to families, businesses, communities, and regions. While that integration has not yet reached full coverage with respect to measurement of all social indicators, a spectrum of all scales, or all geographies, a new opportunity stands to advance the social science rangelands research trend positively and disproportionately as we describe here, and with a unique coordinated infrastructure.

The LTAR network has emerged as an "institutional" participant in the social science rangelands research trends described here. LTAR seeks to apply an agroecosystem approach to analyze agricultural productivity, social, economic, and ecological outcomes of predominant agricultural practices to further a blend of human well-being and agricultural security, including consideration of ancestral approaches.<sup>45</sup> Much broader than just rangelands, LTAR also encompasses cropland and integrated production systems. Coordinated aspects of LTAR's scale, breadth, and diversity offer a new dimension of opportunity specifically targeting rangelands research with respect to experimental design, scale considerations, and long-term coordination of social science rangelands research. As such, LTAR has the potential to address the challenge of broadly integrating science and management of rangelands with human decision-making and reaching a new frontier for documenting agroecosystem effects. Some initial LTAR-related network inquiries include manuresheds, agro-innovation system applications, and co-production of knowledge.<sup>46-48</sup>

The LTAR network provides context-specific information about on-the-ground management issues that inform local decision-making and highlight the interdependencies of management, livelihoods, and well-being at local, regional, and national scales. This local-to-national scale ultimately leads to actionable science valuable to a diversity of stakeholder groups, including landowners, scientists, and lawmakers. Within the 18 designated LTAR sites to date, five have rangelands/grazing lands designation and an additional six have integrated croplands/grazing lands systems designation (Fig. 1). While the map highlights sites representative of agroecosystem types, it also reveals that even LTAR's large-scale effort does not provide "full coverage" of all systems, geographies, and environmental contexts.

After its inception in 2012, LTAR began organizing annual meetings in 2014 to launch network-level activities and establish coordination across sites toward the "common experiment." Between 2014 and 2017, multiple conversations ensued about the interdisciplinary implications of agroecosystems and how best to include human dimensions research given that USDA-ARS as the sponsoring agency has not traditionally had a widespread or diverse cadre of scientists working in socio-economic areas.



**Figure 1.** The 18 sites designated as the LTAR network, including delineation of site classification (Croplands, Grazinglands, and Integrated Systems). Source: LTAR Communications Working Group.

A key example of how the LTAR network locations have worked to integrate the social sciences continues at the USDA-ARS Central Plains Experimental Range in Nunn, Colorado. Here, in 2012, a group of ARS and university researchers initiated a unique and exemplary case of applying social science rangelands research: the Collaborative Adaptive Rangeland Management (CARM) experiment (see Wilmer et al.<sup>49</sup>). CARM uses a living laboratory model to assess synergies and trade-offs in managing rangelands for multiple societal goals, including beef production, ranch profitability, drought resilience, and biodiversity conservation while connecting manager experience and experimental evidence related to cattle production and vegetation outcomes associated with adaptive, multipaddock rotational grazing.<sup>50-53</sup> CARM follows the LTAR common experimental design, and is a ranch-scale, 10-year participatory grazing experiment, including a control (business-as-usual) treatment, as well as a control for stocking rate.<sup>53,54</sup> However, CARM also includes a group of stakeholders (e.g., ranchers, conservation professionals, and state and federal agency professionals) working with interdisciplinary researchers to establish multifunctional management objectives. By operationalizing participatory, stakeholder-relevant research at the ranch scale to better understand grazing social-ecological systems, CARM demonstrates the lessons, challenges, and rewards of bringing stakeholders, and social science, directly into the rangelands research process helping to shape the conversation for future human dimensions efforts detailed below.

LTAR scientists have also taken other approaches to institutionalize more human dimensions efforts. Interdisciplinary discussions continued within the growing network via the LTAR annual meetings occurring in 2015 and 2016. Then, at the 2018 LTAR annual meeting, between ARS agricultural economists in attendance and other university-based social scientists (social-ecological scientists, geographers, agricultural economists, and rural sociologists), a critical mass ex-

isted to form a working group and found collaborative coordination among the larger contingent of bio-physical scientists. After the meeting, a formal Human Dimensions Working Group formed within LTAR. Subsequently, by early Fall 2018, USDA-ARS established a series of agreements with university partners to increase and activate a much greater array of human dimensions components to the network research endeavors. Three of the initial agency-university agreements included:

- A site-based multiyear agreement focused on the Great Basin coordinated by the ARS Northwest Watershed Research Center (Boise, ID). The agreement connects, long-term data based at Reynolds Creek Experimental Watershed in southwestern Idaho to the first intentional commitment to fund a new full-time and fully-dedicated position at the site-level within LTAR's emerging human dimensions scope of work;
- A multiyear regional innovation project agreement focused on the Climate-Risk nexus associated with the emerging Prevented Plant Program in USDA's Risk Management Agency, using the dryland crop production region of the Inland Pacific Northwest as a pilot case for analyses; and
- A multiyear network-wide agreement to intentionally expand and incorporate human dimensions research into LTAR aligning at the network level. This agreement has funded four full-time postdoctoral fellow positions.

After these initial hires, ARS also internally hired a series of additional postdoctoral fellows as well as multiple permanent agency-based human dimensions science positions that have continued to strengthen an inaugural cohort across the period from 2018 to current time.

This description does not cover the entirety of human dimensions-related activities at various sites in the early stages of LTAR. For instance, some sites had past and ongoing social science collaborations such as the Kellogg Biological Station

site, which had existing social science expertise but had not yet received LTAR funding. Our point here emphasizes the network's turning point—a call to action, a major resource commitment by a federal agency, and concerted infusion of intentional coordination to support the larger social science rangelands research phenomenon we assimilate with this special issue. In effect, LTAR has made a noteworthy commitment toward advancing the momentum we describe from within the academic landscape.

## Preview of contributions to the special issue

This special issue brings together a subgroup of rangelands scholars who participated in an organized symposium at the 2020 annual meeting of the Society for Range Management entitled “Social science advancements to rangelands management: Perspectives from the Long-Term Agroecosystem Research (LTAR) network” as well as others who have helped shape recent social science rangelands research efforts and add breadth to this special issue. Despite our attempt to assimilate this suite of articles, it does not inclusively nor fully represent all of the innovative work actively occurring in social science rangelands research.

To preview the issue, we highlight some of the take-home points authors have contributed, organized by the four subsection themes of the issue: management, livelihoods, well-being, and general concluding trends. Two articles (Meredith and Brunson,<sup>55</sup> Wilmer et al.<sup>49</sup>) comprise the management subsection. Meredith and Brunson<sup>55</sup> provide a valuable case study documenting how rangelands management challenges such as “mega” wildfires benefit from existing relationships. Wilmer et al.<sup>49</sup> provide a more in-depth review of the CARM effort highlighted in our introduction and document beneficial outcomes that can result from time and energy commitment in an intensive set of intentional localized relationships.

In the livelihoods subsection of the issue, Spiegel et al.<sup>56</sup> document a long-term effort occurring within LTAR to design a suite of sustainable intensification indicators that ground the national mission of the network in metrics to enable the science. Sorice et al.<sup>57</sup> have contributed an analysis of producer perception of an invasive grass scenario (Kentucky bluegrass in North Dakota) demonstrating the lag between social perception and ecological effects and cascading effects that can result.

Within the well-being subsection of the issue, Rajala and Sorice<sup>58</sup> conducted a quantitative analysis of sense of place on rangelands in three regions and found similar diversities within each rather than commonalities specific to region. Bentley Brymer et al.<sup>59</sup> advance theoretical background on communal processes in well-being in the context of analyzing social-ecological systems like complex range landscapes.

With the concluding trends subsection, two articles (Meredith et al.,<sup>60</sup> Brunson et al.<sup>61</sup>) round out the special issue. Meredith et al.<sup>60</sup> recommend a unique framework based on the cohort of human dimensions postdocs that emerged within LTAR, which is highlighted in this article and across

the issue. Their framework provides a basis for the large network science effort to “evolve a cohesive human dimensions strategy” that integrates social and ecological elements of research.<sup>60</sup> Brunson et al.<sup>61</sup> provide a concluding overview that forecasts future pathways of social science integration into rangelands research and a call to action about continuing to diversify inquiries.

This special issue provides an historical overview of the emergence of human dimensions research in rangelands science, discusses tradeoffs associated with managing for both intensified agricultural production and human well-being, provides examples of interdisciplinary approaches that include novel scientist-stakeholder-practitioner collaborations, and synthesizes information from the natural and social sciences to address complex natural resource issues. In the final paper of this issue, the authors discuss the future of human dimensions research in rangelands and reflect on this context for the LTAR network.

With this special issue, we have the goal to increase awareness about the value of social sciences within rangelands research. In addition, the summary here highlights advancements of how contemporary efforts continue to grow and integrate social science into rangelands research, and outline pathways forward in broadening scientific integration to promote human well-being.

## Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: The authors certify that they have no financial interest in the subject matter discussed in the manuscript. D.A., D.T., D.P., H.W., and D.H. are employees of USDA Agricultural Research Service, the agency that sponsored this special issue. D.T. was associated with management decisions regarding the topics and organization of this special issue but was not involved in the review or decision process for this manuscript. H.W. is a current member of the Rangelands Steering Committee but was not involved in the review or decision process for this manuscript.

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