



Carbon sequestration and private rangelands: Insights from Utah landowners and implications for policy development



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ABSTRACT

The management of private rangelands is important to the overall potential of terrestrial carbon sequestration in the U.S. Previous research has focused on the adoption of innovative range management and conservation practices, but little is known about rangeland owner decision making with respect to carbon sequestration. This study examined Utah rangeland owners' current management practices in relation to soil carbon management and explored factors influencing their likelihood of participating in a carbon sequestration program. Data were collected from a statewide survey of Utah rangeland owners to assess the relationships between their demographics, landownership characteristics, awareness of and attitudes toward carbon sequestration, beliefs about climate change, and reported likelihood to participate in a relevant program. Thirty-seven percent of respondents were considered potential participants. Higher likelihood of participation was associated with dependence on livestock production, considering it a moderately or very important management objective, having an interest in learning more about it, and valuing its potential economic and climate benefits. Although education and outreach are generally considered important policy tools for promoting conservation, special efforts are needed in the case of carbon sequestration to develop innovative strategies to communicate its concept and related processes with rangeland owners without politicizing the issue. One approach is to tailor education and outreach messages to focus on the ecological benefits of carbon sequestration that are valued by many rangeland owners. Instead of developing new programs, carbon sequestration can also be incorporated into existing conservation programs as a management objective at both federal and state levels. Research is needed to further examine the perceived differences between carbon sequestration and other conventional conservation practices in order to improve the carbon sequestration potential of existing conservation programs and attract wider participation among rangeland owners.

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Introduction

Climate change is expected to have detrimental impacts on humans and the environment (e.g., increased temperatures, droughts, floods) and these impacts will vary both geographically and socially (IPCC, 2007). Mitigation is one approach to addressing climate change through reducing emissions of greenhouse gases (such as CO₂) or enhancing carbon sinks (Klein et al., 2007). Terrestrial carbon sequestration is a mitigation strategy which stores atmospheric CO₂ in the soil and in the above and below ground biomass (Izaurralde et al., 2001; Lal et al., 2003). Rangelands can act as carbon sinks and soil carbon levels can be increased

through the implementation of improved land management practices (Schuman et al., 2002; Lal et al., 2003).

Carbon sequestration on rangelands

Although rangelands have a low per acre potential to sequester carbon, they cover about half of the world (Svejcar et al., 2008), one third of the U.S. (Sobecki et al., 2001) and 80% of Utah (USU Cooperative Extension, 2012). This vast amount of rangelands as a whole has great potential for sequestering carbon (Follett et al., 2001). In particular, over half of the rangelands in the nation and one-fifth in Utah are privately owned (Leydsman-McGinty, 2009; SRR, 2011). Schuman et al. (2001) estimated that with improved management practices public and private rangelands in the U.S. could sequester 11 million metric tons of carbon per year (MMTC/yr), while 8 MMTC/yr could be accumulated through keeping private rangelands in the Conservation Reserve Program (CRP) and 43 MMTC/yr could be prevented from loss by maintaining

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current conservation practices. The overall carbon sequestration potential of these private rangelands is equivalent to 5% of the U.S. annual CO₂ emissions (Follett et al., 2001).

Previous research on the effects of rangeland management practices on soil carbon are varied and inconclusive (Derner and Schuman, 2007). However, it has been recognized that general management practices that reduce soil erosion, prevent land degradation, or restore degraded land have the biggest impacts on soil carbon (Lal, 2001). More specifically, management practices such as lowering stocking and forage utilization rates, using nitrogen fertilization, removing woody vegetation, and inter-sowing grasses and legumes are potentially beneficial for soil carbon (Conant et al., 2001; Derner and Schuman, 2007; Gibbens et al., 1983; Lal, 2004). The current literature on the biophysical aspects of carbon sequestration on rangelands raises two questions: 1) What management practices are private rangeland owners currently using which produce carbon benefits? 2) What are the most effective ways to promote further adoption of management practices to enhance carbon sequestration on private rangelands?

Carbon sequestration policy

Although no program is currently focused on carbon sequestration on private rangelands in the U.S., a variety of policy options have been discussed in the literature. Of these policy options, a voluntary market-based approach has been the main focus of research (e.g., Antle et al., 2003; Bonnie et al., 2002; Campbell et al., 2004; De Steiguer et al., 2008; Diaz et al., 2009; Sandor et al., 2002). The Chicago Climate Exchange (CCX), operated from 2003 to 2010, is an example of a voluntary market-based approach. The CCX developed the only protocol for carbon sequestration offset projects on private rangelands in the U.S. Even though rangelands can be competitive in a market setting (Campbell et al., 2004), there are many challenges related to additionality, quantification, verification and permanence for promoting carbon sequestration on private rangelands through such an approach (Bird et al., 2002; Brown et al., 2010; De Steiguer et al., 2008; Schuman et al., 2002; White, 2010). The CCX also imposed geographic limitations on eligible rangelands due to environmental factors such as annual precipitation, which excluded 84% of Utah.

Other policy options discussed in the literature include a compliance market-based approach (e.g., a cap-and-trade program), government payments for landowners to meet voluntary carbon sequestration goals, or modification of existing land conservation programs to include carbon management (Derner and Schuman, 2007; White, 2010). This last option has started gaining attention among researchers and policy makers, as evident by Schuman et al. (2002)'s study on lands enrolled in the CRP and facts sheets published by the Conservation Innovation Grant program and the Conservation of Private Grazing Land initiative (Gebhart et al., 1994; NRCS, 2003, 2010). The ecological benefits of carbon sequestration are generally consistent with those achieved through land conservation programs (e.g., improved soil and water quality, improved grazing management, improved wildlife habitat). Therefore, it is important to examine strategies for incorporating carbon sequestration into existing land conservation programs. Understanding why rangeland owners implement conservation practices and participate in existing conservation programs may be beneficial for identifying factors that influence rangeland owners' interest in carbon sequestration.

Decision making by private rangeland owners

The diffusion of innovations theory (Rogers, 2003) has been widely used to study rancher management decisions. It provides a good basis for understanding why and how innovative range

management practices may be adopted. For instance, it suggests that adoption is influenced by characteristics of the innovation, including whether the innovation has a clear advantage for the adopter, whether it is compatible with the adopter's management objectives, how complex the innovation is, whether the adopter can try it out, and whether the results are readily observable to the adopter. Rogers' theory also suggests that social networks can influence the adoption of innovations by facilitating the spread of information among connected individuals. Didier and Brunson (2004) interviewed Utah ranchers who adopted innovative range management practices. These interviewees reported extensive social interactions with ranching organizations and university extension professionals, contributing to their obtaining information from outside sources about the innovation of interest. Similar results were also observed in Kennedy and Brunson (2007).

Previous research has conceptualized the relationships between environmental value orientations, beliefs, attitudes and actions. In particular, individuals' environmental value orientations and beliefs influence their attitudes toward an environmental action, which in turn influence their decisions about whether or not to take that action (Fishbein and Ajzen, 2010; Larson, 2010; Stern and Dietz, 1994; Stern, 2000). Following this line of thought, rangeland owners' value orientations and beliefs about the environment would influence their rangeland management decisions, such as adopting an innovative practice or participating in a conservation program.

Demographics and ranch structure have been shown to predict rancher decision making. Coppock and Birkenfeld (1999) examined factors influencing the adoption of recommended livestock and range management practices by Utah livestock producers. They found that low education levels and advanced age were associated with low rates of adoption. Peterson and Coppock (2001) examined the differences in management styles between ranchers with public grazing permits and those who relied on private rangelands. They found that investment in ranching operations in Utah was affected by ranchers' old age. Although it is unclear whether the average age of ranchers has actually been increasing over the years, the old age of the current ranching community in Utah and other western states could have profound implications on private land management and conservation policy in the future (Brunson and Huntsinger, 2008). Higher income has also been shown to be a predictor of innovation adoption (Coppock and Birkenfeld, 1999; Didier and Brunson, 2004; Peterson and Coppock, 2001). Dependence on ranch income seemed to influence Utah and Texas ranchers' decisions to invest in range improvement projects and to adopt conservation practices (Didier and Brunson, 2004; Kreuter et al., 2004; Olenick et al., 2005; Rowan and White, 1994). Furthermore, Utah ranchers who owned smaller operations, did not have a public grazing permit, mainly relied on private lands for livestock production, and had higher off-ranch incomes tended to fall under the category of "private hobbyists" and were generally less likely to adopt rangeland management innovations (Coppock and Birkenfeld, 1999).

Ranchers are also motivated by a variety of non-monetary values. For example, Smith and Martin (1972) found that intrinsic values of and personal ties to their land was the most significant factor in explaining why Arizona ranchers did not sell their ranches when the prices were high. Grigsby (1980) found that a large portion of ranchers in southeastern Oregon viewed ranching as a way of life rather than a business. A need to preserve a sense of tradition, culture, and lifestyle has been evident in other studies as well (Didier and Brunson, 2004; Rowe et al., 2001). Ranchers have been shown to forgo opportunities that allow them to adopt innovative practices with economic benefits to keep the traditional lifestyle of ranching and livestock production (Grigsby, 1980). To motivate ranchers to adopt conservation practices, one needs to

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