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Ranchers' Attitudes toward Managing for Vegetation and Landscape Heterogeneity

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Abstract

Grasslands are imperiled due to land conversion, fragmentation, woody encroachment, population growth, and global warming. What remains of intact grasslands are vital for the ecosystem services they provide. Wildlife species native to the North American Great Plains evolved in response to very specific and differing habitats. Without variation in vegetation structure and composition (heterogeneity) the number of species that can thrive is minimized, as are the interconnected ecosystem services. Landowners' assistance in the maintenance of grassland ecosystems is essential because Great Plains grasslands are primarily privately managed. Thus, increasing heterogeneity on working rangelands is a partial solution to balancing the needs of wildlife with that of cattle production. This study tested a predictive model of factors influencing attitudes toward heterogeneous and landscape-scale ranch management. An online survey was sent to ranchers within prescribed-burn and grazing groups in the Great Plains. Predictors of landscape-scale management were spirituality, stewardship, social descriptive norms, consideration of future consequences, and participation in grassland activities. The lone predictor of attitudes toward heterogeneous grassland management was consideration of future consequences. Even though the survey targeted groups that were more likely to be higher in heterogeneous attitudes, a vast majority are still following the "manage to the middle" paradigm. It appears these ranchers are unaware of the benefits of a heterogeneous landscape and the compatibility of its associated management techniques with their cattle production goals. To improve the adoption of techniques that promote vegetation heterogeneity, more resources should be devoted to demonstrating how these practices benefit ranchers' cattle business alongside the larger landscape.

Keywords: grazing, grasslands, vegetation heterogeneity, biodiversity, conservation

1. Introduction

1.1 The Need for Heterogeneous Grasslands

Grasslands provide vital ecosystem services to human populations including providing critical wildlife habitat, yet they are the most threatened and least protected biome (Scholtz & Twidwell, 2022). Increasing pressure to convert grass to row-crop agriculture (Gage, Olimb, & Nelson, 2016) and encroaching trees and shrubs (Briggs et al., 2005; Ratajczak, Nippert, & Collins, 2012) jeopardize the services provided. Grasslands, particularly in the United States Great Plains, are primarily in private ownership, so it is imperative to reconcile the need for working rangelands with the need for functioning grasslands. This appears possible as researchers continue to explore how cattle grazing can be used to sustainably manage grasslands.

As a result of the decreasing volume of grasslands, the quality of those remaining is of growing importance. Attention is therefore being placed on vegetation heterogeneity. Heterogeneity, in rangeland science parlance, is a term illustrative of grassland health. According to Fuhlendorf and Engel (2001, p. 626), "heterogeneity is defined as variability in vegetation stature, composition, density, and biomass", and serves as the foundation of biodiversity, ecosystem resilience, and multifunctionality (Kolasa & Pickett, 1991; Ostfeld, Pickett, Shachak, & Likens, 1997). More simply put, borrowing a phrase from Diacon-Bolli, Holdereger, and Burgi (2012), "heterogeneity fosters biodiversity." Grassland species require very specific habitats which in turn requires plant diversity across the landscape, and without the variation in vegetation (heterogeneity) the number of species that can thrive on the land is minimized, as are the interconnected ecosystem services. To balance the needs of

conservation with that of cattle production, a partial solution to preserving the vital ecosystem services provided by grasslands is increasing heterogeneity on working rangelands.

1.2 How Cattle Can Promote Heterogeneity

Blair, Nippert, and Briggs (2014) found that "grazers [domesticated and wild] promote heterogeneity in grasslands by selectively consuming some species while leaving others, through trampling, soil compaction, soil tunneling, and redistribution of nutrients" (p. 412). Freese, Fuhlendorf, and Kunkel (2014) also suggest that cattle grazing can be utilized to create vegetation heterogeneity, particularly when combined with patch fires. In their 11-year study comparing traditional fire and grazing management with "conservation-based management" (pyric-herbivory applied through patch burning), Limb, Fuhlendorf, Engle, Weir, and Elmore (2011) illustrated that pyric-herbivory does not require reduced stocking rate, deferment, or rest. In addition, the increase in forage quality after fire reduced feed costs. Other studies on this topic have found similar results. Concluding their study of grazing preferences and vegetation feedbacks, Powell, Martin, Dreitz, and Allreda (2018, p. 45) argue "… mixed-grass prairies are resilient to fire-grazing interactions and that rest from grazing following fire is likely ecologically unnecessary." They further assert pyric herbivory (fire-grazing interaction) as a suitable strategy for increasing the heterogeneity of grassland habitat. Similarly, Spiess et al. (2020) examined patch-burn grazing as a drought-resilient management tool and found that despite drought conditions, the "…burned patches maintained grazer attraction and that animal performance was maintained or improved…" (p. 473). While pyric-herbivory is but one management technique used to bolster heterogeneity, it is arguably the most important ecologically and innocuous to cattle enterprise.

Ideally, heterogeneous landscapes would be managed in large units—several hundred thousand hectares, according to Freese et al. (2014). This would allow for large expanses of intact habitat for native herbivores and the predators that rely on them. However, this is beyond the scope of most landowners financially and in terms of management. The existence of private property boundaries also confounds obtaining unfragmented habitat and there is a lack of large-scale management planning, as neighbors do not often collaborate on management strategies (Freese et al., 2014). Yet, some ranchers do acknowledge their land's place in the greater landscape (Belin et al., 2005; Sliwinski, Burbach, Powell, & Schacht, 2018; Kennedy & Burbach, 2020) and take the ecosystem into management consideration. Measuring this landscape-scale perspective alongside rancher attitudes toward managing for heterogeneity will help uncover potential partnership solutions going forward.

1.3 Past Research on Vegetation Heterogeneity

Studies of conservation social science, particularly those exploring farmer conservation behaviors, have not traditionally examined practices that promote vegetation heterogeneity, but rather best management practices (BMPs). It is therefore of interest to include heterogeneity inquiry in the study of grassland management. A majority of the research conducted on heterogeneity has been conducted in the field of rangeland ecology, where studies have put forth its importance for ecosystem health. However, a few studies have utilized a social-science perspective, examining the human dimensions of adopting heterogeneity-promoting measures (Becerra, Engle, Elmore, & Fuhlendorf, 2013; Joshi, Becerra, Engle, Fuhlendorf, & Elmore, 2017; Sliwinski et al., 2018).

Fuhlendorf, Engle, Elmore, Limb, and Bidwell (2012) explored the history behind the mainstream rangeland paradigm and asserted the need for change. They put forth that rangeland management as a discipline has promoted good care of the grass, not heterogeneity. This means that rangeland management courses and professionals have taught ranchers the take-half, leave-half philosophy that maintains an even landscape, which is not how grasslands naturally function and thrive. The decline in biodiversity then has been the result of teachings that put cattle production gains over the health of the ecosystem.

Fuhlendorf and Engle (2001) explained that grassland birds are in decline even with the *improvement* of rangeland conditions, which suggests that current management techniques may not be enough to ensure and maintain biological diversity. Along these lines, the definition of poor range condition is similar to what is needed for heterogeneity. Fuhlendorf et al. (2012) argue that this confirms the lack of importance of biodiversity within the profession and that the current approach to defining rangeland condition is insufficient in determining ecosystem health. They propose a paradigm that promotes the potential heterogeneity of landscapes through an alternate approach to managing rangelands—linking the goals of conservation biologists, ecologists, and rangeland managers. A more collaborative approach, such as this, takes biodiversity *and* productivity into consideration. This alternative paradigm aims to avoid equal distribution and disturbance on the range using fire and grazing to create some patchiness rather than the uniform outcome of "managing to the middle." However, alternative management paradigms such as this have not been adopted by producers en masse (Fuhlendorf et al., 2017; McGranahan et al., 2018; Sliwinski et al., 2018).

1.4 Study Purpose

This study aims to better understand sustainable rangeland management and beef production by testing a research-based model explaining attitudes toward heterogeneous and landscape-scale grassland management. An improved understanding of attitudes toward practices that promote heterogeneity can assist in overcoming barriers to their use by informing education measures and reshaping policies.

2. Methodology

2.1 Study Context

Research focusing on the human dimensions of heterogeneity has predominantly examined landscape preference (Becerra et al., 2013; Becerra et al., 2017; Joshi et al., 2017). While preference is beneficial in understanding some of the underlying factors regarding grassland management, this study delves into attitudes as they pertain to specific management techniques: those that promote heterogeneity.

2.2 Hypothesized Model

2.2.1 Dependent Variables

Regarding the management of heterogeneous landscapes, an article by Freese et al. (2014) put forth a framework of ten major ecological drivers for restoring and conserving biodiversity on Great Plains rangelands. They outline ten tenets to aid in this transition, calling them biodiversity-centered management practices (BCM). These practices include: maintaining or restoring diverse plant communities; allowing for patchiness; using prescribed fires and pyric herbivory; managing for natural stream flows; accepting high temporal ecological variability; allowing other grazing animals and predators on the land; minimizing fragmentation; and creating relatively large management units.

The caveat to this framework is that it was proposed for those whose primary land goal is conservation, while much of the remaining grasslands are working rangelands. Many of the tenets of the BCM framework are challenging to operationalize because of ranch size and the necessity of income generated from cattle production. As Kennedy and Burbach (2020) demonstrated, managing for biodiversity and cattle can be complementary, maybe just not at the scales put forth in the Freese et al. (2014) framework. To operationalize the BCM practices at the individual ranch scale, we reorganized the framework. Freese et al. (2014) state: *"*Of the ten BCM practices, we believe that five—managing for native vegetation and topographic conditions, heterogeneous grazing, patch fires, contiguous landscapes, and larger management units—will often have modest effects (negative or positive) on production and income for the livestock enterprise" (p. 363).

For this reason, we took the practices complementary to cattle production using the above suggestions of Freese et al. (2014) in addition to the alternative paradigm suggested by Fuhlendorf et al. (2012) and condensed the BCM tenets into the following categories:

1. Intact Grasslands with Native Vegetation
2. Grazing and Fire
3. Wildlife

As attitude is a moderator for behavior (Kraus, 1995; Glasman & Albarracín, 2006), if we are interested in the adoption of BCM practices, we must first ask: *how do those whose main goal is production, feel about BCM tenets?*

The second dependent variable in this model is attitude toward landscape-scale management. In their study of rural woodland landowners and their attitudes toward an ecosystem-based approach, Rickenbach et al. (1998) deconstructed the broad ideas of ecosystem-based management, dividing it into three measurable components. One component, landscape-scale, is the focus here. Landscape-scale perspective pertains to landowners' attitudes toward management at spatial scales larger than the individual parcel—or their view of how their property fits into the larger ecosystem. The authors reported that "several items indicated that respondents believed their land was part of something larger and their actions had impacts elsewhere" (Rickenbach et al., 1998, p. 21). Belin et al. (2005) replicated the use of these variables with a larger population of rural woodland landowners and found similar results. Similarly, Sliwinski et al. (2018) found that ranchers' attitude toward cross-boundary management (landscape-scale) was generally positive, which confirmed that ranchers realize they are not isolated on the landscape and that their management practices impact neighboring lands and vice versa.

Regarding measuring attitude, Belin et al. (2005) expressed that while favorable attitudes do not guarantee a behavioral outcome, they do imply uncertainty. This means that if the attitudes were unfavorable, adoption of the

behavior (i.e. recommended management practice) would be unlikely. Belin et al. assert, "an improved understanding of these attitudes can assist managers in addressing landowner concerns and policymakers in reshaping programs to appeal to owners" (2005, p. 28).

This study surveyed ranchers regarding their attitudes toward practices that promote vegetation heterogeneity and landscape-scale management and specifically asked: are there factors that are predictive of heterogeneous landscape-scale grassland management?

2.3 Independent Variables

The following concepts have been gleaned from the literature as showing potential in the study of rancher conservation decisions and have been included as independent variables in the hypothesized model.

2.3.1 Sociodemographic and Grassland Management

Studies of conservation social science, particularly those exploring farmer conservation behaviors, have not traditionally examined the management of vegetation heterogeneity, but rather what motivates farmers to use BMPs. Several studies illustrate that there are few to no universal determinants of conservation behaviors among farmers (Prokopy, Floress, Klotthor-Weinkauf, & Baumgart-Getz, 2008; Knowler & Bradshaw, 2007; Barr & Cary, 2000). Reimer et al. (2014) noted that past studies on farmers' conservation adoption have observed a great deal of unexplained variation due to ignoring the broader context. Accordingly, questions of interest were added such as number of generations ranching, whether there was a succession plan in place, and inquired about additional sources of ranch income.

2.3.2 Consideration of Future Consequences

Strathman, Gleicher, Boninger, and Edwards' (1994) research focused on consideration of future consequences, examining the extent to which people take into consideration distant versus immediate consequences of their behaviors. Consideration of future consequences captures how much a person is driven by short-term rewards or how much an individual focuses on long-term goals (Bruderer Enzler, 2013). While most of the consideration of future consequences literature examines its relationship to various health-related decisions, research has found it can help predict people's pro-environmental behavior (Bruderer Enzler, 2013; Joireman, Lasane, Bennett, Richards, & Solaimani, 2001).

Studies of rancher conservation behaviors have not directly measured consideration of future consequences but have examined similar variables. In their study of conservation program participation and adaptive rangeland decision-making, Lubell et al. (2013) found that orientation toward the future (time horizon) was a significant factor in participation in conservation programs. Similarly, although not rancher specific, in their meta-analysis of time perspective and environmental engagement, Milfont, Wilson, and Diniz (2012) found that future time perspective appears to play an important role in influencing attitudes and behaviors towards the environment.

2.3.3 Stewardship and Spirituality

Along with studies by Didier and Brunson (2004) and Greiner et al. (2009), in their interview of Great Plains ranchers, Sliwinski et al. (2018) found that being viewed as a "good rancher" by their peers was important because they want to be considered good stewards. Similarly, research by Kennedy, Burbach, and Sliwinski (2016) and Kennedy and Burbach (2020) revealed that ranchers desire continuous management improvement to ensure future generations remain on the land. Some mention "doing as the Good Book says" or that "this land belongs to our Creator," thus one must take good care of it. Stewardship and spirituality will thus be included in this study.

2.3.4 Property Rights Orientation and Social Responsibility

Agricultural production and consequent environmental problems have gained increasing regulatory attention. According to Jackson-Smith, Kreuter, and Krannich, "The extension of habitat protection efforts under the federal Endangered Species Act has led to considerable controversy among private landowning constituencies throughout the country" (2005, p. 588). The idea of overstepping regulation can be seen as a threat to individual property rights. Jackson-Smith et al. (2005) surveyed ranchers in Texas and Utah to gain some insight into how ranchers viewed their property rights. Their study explored the impact different demographic variables had on property rights orientation. They found that property rights are multifaceted and inclusive of three dimensions: protection of *individual rights*, recognition of *social responsibility*, and *stewardship* obligations.

Another study by Kreuter, Nair, Jackson-Smith, Conner, and Johnston (2006) found mixed results in the correlation between willingness to adopt socially desirable rangeland management objectives such as noxious weed control, protecting water quality, protecting endangered species habitat, among others, and property rights

orientation. Most of those surveyed felt obligated to be good stewards, but not because of social responsibility. This is similar to findings from Jackson-Smith et al. (2005) who found ranchers support environmental stewardship when it aligns with their moral values, rather than proper land management benefitting all of society. Research by Greiner et al. (2009) also found conservation adoption to align with values and attitudes.

2.3.5 Social and Personal Norms

Like the idea of social responsibility is that of social norms. Descriptive social norms describe what behaviors are 'normal' to a social group, while injunctive social norms are the perception of how others are expected to act (Cialdini, Reno, & Kallgren, 1990). So, to avoid social stigma, individuals act in a way that is seen as 'normal' to their social group or in ways that they assume others want them to act. Personal norms, on the other hand, are self-expectations, based upon feelings of moral obligation (Thogersen, 2006). Sliwinski et al. (2018) found social norms to be important predictors of attitudes toward prairie dogs in their study of rancher attitudes toward vegetation heterogeneity. Similarly, in a survey of beef cattle ranchers, Willcox, Giuliano, and Monroe (2012) examined intentions to consider wildlife management in routine cattle management activities and found that attitudes and subjective norms best explained rancher intentions.

2.3.6 Innovativeness

Kennedy et al. (2016) and Kennedy and Burbach (2020) illustrate that producers often look for ways to improve, including trying new things. They view ranching as an experiment, which takes a certain amount of innovativeness. Adoption of innovation in range management has been used as a dependent variable in research, such as the study of livestock operators by Didier and Brunson (2004), who found that innovation was related to ranching full-time, dependence on ranch income, anticipated future of the ranch, the extent of social networks, and a desire to illustrate stewardship. Or, it can be used as an independent variable like in the study of variables that influence the grazing strategy preference (Roche et al., 2015). Roche et al. (2015) found that variables associated with ranchers' grazing preferences included a combination of human dimensions (goal setting, views on experiment and risk tolerance, information networks). Whether used as an independent or dependent variable, the focus of innovativeness is the adoption of better range management practices.

2.3.7 Ranching Operation Activities Affecting Land Management

In a study of attitudes toward heterogeneity, Joshi et al. (2017) explored attitudinal and socio-demographic determinants impacting landscape preferences among the general population. The authors defined 'activity' as a level of engagement in prairie or grassland area activities. They hypothesize, "Since active involvement in educational, outreach, and other activities might help a respondent to know more about benefits associated with heterogeneous landscapes, we expected to have a positive relationship of this variable" (p. 927). This study, framed with Random Utility Theory, found population groups involved in local activities leaned toward heterogeneous landscapes (significant at the 5% level). However, contrary to expectations, those with higher levels of activity did not prefer the most heterogeneous landscape.

2.4 Questionnaire Design

Questions related to independent variables were pulled from existing instruments, which allowed minimal room for editing, whereas questions of dependent variables were original and had not yet been tested. The Bureau of Sociological Research (BOSR) assisted with improving the latter and demographic questions with adherence to principles of questionnaire design without altering the substantive content.

The final questionnaire retained 9 questions for independent variables, 46 questions for dependent variables, and 11 questions asking for demographics and other information of interest. Dependent variables were specific to attitudes toward BCM management practices (i.e., questions about grassland conversion, use of fire, use of fire in conjunction with grazing, other grazers, predators, etc.) and landscape-scale management. The independent variable questions measured 11 constructs including spirituality (Delaney, 2005), social and personal norms (Weir, 2012), property rights orientation (Jackson-Smith et al., 2005), consideration of future consequences (Joireman et al., 2001), innovativeness (Goldsmith, 1995), motivation (Greiner et al., 2009), and activities (Joshi et al., 2017).

2.5 Data Collection Process

In the early phase of data collection, ranchers, over 19 years old, of the National Grazinglands Coalition were invited to participate in this 15-minute-long online survey using Qualtrics. The National Grazinglands Coalition was selected due to the organization's mission to "Provide voluntary ecologically and economically sound management of all grazing lands for their adaptive uses and multiple benefits to the environment and society through science-based technical assistance, research and education". Ranchers, specifically those working

toward ecologically sound management, were expected to have more favorable attitudes toward heterogeneous landscape-scale management. The first email invitation with a link to the online survey was sent to two listserv administrators of the National Grazinglands Coalition to help distribute this survey to their listserv. An email reminder was sent to the same two administrators two weeks later to ask for help with distributing the reminder email to the listserv. Due to the low response rate, a second email reminder was added and was sent to the listserv administrators two weeks after the first reminder email. Due to the lack of autonomic manipulation over the distribution of these recruitment communications where pre-planned times of distribution could not be guaranteed, and the shortage of sufficient responses, more rancher groups suspected of having members with favorable attitudes toward heterogeneous grassland and landscape-scale management were recruited. Eight more rancher groups agreed to participate including Independent Cattlemen, Centennial Valley Association, East Kansas Prescribed Burning Association, Tri-County Prescribed Burning Association, Sandhills Prescribed Burn Association, Oklahoma Grazinglands coalition, Mid-Missouri River Prescribed Burn Association, and Nebraska Prescribed Fire Council. These groups were selected because the use of fire is essential in creating a heterogeneous landscape. In addition, four potential respondents who had taken part in a prior case study as part of this project were contacted to participate in this survey. The original survey invitation along with the reminders was tailored to recruit the additional groups mentioned above on a rolling basis. All distributions of these recruiting materials were handled by their respective group administrator who oversaw their members' contact information. The researchers maintained contact with these distributors during the period of data collection (~6 weeks) to remind them to send out each recruitment material at the pre-scheduled time point.

2.5.1 Response Rate

Information regarding the exact number of ranchers on each group's contact list was not provided to either the researcher or BOSR and there was also no guarantee that all survey invitations and reminders had been sent out to each group by those distributors, therefore, it was not possible to calculate the final overall response rate because of a lack of key information. However, demographic data illustrates that study participants are representative of the ranching population. Among those who answered the age question, the average age was 57.6 years, and over four-fifths of the respondents were male (81.9%). According to the USDA Census of Agriculture (2012), the average age of a beef cattle rancher is 58 years. Eleven percent of ranches are operated by women.

2.5.2 Data Cleaning

BOSR deleted IP addresses from the dataset. Respondents that started the survey but did not answer all questions were removed from the dataset, ending up with a total of 189 responses including responses from two sources; the rancher groups managed by their "gatekeeper" who helped distribute the surveys and the case study participants. Frequency distributions were run on each of the variables in the survey. Out-of-range values on all survey items were checked. One invalid zip code was coded as a missing value.

2.5.3 Data Management

Eleven constructs, "spirituality", "social injunctive norms", "social norms", "personal norms", "rights", "stewardship", "social responsibility", "future consideration", "motivation", participation in grassland activities, and "innovativeness", used questions from existing instruments, but were placed in a grid using the same response scales. To ensure consistent statistical findings, variables in the model were standardized. According to Kwan and Chan (2011, p. 730), "Standardized data are affected less by the scales of measurement and can be used to compare the relative impact of variables that are incommensurable (i.e., measured in different units on the same/different scales)". This is a common practice in multiple regression analysis and SEM modeling. A mean score was then calculated for each observation. Questions for the other two constructs, "heterogeneous grassland management" and "landscape-scale management", were written by the researchers and went through internal pilot testing for face validity. These questions did not share the same response scales, which, therefore, made a summated score irrelevant. Principal axis factoring was conducted on all the items for each of these two constructs to identify items that had a low correlation with the factor. For "heterogeneous grassland management", four rounds of principal axis factoring were done to remove the clutter of low correlations (any correlations below 0.3) that were not likely to be meaningful. Eighteen items that had a less than 0.3 correlation with the factor were removed, leaving 26 items for the factor of "heterogeneous grassland management". The total amount of variance explained by this factor was 22.43%.

Likewise, a principal axis factoring was conducted with the eight items for "landscape-scale management" which singled out one item that had a less than 0.3 correlation with the factor. The total variance explained by this factor was 34.62%.

2.6 Model

Structural equation modeling was employed to test the regression equations simultaneously. In the original model (Figure 1), "norms" and "property rights" variables were set as latent variables. Based on the theory detailed in the literature review, given that social norms and property rights each is an umbrella consisting of three facets, the variable "norms" is assumed to cause the scores observed on the measured variables "personal norms", "social injunctive norms", and "descriptive norms". The variable "property rights" is assumed to cause the scores observed on the measured variables "rights," "stewardship," and "social responsibility." Factor loading of "social norms" on "personal norms" was fixed to 1, and the factor loading of "property rights" on "rights" was also fixed to 1. Variables "heterogeneous grassland management" and "landscape-scale management" were allowed to covary and were regressed on "spirituality", "norms", "property rights", "consideration of future consequence", "innovativeness", "motivation", and "activity". Cases with missing data were excluded from the statistical analysis through listwise deletion of cases.

Mplus output indicated that a negative error covariance estimate for measured variables was obtained where the high correlation (r=.645) between "personal norms" and "social injunctive norms" was found to be the cause.

According to Hu and Bentler (1999), RMSEA values below .06 and Tucker-Lewis Index values of .95 or higher are recommended. The chi-square statistic of absolute model fit along with various descriptive model fit indices indicated that the model did not fit the data well: $\chi^2(57) = 223.997$, $p<.0001$; CFI = .379, TLI = .260, RMSEA = .145, $p<.001$. A model modification was needed to obtain a better-fitting model.

2.7 Model Modification

In the modified model (Figure 2), the latent variable "norms" and "property rights" were removed from the model while the six facets "personal norm," "social injunctive norm," "descriptive norm," "rights," "stewardship," and "social responsibility" were treated as exogenous variables. Thus, all endogenous and exogenous variables were assumed to be observed variables.

Since the models in question are nested models where a chi-square difference test is meaningful, altering the structural component of the model resulted in a significant increase in model fit, with a difference of 183.772 ($\chi^2_{diff} = \chi^2_{old} - \chi^2_{modified}$), degree of freedom =23 ($df_{diff} = df_{old} - df_{modified}$), $p<.01$. After making the modifications mentioned above, the chi-square value of 40.225 with 34 degrees of freedom is non-significant at the .05 level: its p-value is .214. This finding suggests the model fits the data acceptably in the population from which the researchers drew their sample. Corroborating evidence is provided by the RMSEA fit statistic – the obtained value of .036 is well below the desired .06 cutoff. Similarly, the Tucker-Lewis Index result of .960 is above the .95 threshold denoting a satisfactory model fit.

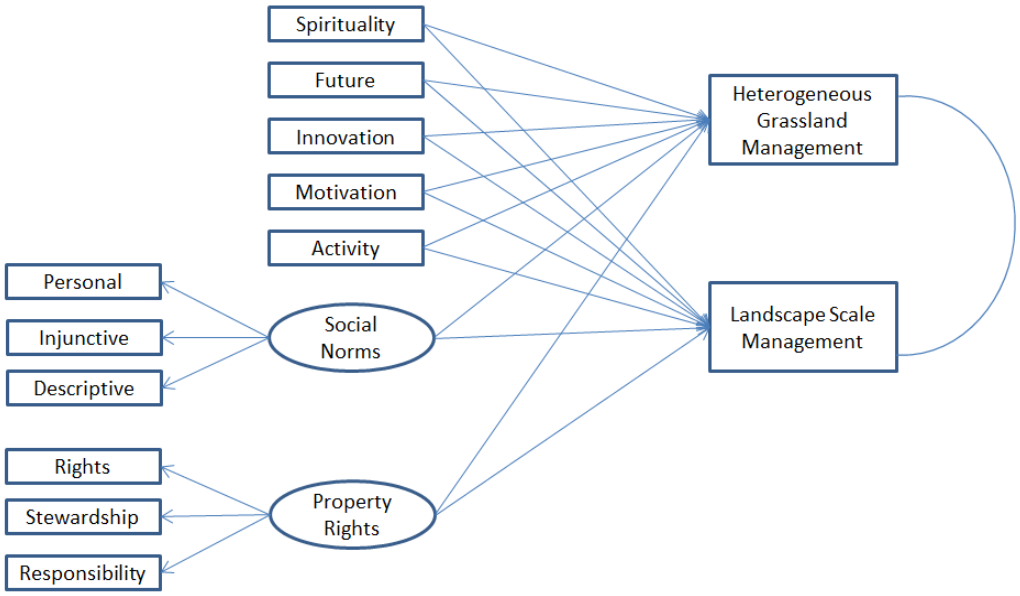

Figure 1. SEM model with latent variables

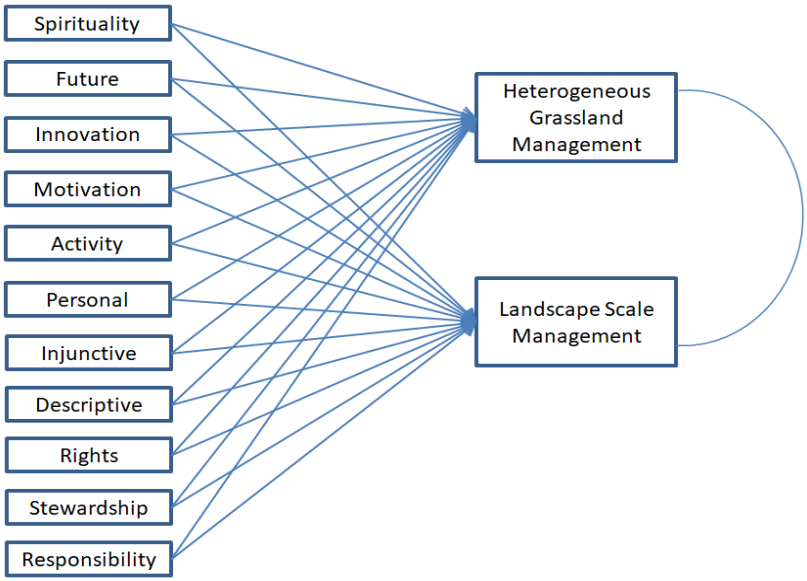

Figure 2. Modified model – multivariate multiple regression

3. Results

3.1 Demographic Information

More than half of the participating ranchers strongly agreed or agreed that they are dependent on the ranch as a source of income (55.1%). About two-fifths (38.2%) of ranchers indicated their great-grandparents were ranchers; one-fifth (20.6%) had great-great-grandparents as ranchers, and a similar rate are first-generation ranchers (18.4%). Three-quarters (77%) either have a succession plan in place or in progress. The majority of ranchers who answered this set of questions have extractive recreation businesses, such as hunting or fishing, that affect land management (64.7%), with other agricultural production enterprises (58.1%) as the second most common facet in their ranching operation (Figure 3). Over four-fifths of the ranchers were male (81.9%). There was an equal number of respondents aged 46 to 64 years old and 65-80 years old (38.5% each).

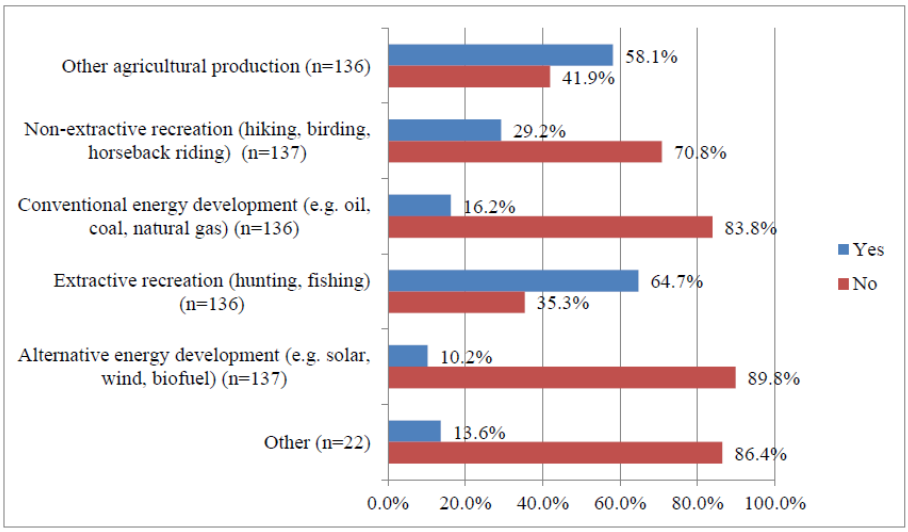

Figure 3. Activities as part of the ranching operation that affect land management

3.2 Other Questions of Interest

While fire was the BCM practice highlighted throughout this study, an important first step in grassland conservation is to leave them intact. Therefore, we asked about respondents' perception of converting grazinglands (grasslands) to croplands. More than two-thirds (68.5%) of ranchers who answered this question perceived converting their grazinglands to croplands for agricultural profits as detrimental or very detrimental

(Figure 4). We also asked if they feel financial pressure to convert grazingland to cropland and if financial incentives are important in that decision. While a vast majority of ranchers reported not feeling pressured (80.5%) to convert their graziglands to croplands, one-fifth (19.5%) were pressured "a little" to "a lot" (Figure 5). About three-quarters of respondents (74.8%) considered financial incentives (e.g., crop insurance, subsidies) as somewhat unimportant or very unimportant in making decisions to convert graziglands to croplands.

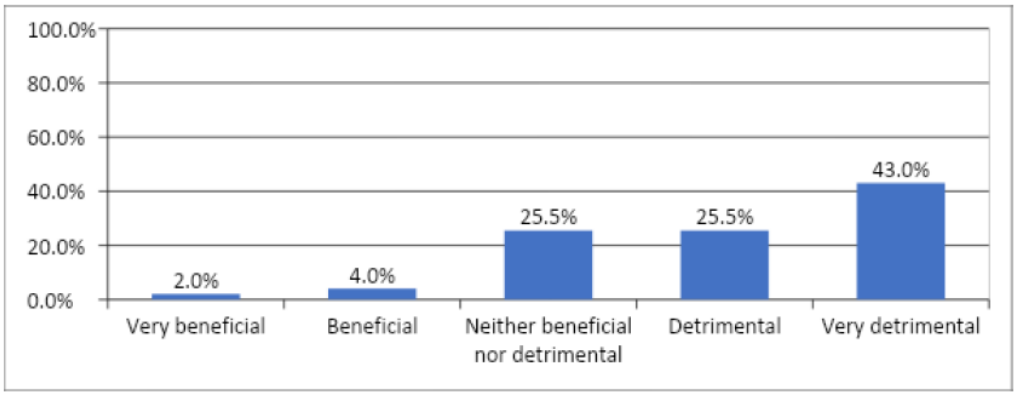

Figure 4. Perception of converting graziglands to croplands (n = 149)

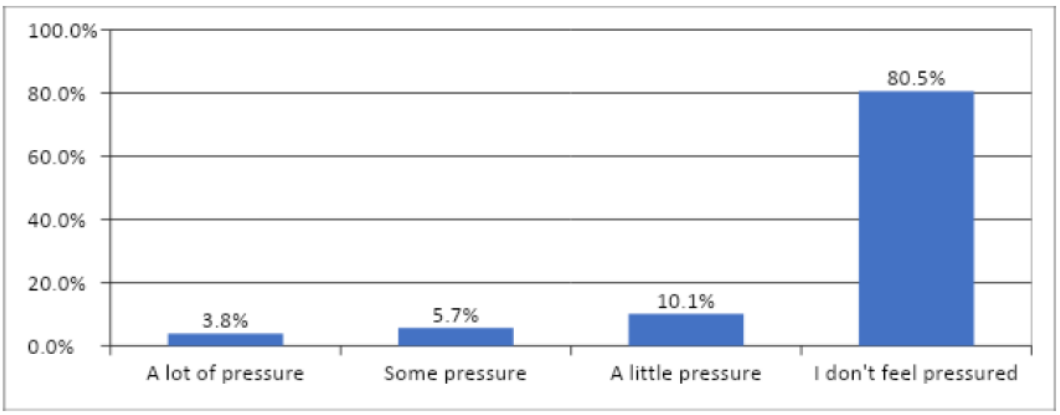

Figure 5. Financial pressure to convert graziglands to croplands (n = 159)

Descriptive statistics and correlations

Descriptive statistics and Pearson correlations provided the initial basis of analysis for the variables. Results are presented in Table 1.

Table 1. Descriptive statistics and correlations among variables

Variable	Mn	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Heterogeneous grassland management	86.83	12.05												
2. Landscape-scale management	14.46	3.87	0.539**											
3. Spirituality	20.53	8.59	0.135	0.468**										
4. Social injunctive norm	6.67	2.73	0.028	0.10	0.213*									
5. Social descriptive norm	8.11	2.39	-0.153	-0.127	0.156	0.276**								
6. Personal norm	5.62		0.081	0.117	0.094	0.643**	-0.071							
7. Rights	5.46	1.42	0.278**	0.182*	0.176*	0.008	-0.061	0.040						
8. Stewardship	3.43	1.44	0.258**	0.277**	0.207*	0.097	0.021	0.036	0.364**					
9. Social responsibility	6.36	2.72	-0.243**	-0.156	-0.023	0.115	0.180*	0.014	-0.338**	-0.129				
10. Future consideration	16.22	5.79	0.315**	0.489**	0.47**	0.033	-0.011	0.059	0.146	0.025	-0.078			
11. Motivation	20.35	5.82	0.175	0.404**	0.410**	0.066	0.055	0.037	-0.09	0.287**	0.034	0.326**		
12.Innovativeness	26.01	4.87	0.216	0.425**	0.381**	0.116	0.108	-0.087	0.025	0.014	-0.028	0.467**	0.305**	
13. Activity affecting management	1.67	0.85	0.202	0.312**	0.046	0.251**	0.031	0.079	0.077	0.119	0.010	0.075	0.134	0.266**

*p < 0.05; **p < 0.01. Note: Smaller means suggest higher levels in each variable.

3.3 Predictor Variables and Heterogeneous Grassland Management

Consistent with expectations, ranchers with a stronger tendency to "consider future consequences" (B=.214, Z=.105) are likely to have a positive attitude regarding heterogeneous grassland management, which is significant at $p<.05$ (Table 2). The were no other significant relationships between the predictor variables and heterogenous grassland management.

3.4 Predictor Variables and Landscape-scale Management

Ranchers with a higher level of "spirituality" (B=.234, Z=.078) are likely to hold a positive attitude towards landscape-scale management (significant at $p < .01$) (Table 2). Ranchers with a higher level of "stewardship" (B=.170, Z=.070) are likely to have a positive attitude towards landscape-scale management (significant at $p < .05$). Those with a higher level of "social descriptive norm" (B=-.161, Z=.070) are significantly more likely to have a negative opinion on landscape-scale management ($p < .05$).

In addition, ranchers who have more "consideration for future consequences" (B=.237, Z=.080) are significantly more likely to have a positive opinion on landscape-scale management ($p < .01$). Those who are more actively involved in activities on grassland or prairie (B=.232, Z=.069) are significantly more likely to have a positive opinion on landscape-scale management ($p < .01$). Ranchers who are more open to innovation (B=.172, Z=.076) are significantly more likely to have a positive opinion ($p < .05$).

Table 2. Results of Multivariate Multiple Regression

Heterogeneous grassland management on	Estimate (Standardized)	SE (Standardized)
Spirituality	-0.063	0.109
Personal norm	0.064	0.125
Social injunctive norm	-0.012	0.140
Social descriptive norm	-0.115	0.095
Consideration for future consequence	0.214*	0.105
Innovativeness	0.119	0.106
Activity	0.085	0.109
Motivation	0.017	0.108
Rights	0.124	0.094
Stewardship	0.159	0.099
Social responsibility	-0.097	0.090
Landscape-scale management on	Estimate (Standardized)	SE (Standardized)
Spirituality	0.234**	0.078
Personal norm	0.114	0.091
Social injunctive norm	-0.090	0.099
Social descriptive norm	-0.161*	0.070
Consideration for future consequence	0.237**	0.080
Innovativeness	0.172*	0.076
Activity	0.232**	0.069
Motivation	0.101	0.075
Rights	-0.020	0.070
Stewardship	0.170*	0.070
Social responsibility	-0.063	0.067
Factor covariance		
Heterogeneous grassland management with landscape-scale management	0.397***	0.079
Model fit indices		
X2	32.362	
AIC	4559.575 (df=34)	
BIC	4774.399	
R-Squared		
Heterogeneous grassland management	0.176**	0.058
Landscape-scale management	0.472***	0.058

Note. SE = standard error. *p < .05; ** p < .01; ***p < .001

4. Discussion

While the model fit is satisfactory for the population, there are some interesting things to note. Contrary to what was expected, those with a higher level of "social responsibility" are likely to have a negative opinion of landscape-scale management. While this seems counterintuitive, it corresponds with previous studies of property rights orientation (Kreuter et al., 2006; Jackson-Smith et al., 2005), where most of those ranchers surveyed felt obligated to be good stewards not because of social responsibility (benefit to society), but because it aligns with their moral values. Similarly, those with a higher level of "social injunctive norm" are more likely to have a negative opinion of landscape-scale management. This may relate to the idea that they manage their rangelands in specific ways not because others do it, but because it ought to be that way. Those with a higher level of "descriptive norm" were also significantly more likely to have a negative opinion of landscape-scale management. The less their neighbors, friends, and family act in the rangelands' best interests the lower their attitude toward landscape-scale management. Ranchers' attitudes toward landscape-scale management not only reflected a concern with their ranches and the more extensive natural system, but also the importance that their land has relative to other ranches—providing important habitat and benefiting society. This illustrates the complexity of rancher ideals.

One of the most noteworthy findings from this study is the general lack of acceptance of BCM techniques. While predictors accounted for approximately 47% of the variation found within attitudes toward landscape-scale management, they accounted for only 17.6% of the variation in attitudes toward heterogeneous grassland management. Interestingly, even though the survey targeted prescribed burn associations, only half (49.5%) of those who responded currently manage their grazinglands using prescribed fire. However, three-quarters of participants responded that they are very—or somewhat likely to use prescribed fire in the future. This was similar to the percentage of respondents that considered the use of fire on their grazinglands as beneficial (77.7%). Pyric herbivory—grazing within a few weeks after fire—was *not* utilized by a majority of those who responded (67.3%). Approximately half (49.4%) of those surveyed were likely to consider grazing within a few weeks after fire in the future, while only 30% considered pyric-herbivory as beneficial to their grazinglands.

There appears to be many ranchers who still follow the "manage to the middle" paradigm. Examining the descriptive data, it is the objective of 84.9% of those who responded to achieve an even distribution of grazing animals, and the objective of 80.7% to achieve even use of all grass plants. When asked how beneficial or detrimental they viewed patchy grazing on their grazinglands, the results were split: approximately 37% found it very beneficial or beneficial, 35% found it detrimental or very detrimental and 27% found it neither beneficial nor detrimental. However, approximately 81% of those who answered would consider managing for uneven use of grasses, if they wouldn't lose production per acre.

A majority of ranchers who participated in this survey currently manage their grazinglands to favor native grasses (92.6%), considering native forage species very important to their grazing operation (74.1%). Almost all of them control invasive species (92.5%), considering them detrimental to their operation (87%). A majority (95%) of ranchers who participated in this study have not converted any of their grassland to cropland in the last ten years and are not at all likely to do so in the future (70.4%). More than two-thirds (68.5%) of ranchers who answered this question considered converting their grazinglands to croplands for agricultural profits as detrimental or very detrimental. About three-quarters of respondents (74.8%) who answered this question considered financial incentives (e.g., crop insurance, subsidies) as somewhat unimportant or very unimportant in making decisions to convert grazinglands to croplands. Using all this information to paint a broad picture: ranchers are not interested in converting their grasslands to croplands and do not feel financially pressured to do so. They prefer native forage species and control for invasives.

This model is a starting point for the exploration of attitudes toward specific rangeland management practices. Other potentially important variables such as ranch size, production types, and management goals should be considered in future research to help further explain managing for vegetation and landscape heterogeneity.

5. Conclusion

It appears the ranchers who participated in this study are unaware of the benefits of a heterogeneous landscape and the compatibility of its associated management techniques with their cattle production goals, despite being members of progressive grazing and prescribed burn groups. This supports other studies, which note that the paradigm shift of rangeland ecology professionals to focus on heterogeneity has not made its way to producers (e.g., Fuhlendorf et al., 2017; McGranahan et al., 2018; Sliwinski et al., 2018). Those making management recommendations should consider these findings and plea to individual values and utilize trusted community leaders as exemplars. If one's neighbors are utilizing BCM practices and receiving positive results, the

conversion of others may be easier.

While the great expanses of national parks and private conservation areas are an important part of conserving grassland ecosystems, the part of private landowners is also crucial. The balance of cattle production and grassland conservation must be considered when recommending management practices. Managing grass sustainably is understood to help the longevity and profitability of a ranch, especially with regard to running a multigenerational business (Kennedy & Burbach, 2020). Changing practices requires awareness and evaluation of available choices. To improve the adoption of techniques that promote vegetation heterogeneity, more resources should be devoted to demonstrating how these practices benefit ranchers' cattle business alongside the larger landscape.

References

Barr, N., & Cary, J. (2000). *Influencing improved natural resource management on farms: A guide to understanding factors influencing the adoption of sustainable resource practices.* Canberra, Australia: Bureau of Rural Sciences.

Becerra, T. A., Engle, D. M., Elmore, R. D., & Fuhlendorf, S. D. (2013). Contrasting preference for grassland landscapes among population groups in the central and southern great plains. *Rangeland Ecology and Management, 66*(5), 529-538. https://doi.org/10.2111/REM-D-12-00174.1

Becerra, T. A., Engle, D. M., Fuhlendorf, S. D., & Elmore, D. R. (2017). Preference for grassland heterogeneity: Implications for biodiversity in the Great Plains. *Society and Natural Resources, 30*(5), 601-612. https://doi.org/10.1080/08941920.2016.1239293

Belin, D. L., Kittredge, D. B., Stevens, T. H., Dennis, D. C., Schweik, C. M., & Morzuch, B. J. (2005). Assessing private forest owner attitudes toward ecosystem-based management. *Journal of Forestry, 103,* 28-35.

Blair, J., Nippert, J., & Briggs, J. (2014). Grassland ecology. In R. K. Monson (Ed.), *Ecology and the Environment* (pp. 389-423). New York, NY: Springer. https://doi.org/10.1007/978-1-4614-7501-9_14

Briggs, J. M., Knapp, A. K., Blair, J. M., Heisler, J. L., Hoch, G. A., Lett, M. S., & McCarron, J. K. (2005). An ecosystem in transition: Causes and consequences of the conversion of mesic grassland to shrubland. *BioScience, 55*(3), 243-254. https://doi.org/10.1641/0006-3568(2005)055[0243:AEITCA]2.0.CO;2

Bruderer Enzler, H. (2013). Consideration of future consequences as a predictor of environmentally responsible behavior: Evidence from a general population study. *Environment and Behavior, 47*(6), 618-643. https://doi.org/10.1177/0013916513512204

Cialdini, R., Reno, R., & Kallgren, C. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58*(6), 1015-1026. https://doi.org/10.1037/0022-3514.58.6.1015

Delaney, C. (2005). The spirituality scale: Development and psychometric testing of a holistic instrument to assess the human spiritual dimension. *Journal of Holistic Nursing, 23,* 145-167. https://doi.org/10.1177/0898010105276180

Diacon-Bolli, J., Daland, T., Holderegger, R., & Bürgi, M. (2012). Heterogeneity fosters biodiversity: Linking history and ecology of dry calcareous grasslands. *Basic and Applied Ecology, 13,* 641-653. https://doi.org/10.1016/j.baae.2012.10.004

Didier, E. A., & Brunson, M. E. (2004). Adoption of range management innovations by Utah ranchers. *Journal of Range Management, 57,* 330-336. http://dx.doi.org/10.2307/4003855

Freese, C., Fuhlendorf, S. D., & Kunkel, K. (2014). A management framework for the transition from livestock production toward biodiversity conservation on Great Plains rangelands. *Ecological Restoration, 32*(4), 358-368. https://doi.org/10.3368/er.32.4.358

Fuhlendorf, S. D., & Engle, D. M. (2001). Restoring heterogeneity on rangelands: Ecosystem management based on evolutionary grazing patterns. *BioScience, 51*(8), 625-632. https://doi.org/10.1641/0006-3568(2001)051[0625:RHOREM]2.0.CO;2

Fuhlendorf, S. D., Engle, D. M., Elmore, R. D., Limb, R. F., & Bidwell, T. G. (2012). Conservation of pattern and process: Developing an alternative paradigm of rangeland management. *Rangeland Ecology & Management, 65*(6), 579-589.https://doi.org/10.2111/REM-D-11-00109.1

Fuhlendorf, S. D., Fynn, R. W. S., McGranahan, D. A., & Twidwell, D. (2017). Heterogeneity as the basis for rangeland management. In Briske D. D. (Ed.), *Rangeland systems: Processes, management and challenges*

(pp. 169-196). New York: Springer. https://doi.org/10.1007/978-3-319-46709-2

Gage, A. M., Olimb, S. K., & Nelson, J. (2016). Plowprint: Tracking cumulative cropland expansion to target grassland conservation. *Great Plains Research, 26*(2), 107-116. https://doi.org/10.1353/gpr.2016.0019

Glasman, L. R., & Albarrac ń, D. (2006). Forming attitudes that predict future behavior: A meta-analysis of the attitude-behavior relation. *Psychological Bulletin, 132*(5), 778-822. https://doi.org/10.1037/0033-2909.132.5.778

Goldsmith, E. (1995). The validity of a scale to measure global innovativeness. *Journal of Applied Business Research, 7*(2), 89-97. https://doi.org/10.19030/jabr.v7i2.6249

Greiner, R., Patterson, L., & Miller, O. (2009). Motivations, risk perceptions and adoption of conservation practices. *Agricultural Systems, 99*, 86-104. https://doi.org/10.1016/j.agsy.2008.10.003

Jackson-Smith, D., Kreuter, U., & Krannich, R. S. (2005). Understanding the multidimensionality of property rights orientations: Evidence from Utah and Texas ranchers. *Society and Natural Resources, 18*(7), 587-610. https://doi.org/10.1080/08941920590959578

Joireman, J. A., Lasane, T. P., Bennett, J., Richards, D. & Solaimani, S. (2001). Integrating social value orientation and the consideration of future consequences within the extended norm activation model of proenvironmental behavior. *British Journal of Social Psychology, 40*, 133-155. https://doi.org/10.1348/014466601164731

Joshi, O. Becerra, T. A., Engle, D. M., Fuhlendorf, S. D., & Elmore, R. D. (2017). Factors affecting public preferences for grassland landscape heterogeneity in the Great Plains. *Environmental Management, 60*, 922-930. https://doi.org/10.1007/s00267-017-0921-5

Kennedy C. A., & Brunson, M. W. (2007). Creating a culture of innovation in ranching: A study of outreach and cooperation west-central Colorado. *Rangelands, 29*(3), 35-40. https://doi.org/10.2111/1551-501X(2007)29[35:CACOII]2.0.CO;2

Kennedy, S., Burbach, M., & Sliwinski, M. (2016). Sustainable grassland management: An exploratory study of progressive ranchers in Nebraska. *Sustainable Agriculture Research, 5*(2), 103-113. https://doi.org/10.5539/sar.v5n2p103

Kennedy, S. M., & Burbach, M. E. (2020). Great Plains ranchers managing for vegetation heterogeneity: A multiple case study. *Great Plains Research, 30*(2), 137-148. https://doi.org/10.1353/gpr.2020.0016

Knowler, D., & Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food Policy, 32*, 25-48. http://dx.doi.org/10.1016/j.foodpol.2006.01.003

Kolasa, J., & Pickett, S. T. A. (1991). *Ecological heterogeneity*. New York, NY: Springer-Verlag. https://doi.org/10.1007/978-1-4612-3062-5

Kraus, S. J. (1995). Attitudes and the prediction of behavior: A meta-analysis of the empirical literature. *Personality and Social Psychology Bulletin, 21*, 58-75. https://doi.org/10.1177/0146167295211007

Kreuter, U. P., Nair, M. V., Jackson-Smith, D., Conner, J. R., & Johnston, J. E. (2006). Property rights orientations and rangeland management objectives: Texas, Utah, and Colorado. *Rangeland Ecology and Management, 59*, 632-639. https://doi.org/10.2111/05-173R1.1

Kwan, J. L., & Chan, W. (2011). Comparing standardized coefficients in structural equation modeling: a model reparameterization approach. *Behavior research methods, 43*(3), 730-745. https://doi.org/10.3758/s13428-011-0088-6

Lien, A. M., Svancara, C., Vanasco, W., Ruyle, G. B., & Lopez-Hoffman, L. (2017). The land ethic of ranchers: A core value despite divergent views of government. *Rangeland Ecology & Management, 70*, 787-793. https://doi.org/10.1016/j.rama.2017.06.004

Limb, R. F., Fuhlendorf, S. D., Engle, D. M., Weir, J. R., & Elmore, R. D. (2011). Pyric-herbivory and cattle performance in grassland ecosystems. *Rangeland Ecology & Management, 64*, 659-663. https://doi.org/10.2111/REM-D-10-00192.1

Lubell, M. N., Cutts, B. B., Roche, L. M., Hamilton, M., Derner, J. D., Kachergis, E., & Tate, K. W. (2013). Conservation program participation and adaptive rangeland decision-Making. *Rangeland Ecology & Management, 66*(6), 609-620. https://doi.org/10.2111/REM-D-13-00025.1

McGranahan, D. A., Hovick, T. J., Elmore, R. D., Engle, D. M., & Fuhlendorf, S. D. (2018). Moderate

patchiness optimizes heterogeneity, stability, and beta diversity in mesic grassland. *Ecology and Evolution, 8*, 5008-5015. https://doi.org/10.1002/ece3.4081

Milfont, T. L., Wilson, J., & Diniz, P. K. C. (2012). Time perspective and environmental engagement: A meta-analysis. *International Journal of Psychology, 47*, 325-334. https://doi.org/10.1080/00207594.2011.647029

Ostfeld, R. S., Pickett, S. T. A., Shachak, M., & Likens, G. E. (1997). Defining scientific issues. In S. T. A. Pickett, R. S. Ostfeld, M. Shachak, & G. E. Likens, (Eds.), *The ecological basis of conservation: Heterogeneity, ecosystems, and biodiversity* (pp. 3-10). New York, NY: Chapman and Hall. https://doi.org/10.1007/978-1-4615-6003-6_1

Powell, J., Martin, B., Dreitz, V., & Allreda, B. (2018) Grazing preferences and vegetation feedbacks of the fire-grazing interaction in the Northern Great Plains. *Rangeland Ecology & Management, 71*(1), 45-52. https://doi.org/10.1016/j.rama.2017.09.003

Prokopy, L. S., Floress, K., Klotthor-Weinkauf, D., & Baumgart-Getz, A. (2008). Determinants of agricultural best management practice adoption: Evidence from the literature. *Journal of Soil and Water Conservation, 63*, 300-312. https://doi.org/10.2489/jswc.63.5.300

Prokopy, L. S., Floress, K., Arbuckle, J. G., Church, S. P., Eanes, F. R., Gao, Y., … Singh, A. S. (2019). Adoption of agricultural conservation practices in the United States: Evidence from 35 years of quantitative literature. *Journal of Soil and Water Conservation, 74*, 520-534. https://doi.org/10.2489/jswc.74.5.520

Ratajczak, Z., Nippert, J. B., & Collins, S. L. (2012). Woody encroachment decreases diversity across North American grasslands and savannas. *Ecology, 93*, 697-703. https://doi.org/10.1890/11-1199.1

Reimer, A., Thompson, A., Stalker-Prokopy, L., Arbuckle, J. G., Genskow, K., Jackson-Smith, D., … Nowak, P. (2014). People, place, behavior, and context: A research agenda for expanding our understanding of what motivates farmers' conservation behaviors. *Journal of Soil and Water Conservation, 69*(2), 57-61. https://doi.org/10.2489/jswc.69.2.57A

Rickenbach, M. G., Kittredge, D. B., Dennis, D. M., & Stevens, T. H. (1998). Ecosystem management: Capturing the concept for woodland owners. *Journal of Forestry, 96*, 18-24.

Roche, L. M., Cutts, B. B., Derner, J. D., Lubell, M. N., & Tate, K.W. (2015). On-ranch grazing strategies: Context for the rotational grazing dilemma. *Rangeland Ecology and Management, 68*, 248-256. https://doi.org/10.1016/j.rama.2015.03.011

Scholtz, R., & Twidwell, D. (2022). The last continuous grasslands on Earth: Identification and conservation importance. *Conservation Science and Practice, 4*, e626. https://doi.org/10.1111/csp2.626

Sliwinski, M., Burbach, M., Powell, L., & Schacht, W. (2018). Ranchers' perceptions of vegetation heterogeneity in the Northern Great Plains. *Great Plains Research, 28*, 185-197. https://doi.org/10.1353/gpr.2018.0029

Sliwinski, M., Burbach, M. E., Powell, L., &, Schacht, W. (2018). Factors influencing ranchers' support for landscape heterogeneity in the Northern Great Plains. *Ecology and Society, 23*(4), 45. https://doi.org/10.5751/ES-10660-230445

Spiess, J. W., McGranahan, D. A., Geaumont, B., Sedivec, K., Lakey, M., Berti, M., Hovick, T. J., & Limb, R. F. (2020). Patch-burning buffers forage resources and livestock performance to mitigate drought in the Northern Great Plains. *Rangeland Ecology & Management, 73*(4), 473-481. https://doi.org/10.1016/j.rama.2020.03.003

Strathman, A., Gleicher, F., Boninger, D. S., & Edwards, C. S. (1994). The consideration of future consequences: Weighing immediate and distant outcomes of behavior. *Journal of Personality and Social Psychology, 66*(4), 742-752. https://doi.org/10.1037/0022-3514.66.4.742

Toma, L., & Mathijs, E. (2007). Environmental risk perception, environmental concern and propensity to participate in organic farming programmes. *Journal of Environmental Management, 83*(2), 145-157. https://doi.org/10.1016/j.jenvman.2006.02.004

Turner, B. L., Wuellner, M., Nichols, T., & Gates R. (2014). Dueling land ethics: Uncovering agricultural stakeholder mental models to better understand recent land use conversion. *Journal of Agricultural Environmental Ethics, 27*, 831-856. https://doi.org/10.1007/s10806-014-9494-y

Weir, E. (2012). *The focus theory of normative conduct: Application to pro-environmental grocery shopping*

behaviors. Master's thesis. University of Washington, Seattle, WA. Retrieved from https://digital.lib.washington.edu/researchworks/handle/1773/20563

Willcox, A. S., Giuliano, W. M., & Monroe, M. C. (2012). Predicting cattle rancher wildlife management activities: An application of the theory of planned behavior. *Human Dimensions of Wildlife, 17*, 159-173. https://doi.org/10.1080/10871209.2012.639043