Projected Use of Grazed Forages in the United States:

2000 to 2050

Larry W. Van Tassell, E. Tom Bartlett, John E. Mitchell

A Technical Document Supporting the 2000 USDA Forest Service RPA Assessment

U.S. Department of Agriculture Forest Service

Abstract

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Scenario analysis techniques were used to combine projections from 35 grazed forage experts to estimate future forage demand scenarios and examine factors that are anticipated to impact the use of grazed forages in the South, North, and West Regions of the United States. The amount of land available for forage production is projected to decrease in all regions while local impacts from environmental concerns and government policies will be significant in areas where resource concerns have already emerged. Urban sprawl, suburbanization, and increased demands for recreation were projected to be the major factors decreasing grazing lands. A decline in the utilization of grazing lands by livestock is anticipated in the West and North Regions but should not change significantly in the South Region. Conversely, wildlife utilization of grazing lands is anticipated to increase in all regions, with nonconsumptive utilization of wildlife being a significant contributor to this trend. Technology development in forage production is projected to play a role in the utilization of grazed forages in the West and South Regions but not as much in the North Region. Grazing system technology and biological control of weeds are the two most anticipated developments.

Keywords: rangeland, Resources Planning Act, scenario analysis, livestock grazing, wildlife, environmental issues, grazing technology

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Executive Summary

The Forest and Rangeland Renewable Resources Planning Act of 1974, as amended, (RPA) requires an analysis of present and anticipated uses, demand for, and supply of U.S. renewable resources. Forage supplies constitute a predominant renewable commodity resource on rangeland, although other resources such as wildlife habitat, water, timber, energy and minerals, and recreational opportunities are also jointly provided.

Numerous factors are correlated with and affect the supply and value of grazed forages. Quantifying either of these factors is not an easy task, however. In the 1989 Assessment, future demand for forage was derived from model projections of beef and lamb production under the assumption that demand for forage is a function of the demand for beef cattle and sheep. The USDA Economic Research Service agricultural projection modeling system used in 1989, or a suitable replacement, was not available for the 2000 RPA Assessment, so we utilized an alternative approach—scenario analysis.

A scenario is a description of a likely future state of a system considering possible developments of relevant interdependent factors affecting the system. Scenario analysis allows the reduction of uncertainties associated with these factors, thus providing decision makers with information that accounts for change and unknowns.

Scenario analysis requires a set of experts to help carry out the steps in scenario development. The steps in scenario analysis are:

1. Determine factors affecting the use of grazed forage.
2. Determine two or three possible outcomes for each factor through historical trends, current conditions, and expert opinion. Factor outcomes should be collectively exhaustive and mutually exclusive.
3. Determine probabilities of occurrence for each factor outcome. This was done by three assessment regions—West, South, and North.
4. Consider interdependencies between all factor outcomes to ensure that generated scenarios are internally consistent. We used a compatibility rating scale of –2 to +2.
5. Generate scenarios. The objective of scenario analysis is to develop a small number of representative scenarios that can be used in strategic planning. In our study, representative scenarios were obtained using cluster analysis to group scenarios based upon their compatibility.
6. Calculate scenario probabilities. To do this, compatibility estimates were transformed into joint probabilities. The calculated probabilities were preliminary in that the probability of each outcome most likely did not equal the sum of the joint probabilities of that outcome and every outcome occurring and not occurring. To determine scenario probabilities, we used goal programming to minimize the differences between the initial and corrected joint probabilities.
7. Project future grazed forage use. This step was not a part of the scenario analysis, but was used to help the experts assess how grazed forage use might change under each scenario.

Five factors were seen as important in determining future use of grazed forages: 1) land available for forage production, 2) environmental concerns and government policies, 3) livestock utilization of grazing lands, 4) wildlife utilization of grazing lands, and 5) technology changes related to forage production. Factor outcomes with the highest marginal probabilities were fairly consistent across Assessment Regions. The probability that land available for forage production will decrease was twice the other possible outcomes. Probabilities for increasing wildlife utilization of grazing lands were greater than 50 percent for each Assessment Region. The largest difference between Assessment Regions was with projections concerning livestock utilization of grazing lands: in the South, it is expected to slightly increase; in the West, it will likely decrease.

The most likely scenarios had a probability of 64 percent in the South, 54 percent in the North, and 72 percent in the West. Under these scenarios, the use of grazed forages is expected to decrease 8 percent between 1998 and 2050 in the South. In the North, the decrease is projected to be 32 percent, although a much smaller change is also likely. The west assessment region is expected to see a 22 percent reduction in grazed forages, from 153 million AUM's in 1998 to 119 million AUM's in 2050.

Acknowledgments

This study could not have been completed without the volunteered dedication of our panel of experts (appendix tables A1–A3). We also wish to recognize Dr. Neil Rimbey, Professor and Range Economist at the University of Idaho, Caldwell Research and Extension Center, and Dr. L. Allen Torrell, Professor of Agricultural Economics at New Mexico State University. These two scientists provided valuable advice at the start of our research that facilitated an effective approach to studying the problem.

Introduction

Grazed forages are the basis for much of the livestock production in the United States. The Renewable Resources Planning Act of 1974 requires the USDA Forest Service to analyze the present and anticipated uses of grazed forages in the United States every 10 years. Historically, the anticipated use of grazed forages has been estimated by using econometric models to project consumer demand for beef and determine the grazed forages required to meet that demand (Gee and others 1990). This methodology depends on the accuracy of the econometric model and makes the assumption that the future will be a continuation of the past. Risk and uncertainty are often overlooked.

Risk and uncertainty are naturally inherent in agricultural production. To enable producers and government agencies to plan strategically, an accounting and understanding of the uncertainties confronting them is important (Porter 1985). Huss (1988) stated that for long-range forecasts to gain support, forecasters must broaden their perspective from one that simply predicts the future to one that assists in understanding and planning for the future. The Delphi technique may be used to increase this understanding, but it has the limitation that each event or factor being contemplated is considered in isolation; in other words, the occurrence of any one event is assumed not to affect the probability of occurrence of any other (Mitchell and others 1979). Scenario analysis is an alternative to econometric and Delphi forecasting that develops an understanding of the causal relationships and factors that contribute to change and instability (Wack 1985b; Huss 1988).

Brauers and Weber (1988) defined a scenario as "a description of a possible future state of an organization's environment considering possible developments of relevant interdependent factors in this environment." According to Huss (1988), scenarios are best suited for long-term, macroeconomic, uncertain environments that are typified by a scarcity of data and a large number of nonquantifiable factors. By reducing uncertainties into a set of scenarios, decisionmakers are provided with information that accounts for change and unknowns. Wack (1985a) stated that scenarios can effectively organize a variety of seemingly unrelated economic, technological, political, and societal information and translate it into a framework for judgment in a way that no econometric model can.

The objectives of this study were to develop alternative scenarios concerning the future use of grazed forages and to identify the likely demand for grazed forages in the United States. Grazed forages include native pasture and range, annual pasture, seeded perennial pasture, small grain pasture, hay aftermath, and crop residue.

Procedures

Determining Scenarios

Several methodologies exist for developing futuristic views known as scenarios (Godet 1987; Ringland 1998; van der Heijden 1996). The methodology used in this study was an extension of techniques developed by Brauers and Weber (1988) for combining the opinions of experts. Interest was directed toward factors that could influence the future use of grazed forages in the United States. We employed a 50-year planning horizon in the analysis to make it consistent with other technical documents supporting the 2000 Assessment required by the Forest and Rangeland Renewable Resources Planning Act of 1974. The act specifies a Renewable Resources Program that covers at least four fiscal decades beyond the period of each update.

Expert panel

The country was divided into three regions—South, North, and West—based upon the Assessment Regions used by the USDA Forest Service (1989) (fig. 1). Our study objective was not to determine public opinion concerning the use of grazed forages, but to use the expertise of qualified individuals to determine scenarios relating to grazed forage use in each region. Twelve individuals in each region were contacted to form the expert panel (appendix A, tables A1–A3). Sample size was based upon Delphi studies where research showed the error rate was small when eight or more qualified participants were used (Hodgetts 1979). It was hoped that at least 8 out of the 12 participants in each region would provide useable input. Names of participants were obtained through peer recommendations on the basis of their knowledge concerning the grazed forage industry.

Description of future states

The first step in developing the regional scenarios was to identify factors hypothesized to influence the future use of grazed forages. Because of the complexity of the survey and synthesis process, the number of

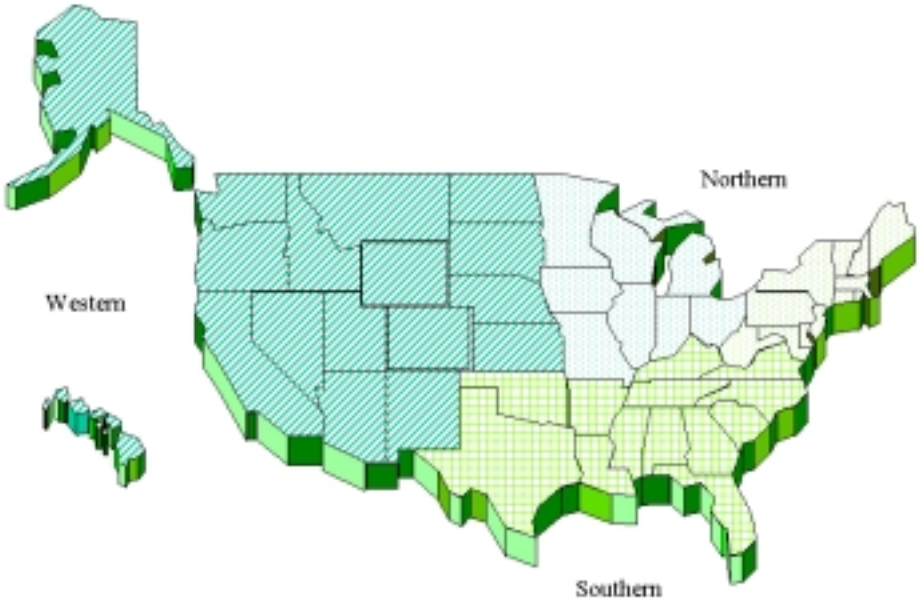

Figure 1. Regions of interest for development of grazed forages scenarios. The regions are identical to the regions used in the Forest Service's assessment of the U.S. forest and rangeland situation, as required by the Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976 (USDA Forest Service 1989).

factors was kept to a minimum. The selected factors, though, needed to be comprehensive enough to reflect all relevant concerns about the future and be thoroughly defined so that all experts were dealing with the same assumptions.

We hypothesized that five major factors will influence the use of grazed forages to the year 2050: (1) use by livestock, (2) use by wildlife, (3) land available for grazing, (4) environmental concerns and government policies affecting grazed forage use, and (5) technological advancements influencing the production and use of grazed forages. These factors were reviewed by the panel of experts, who assented to them with few changes. The final factors and rationalization for including them are presented in table 1.

We designated two or three possible future outcomes for each factor by evaluating historical trends, current conditions, and expert opinion (table 1). These factor outcomes were mutually exclusive and technically exhaustive; in other words, other outcomes were thought to have a probability of occurrence so low as to justify their exclusion. Assignment of possible future outcomes for each factor has been handled in a variety of ways in past scenario generations. Palmer and Schmid (1976), in forecasting the banking world of 1985, developed factor outcomes based upon specific alternate future states that could occur, such as "antitrust actions are taken against large banks." They also used increase or decrease measures. Goldfarb and Huss (1988) established an outcome for each factor that corresponded to the particular scenario they wished to generate: high, moderate, and low economic growth. These outcomes were either very specific, such as indicating certain percentages of returns on equity in certain timeframes, or were very general indicating an increase or decrease in the current level of the factor. We used a combination of these methods to specify factor outcomes in this analysis.

Synthesis stage

The interdependencies between factor outcomes were considered in this stage, and alternative scenarios were generated through synthesis of the future outcomes. Cross-impact analysis (Sarin 1979) and the Battelle method (Brauers and Weber 1988) are the two basic methodologies typically used to implement the synthesis phase. Cross-impact analysis requires participants to provide both marginal and conditional or joint probability responses for the pairs of events. The output is a ranking of scenarios in order of their likelihoods. The Battelle method explicitly does not use probabilities; instead, it requires compatibility estimates for every possible pair of factor outcomes.

Table 1. Factors hypothesized to influence the use of grazed forages over the next 50 years and their associated mutually exclusive outcomes.

A. Land Available for Forage Production.		
	Rationale:	To take into account the impact changing land use may have upon the availability of lands for forage production.
	Outcomes:	1. Changes in land use will increase the amount of land available for grazing. 2. Changes in land use will have little impact on the amount of land available for grazing. 3. Changes in land use will decrease the amount of land available for grazing.
B. Environmental Concerns and Government Policies.		
	Rationale:	To consider the effect environmental regulations and government policies will have upon the availability of grazing lands and the opportunity of stocking them to their economic or biological capacity.
	Outcomes:	1. Regulations will increase on a national level, with lands on the margin being taken out of grazing use. 2. Nationally, a significant effect will not be seen, but local effects will be significant where resource concerns have already emerged. 3. After initial minor changes, the impacts of regulation will subside.
C. Livestock Utilization of Grazing Lands.		
	Rationale:	To evaluate the trends in livestock numbers and their utilization of, and demand for, grazing lands. Utilization includes the amount of forage consumed and habitat used.
	Outcomes:	1. Livestock utilization of grazing lands will increase. 2. Livestock utilization of grazing lands will not change significantly. 3. Livestock utilization of grazing lands will decrease.
D. Wildlife Utilization of Grazing Lands.		
	Rationale:	To evaluate the trends in wildlife numbers and their utilization of, and demand for, grazing lands. Utilization includes the amount of forage consumed and habitat used. Consumptive and non-consumptive demands on wildlife are both considered.
	Outcomes:	1. Wildlife utilization of grazing lands will increase. 2. Wildlife utilization of grazing lands will not change significantly. 3. Wildlife utilization of grazing lands will decrease.
E. Technology Changes in Forage Production.		
	Rationale:	To determine impacts on grazing resources from development or use of technology that would enhance the use of grazed forages.
	Outcomes:	1. There will not be significant changes in the development or use of forage production technology. 2. There will be significant changes in the development or use of forage production technology.

The output is a range of compatible scenarios and their average compatibility values.

Brauers and Weber (1988) suggested an alternative method that combines cross-impact analysis and the Battelle method. This method incorporates both marginal and joint probabilities, with the joint probabilities being estimated using marginal probabilities and compatibility ratings obtained by panel members. This methodology serves as the basis to obtain cross-impact probabilities and conduct the generation of scenarios.

The majority of work done with scenario analysis has been within individual corporations where a panel can be assembled to work closely as a group until the project is completed. When the experts do not live in proximity, work for different organizations, and have little incentive to spend their time with such a planning process other that for personal interest, then continual and close contact is not possible. To resolve this situation, surveys were developed (appendix B) to elicit from panel members information essential for developing scenarios.

With assistance from panel members, lists of issues expected to influence each factor were identified in order to better interpret their evaluation of the factor/outcome predictions (appendix B, form A). Respondents were asked to indicate the direction of change they believed each issue would take and also rate the influence each issue was expected to have on the use of grazed forages via the factor with which the issue was associated. The direction each issue was expected to take was rated as significant decrease, decrease, no change, increase, or significant increase. The influence each issue was expected to exhibit on the use of grazed forages via the factor being considered was rated as very negative, negative, neutral, positive, or very positive.

A probability of occurrence for each factor outcome was obtained from panel members. These probabilities

can be referred to as marginal probabilities and expressed as $p(i)$, $p(j)$, and so forth, where $p(i)$ is the probability that outcome i will occur and $p(j)$ is the probability that outcome j will occur. Because possible future states of each factor were considered to be exhaustive and mutually exclusive, the assigned marginal probabilities of each factor's outcomes summed to 1. Factor outcomes not examined in this study were hypothesized to have a zero or low likelihood of occurrence and were deleted from consideration to simplify the study.

Interdependencies between all factor outcomes were considered to ensure that the generated scenarios were internally consistent; in other words, scenarios were not composed of factor outcomes that had low likelihoods of occurring together. Interdependencies between factor outcomes can be expressed as either conditional or joint probabilities. Conditional probabilities reflect the probability of i given j, or $p(i/j)$. Joint probabilities reflect the probability of i and j occurring simultaneously, or $p(i\ {}^*j)$. Joint probabilities assume symmetry, in other words, $p(i\ {}^*j) = p(j\ {}^*i)$; however, with conditional probabilities, $p(i/j)$ does not necessarily equal $p(j/i)$.

To determine compatible scenarios, simultaneous occurrence was assumed rather than a conditional relationship. Some settings may require a conditional inquiry, such as a link between oil supply and war. War may create a higher likelihood of a shortage in oil supply, but a shortage in oil supply may not necessarily create a higher likelihood of war. In forecasting the future state of grazed forages, rather than considering conditional relationships, events were evaluated as either being or not being compatible with one another. Joint probabilities reflect this condition of symmetry, allowing consideration of concurrent occurrence rather than conditional relationships.

To keep the information demanded from respondents as simple as possible, we asked participants to evaluate how compatible two factor outcomes were (for example, factor A, outcome 1, and factor B, outcome 3), rather than directly estimating their joint probability. Compatibility ratings were expressed on a scale of 1 to 5. A compatibility rating of 5 indicated two possible occurrences were very compatible, and a rating of 1 indicated they were not likely to occur together. Values of 2, 3, and 4 represented increasing compatibility. At the suggestion of reviewers, compatibility ratings in the panel survey were expressed as –2, –1, 0, +1, and +2 instead of 1 through 5, respectively. However, they were converted back to 1 through 5 for analysis.

Panel data from forms B and C (appendix B) were consolidated by region to obtain the data needed for the synthesis stage. Regional marginal probability estimates for each factor outcome were obtained by averaging individual responses. Factor outcome compatibility estimates were converted to the 1 to 5 scale used by Brauers and Weber (1988). The median response was used for the aggregated regional compatibility (appendix A, tables A4–A6). When the number of responses was an even number and the median fell between two different values, the mean was used as a pointer to select the compatibility rating between the two median values.

Generation of scenarios

A total of 162 scenarios (appendix A, tables A7–A9) were possible given that four factors had three possible outcomes and one factor had two possible outcomes ($3^4 \times 2^1$). Scenarios deemed to have a low possibility of occurring were eliminated under two conditions: First, if a compatibility rating of 1 (not likely to occur together) existed between any two factor outcomes in a scenario, the scenario was eliminated. Second, intrascenario compatibility ratings were developed by averaging the individual compatibilities between the factor outcomes in each scenario. If the intrascenario compatibility of the scenario was less than 3.1, the scenario was eliminated. A lower limit of 3.1 was chosen to assure the remaining scenarios had an intrascenario compatibility above 3 (in other words, above a neutral compatibility).

The objective of scenario analysis was to develop a small number (two or three) of representative scenarios that can be used in strategic planning. Brauers and Weber (1988) recommended cluster analysis (Martino and Chen 1978) be used to organize scenarios into homogeneous groupings that are as heterogeneous between themselves as possible. The optimal number of scenario groupings to consider often is controlled by the ability of the end user to conceptualize the alternatives and use them in planning. Two to four scenarios are usually recommended.

In this study, we developed representative scenarios using cluster analysis to group scenarios on the basis of their compatibility. To accomplish this, interscenario compatibility ratings were determined by comparing the compatibility ratings between the factor outcomes in one scenario with each factor outcome in another scenario, summing all of these compatibility levels, and dividing by the number of factors levels compared. The resulting scenario compatibilities ranged from 1 to 5. Finalized input for the cluster analysis was a q^*q diagonal matrix (q = number of acceptable scenarios) composed of compatibility ratings between all scenarios. Diagonal values were assigned a rating of 5.

All scenarios were clustered into two or three groups so as to maximize the interscenario compatibility within a group and minimize the interscenario compatibility between groups. To determine whether two or three clusters were optimal, we developed an average intercompatibility rating for all scenarios within each cluster, and subsequently compared them to determine which number obtained a maximum average compatibility rating.

To determine a representative scenario for each cluster, the mean, mode, and median of each factor outcome within a cluster were examined (appendix A, tables A10–A15). Three representative scenarios were determined for each cluster based upon each statistic (mean, mode, and median). If the statistics disagreed on the representative scenario, scenario intracompatibility ratings were used to decide between the three alternatives.

Determining scenario probabilities

To calculate scenario likelihoods or probabilities of occurrence, the compatibility estimates, k_{ij}, of values 1 through 5 were transformed into probabilities. Marginal probabilities of the two events, i and j, were used to determine the upper and lower bounds of the joint probability $p(i\ *j)$ according to probability theory axioms, as:

$$l_{ij} = max\{0, p(i) + p(j) - 1\} \leq p(i\ *j) \leq min\{p(i),p(j)\} = u_{ij}, \quad (1)$$

where, l_{ij} = joint probability lower limit and u_{ij} = joint probability upper limit.

Compatibility values were then transformed into joint probabilities $p(i\ *j)$ using the equations:

$$p(i\ *j) = p(i)\ *p(j) - \{(l_{ij} - p(i)\ *p(j))\ *(k_{ij} - 3)/2\}, \text{ and} \quad (2)$$

$$p(i\ *j) = p(i)\ *p(j) + \{(u_{ij} - p(i)\ *p(j))\ *(k_{ij} - 3)/2\}. \quad (3)$$

This gave two linear interpolations, one for $1 \leq k \leq 3$ and one for $3 \leq k \leq 5$. The calculated joint probabilities $p(i\ *j)$ were preliminary in that the probability of each outcome would probably not be equal to the sum of the joint probabilities for this outcome and every other outcome both occurring and not occurring, or

$$p(i) = p(i\ *j) + p(i\ *\sim j), \quad (4)$$

where $p(i\ *\sim j)$ is the joint probability that event i will occur and event j will not.

To adjust joint probabilities and determine scenario probabilities, a goal programming model (GP) with the objective of minimizing the differences of the initial or preliminary (p) and corrected or final (p') joint probabilities was developed (Brauers and Weber 1988). Once the corrected joint probabilities $p'(i\ *j)$ that satisfied the condition $p(i) = p'(i\ *j) + p'(i\ *\sim j)$ were obtained, the difference between the initially calculated joint probabilities $p(i\ *j)$, and the corrected probabilities $p'(i\ *j)$ was measured as d^- and d^+. When $p'(i\ *j) < p(i\ *j)$, the difference was d^-, and when $p'(i\ *j) > p(i\ *j)$, the difference was d^+. If the two joint probabilities were equal, the difference was zero. Following Brauers and Weber (1988), the GP was of the form:

$$\min \textstyle\sum_{ij}(d_{ij}^- + d_{ij}^+) + M*D \quad (5)$$

subject to

$$y^{t*}a_i = p(i) \quad (6)$$

$$y^{t*}(a_i\ *a_j) - p'(i\ *j) = 0 \quad (7)$$

$$\textstyle\sum y_s = 1,\ s = 1 \text{ to } N \quad (8)$$

$$p'(i\ *j) + (d_{ij}^-) - (d_{ij}^+) = p(i\ *j) \quad (9)$$

$$p'(i\ *j) + p'(i\ *\sim j) = p(i) \quad (10)$$

$$D - d_{ij}^+ \geq 0 \quad (11)$$

$$D - d_{ij}^- \geq 0$$

$$y_s,\ d_{ij}^-,\ d_{ij}^+,\ D \geq 0\ i, j = 1,\ldots,N. \quad (12)$$

where,

M = a large value, for example, 10,000
D = the maximum of all individual difference variables
a_i = 0 if outcome A was not in the scenario and 1 if outcome A was in the scenario
y^t = probability of outcome.

The objective function (equation 5) minimized both the maximum difference between the initial and final joint probabilities and the sum of the individual deviations. Equation 6 constrained the sum of the probabilities for the scenarios that comprised factor level a_i to be equal to the marginal probability of factor level a_i. Similarly, equation 7 constrained the joint probability of i and j to equal the sum of the probabilities of scenarios including both i and j. Equation 8 constrained the sum of individual scenario probabilities to be equal to 1. Equation 9 determined the difference between the preliminary and final joint probabilities. In equation 10, the probability of outcome i was constrained to be equal to the sum of the joint probabilities for outcome i and every other outcome both occurring and nonoccurring. Equation 11 defined the generalized difference variable as an upper limit and equation 12 ensured that all variables were nonnegative. Because only a subset of all possible scenarios was examined, the equality constraints on equations 6, 7, and 8 were replaced with less-than-or-equal-to constraints.

The GP model provided individual scenario probabilities, but because of the degenerate solution problem in linear programming, alternative probabilities existed. Brauers and Weber (1988) suggest solving the GP to obtain the minimum possible deviation ($\mathrm{MIN}_{\mathrm{dev}}$) and then creating a new objective function and one additional constraint for use in a postoptimality analysis. Using this suggestion, the new objective function was

$$\text{Min } y_s \text{ or Max } y_s, \tag{13}$$

and the additional constraint was

$$\min \textstyle\sum_{ij}(d_{ij}^- + d_{ij}^+) + M\,{}^*D = \mathrm{MIN}_{\mathrm{dev}},\ s = 1, \ldots, K. \tag{14}$$

This model was solved for each of the K scenarios to obtain their minimum and maximum probability of occurrence. The arithmetic mean of the upper and lower bound, after being adjusted by the summation of all scenarios so the probabilities summed to 1, defined the probability of each scenario.

Projection of Grazed Forage Use

After the major scenarios were developed for each region, panel members were shown historical grazed forage use from 1968 through 1998 for their region and were asked to project grazed forage use under each scenario. The historical trend in grazed forages was estimated using January 1 cattle and sheep inventory numbers along with estimates of grazed forage consumption from enterprise budgets developed by USDA Forest Service, USDI Bureau of Land Management (BLM), and USDA Economic Research Service (Gee and others 1990). The unit of measurement was animal unit months (AUM), which is the amount of forage required to feed 1 animal unit—a 1,000-lb cow with nursing calf or equivalent—for 1 month (Glossary Update Task Group 1998). Panel members estimated regional grazed forage use by providing a distribution (10 estimates) of expected forage use in the years 2010 and 2050 for each scenario.

Results

Twelve useable responses from panel members were obtained for the West and South Region and 11 in the North Region, where one individual failed to respond. Grazed forage projections were received from 9, 10, and 11 panel members in the South, North, and West Regions, respectively.

Marginal Probabilities

Factor outcomes with the highest marginal probabilities were fairly consistent among regions (table 2). The probability that land available for forage production will decrease was almost double other land availability outcomes. Wildlife utilization of grazing lands was expected to increase in each region with a marginal probability of 54 to 60 percent. Conversely, small probabilities were attached to decreases in wildlife use of rangelands. Technology change outcomes in forage production also was consistent between regions with significant changes having the highest probability of occurrence.

A slight difference existed between regions on environmental concerns and government policies. For the South and West Regions, respondents attached the highest probability of occurrence to the outcome that regulations will increase on a national level, with lands on the margin being taken out of grazing use. North Region respondents narrowly felt that a significant national effect will not be seen; however, local effects will be significant in areas where resource concerns have already emerged. Both of these outcomes were ranked either 1 or 2 in all regions. The lowest probability in each region for an environmental/government outcome was attached to outcome 3, where, after initial minor changes, the impacts of regulation will subside.

The largest difference between regional assessments was with projections concerning livestock utilization of grazing lands. An increase in livestock utilization had a probability of occurrence of 56 percent in the North Region while a decrease in livestock utilization of grazing lands in the West Region had a marginal probability of 50 percent. The marginal probabilities for livestock utilization in the South Region were more uniform, with a 35, 38, and 27 percent probability of an increase, no change, and decrease, respectively.

Higher probabilities were attached to land being removed from grazing use because of regulations and changes in land use in the West Region than in the other two regions. A lower probability was also attached to the ability of forage production technologies to improve the use of forage in the West.

Compatibility Ratings

As a general rule, outcomes that had a high marginal probability of occurrence had high compatibility ratings with other outcomes (tables 3–5). Outcomes with a low marginal probability typically had lower compatibility ratings. For example, for the South Region

Table 2. Marginal probabilities of outcomes for each factor influencing the use of grazed forages, all regions.

Factor/Alternative	Marginal Probability by Region		
	South	North	West
A. Land Available for Forage Production			
1. Changes in land use will increase the amount of land available for forage production.	.25	.27	.12
2. Changes in land use will have little impact on the amount of land available for grazing.	.26	.23	.24
3. Changes in land use will decrease the amount of land available for grazing.	.49	.50	.64
B. Environmental Concerns and Government Policies			
1. Regulations will increase on a national level, with lands on the margin being taken out of grazing use.	.42	.35	.56
2. Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.	.38	.41	.35
3. After initial minor changes, the impacts of regulation will subside.	.20	.24	.09
C. Livestock Utilization of Grazing Lands			
1. Livestock utilization of grazing lands will increase.	.35	.56	.13
2. Livestock utilization of grazing lands will not change significantly.	.38	.19	.37
3. Livestock utilization of grazing lands will decrease.	.27	.25	.50
D. Wildlife Utilization of Grazing Lands			
1. Wildlife utilization of grazing land will increase.	.60	.54	.59
2. Wildlife utilization of grazing lands will not. change significantly	.28	.37	.31
3. Wildlife utilization of grazing lands will decrease.	.12	.09	.10
E. Technology Changes in Forage Production			
1. There will not be significant changes in the development or use of forage production technologies.	.30	.25	.41
2. There will be significant changes in the development or use of forage production technologies.	.70	.75	.59

Table 3. Compatibility ratings of mutually exclusive outcomes for each factor[a], South Region.

Factor Outcomes	Factor Outcomes													
A1	na													
A2	na	na												
A3	na	na	na											
B1	1	2	4	na										
B2	2	3	4	na	na									
B3	3	4	4	na	na	na								
C1	4	3	4	2	3	4	na							
C2	2	3	3	2	3	4	na	na						
C3	2	2	5	4	3	3	na	na	na					
D1	2	4	4	4	4	4	2	4	5	na				
D2	2	3	3	2	3	3	3	4	2	na	na			
D3	2	2	2	2	2	2	4	3	1	na	na	na		
E1	2	4	3	2	3	3	2	3	3	4	3	2	na	
E2	4	4	4	4	4	4	5	4	2	4	4	2	na	0na
	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2

[a]*A, B, C, D, and E represent the five factors. 1, 2, and 3 are the factor outcomes. Refer to table 1 for definitions.*
[b]*na = not applicable.*

Table 4. Compatibility ratings of mutually exclusive outcomes for each factor[a], North Region.

Factor Outcomes	Factor Outcomes													
A1	na													
A2	na	na												
A3	na	na	na											
B1	1	2	5	na										
B2	4	3	4	na	na									
B3	4	3	3	na	na	na								
C1	5	3	1	2	3	4	na							
C2	3	4	2	3	4	3	na	na						
C3	1	2	5	4	4	3	na	na	na					
D1	5	4	3	4	4	4	4	4	4	na				
D2	2	3	3	3	3	3	3	4	3	na	na			
D3	2	2	3	2	2	3	3	2	1	na	na	na		
E1	2	2	3	3	3	3	2	4	4	4	3	3	na	
E2	4	3	2	4	4	4	5	3	2	4	3	2	na	0na
	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2

[a]*A, B, C, D, and E represent the five factors. 1, 2, and 3 are the factor outcomes. Refer to table 1 for definitions.*
[b]*na = not applicable.*

(table 3), significant changes in the development or use of forage production technologies had the highest marginal probability (70 percent), and the decrease in wildlife utilization of grazing lands had the lowest marginal probability (12 percent). The majority of compatibility ratings associated with increased forage technologies were level 4 (likely to occur together). The majority of compatibility ratings for a decrease in wildlife utilization of grazed forages were level 2 (low likelihood of occurring together).

Compatibility ratings were fairly equally divided between compatibility levels 2, 3, and 4. Unless a near consensus occurred between regional panel members, extreme compatibility ratings (1 and 5) were eliminated by the central tendency method (using the median, mode, or average) used to develop each regional compatibility matrix. Level 1 compatibility ratings (will not occur together) occurred twice in the South and West Regions and four times in the North Region. Compatibility ratings of 5 (very likely to occur

Table 5. Compatibility ratings of mutually exclusive outcomes for each factor[a], West Region.

Factor Outcomes	Factor Outcomes													
A1	na													
A2	na	0na												
A3	na	na	na											
B1	1	2	5	na										
B2	2	3	5	na	na									
B3	3	4	3	na	na	na								
C1	4	3	1	2	2	2	na							
C2	2	4	2	2	3	4	na	na						
C3	2	3	5	5	4	3	na	na	na					
D1	2	4	5	4	4	4	2	4	5	na				
D2	2	4	4	4	3	3	2	3	4	na	na			
D3	2	3	3	2	2	2	2	2	2	na	na	na		
E1	2	3	3	4	3	3	2	3	4	3	3	2	na	
E2	2	4	4	4	4	3	4	4	3	4	3	2	na	na
	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2

[a]*A, B, C, D, and E represent the five factors. 1, 2, and 3 are the factor outcomes. Refer to table 1 for definitions.*
[b]*na = not applicable.*

together) resulted three, six, and five times in the South, North, and West Regions, respectively. Most of the level 1 and 5 compatibility ratings involved the relationships between available land, government regulations, and numbers of livestock and wildlife. In general, increased regulations implied decreased land available for grazing, which in turn implied less livestock grazing activity. An inverse relationship between the utilization of grazing lands by livestock and wildlife was expressed. Panel members in the South and North Regions indicated that an increase in the utilization of grazing lands by livestock would be attached to significant changes in the development or use of forage production technologies.

South Region, Assessment of Issues

Land available for forage production

Few issues were projected to have major impacts on the amount of land available for forage production over the next several decades in the South Region (table 6). The major influence was an expansion in urbanization and suburban development. Urban sprawl is expected to have the most negative impact on the amount of land available for forage production. Recreational demand, reforestation projects and allocation of lands for parks and watershed districts should increase slightly but have negligible impacts on forage production. An increase in the use of conservation easements and "green space" promotion was expected, but should have a modest influence on the land available for forage production.

In 1997, slightly less than 80,000 AUMs were permitted for grazing on National Forest System lands in the South Region, with 80 percent of these being authorized or paid permits (USDA Forest Service 1998). About 9,000 head of livestock, mostly cattle, were grazed sometime during the year. Continued use of these lands for livestock grazing was expected to decrease slightly and exhibit a slightly negative influence on the use of grazed forages in the South Region.

Environmental concerns and government policies

Environmental regulations were expected to negatively impact the use of grazed forages in the South Region (table 7). Regulations regarding wetland and riparian management were foreseen to have the greatest negative influence, followed by preservation programs and regulations anticipated from the Endangered Species Act. The greatest increase in environmental regulations were anticipated from the Clean Water Act, but respondents were divided on the impact of these regulation on the use of grazed forages.

Government commodity programs impacting crops grown in the South Region were expected to decrease slightly. This in turn should have a slightly positive impact on the use of grazed forages. Federal conservation programs such as the Conservation Reserve Program (CRP), initiated in Title XII of the Food Security Act of 1985, should change little in the future. The CRP was anticipated to exert a slightly positive influence on the use of grazed forages as some of these lands convert to grazing use in future years. Conversely, wilderness and other preservation programs should increase and exhibit a neutral to very negative influence on the use of grazed forages.

Respondents did not anticipate much future assistance to the grazed forage industry via range

Table 6. Issues influencing Factor 1: land available for forage production, South Region.

Issue	Direction[a]						Influence					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Suburbanization (ranchettes, etc.)	8	17	0	58	17	0.58	17	42	17	25	0	–0.50
Expansion of population centers (urban sprawl)	0	25	0	50	25	0.75	25	58	16	0	0	–1.08
Building "second" homes in rural settings	8	25	17	42	8	0.17	8	50	25	17	0	–0.50
Use of conservation easements and similar programs	8	0	17	67	8	0.67	0	50	25	17	8	–0.17
"Open space" or "green space" promotion	0	8	50	33	8	0.42	0	17	75	8	0	–0.08
Recreational demands on grazing lands	9	9	18	54	9	0.45	0	46	36	18	0	–0.27
Land in crop production vs. grazed forages	8	33	25	33	0	–0.17	0	25	42	25	8	0.17
Use of U.S. Forest Service lands for livestock grazing	10	50	30	10	0	–0.60	0	60	40	0	0	–0.60
Natural and planned reforestation	0	36	9	55	0	0.18	0	64	18	18	0	–0.45
Allocation of lands for other uses like local parks and watershed districts	0	8	58	25	8	0.33	0	33	67	0	0	–0.33

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*

[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

Table 7. Issues influencing Factor 2: environmental concerns and government policies, South Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Regulations regarding wetland and riparian area conservation	17	8	0	50	25	0.58	25	42	17	0	17	–0.58
Regulations due to the Endangered Species Act	8	0	17	58	17	0.75	8	50	25	17	0	–0.50
Regulations due to the Clean Water Act	8	0	8	58	25	0.92	8	25	34	25	8	0.00
Conservation programs (for example CRP)	0	46	18	36	0	–0.09	0	18	36	36	9	0.36
Quantity of water available for agriculture (vs. residential) use	0	33	42	8	17	0.08	8	17	58	17	0	–0.17
Wilderness area and other preservation programs	0	18	36	46	0	0.27	9	36	55	0	0	–0.55
Predator control laws and regulations	0	9	55	36	0	0.27	0	27	64	9	0	–0.18
BLM and USFS grazing regulations (standards and guidelines, rangeland monitoring, etc.)	17	0	33	50	0	0.17	0	33	50	0	17	0.00
Range improvement cost share programs	0	33	34	33	0	0.00	0	33	34	22	11	0.11
Government commodity programs	10	50	20	20	0	–0.50	0	10	40	50	0	0.40
Pesticide and animal health product restrictions	0	8	17	67	8	0.75	0	33	50	8	8	–0.08

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

improvement cost share programs. Pesticide and animal health product restrictions should increase but exhibit a neutral influence on the use of grazed forages.

Livestock utilization of grazed lands

Beef cattle, goat, and horse numbers were projected to increase in the South Region, while the number of dairy cattle and sheep were seen to decline (table 8). Concomitant with changes in livestock numbers, goat and beef cattle producer profit margins were anticipated to increase. Profit margins of dairy cattle producers and sheep producers, conversely, were expected to decline.

The use of grazed forages in the diets of beef and dairy cattle was projected to rise. The increased use of grazed forages in dairy cattle diets should somewhat offset the negative impact from decreased dairy numbers. The time goats and horses spend on grazed forages also should increase slightly. The use of livestock (most expectedly goats) to combat weed infestations was projected to increase and have a positive influence on use of grazed forages. Alternative livestock such as bison, elk, and deer were expected to increase slightly but have little influence on the overall use of grazed forages in the region. An increase in fee and nonfee costs of operating on both private and Federal lands and an increase in public concern for animal rights should somewhat temper the projected increase in the demand for grazed forages in the South Region. Advances in livestock production technologies also were projected to slightly decrease the number of livestock required to meet consumer demand.

Wildlife utilization of grazing lands

Demand for wildlife resources in the South Region were expected to increase over the next several decades (table 9). The most significant increase in demand should extend from hunting, followed closely by nonconsumptive demand for wildlife and demand for existence, option, or bequest values.

Nonmarket uses of wildlife were not projected to be as complementary with livestock grazing as hunting and nonconsumptive activities. Hunting and nonconsumptive demands were expected to have a neutral influence on the use of grazed forages in the South Region. A slightly negative impact was anticipated from an increased demand for wildlife from existence, option, or bequest values. The influence of wildlife nonmarket demands on the use of grazed forages may be related to the anticipated increase in the area of grazing lands projected to be purchased or set aside for wildlife habitat. Also, while the utilization of both private and public lands for wildlife purposes was expected to increase, only the increased utilization on public lands was projected to hinder the use of grazed forages.

Technology changes in forage production

Development and application of new technologies were expected to play a role in the increased use of grazed forages over the next several decades (table 10). Foremost is the use of biological control methods for weed and brush management. Development of new forage species and varieties, development of grazing

Table 8. Issues influencing Factor 3: livestock utilization of grazing lands, South Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Number of beef cattle in your region	0	8	25	67	0	0.58	0	8	25	67	0	0.58
Number of dairy cattle in your region	17	50	17	17	0	-0.67	8	17	42	25	8	0.08
Number of sheep in your region	10	30	60	0	0	-0.50	0	30	70	0	0	–0.30
Number of goats in your region	0	9	18	73	0	0.64	0	0	36	64	0	0.64
Number of horses in your region	0	0	33	50	17	0.83	0	0	42	58	0	0.58
Time beef cattle spend on grazed forages	0	0	25	67	8	0.83	0	0	33	58	8	0.75
Time dairy cattle spend on grazed forages	8	25	8	50	8	0.25	0	25	25	33	17	0.42
Time sheep spend on grazed forages	0	0	100	0	0	0.00	0	0	90	10	0	0.10
Time goats spend on grazed forages	0	0	73	27	0	0.27	0	0	64	36	0	0.36
Time horses spend on grazed forages	0	0	75	25	0	0.25	0	0	75	8	17	0.42
Alternative feed sources for livestock in lieu of grazed forages	0	33	34	33	0	0.00	0	17	67	17	0	0.00
Use of grazing livestock to combat weed infestations	0	0	45	46	9	0.64	0	0	55	36	9	0.55
Advances in livestock production technology so as to decrease the number of livestock required for food	0	0	40	60	0	0.60	0	30	70	0	0	–0.30
Fee and non-fee costs of operating on public lands	0	0	14	72	14	1.00	0	29	57	14	0	–0.14
Fee and non-fee costs of operating on private lands	0	0	11	89	0	0.89	0	45	33	22	0	–0.22
Profit margins of beef cattle producers	0	17	50	25	8	0.25	0	8	50	42	0	0.33
Profit margins of dairy cattle producers	8	42	42	8	0	–0.50	0	33	42	17	8	0.00
Profit margins of sheep producers	0	20	70	10	0	–0.10	0	20	80	0	0	–0.20
Profit margins of goat producers	0	0	36	64	0	0.64	0	0	45	55	0	0.55
Profit margins of horse producers	0	9	73	18	0	0.09	0	0	91	9	0	0.09
Use by alternative livestock (bison, elk, deer)	0	0	54	36	9	0.55	0	18	64	18	0	0.00
Public concern for animal health/rights	0	0	8	75	17	1.08	0	58	17	17	8	–0.25

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

Table 9. Issues influencing Factor 4: wildlife utilization of grazing lands, South Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Demand for wildlife for hunting purposes	0	0	17	50	33	1.17	0	42	33	17	8	–0.08
Nonconsumptive[c] demand for wildlife	0	0	8	75	17	1.08	0	33	42	17	8	0.00
Demand for wildlife occurring from existence, option or bequest values[d]	0	0	27	55	18	0.91	9	37	36	9	9	–0.27
Number of grazing lands purchased or set-aside for wildlife use/habitat	0	0	25	58	17	0.92	8	50	25	8	8	–0.42
Wildlife utilization of private lands	0	0	25	42	33	1.08	0	33	42	17	8	0.00
Wildlife utilization of public lands	0	0	10	70	20	1.10	10	30	40	20	0	–0.30

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*
[c]*Nonconsumptive use is use of a resource in a manner that does not diminish the available total stock (for example, bird-watching or photography).*
[d]*Existence value is the external benefit that accrues to individuals having no intention of ever visiting or using the site or environment in question. These individuals are willing to give up resources simply to know that the good exists in a particular condition.*

Option value is the amount an individual would be willing to pay to preserve the option to participate in some activity or use some resource at some future time, whether or not that individual ever actually participates or uses the resource.
Bequest value is the amount an individual would be willing to pay to preserve a resource so it will be available for future generations.

Table 10. Issues influencing Factor 5: technology changes in forage production, South Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Use of brush control on grazing lands	0	8	33	59	0	0.50	0	17	42	33	8	0.33
Use of weed control on grazing lands	0	0	17	75	8	0.92	0	8	33	50	8	0.58
Development of new chemicals for brush and weed control on grazing lands	0	17	8	67	8	0.67	0	8	33	58	0	0.50
Use of existing chemicals for brush and weed control	0	17	42	42	0	0.25	0	17	50	25	8	0.25
Use of biological control methods for brush and weed control	0	0	8	58	33	1.25	0	0	17	67	17	1.00
Development of new forage species and varieties	0	0	8	75	17	1.08	0	8	25	50	17	0.75
Use of fertilizer on grazing lands	0	8	50	42	0	0.33	0	17	50	33	0	0.17
Use of irrigation on grazing lands	17	25	58	0	0	–0.58	0	17	75	8	0	–0.08
Development of grazing management methods (for example, grazing systems)	0	8	17	42	33	1.00	0	17	25	33	25	0.67
Advances in technology for livestock distribution, monitoring and handling	0	0	17	75	8	0.92	0	8	33	50	8	0.58
Water development for animal use	0	8	50	33	8	0.42	0	8	58	33	0	0.25
Technology transfer and education programs	0	8	8	58	25	1.00	0	25	8	42	25	0.67

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

management methods, and advances in technology for livestock distribution, monitoring, and handling may also positively influence the use grazed forages. An increase in educational programming was anticipated to assist producers in the adoption of these advances.

While biological control methods were expected to have the greatest influence on weed and brush management, development of new chemicals for these purposes was also expected. Conversely, a substantial increase in the use of existing chemicals for brush and weed control was not anticipated.

The use of fertilizer on grazing lands and the development of water for animal use were projected to increase slightly. Both of these advancements should have a small positive influence on forage production. Irrigation for forage production purposes, though, was expected to decline in the South Region but have a neutral influence on the use of grazed forages.

North Region, Assessment of Issues

Land available for forage production

Land available for forage production was expected to be negatively impacted over the next several decades in the North Region (table 11). All respondents felt urban sprawl should increase or significantly increase, along with suburbanization. The building of second homes in rural settings also was projected to increase. Expected, but less significant, increases in reforestation projects and allocation of lands for uses such as parks and watershed districts were seen to negatively impact the grazed forage industry. Increased recreational activities on grazing lands should not have much effect on the use of grazed forages.

Only a small amount of land was expected to change from grazing to crop production in the North Region. Grazed forages should also be slightly negatively impacted by a modest decrease in the use of National Forest System lands for livestock grazing. Approximately 57,000 permitted AUMs, representing 7,300 cattle and only a few sheep, were authorized in the North Region in 1997 (USDA Forest Service 1998).

Somewhat countering these negative influences on the use of grazed forages was an expected increase in the promotion of "open" or "green spaces." The use of conservation easements and similar programs should increase in the North Region, serving to maintain the use of grazed forages.

Environmental concerns and government policies

Issues concerning water should be relevant to grazed forage supplies in the North Region over the projected planning horizon (table 12). An increase in regulations protecting wetlands and riparian areas, along with regulations imposed by the Clean Water Act, were anticipated. These issues were projected to have the most significant negative impact on the use of grazed

Table 11. Issues influencing Factor 1: land available for forage production, North Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Suburbanization (ranchettes, etc.)	0	0	0	40	60	1.60	10	90	0	0	0	–1.10
Expansion of population centers (urban sprawl)	0	0	0	60	40	1.40	30	60	10	0	0	–1.20
Building "second" homes in rural settings	0	0	20	70	10	0.90	0	50	50	0	0	–0.50
Use of conservation easements and similar programs	0	0	0	90	10	1.10	0	40	20	40	0	0.00
"Open space" or "green space" promotion	0	0	30	60	10	0.80	0	10	60	30	0	0.20
Recreational demands on grazing lands	0	0	20	60	20	1.00	0	40	40	20	0	–0.20
Land in crop production vs. grazed forages	0	40	10	40	10	0.20	10	40	10	40	0	–0.20
Use of U.S. Forest Service lands for livestock grazing	11	33	56	0	0	–0.56	11	33	56	0	0	–0.56
Natural and planned reforestation	0	10	30	50	10	0.60	0	60	40	0	0	–0.60
Allocation of lands for other uses like local parks and watershed districts	0	10	0	80	10	0.90	0	80	20	0	0	–0.80

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

forages. Conflicts between urban and agriculture water uses also were expected to negatively influence the use of grazed forages.

Regulations due to the Endangered Species Act should have similar but less notable impacts than those associated with water issues. Wilderness area and other preservation programs were expected to increase but should only have a slight detrimental influence on the use of grazed forages in the region.

Federal agricultural programs should manifest a positive influence on the grazed forage industry and somewhat abate the issues previously discussed. Commodity programs were expected to decrease moderately and result in a fairly positive outcome on grazed forages, whereas respondents were divided concerning the impacts of the Conservation Reserve Program on the grazed forage industry. An anticipated increase in the use of range improvement cost share programs also should increase the use of grazed forages in the region. Conversely, projected grazing regulations on Federally owned lands should negatively impact the use of the forage grazed in the North Region.

Table 12. Issues influencing Factor 2: environmental concerns and government policies, North Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Regulations regarding wetland and riparian area conservation	0	10	0	70	20	1.00	30	60	10	0	0	–1.20
Regulations due to the Endangered Species Act	0	10	40	40	10	0.50	10	30	60	0	0	–0.50
Regulations due to the Clean Water Act	0	10	0	60	30	1.10	30	30	20	20	0	–0.70
Conservation programs (for example CRP)	10	30	10	50	0	0.00	0	40	20	40	0	0.00
Quantity of water available for agriculture (vs. residential) use	0	30	60	0	10	–0.10	0	40	60	0	0	–0.40
Wilderness area and other preservation programs	0	0	33	56	11	0.78	0	44	56	0	0	–0.44
Predator control laws and regulations	0	20	70	0	10	0.00	0	10	90	0	0	–0.10
BLM and USFS grazing regulations (standards and guidelines, rangeland monitoring, etc.)	0	17	50	17	17	0.33	17	33	50	0	0	–0.67
Range improvement cost share programs	0	17	17	50	17	0.67	0	0	33	67	0	0.67
Government commodity programs	33	67	0	0	0	–1.33	0	0	44	45	11	0.67
Pesticide and animal health product restrictions	0	0	20	60	20	1.00	0	10	70	20	0	0.10

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*\

Livestock utilization of grazed lands

Profit margins for beef and dairy cattle producers were expected to decrease over the next several decades, but profits for sheep, goat, and horse producers were projected to remain constant or slightly increase (table 13). During this same period, panel members expected beef cattle numbers to increase slightly, horse numbers to increase moderately, goat numbers to remain constant, and dairy cattle and sheep numbers to slightly decrease. The strongest change in the use of grazed forages was expected from increased horse numbers followed by the increase in beef cattle and goats.

The amount of time livestock, especially beef and dairy cattle, spend on grazed forages was anticipated to increase somewhat. The effect of this extended use on grazed forages varied by species. The largest impact was anticipated from beef and dairy cattle, while increased grazing duration by sheep and goats should cause minimal, if any, changes. Use of grazed forages by alternative ungulates managed for their meat, such as bison, also was expected to increase, with an anticipated positive influence on the use of grazed forages.

Several other issues were projected to influence the utilization of grazing lands by livestock in the North Region. Fee and nonfee costs were expected to increase on both private and public lands. While a higher increase was anticipated for private lands, the increase on public leases was expected to have a greater impact on the use of grazed forages. Alternative feed sources for livestock and advances in livestock production technology should also negatively impact the use of grazed forages in the region. Countering these influences was an anticipated increased public concern for animal health and animal rights. This concern should make it more politically correct, and perhaps more profitable, to produce animals such as dairy cattle using grazed forages rather than a confinement system.

Wildlife utilization of grazing lands

Although an increase in the use of grazing lands by wildlife was anticipated, the increase was projected to have only a tempered impact on the use of grazed forages (table 14). The expanded presence of wildlife should be derived more from a demand in nonconsumptive uses and existence, option, or bequest values than from an increase in hunting demand. The

Table 13. Issues influencing Factor 3: livestock utilization of grazing lands, North Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Number of beef cattle in your region	0	27	27	37	9	0.27	0	27	27	37	9	0.27
Number of dairy cattle in your region	0	60	10	30	0	–0.30	0	40	30	30	0	–0.10
Number of sheep in your region	0	55	36	9	0	–0.45	0	46	46	9	0	–0.36
Number of goats in your region	0	20	60	20	0	0.00	0	0	70	30	0	0.30
Number of horses in your region	0	0	9	91	0	0.91	0	0	27	73	0	0.73
Time beef cattle spend on grazed forages	0	0	36	55	9	0.73	0	0	36	46	18	0.82
Time dairy cattle spend on grazed forages	0	18	0	82	0	0.64	0	18	0	73	9	0.73
Time sheep spend on grazed forages	0	0	82	18	0	0.18	0	0	91	9	0	0.09
Time goats spend on grazed forages	0	0	80	20	0	0.20	0	0	90	10	0	0.10
Time horses spend on grazed forages	0	9	55	36	0	0.27	0	0	64	36	0	0.36
Alternative feed sources for livestock in lieu of grazed forages	0	9	46	46	0	0.36	0	27	73	0	0	–0.27
Use of grazing livestock to combat weed infestations	0	0	82	18	0	0.18	0	0	91	9	0	0.09
Advances in livestock production technology so as to decrease the number of livestock required for food	0	0	27	55	18	0.91	0	36	46	18	0	–0.18
Fee and nonfee costs of operating on public lands	0	14	43	43	0	0.29	14	43	43	0	0	–0.71
Fee and nonfee costs of operating on private lands	0	0	46	46	9	0.64	0	46	54	0	0	–0.45
Profit margins of beef cattle producers	0	55	27	18	0	–0.36	9	18	27	46	0	0.09
Profit margins of dairy cattle producers	0	46	36	18	0	–0.27	9	37	18	36	0	–0.18
Profit margins of sheep producers	0	27	37	36	0	0.09	0	27	37	36	0	0.09
Profit margins of goat producers	0	30	30	40	0	0.10	0	20	50	30	0	0.10
Profit margins of horse producers	0	0	100	0	0	0.00	0	0	91	9	0	0.09
Use by alternative livestock (bison, elk, deer)	0	0	9	82	9	1.00	0	0	18	82	0	0.82
Public concern for animal health/rights	0	0	36	46	18	0.82	0	9	46	46	0	0.36

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

Table 14. Issues influencing Factor 4: wildlife utilization of grazing lands, North Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Demand for wildlife for hunting purposes	0	9	18	55	18	0.82	0	36	27	36	0	0.00
Nonconsumptive[c] demand for wildlife	0	0	27	36	36	1.09	0	27	46	27	0	0.00
Demand for wildlife occurring from existence, option or bequest values[d]	0	0	18	64	18	1.00	0	55	36	9	0	–0.45
Number of grazing lands purchased or set-aside for wildlife use/habitat	0	0	36	46	18	0.82	9	46	46	0	0	–0.64
Wildlife utilization of private lands	0	0	27	64	9	0.82	9	18	46	27	0	–0.09
Wildlife utilization of public lands	0	0	46	46	9	0.64	0	27	55	18	0	–0.09

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*
[c]*Nonconsumptive use is use of a resource in a manner that does not diminish the available total stock (for example, bird-watching or photography)*
[d]*Existence value is the external benefit that accrues to individuals having no intention of ever visiting or using the site or environment in question. These individuals are willing to give up resources simply to know that the good exists in a particular condition.*

Option value is the amount an individual would be willing to pay to preserve the option to participate in some activity or use some resource at some future time, whether or not that individual ever actually participates or uses the resource.
Bequest value is the amount an individual would be willing to pay to preserve a resource so it will be available for future generations to use.

mitigated impact on the use of grazed forages was a result of a divergence of opinion among the panel members concerning the influence increased wildlife should have on the use of grazed forages. While larger wildlife herd sizes may shift grazed forages and habitat toward wildlife enterprises, the displacement of livestock by wildlife could decrease the overall use of grazed forages.

The change in wildlife utilization was expected to occur on private lands more than on pubic lands. The largest impact on the use of grazed forages was anticipated from the purchase and set-aside of lands for wildlife habitat. A close relationship between lands set aside for wildlife use and nonmarket uses of wildlife was seen to exist.

Technology changes in forage production

An emphasis on the development of technologies applicable to forage production in the North Region was anticipated (table 15). A significant increase in the improvement of grazing management methods should be accompanied by advances in technology for livestock distribution, monitoring and handling as well as the development of new forage species and varieties. These advancements were projected to have a positive to very positive impact on the use of grazed forages in the region. As with the anticipation of increased technology changes, an ensuing increase in technology transfer and education programs was expected.

A moderate increase in brush and weed control on grazing lands was expected to have a positive influence on the use of grazed forages. This increase should be more associated with the use of biological control methods and less associated with the development of new or the use of existing chemicals.

Traditional fertilization practices were projected to increase somewhat on grazing lands, with a resultant positive influence on the use of grazed forages. And while the use of irrigation on grazed forages was not expected to change, additional water development for animal use should be experienced.

West Region, Assessment of Issues

Land available for forage production

With a large portion of the West Region comprised of Federally owned land, the Forest Service and BLM are important elements when assessing the availability of land for forage production (table 16). Use of lands administered by both agencies for livestock grazing was expected to decrease in the future, with the Forest Service losing the most AUMs. Consequently, a negative influence on the use of grazed forages in the West was anticipated. The influence of this expected reduction in Federal AUMs on the grazed forage industry was projected to be stronger than any other issue influencing land available for forage production.

Table 15. Issues influencing Factor 5: technology changes in forage production, North Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Use of brush control on grazing lands	0	10	40	50	0	0.40	0	0	50	50	0	0.50
Use of weed control on grazing lands	0	10	30	60	0	0.50	0	0	50	50	0	0.50
Development of new chemicals for brush and weed control on grazing lands	0	20	40	40	0	0.20	0	10	60	30	0	0.20
Use of existing chemicals for brush and weed control	0	30	30	40	0	0.10	0	10	60	30	0	0.20
Use of biological control methods for brush and weed control on grazing lands	0	0	20	70	10	0.90	0	0	50	50	0	0.50
Development of new forage species and varieties	0	0	18	64	18	1.00	0	0	36	55	9	0.73
Use of fertilizer on grazing lands	0	9	27	37	27	0.82	0	10	10	70	10	0.80
Use of irrigation on grazing lands	0	9	82	9	0	0.00	0	0	91	9	0	0.09
Development of grazing management methods (for example, grazing systems)	0	0	0	27	73	1.73	0	0	0	36	64	1.64
Advances in technology for livestock distribution, monitoring and handling	0	0	18	55	27	1.09	0	0	18	46	36	1.18
Water development for animal use	0	9	18	73	0	0.64	0	9	18	64	9	0.73
Technology transfer and education programs	0	18	9	55	18	0.73	0	0	18	46	36	1.18

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

After the influence of Federal lands, an anticipated increase to significant increase in suburbanization, including the development of ranchettes, was expected to have the next most negative influence on the use of grazed forages. A slight expansion in urban sprawl and the building of "second homes" in rural settings should further diminish land available for forage production, but their influences will likely be secondary to suburbanization.

A continued increase in recreational demands on grazing lands was anticipated by all respondents. This movement was not expected to have as strong of an influence on the use of grazed forages as an increase in the allocation of lands for uses such as parks and watershed districts. Small increases in natural and planned reforestation projects should additionally displace some grazing lands.

The only two issues expected to exhibit a neutral to positive influence on the use of grazed forages were a persistent increase in the use of conservation easements and a promotion of "open" or "green space." The projected influence of these preservation practices

Table 16. Issues influencing Factor 1: land available for forage production, West Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Suburbanization (ranchettes, etc.)	0	0	0	58	42	1.42	17	58	8	0	17	–0.58
Expansion of population centers (urban sprawl)	0	8	8	58	25	1.00	0	58	25	8	8	–0.33
Building "second" homes in rural settings	0	0	33	50	17	0.83	8	25	58	0	8	–0.25
Use of conservation easements and similar programs	0	0	17	83	0	0.83	0	8	58	25	8	0.33
"Open space" or "green space" promotion	0	0	27	64	9	0.82	0	27	46	18	9	0.09
Recreational demands on grazing lands	0	0	0	75	25	1.25	8	50	17	8	17	–0.25
Land in crop production vs. grazed forages	0	33	42	25	0	–0.08	17	8	50	17	8	–0.08
Use of U.S. Forest Service lands for livestock grazing	33	67	0	0	0	–1.33	42	42	8	0	8	–1.08
Use of Bureau of Land Management lands for livestock grazing	17	67	16	0	0	–1.00	17	50	25	0	8	–0.67
Natural and planned reforestation	0	8	33	58	0	0.50	0	17	83	0	0	–0.17
Allocation of lands for other uses such as local parks and watershed districts	0	8	25	42	25	0.83	8	33	50	0	8	–0.33

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

on the use of grazed forages in the West Region does not appear to be of sufficient strength to reverse the trend associated with the land utilization issues previously discussed.

Environmental concerns and government policies

Federal regulations and environmental concerns were projected to be important factors influencing the use of grazed forages (table 17). The strongest negative impacts should result from expanded regulations attending the Clean Water Act followed closely by those associated with a close to significant increase in wetland and riparian area conservation regulations. Standards and guidelines, rangeland monitoring, and other regulations ensuing from the Forest Service and BLM also were anticipated to have a negative influence on the use of grazed forages. Other regulations that were predicted to be strengthened, but should have a minor influence on the use of grazed forages, were those due to the Endangered Species Act, wilderness and preservation programs, predator control regulations, and pesticide and animal health product regulations.

While government commodity programs were expected to be reduced, they should have little influence upon the grazed forage industry in the West. Conservation programs such as the Conservation Reserve Program will tend to subside with conservation lands being returned to grazing.

In the past, range improvement cost-share programs have had a positive influence on the use of grazed forages in the West Region. A further reduction in these programs was anticipated but was expected to be associated with a relatively minor negative influence on the future use of grazed forages.

Competition for water between agriculture and urban uses was anticipated to decrease slightly from what has been seen in the past, but should continue to exhibit negative pressure on grazed forages.

Livestock utilization of grazed lands

The number of beef cattle and sheep in the West Region was expected to decline over the next few decades (table 18). Conversely, the number of dairy cattle, goats, and horses should be on the rise, but this trend was not anticipated to be as prominent as the trend associated with beef cattle and sheep. The practice of using sheep and goats to control weed infestations should expand and be somewhat of a positive influence on grazed forage use. Likewise, the decrease in beef cattle numbers should be partially offset by the increased amount of time they will spend on grazed forages. Profit margins of beef and dairy cattle were projected to decrease slightly, but were not expected to have repercussions on grazed forage use. Alternative classes of domesticated or managed grazing animals were projected to increase in the West Region; they were not expected to be as demanding on grazed forages as the livestock they replace.

Fee and nonfee costs of grazing public and private lands were expected to increase. The increase should be more pronounced on public lands and should negatively impact the grazing on those areas.

Table 17. Issues influencing Factor 2: environmental concerns and government policies, West Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Regulations regarding wetland and riparian area conservation	0	0	0	58	42	1.42	33	42	0	17	8	–0.75
Regulations due to the Endangered Species Act	0	8	17	50	25	0.92	17	42	25	8	8	–0.50
Regulations due to the Clean Water Act	0	8	0	58	33	1.17	25	58	8	0	8	–0.92
Conservation programs (for example CRP)	0	46	27	27	0	–0.18	0	9	55	36	0	0.27
Quantity of water available for agriculture (vs. residential) use	0	58	8	25	8	–0.17	8	50	25	8	8	–0.42
Wilderness area and other preservation programs	0	0	33	58	8	0.75	8	33	50	0	8	–0.33
Predator control laws and regulations	0	17	33	50	0	0.33	0	50	50	0	0	–0.50
BLM and USFS grazing regulations (standards and guidelines, rangeland monitoring, etc.)	8	8	0	59	25	0.83	17	58	17	0	8	–0.75
Range improvement cost share programs	17	33	33	17	0	–0.50	0	25	67	8	0	–0.17
Government commodity programs	27	64	9	0	0	–1.18	0	36	46	18	0	–0.18
Pesticide and animal health product restrictions	0	8	25	67	0	0.58	0	42	50	8	0	–0.33

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

Table 18. Issues influencing Factor 3: livestock utilization of grazing lands, West Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Number of beef cattle in your region	9	83	8	0	0	–1.00	0	67	17	8	8	–0.42
Number of dairy cattle in your region	17	8	8	59	8	0.33	0	17	66	17	0	0.00
Number of sheep in your region	8	50	42	0	0	–0.67	0	34	58	8	0	–0.25
Number of goats in your region	0	9	55	36	0	0.27	0	0	100	0	0	0.00
Number of horses in your region	0	8	33	50	9	0.58	0	42	50	8	0	–0.33
Time beef cattle spend on grazed forages	0	8	33	50	9	0.58	0	0	50	50	0	0.50
Time dairy cattle spend on grazed forages	8	17	42	33	0	0.00	0	17	66	17	0	0.00
Time sheep spend on grazed forages	0	17	66	17	0	0.00	0	0	83	17	0	0.17
Time goats spend on grazed forages	0	9	82	9	0	0.00	0	0	82	18	0	0.18
Time horses spend on grazed forages	0	0	75	25	0	0.25	0	17	75	8	0	–0.08
Alternative feed sources for livestock in lieu of grazed forages	0	27	27	36	10	0.27	0	9	73	18	0	0.09
Use of grazing livestock to combat weed infestations	0	0	18	73	9	0.91	0	0	64	36	0	0.36
Advances in livestock production technology so as to decrease the number of livestock required for food	0	0	25	67	8	0.83	8	25	42	25	0	–0.17
Fee and nonfee costs of operating on public lands	0	0	0	67	33	1.33	9	50	25	8	8	–0.42
Fee and nonfee costs of operating on private lands	0	0	17	66	17	1.00	0	34	50	8	8	–0.08
Profit margins of beef cattle producers	8	25	42	25	0	–0.17	0	33	42	17	8	0.00
Profit margins of dairy cattle producers	8	34	50	8	0	–0.42	0	25	67	0	8	–0.08
Profit margins of sheep producers	0	17	58	25	0	0.08	0	25	50	25	0	0.00
Profit margins of goat producers	0	9	73	18	0	0.09	0	0	91	9	0	0.09
Profit margins of horse producers	0	8	75	17	0	0.08	0	8	92	0	0	–0.08
Use by alternative livestock (bison, elk, deer)	0	0	0	83	17	1.17	8	42	33	9	8	–0.33
Public concern for animal health/rights	0	0	33	34	33	1.00	8	42	42	0	8	–0.42

[a]*Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.*
[b]*Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.*

Public concern for animal rights was projected to be on the rise with an ensuing negative impact to the use of grazed forages. Advances in livestock production technology that have the potential to decrease the number of livestock required to meet consumer demand were likewise expected to reduce the use of grazed forages slightly.

Wildlife utilization of grazing lands

A decrease in the demand for wildlife associated with hunting was anticipated in the future, while the consumptive and nonmarket demands for wildlife were projected to increase (table 19). Associated with the increase in consumptive and nonmarket demands for wildlife was an expected expansion in the amount of grazing land set aside for wildlife habitat. Wildlife utilization on both private and public lands should equally increase. The influence on the use of grazed forages in the West Region from an increase in wildlife utilization was expected to be slightly negative.

Technology changes in forage production

Future technological developments were not projected to have a consequential influence on the grazed forage industry in the West Region (table 20). The major increase in technology was anticipated in the areas of biological methods for brush and weed control, development of grazing management methods, and advances in technology for livestock distribution, monitoring, and handling. These innovations were predicted to have a moderately positive influence on the use of grazed forages. Development of new forage cultivars were expected to exhibit a slight positive impact on the use of grazed forages. A modest increase in technology transfer and education programs also should accompany these projected developments.

Chemical use for control of weeds and brush, fertilization of grazing lands, and irrigation were expected to decline; however, a negative impact on grazed forage use was not anticipated from these reductions. The development of new water sources for livestock use should also be negligible in the future.

Table 19. Issues influencing Factor 4: wildlife utilization of grazing lands, West Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Demand for wildlife for hunting purposes	0	58	9	33	0	–0.25	8	34	58	0	0	–0.50
Nonconsumptive[c] demand for wildlife	0	0	0	58	42	1.42	8	50	34	0	8	–0.50
Demand for wildlife occurring from existence, option or bequest values[d]	0	0	17	58	25	1.08	8	42	33	9	8	–0.33
Number of grazing lands purchased or set-aside for wildlife use/habitat	0	0	8	58	34	1.25	17	50	25	0	8	–0.67
Wildlife utilization of private lands	0	0	33	50	17	0.83	0	42	42	8	8	–0.17
Wildlife utilization of public lands	0	8	17	58	17	0.83	8	67	17	0	8	–0.67

[a]Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.
[b]Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.
[c]Nonconsumptive use is use of a resource in a manner that does not diminish the available total stock (for example, bird-watching or photography)
[d]Existence value is the external benefit that accrues to individuals having no intention of ever visiting or using the site or environment in question. These individuals are willing to give up resources simply to know that the good exists in a particular condition.

Option value is the amount an individual would be willing to pay to preserve the option to participate in some activity or use some resource at some future time, whether or not that individual ever actually participates or uses the resource.
Bequest value is the amount an individual would be willing to pay to preserve a resource so it will be available for future generations to use.

Table 20. Issues influencing Factor 5: technology changes in forage production, West Region.

Issue	Direction[a]						Influence[b]					
	–2	–1	0	1	2	Mean	–2	–1	0	1	2	Mean
	Percent of respondents											
Use of brush control on grazing lands	0	33	34	33	0	0.00	0	33	34	33	0	0.00
Use of weed control on grazing lands	0	9	27	64	0	0.55	0	9	36	55	0	0.45
Development of new chemicals for brush and weed control on grazing lands	9	37	27	27	0	–0.27	0	18	64	18	0	0.00
Use of existing chemicals for brush and weed control	0	64	27	9	0	–0.55	0	46	36	18	0	–0.27
Use of biological control methods for brush and weed control	0	0	8	84	8	1.00	0	8	42	42	8	0.50
Development of new forage species and varieties	0	33	17	33	17	0.33	0	8	58	34	0	0.25
Use of fertilizer on grazing lands	8	17	50	25	0	–0.08	0	8	67	25	0	0.17
Use of irrigation on grazing lands	8	59	25	8	0	–0.67	0	42	50	8	0	–0.33
Development of grazing management methods (for example, grazing systems)	0	0	8	67	25	1.17	0	8	8	59	25	1.00
Advances in technology for livestock distribution, monitoring and handling	0	0	17	66	17	1.00	0	8	33	42	17	0.67
Water development for animal use	0	25	42	33	0	0.08	0	33	26	33	8	0.17
Technology transfer and education programs	0	8	17	75	0	0.67	0	8	34	58	0	0.50

[a] Direction of change each issue will take: –2 = significant decrease; –1 = decrease; 0 = no change; 1 = increase; 2 = significant increase.
[b]Influence each issue will have on the use of grazed forages via the factor: –2 = very negative; –1 = negative; 0 = neutral; 1 = positive; 2 = very positive.

Scenarios

A possible 162 scenarios were developed from the five factors and associated outcomes. The intra-compatibility of each scenario was examined and individual scenarios were discarded if the compatibility criteria between outcomes were not met.

For the South Region, 83 qualifying scenarios were obtained (appendix A, table A7). Thirty-four scenarios were eliminated because at least one compatibility 1 level (the two outcomes will not occur together) existed between factor outcomes. Another 45 scenarios were discarded because their average compatibility level was less than the 3.1 standard established. Of the 162 possible scenarios for the North Region, 59 were rejected because they failed to meet the 3.1 average compatibility standard, and 36 were dismissed because they contained at least one compatibility 1 rating (appendix A, table A8). This left a total of 67 qualifying scenarios. For the West Region, 76 qualifying scenarios were obtained, while 50 were discarded because of their low average compatibility rating, and 36 were

disposed of because an individual compatibility level of 1 was observed (appendix A, table A9).

To combine the qualifying scenarios into two to three representative scenarios, the qualifying scenarios were first clustered based upon their interscenario compatibilities (compatibilities between each scenario). The outcome level to represent factors in each cluster was determined by examining the mean, median, and mode of each outcome in the cluster (appendix A, tables A10–A15).

The qualifying scenarios were grouped into two and three clusters for each region. Two clusters were deemed optimal for each region based upon the average interscenario rating obtained for the clusters (appendix A, tables A10–A12). The probability of occurrence for each cluster was obtained by summing the probabilities of the individual scenarios contained in the cluster. Although not discussed further, the results of the three-cluster, most likely scenarios are presented in appendix A, tables A13–A15, for the South, North, and West Regions, respectively.

South Region

The two most likely scenarios for the South Region are found in table 21. The major difference between the two scenarios was the grazed forage utilization by livestock and wildlife. Scenario 1, the most likely to occur (64 percent probability), consisted of an increase in wildlife utilization of grazing lands while livestock utilization was not expected to change significantly. Conversely, scenario 2 (27 percent probability) anticipated an increase in livestock utilization and a relative continuance of wildlife utilization of grazing lands.

Increased use of grazing lands by either livestock or wildlife was projected to be associated with significant changes in the development or use of forage production technology in the South Region. Environmental concerns and government policies should continue under both scenarios in areas where resource concerns have already emerged, but further repercussions on the grazed forage industry were not anticipated. Livestock utilization of grazing lands and land available for forage production were tied rather closely in both scenarios. Increases in livestock utilization of grazed forages appeared to be dependent upon the maintenance of land available for forage production. In scenario 2, the amount of land available for forage production was expected to have little impact on grazing resources, while in scenario 1 changes in land use should decrease the amount of land available for grazing.

The maintenance or increase in the utilization of grazed forages by livestock was expected to be motivated by two major factors: First, the number of beef cattle, goats, and horses was expected to increase in the region. This increase should be ushered by a rise in the profit margins of these producers. The increase in goats and maintenance of sheep numbers should, in part, be precipitated by an increased demand for livestock to combat weed infestations. Second, the amount of time beef cattle, dairy cattle, goats, and horses spend on grazed forages was expected to increase. These influences should be moderated by an increase in the fee and nonfee costs of operating on

Table 21. Most likely scenarios (two clusters) for the grazed forage industry considering a 50-year planning horizon, South Region.

Factor	Scenario 1	Scenario 2
A. Land Available for Forage Production	Changes in land use will decrease the amount of land available for grazing.	Changes in land use will have little impact on the amount of land available for grazing.
B. Environmental Concerns and Government Policies	Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.	Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.
C. Livestock Utilization of Grazing Lands	Livestock utilization of grazing lands will not change significantly.	Livestock utilization of grazing land will increase.
D. Wildlife Utilization of Grazing Lands	Wildlife utilization of grazing lands will increase.	Wildlife utilization of grazing lands will not change significantly.
E. Technology Changes in Forage Production	There will be significant changes in the development or use of forage production technology.	There will be significant changes in the development or use of forage production technology.
Probability of Occurrence[a]	64 percent	27 percent

[a]*Scenario probabilities may not add to 1 because of the probability of other scenarios occurring.*

private lands and by advances in livestock production technologies that were projected to increase production per animal.

A slight to significant increase in the wildlife numbers in the South Region should be driven by an increase in the demand for hunting, nonconsumptive uses, and from existence, option, or bequest values.

Panel members were divided as to the impact an increase in wildlife numbers would have upon the use of grazed forages. Most respondents anticipated an increase in the amount of grazing lands purchased or set aside for wildlife habitat. The general consensus was that these lands would negatively impact livestock use of grazed forages by displacing this land. The demand for wildlife occurring from existence, option, or bequest values was particularly expected to negatively influence livestock use of grazed forages. This use of wildlife would be conducive to the establishment of game reserves and other set-aside programs.

Panel members generally made a distinction between increases in livestock and wildlife and their influence on grazed forages. Increases in livestock implied an increase in the use of grazed forages, while an increase in wildlife generally was associated with a continuity or decrease in the use of grazed forages. The displacement of livestock forage for wildlife was not a one-to-one conversion because of the habitat requirements of wildlife. Panel members anticipated an increase in wildlife utilization of grazing lands occurring on both private and pubic lands, with the use of public lands (for example, increase in game preserves) exhibiting a more negative influence on grazed forages because of livestock displacement.

Regardless of the anticipated scenario, significant changes in the development or use of forage production technologies were seen as important to the use of grazed forages. Biological weed and brush control methods, development of grazing management methods, and development of new forage cultivars were seen by the majority of respondents as having a positive to very positive influence on the supply of grazed forages. A strong technology transfer and education programming component was anticipated in the South Region.

Land available for forage production had a positive relationship with increased livestock utilization of grazed forages. Urban sprawl was seen as the main contributor to a decrease in land available for grazing, while suburbanization and the transfer of lands to nonagricultural conservation uses were also instrumental factors. Although a small component of the amount of grazed forages in the South Region, a reduction in AUMs grazed on National Forest System lands was anticipated.

A consensus between scenarios as to the direction of environmental concerns and government policies also was obtained. Because of anticipated strengthening in regulations associated with wetland and riparian conservation, the Endangered Species Act and preservation programs, local effects in areas where resource concerns have already emerged were expected to be significant. Respondents, though, did not foresee these impacts extending much beyond these areas. Projected reductions in Federal commodity programs and additional government-sponsored conservation programs should exhibit a buffering influence on the declining use of grazed forages from government involvement.

North Region

The scenarios developed for the North Region outline two fairly distinct directions for the use of grazed forages (table 22). The event held in common is that wildlife utilization of grazing lands was expected to increase. Scenario 1 (54 percent probability) projected a decrease in livestock utilization, while scenario 2 (29 percent probability of occurrence) anticipated an increase in livestock utilization of grazing lands. A decrease in livestock utilization of grazing lands (scenario 1) was compatible with decreases in land available for grazing, notable impacts from localized environmental concerns, and minor changes in the development or use of forage production technologies. Conversely, an increase in livestock utilization of grazing lands (scenario 2) was associated with significant changes in technology, the subsiding of environmental and government interference, and a modest impact on land available for forage production from envisioned changes in land use.

Increased wildlife utilization of grazing lands should be driven by nonconsumptive uses, existence, option, or bequest values, and by an expanded demand for hunting. The influence of hunting demand was not projected to be as strong as the other influences. The conversion of grazing lands for wildlife habitat (for example, set-aside) should have the most negative influence on livestock use of grazed forages, although wildlife utilization was anticipated to occur on private more than public lands.

Several issues were projected to have strong impacts on the use of grazed forages in the North Region. The diversity of these issues and their anticipated impact on grazed forage use are the basis for the contrast in scenarios. All panel members agreed that urban sprawl and suburbanization will rise and have a negative to very negative influence on the use of grazed forages.

Table 22. Most likely scenarios (two clusters) for the grazed forage industry considering a 50-year planning horizon, North Region.

Factor	Scenario 1	Scenario 2
A. Land Available for Forage Production	Changes in land use will decrease the amount of land available for grazing.	Changes in land use will have little impact on the amount of land available for grazing.
B. Environmental Concerns and Government Policies	Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.	After initial minor changes, the impacts of regulation will subside.
C. Livestock Utilization of Grazing Lands	Livestock utilization of grazing lands will decrease.	Livestock utilization of grazing land will increase.
D. Wildlife Utilization of Grazing Lands	Wildlife utilization of grazing lands will increase.	Wildlife utilization of grazing lands will increase.
E. Technology Changes in Development of Forage Production	There will not be significant changes in the development or use of forage production technology.	There will be significant changes in the development or use of forage production technology.
Probability of Occurrence[a]	54 percent	29 percent

[a]*Scenario probabilities may not add to 1 because of the probability of other scenarios occurring.*

Recreational demands and nonagricultural conservation uses also should increase and negatively influence the use of grazed forages. Concurrently, environmental issues surrounding water resources and endangered species were projected to negatively impact the use of grazed forages. Nonagricultural land preservation programs should continue to be important. An anticipated reduction in government commodity programs should mitigate these impacts by shifting some land resources into grazed forages.

A slight increase in cattle numbers and a large increase in horse numbers was expected, along with an expansion of wildlife enterprises (for example, elk, deer, buffalo). The amount of time livestock spend on grazed forages was projected to increase for all livestock and should have a positive influence on the use of grazed forages in the region. These forces should be moderated by an increase in the use of alternative feed sources, by an increase in fee and nonfee grazing costs, and by advances in livestock production technologies that should increase production per animal. Panel members also anticipated a decline in dairy cattle numbers along with the profitability of those remaining in business.

Closely associated with changes in the utilization of grazed forages by livestock is the development and use of forage production technology. The estimated marginal probability of significant changes occurring for this factor was 75 percent. Yet, significant changes in technology were not thought to be compatible with decreases in the utilization of grazed forages by livestock nor strong enough to overcome the land availability and environmental concerns anticipated in this region as outlined in scenario 1. In the event that livestock and wildlife utilization of grazed forages increase (scenario 2), the development or use of forage production technologies should play a major role. Those technologies projected to be at the forefront are development of grazing management methods, technology for livestock distribution, monitoring, and handling, fertilization of grazing lands, and development of new forage cultivars. Technology transfer and education programs are projected to be a strong component of these advancements.

West Region

The two scenarios for the West Region can be interpreted in terms of the utilization of grazed forages by livestock and wildlife (table 23). Scenario 1 (72 percent probability of occurrence) specified a decrease in the utilization of grazed forages by livestock and an increase by wildlife. Conversely, the utilization of grazed forages by livestock and wildlife was not expected to change significantly under scenario 2 (21 percent probability of occurrence). Independent of the scenario, significant changes in the development or use of forage production technologies were consistent with the utilization of grazed forage projected. Land availability and environmental concerns were closely associated to the degree of grazed forage utilization anticipated.

For scenario 1, changes in land use were expected to decrease the amount of land available for grazing. The marginal probability of this event occurring was 64 percent. Urban sprawl and suburbanization were

Table 23. Most likely scenarios (two clusters) for the grazed forage industry considering a 50-year planning horizon, West Region.

Factor	Scenario 1	Scenario 2
A. Land Available for Forage Production	Changes in land use will decrease the amount of land available for grazing.	Changes in land use will have little impact on the amount of land available for grazing.
B. Environmental Concerns and Government Policies	Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.	After initial minor changes, the impacts of regulation will subside.
C. Livestock Utilization of Grazing Lands	Livestock utilization of grazing lands will decrease.	Livestock utilization of grazing land will not change significantly.
D. Wildlife Utilization of Grazing Lands	Wildlife utilization of grazing lands will increase.	Wildlife utilization of grazing lands will not change significantly.
E. Technology Changes in development of Forage Production	There will be significant changes in the development or use of forage production technology.	There will be significant changes in the development or use of forage production technology.
Probability of Occurrence[a]	72 percent	21 percent

[a]*Scenario probabilities may not add to 1 because of the probability of other scenarios occurring.*

anticipated to increase or significantly increase. Additional recreational demands on grazing lands were forecast, as were reforestation projects and allocation of lands for nonagricultural conservation use. These events should limit the utilization of grazed forages under this scenario. Nearly all panel members expected the use of Federal lands for livestock grazing to decrease or significantly decrease and to negatively impact the utilization of grazed forages in the West Region. The major impact should occur on National Forest System lands, although over half of the respondents expect grazing on BLM allotments to also decrease.

The only two issues expected to exhibit a neutral to positive influence on the use of grazed forages were a persistent increase in the use of conservation easements and a promotion of "open" or "green" space. The impact of both issues on the use of grazed forages was not expected to be prominent. For the events in scenario 2 to be realized, then, the impact of those issues projected to negatively influence the amount of land available for grazing will need to be modest.

For the factor, Environmental Concerns and Government Policies, respondents assigned the largest marginal probability of occurrence to the event that regulations will increase on a national level, with lands on the margin being taken out of grazing use. But because this factor outcome had a low degree of compatibility with other factor outcomes in scenario 1 and scenario 2, less critical environmental circumstances entered these scenarios. The maintenance of current grazing utilization levels by both wildlife and livestock (scenario 2) necessitates that after initial minor changes, the impacts of regulation will subside. For scenario 1, where a decline in utilization of grazing lands by livestock but an increase by wildlife were anticipated, environmental impacts should be significant in localized areas where resource concerns have already emerged

Regulations associated with water issues appeared to be the major concern identified by panel members. Wetland and riparian area conservation, Clean Water Act regulations, and the competition for water resources between agriculture and residential users should provide the major impacts. Regulations emanating from the Endangered Species Act and wilderness/preservation programs were also expected to negatively influence the use of grazed forages. Grazing on BLM and Forest Service allotments should be further impacted by new regulations and monitoring practices.

The anticipated decline in livestock numbers in scenario 1 was projected to occur in beef cattle and sheep. Dairy cattle, goat, and horse numbers were expected to increase slightly. A modest decline in profit margins of beef producers, increases in fee and nonfee costs of operating on public and private lands, along with increased public concerns for animal health rights should provide added pressure on diminishing livestock numbers. For livestock utilization of grazing lands to maintain current levels as depicted in scenario 2, the time livestock spend on grazed forages should increase to compensate for the reduction in livestock numbers. While this was envisioned for beef cattle, most respondents did not feel increases in the time spent on grazed forages was in order for

other livestock species. Another area of anticipated promise was the use of grazing livestock to manage weed infestations.

While panel members were not overly optimistic that significant changes in the development or use of forage production technologies would occur (59 percent marginal probability), the fact that both scenarios contained this event emphasizes the importance of technological advancements and educational programs in preserving the use of grazed forages in the West Region. Most benefits were anticipated in the development of grazing management methods and in advances in technology for livestock distribution, monitoring, and handling. Somewhat less influential should be the use of biological methods for brush and weed management. Use of chemical methods, both existing and prospective, were expected to decline, as were fertilization and irrigation of grazing lands.

The future demand for wildlife resources was expected to come more from nonconsumptive use and existence value than from hunting, which was projected to decrease slightly. Wildlife should utilize public and private resources equally, while an increase in grazing lands purchased or set-aside for wildlife habitat was anticipated. The expected displacement of livestock by wildlife should exhibit a negative influence on the overall use of grazed.

Grazed Forage Use Projections

The graphs in figures 2 through 4 contain the historical use of grazed forage (AUMs) for each region along with the projections provided by panel members. The panel members' projections are for 2010 and 2050. Each panel member provided a distribution of 10 estimates for each year under each scenario. Every estimate had an equal probability of occurring (10 percent). The extent to which a panel member spread out his 10 estimates reflected the degree of uncertainty of the estimate for that year (appendix B, Projection Survey). All estimates for each year and scenario are plotted and the trend line from the historical data is extended through the mean point for each year and scenario. The maximum, median, and minimum values for each year/scenario projection also are plotted, along with the second and third quartile values.

Scenario 1 for each region (tables 21 through 23) tended to be the least optimistic of the two scenarios concerning the level of future grazed forage use (table 24). Historical forage use in the South Region (fig. 2), although cyclical, has somewhat stabilized over the past decade. Relatively small changes in forage use were projected to occur in the South Region, with a –4 percent change anticipated by 2010 under scenario 1 and a 6 percent change expected by 2010 given scenario 2. The declines that have occurred historically in the North (fig. 3) and West (fig. 4) Regions were expected to continue under Scenario 1, but should be slowed somewhat under Scenario 2. The largest decline in forage use was expected in the North Region, with a –17 percent change in forage use by 2010 and a –32 percent change by 2050 under scenario 1. Given scenario 2, forage use was expected to increase slightly by 2010 before again declining slightly by 2050. A decline in forage use was envisioned for the West Region regardless of the scenario assumption.

When all regions were combined, a reduction in grazed forage use of 35 million AUMs by 2010 and 69 million AUMs by 2050 was projected under scenario 1

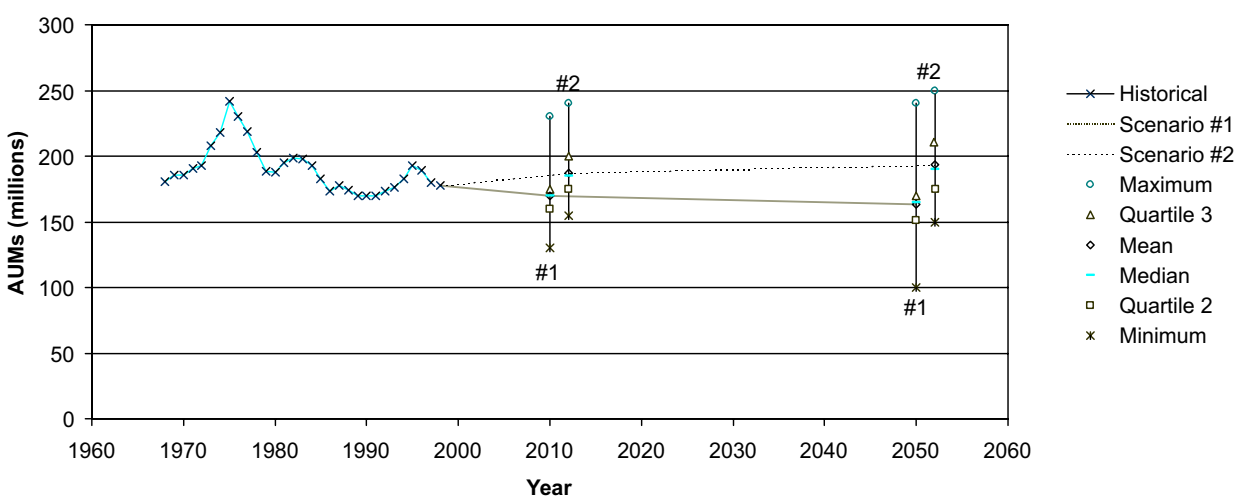

Figure 2. South Region historical use and projections for scenario 1 and scenario 2, 2010 and 2050.

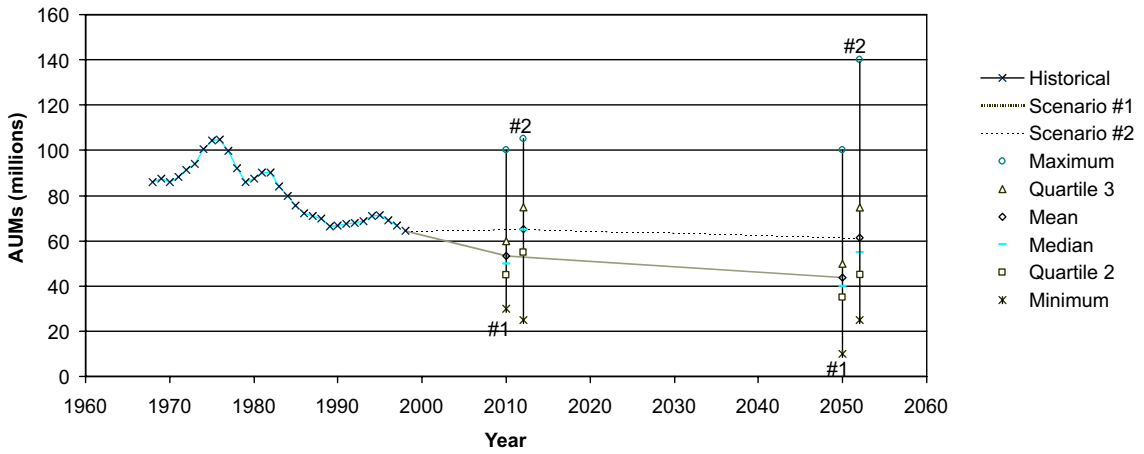

Figure 3. North Region historical use and projections for scenario 1 and scenario 2, 2010 and 2050.

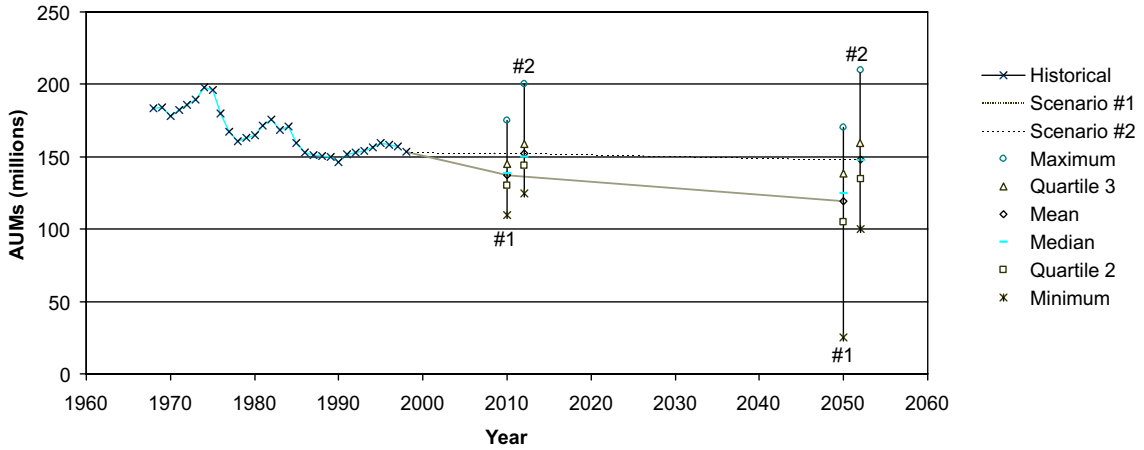

Figure 4. West Region historical use and projections for scenario 1 and scenario 2, 2010 and 2050.

(table 24). Under the more optimistic scenario 2, increased AUM use in the South Region more than compensated for losses in the North and West Regions. Grazed forage use in the United States was projected to increase by 9.5 million AUMs in 2010 and by 7.3 million AUMs in 2050 under scenario 2.

Conclusions

The scenarios describing the anticipated conditions facing the use of grazed forages in the United States 0sight and understanding to possible futures that may emerge. They were not intended to be single point indicators that are absolute. When viewed as a whole, the scenarios can allow exploration as to what might happen, providing a guideline to aid understanding and planning insight by policy analysts, educators, those involved in assessing U.S. rangeland sustainability at a national scale (Mitchell and Joyce 2000), and interested publics.

In general, the use of grazed forages for beef cattle was anticipated to decline over the next several decades. The exception to this was in the South Region, where an anticipated increase, or at least a maintenance of livestock numbers, was expected. An increase in livestock numbers was anticipated in the North Region under the more optimistic conditions, but was expected to decrease otherwise. A similar decline in livestock numbers was anticipated in the West Region. These outlooks should further strengthen the trend of cattle feeding becoming more concentrated in the South

Table 24. Animal unit months (AUM) of historical use (1998) and projected use under scenario 1 and scenario 2 for all regions and the United States.

		Projections (AUM x 10^6)			
		Scenario 1		Scenario 2	
	1998	2010	2050	2010	2050
South Region AUMs	177.43	170.11	163.61	187.39	193.33
Change from 1998		–7.32	–13.82	9.96	15.90
Percent change from 1998		–4.13	–7.79	5.61	8.96
North Region AUMs	64.47	53.50	43.55	65.35	61.35
Change from 1998		–10.97	–20.92	0.88	–3.12
Percent change from 1998		–17.01	–32.45	1.36	–4.84
West Region AUMs	153.41	137.09	119.01	152.00	147.95
Change from 1998		–16.32	–34.40	–1.41	–5.46
Percent change from 1998		–10.64	–22.42	–0.92	–3.56
United States AUMs	395.31	360.70	326.17	404.74	402.63
Change from 1998		–34.61	–69.14	9.43	7.32
Percent change from 1998		–8.76	–17.49	2.39	1.85

Region (Texas and Oklahoma) while filtering into Kansas (Ward and Schroeder 1998).

The sheep and goat industries should be strengthened by an expected increase in livestock for purposes of controlling weed infestations. This demand should assist an anticipated stabling in the profit margins of these industries.

Most scenarios hinged on an anticipated increase in the development of technologies that were expected to improve the productivity and utilization of grazed forages. Developments in the areas of grazing system technology and biological control of weeds were anticipated. A strong educational component to assist the adaptation process also was expected.

The projections for grazed forge use in the United States appear to be region specific. Declines in future AUM use under the most pessimistic scenario was expected to be less for the South than the West and North Region. Declines were anticipated in the West Region regardless of the scenario examined. Increases in the South Region should compensate for declines in other regions under scenario 2.

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APPENDIX A

Table A1. Panel of experts, South Region

Dr. C. Pat Bagley
Extension Professor - Livestock Marketing
Department of Agricultural Economics
University of Kentucky
Lexington, Kentucky

Dr. J. Richard Conner
Professor of Agricultural Economics and
T.M. O'Connor Professor of Rangeland
Ecology and Management
Department of Agricultural Economics
Texas A&M University
College Station, Texas

Jack Cutshall
Rangeland Consultant
Glenmora, Louisiana

Dr. Troy Johnson
Extension Forage Agronomist
University of Georgia
Tifton, Georgia

Dr. David J. Lang
Associate Professor of Agronomy
Department of Plant and Soil Science
Mississippi State University
Mississippi State, Mississippi

Dr. John C. McKissick
Professor & Extension Economist
Department of Agricultural and
Applied Economics
University of Georgia
Athens, Georgia

Dr. Lee Meyer
Extension Specialist and Head
North Mississippi Research and
Extension Center
Verona, Mississippi

Dr. Jeff Mullahey
Associate Professor, Range Science
Southwest Florida Research and
Education Center
Immokalee, Florida

Dr. Derrell Peel
Associate Professor & Extension Livestock
Marketing Specialist
Department of Agricultural Economics
Oklahoma State University
Stillwater, Oklahoma

Dr. Paul Peterson
Extension Agronomist, Forages
Dept. Crop and Soil Environmental Sciences
Virginia Polytechnic Institute and State
University
Blacksburg, Virginia

Dr. Emmit Rawls
Professor - Agricultural Extension Service
University of Tennessee
Knoxville, Tennessee

Dr. Bill Stringer
Professor
Agronomy Department
Clemson University
Clemson, South Carolina

Table A2. Panel of experts, North Region

Dr. Ben Bartlett
Dairy and Livestock Extension Agent
Michigan State University
Chatham, Michigan

Dr. Larry Chase
Associate Professor
Dairy Cattle Nutrition
Cornell University
Ithaca, New York

Jim Cropper
Forage Management Specialist
USDA, NRCS
Pasture Systems and Watershed
Management Research Lab
University Park, Pennsylvania

Mr. Jim Gerrish
Research Assistant Professor
Forage Systems Research Center
Linneus, Missouri

Dr. Stuart Gibson
Animal and Food Science Department
University of Vermont
Burrlington, Vermont

Dr. Keith Johnson
Professor of Agronomy
Department of Agronomy
Purdue University
W. Lafayette, Indiana

David Miller
Director, Commodity Services
Farm Bureau Federation
West Des Moines, Iowa

Dr. Kevin C. Moore
Associate Professor
Department of Agricultural Economics
University of Missouri
Columbia, Missouri

Dr. Edward B. Rayburn
Extension Forage Agronomist
West Virginia University
Morgantown, West Virginia

Dr. James Russell
Professor
Department of Animal Science
Iowa State University
Ames, Iowa

Dr. Daniel J. Undersander
Professor
Department of Agronomy
University of Wisconsin
Madison, Wisconsin

Table A3. Panel of experts, West Region

Dr. R. Dennis Child
Department Head
Rangeland Ecosystem Science
Colorado State University
Fort Collins, Colorado

Dr. W. James Clawson
Extension Range Specialist Emeritus
University of California
Davis, California

Dr. C. Wilson Gray
Extension Economist
University of Idaho
Twin Falls R&E Center
Twin Falls, Idaho

Dr. Paul Gutierrez
Ag. & Business Economist (ABM)
Department of Agricultural & Resource Economics
Colorado State University
Fort Collins, Colorado

Dr. Jack Hanson
Owner/Manager
Willow Creek Ranch
Susanville, California

Dr. Harlan Hughes
Professor
Department of Agricultural Economics
North Dakota State University
Fargo, North Dakota

Dr. Chuck Lambert
National Beef Cattlemen's Association
Washington, DC

Jack Maddux
Rancher
Wauneta, Nebraska

Dr. Fred Obermiller
Professor
Department of Agricultural Economics
Oregon State University
Corvallis, Oregon

Dr. Neil Rimbey
Professor
Univ. of Idaho Coop. Extension
Caldwell R&E Center
Caldwell, Idaho

James Robb
Director
Livestock Marketing Information Center
Lakewood, Colorado

Dr. L. Allen Torrell
Professor
Department of Agricultural Economics
New Mexico State University
Las Cruces, New Mexico

Table A4. Factor/outcome compatibility ratings and statistics, South Region.

Factor/ Outcome[a]	Compatibility Levels[b] 1	2	3	4	5	Median	Mode	Mean	Std Dev
	- - - - - - - - - - - - - - -		*Frequency*	- - - - - - - - - - - - -					
A1 - B1	7	3	1	1	0	1	1	1.67	0.98
A1 - B2	4	4	2	2	0	2	1,2	2.17	1.11
A1 - B3	1	1	5	5	0	3	3,4	3.17	0.94
A2 - B1	1	5	1	5	0	2,3	2,4	2.83	1.11
A2 - B2	0	2	5	4	1	3	3	3.33	0.89
A2 - B3	0	1	4	6	1	4	4	3.58	0.79
A3 - B1	0	2	3	2	5	4	5	3.83	1.19
A3 - B2	0	0	3	6	3	4	4	4.00	0.74
A3 - B3	1	0	5	6	0	3,4	4	3.33	0.89
A1 - C1	2	2	1	2	5	4	5	3.50	1.62
A1 - C2	2	7	1	2	0	2	2	2.25	0.97
A1 - C3	5	5	0	2	0	2	1,2	1.92	1.08
A2 - C1	1	4	3	4	0	3	2,4	2.83	1.03
A2 - C2	0	2	6	1	3	3	3	3.42	1.08
A2 - C3	2	4	2	4	0	2,3	2,4	2.67	1.15
A3 - C1	3	3	0	5	1	2,4	4	2.83	1.47
A3 - C2	0	4	3	5	0	3	4	3.08	0.90
A3 - C3	1	2	1	2	6	4,5	5	3.83	1.47
A1 - D1	1	5	0	2	4	2,4	2	3.25	1.54
A1 - D2	1	5	3	3	0	2,3	2	2.67	0.98
A1 - D3	5	4	1	2	0	2	1	2.00	1.13
A2 - D1	0	2	3	7	0	4	4	3.42	0.79
A2 - D2	0	3	4	3	2	3	3	3.33	1.07
A2 - D3	2	7	2	1	0	2	2	2.17	0.83
A3 - D1	0	4	0	4	4	4	2,4,5	3.67	1.30
A3 - D2	0	4	4	4	0	3	2,3,4	3.00	0.85
A3 - D3	1	6	1	3	1	2	2	2.75	1.22
A1 - E1	2	5	3	2	0	2	2	2.42	1.00
A1 - E2	1	2	2	4	3	4	4	3.50	1.31
A2 - E1	1	2	3	6	0	3,4	4	3.17	1.03
A2 - E2	0	3	3	5	1	3,4	4	3.33	0.98
A3 - E1	3	3	1	5	0	2,3	4	2.67	1.30
A3 - E2	2	1	2	2	5	4	5	3.58	1.56
B1 - C1	5	2	0	3	2	2	1	2.58	1.68
B1 - C2	0	7	1	4	0	2	2	2.75	0.97
B1 - C3	1	4	0	3	4	4	2,5	3.42	1.51
B2 - C1	0	5	2	4	1	3	2	3.08	1.08
B2 - C2	0	4	3	4	1	3	2,4	3.17	1.03
B2 - C3	1	1	4	4	2	3,4	3,4	3.42	1.16
B3 - C1	0	3	3	3	3	3,4	2,3,4,5	3.50	1.17
B3 - C2	0	2	3	7	0	4	4	3.42	0.79
B3 - C3	1	4	4	3	0	3	2,3	2.75	0.97
B1 - D1	0	1	1	5	5	4	4,5	4.17	0.94
B1 - D2	0	6	4	2	0	2,3	2	2.67	0.78
B1 - D3	5	5	0	2	0	2	1,2	1.92	1.08
B2 – D1	0	0	2	7	3	4	4	4.08	0.67
B2 - D2	0	3	6	3	0	3	3	3.00	0.74
B2 - D3	2	8	0	2	0	2	2	2.17	0.94
B3 - D1	0	1	3	7	1	4	4	3.67	0.78
B3 - D2	0	2	5	5	0	3	3,4	3.25	0.75

(cont'd.)

Table A4. (Cont'd.)

Factor/ Outcome[a]	Compatibility Levels[b] 1	2	3	4	5	Median	Mode	Mean	Std Dev
	- - - - - - - - - - - - - - - - Frequency - - - - - - - - - - - - - -								
B3 - D3	1	6	2	3	0	2	2	2.58	1.00
B1 - E1	2	6	1	3	0	2	2	2.42	1.08
B1 - E2	1	1	0	5	5	4	4,5	4.00	1.28
B2 - E1	0	5	5	2	0	3	2,3	2.75	0.75
B2 - E2	0	0	5	4	3	4	3	3.83	0.83
B3 - E1	0	4	6	2	0	3	3	2.83	0.72
B3 - E2	0	0	3	9	0	4	4	3.75	0.45
C1 - D1	2	7	0	2	1	2	2	2.42	1.24
C1 - D2	0	5	2	4	1	3	2	3.08	1.08
C1 - D3	1	1	2	8	0	4	4	3.42	1.00
C2 - D1	0	2	1	8	1	4	4	3.67	0.89
C2 - D2	0	1	3	6	2	4	4	3.75	0.87
C2 - D3	1	4	4	3	0	3	2,3	2.75	0.97
C3 - D1	0	2	0	4	6	4,5	5	4.17	1.11
C3 - D2	0	6	4	2	0	2,3	2	2.67	0.78
C3 - D3	7	3	0	2	0	1	1	1.75	1.14
C1 - E1	2	6	2	2	0	2	2	2.33	0.98
C1 - E2	2	0	1	3	6	4,5	5	3.92	1.51
C2 - E1	0	5	3	4	0	3	2	2.92	0.90
C2 - E2	0	4	2	5	1	3,4	4	3.25	1.06
C3 - E1	1	3	3	5	0	3	4	3.00	1.04
C3 - E2	4	4	2	0	2	2	1,2	2.33	1.44
D1 - E1	0	3	2	7	0	4	4	3.33	0.89
D1 - E2	1	1	1	5	4	4	4	3.83	1.27
D2 - E1	1	2	4	5	0	3	4	3.08	1.00
D2 - E2	0	3	3	6	0	3,4	4	3.25	0.87
D3 - E1	2	5	2	3	0	2	2	2.50	1.09
D3 - E2	1	5	3	3	0	2,3	2	2.67	0.98

[a]*Factor A: Land Available for Forage Production.*
Option A1: Changes in land use will increase the amount of land available for forage production.
Option A2: Changes in land use will have little impact on the amount of land available.
Option A3: Changes in land use will decrease the amount of land available for grazing.

Factor B: Environmental Concerns and Government Policies.
Option B1: Regulations will increase on a national level, with lands on the margin being taken out of grazing use.
Option B2: Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.
Option B3: After initial minor changes, the impacts of regulation will subside.

Factor C: Livestock Utilization of Grazing Lands.
Option C1: Livestock utilization of grazing lands will increase.
Option C2: Livestock utilization of grazing lands will not change significantly.
Option C3: Livestock utilization of grazing lands will decrease.

Factor D: Wildlife Utilization of Grazing Lands.
Option D1: Wildlife utilization of grazing lands will increase.
Option D2: Wildlife utilization of grazing lands will not change significantly.
Option D3: Wildlife utilization of grazing lands will decrease.

Factor E: Technology Changes in Forage Production.
Option E1: There will not be significant changes in the development or use of forage production technologies.
Option E2: There will be significant changes in the development or use of forage production technologies.

[b]*1 = Will not occur together.*
2 = Low likelihood of occurring together.
3 = Neutral.
4 = Likely to occur together.
5 = Very likely to occur together.

Table A5. Factor/outcome compatibility ratings and statistics, North Region.

Factor/ Outcome[a]	Compatibility Levels[b] 1	2	3	4	5	Median	Mode	Mean	Std Dev
	- - - - - - - - - - - - - - -		*Frequency*	- - - - - - - - - - - - - - -					
A1 - B1	9	1	0	1	0	1	1	1.36	0.92
A1 - B2	3	1	1	6	0	4	4	2.91	1.38
A1 - B3	0	1	4	5	1	4	4	3.55	0.82
A2 - B1	1	6	2	2	0	2	2	2.45	0.93
A2 - B2	0	2	5	4	0	3	3	3.18	0.75
A2 - B3	0	1	5	2	3	3	3	3.64	1.03
A3 - B1	0	1	1	2	7	5	5	4.36	1.03
A3 - B2	0	3	0	3	5	4	5	3.91	1.30
A3 - B3	1	3	3	2	2	3	2,3	3.09	1.30
A1 - C1	0	0	0	1	10	5	5	4.91	0.30
A1 - C2	1	2	5	2	1	3	3	3.00	1.10
A1 - C3	7	3	0	0	1	1	1	1.64	1.21
A2 - C1	3	1	2	5	0	3	4	2.82	1.33
A2 - C2	0	1	3	2	5	4	5	4.00	1.10
A2 - C3	1	5	3	2	0	2	2	2.55	0.93
A3 - C1	9	1	0	1	0	1	1	1.36	0.92
A3 - C2	3	5	2	1	0	2	2	2.09	0.94
A3 - C3	0	0	0	3	8	5	5	4.73	0.47
A1 - D1	0	1	1	3	6	5	5	4.27	1.01
A1 - D2	0	7	3	1	0	2	2	2.45	0.69
A1 - D3	4	5	2	0	0	2	2	1.82	0.75
A2 - D1	0	3	1	6	1	4	4	3.45	1.04
A2 - D2	0	1	5	4	1	3	3	3.45	0.82
A2 - D3	2	5	2	2	0	2	2	2.36	1.03
A3 - D1	1	4	1	3	2	3	2	3.09	1.38
A3 - D2	1	4	3	3	0	3	2	2.73	1.01
A3 - D3	2	3	1	3	2	3	2,4	3.00	1.48
A1 - E1	2	5	2	1	1	2	2	2.45	1.21
A1 - E2	1	1	1	5	3	4	4	3.73	1.27
A2 - E1	1	5	4	1	0	2	2	2.45	0.82
A2 - E2	1	2	4	4	0	3	3,4	3.00	1.00
A3 - E1	2	2	2	5	0	3	4	2.91	1.22
A3 - E2	2	5	0	2	2	2	2	2.73	1.49
B1 - C1	4	5	0	2	0	2	2	2.00	1.10
B1 - C2	1	3	2	4	1	3	4	3.09	1.22
B1 - C3	0	1	0	5	5	4	4,5	4.27	0.90
B2 - C1	1	4	1	5	0	3	4	2.91	1.14
B2 - C2	0	2	3	5	1	4	4	3.45	0.93
B2 - C3	0	4	1	4	2	4	2,4	3.36	1.21
B3 - C1	0	1	2	7	1	4	4	3.73	0.79
B3 - C2	0	1	5	3	2	3	3	3.55	0.93
B3 - C3	1	2	5	2	1	3	3	3.00	1.10
B1 - D1	1	1	2	5	2	4	4	3.55	1.21
B1 - D2	0	0	6	5	0	3	3	3.45	0.52
B1 - D3	1	5	2	0	3	2	2	2.91	1.45
B2 - D1	0	2	2	6	1	4	4	3.55	0.93
B2 - D2	0	1	6	4	0	3	3	3.27	0.65
B2 - D3	0	7	2	1	1	2	2	2.64	1.03
B3 - D1	0	1	4	5	1	4	4	3.55	0.82
B3 - D2	0	1	6	3	1	3	3	3.36	0.81
B3 - D3	1	3	6	1	0	3	3	2.64	0.81

(cont'd.)

Table A5. (Cont'd.)

Factor/ Outcome[a]	Compatibility Levels[b] 1	2	3	4	5	Median	Mode	Mean	Std Dev
	- - - - - - - - - - - - - - - - Frequency - - - - - - - - - - - - - - - -								
B1 - E1	1	4	1	5	0	3	4	2.91	1.14
B1 - E2	0	1	2	4	4	4	4,5	4.00	1.00
B2 - E1	1	4	4	2	0	3	2,3	2.64	0.92
B2 - E2	0	1	3	6	1	4	4	3.64	0.81
B3 - E1	0	5	4	2	0	3	2	2.73	0.79
B3 - E2	0	0	4	7	0	4	4	3.64	0.50
C1 - D1	0	1	1	6	3	4	4	4.00	0.89
C1 - D2	1	1	6	3	0	3	3	3.00	0.89
C1 - D3	2	3	2	3	1	3	2,4	2.82	1.33
C2 - D1	0	1	1	7	2	4	4	3.91	0.83
C2 - D2	0	1	4	4	2	4	3,4	3.64	0.92
C2 - D3	2	6	1	1	1	2	2	2.36	1.21
C3 - D1	1	3	1	3	3	4	2,4,5	3.36	1.43
C3 - D2	1	2	4	4	0	3	3,4	3.00	1.00
C3 - D3	6	2	0	0	3	1	1	2.27	1.79
C1 - E1	1	7	0	3	0	2	2	2.45	1.04
C1 - E2	0	0	0	3	8	5	5	4.73	0.47
C2 - E1	0	3	2	4	2	4	4	3.45	1.13
C2 - E2	0	5	2	4	0	3	2	2.91	0.94
C3 - E2	5	3	0	2	1	2	1	2.18	1.47
C3 - E1	0	3	1	4	3	4	4	3.64	1.21
D1 - E1	0	2	3	5	1	4	4	3.45	0.93
D1 - E2	0	0	1	5	5	4	4,5	4.36	0.67
D2 - E1	0	2	6	3	0	3	3	3.09	0.70
D2 - E2	0	1	7	2	1	3	3	3.27	0.79
D3 - E1	2	3	4	2	0	3	3	2.55	1.04
D3 - E2	4	3	2	0	2	2	2.45	1.04	

[a]*Factor A: Land Available for Forage Production.*
Option A1: Changes in land use will increase the amount of land available for forage production.
Option A2: Changes in land use will have little impact on the amount of land available.
Option A3: Changes in land use will decrease the amount of land available for grazing.

Factor B: Environmental Concerns and Government Policies.
Option B1: Regulations will increase on a national level, with lands on the margin being taken out of grazing use.
Option B2: Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.
Option B3: After initial minor changes, the impacts of regulation will subside.

Factor C: Livestock Utilization of Grazing Lands.
Option C1: Livestock utilization of grazing lands will increase.
Option C2: Livestock utilization of grazing lands will not change significantly.
Option C3: Livestock utilization of grazing lands will decrease.

Factor D: Wildlife Utilization of Grazing Lands.
Option D1: Wildlife utilization of grazing lands will increase.
Option D2: Wildlife utilization of grazing lands will not change significantly.
Option D3: Wildlife utilization of grazing lands will decrease.

Factor E: Technology Changes in Forage Production.
Option E1: There will not be significant changes in the development or use of forage production technologies.
Option E2: There will be significant changes in the development or use of forage production technologies.

[b]*1 = Will not occur together.*
2 = Low likelihood of occurring together.
3 = Neutral.
4 = Likely to occur together.
5 = Very likely to occur together.

Table A6. Factor/outcome compatibility ratings and statistics, West Region.

Factor/ Outcome[a]	Compatibility Levels[b] 1	2	3	4	5	Median	Mode	Mean	Std Dev
	- - - - - - - - - - - - - - -		*Frequency*	- - - - - - - - - - - - -					
A1 - B1	9	3	0	0	0	1	1	1.25	0.45
A1 - B2	4	7	1	0	0	2	2	1.75	0.62
A1 - B3	3	3	3	3	0	2,3	1,2,3,4	2.50	1.17
A2 - B1	3	5	1	3	0	2	2	2.33	1.15
A2 - B2	2	4	4	1	1	2,3	2,3	2.58	1.16
A2 - B3	2	1	3	5	1	3,4	4	3.17	1.27
A3 - B1	0	0	0	4	8	5	5	4.67	0.49
A3 - B2	0	0	0	5	7	5	5	4.58	0.51
A3 - B3	1	1	5	3	2	3	3	3.33	1.15
A1 - C1	3	3	0	2	4	2,4	5	3.08	1.73
A1 - C2	3	4	3	2	0	2	2	2.33	1.07
A1 - C3	5	3	1	2	1	2	1	2.25	1.42
A2 - C1	1	4	6	1	0	3	3	2.58	0.79
A2 - C2	1	0	3	4	4	4	4,5	3.83	1.19
A2 - C3	2	3	3	4	0	3	4	2.75	1.14
A3 - C1	6	4	0	1	1	1,2	1	1.92	1.31
A3 - C2	1	6	3	1	1	2	2	2.58	1.08
A3 - C3	0	1	0	4	7	5	5	4.42	0.90
A1 - D1	5	3	0	4	0	2	1	2.25	1.36
A1 - D2	2	6	2	2	0	2	2	2.33	0.98
A1 - D3	5	2	1	4	0	2	1	2.33	1.37
A2 - D1	2	0	2	8	0	4	4	3.33	1.15
A2 - D2	1	1	2	6	2	4	4	3.58	1.16
A2 - D3	3	2	4	3	0	3	3	2.58	1.16
A3 - D1	0	0	2	3	7	5	5	4.42	0.79
A3 - D2	0	2	1	7	2	4	4	3.75	0.97
A3 - D3	3	3	1	3	2	2,3	1,2,4	2.83	1.53
A1 - E1	3	5	3	1	0	2	2	2.17	0.94
A1 - E2	1	5	2	3	1	2,3	2	2.83	1.19
A2 - E1	2	2	5	3	0	3	3	2.75	1.06
A2 - E2	1	2	2	5	2	4	4	3.42	1.24
A3 - E1	1	4	3	1	3	3	2	3.08	1.38
A3 - E2	1	1	1	7	2	4	4	3.67	1.15
B1 - C1	6	6	0	0	0	1,2	1,2	1.50	0.52
B1 - C2	4	4	2	2	0	2	1,2	2.17	1.11
B1 - C3	1	0	0	5	6	4,5	5	4.25	1.14
B2 - C1	4	5	3	0	0	2	2	1.92	0.79
B2 - C2	0	4	3	4	1	3	2,4	3.17	1.03
B2 - C3	1	0	0	7	4	4	4	4.08	1.08
B3 - C1	4	4	1	2	1	2	1,2	2.33	1.37
B3 - C2	3	0	3	5	1	3,4	4	3.08	1.38
B3 - C3	3	1	5	3	0	3	3	2.67	1.15
B1 - D1	0	1	0	6	5	4	4	4.25	0.87
B1 - D2	0	2	4	6	0	3,4	4	3.33	0.78
B1 - D3	5	6	0	1	0	2	2	1.75	0.87
B2 - D1	1	1	1	5	4	4	4	3.83	1.27
B2 - D2	0	3	4	5	0	3	4	3.17	0.83
B2 - D3	5	4	2	1	0	2	1	1.92	1.00
B3 - D1	1	1	2	7	1	4	4	3.50	1.09
B3 - D2	1	4	5	2	0	3	3	2.67	0.89
B3 - D3	4	4	2	2	0	2	1,2	2.17	1.11

(cont'd.)

Table A6. (Cont'd.)

Factor/ Outcome[a]	Compatibility Levels[b] 1	2	3	4	5	Median	Mode	Mean	Std Dev
	- - - - - - - - - - - - - - - - *Frequency* - - - - - - - - - - - - - -								
B1 - E1	2	2	1	7	0	4	4	3.08	1.24
B1 - E2	0	1	4	3	4	4	3,5	3.83	1.03
B2 - E1	2	3	2	5	0	3	4	2.83	1.19
B2 - E2	1	0	2	8	1	4	4	3.67	0.98
B3 - E1	2	1	5	4	0	3	3	2.92	1.08
B3 - E2	2	1	5	4	0	3	3	2.92	1.08
C1 - D1	5	3	1	3	0	2	1	2.17	1.27
C1 - D2	2	6	2	2	0	2	2	2.33	0.98
C1 - D3	5	2	1	4	0	2	1	2.33	1.37
C2 - D1	0	3	1	8	0	4	4	3.42	0.90
C2 - D2	1	2	4	5	0	3	4	3.08	1.00
C2 - D3	1	7	1	3	0	2	2	2.50	1.00
C3 - D1	0	1	0	4	7	5	5	4.42	0.90
C3 - D2	0	3	2	6	1	4	4	3.42	1.00
C3 - D3	1	8	1	2	0	2	2	2.33	0.89
C1 - E1	2	7	1	2	0	2	2	2.25	0.97
C1 - E2	0	3	0	4	5	4	5	3.92	1.24
C2 - E1	0	5	3	4	0	3	2	2.92	0.90
C2 - E2	1	1	4	6	0	3,4	4	3.25	0.97
C3 - E1	2	1	1	7	1	4	4	3.33	1.30
C3 - E2	1	4	3	2	2	3	2	3.00	1.28
D1 - E1	2	2	5	3	0	3	3	2.75	1.06
D1 - E2	0	1	1	6	4	4	4	4.08	0.90
D2 - E1	2	2	5	3	0	3	3	2.75	1.06
D2 - E2	0	2	7	2	1	3	3	3.17	0.83
D3 - E1	1	5	2	4	0	2,3	2	2.75	1.06
D3 - E2	2	7	3	0	0	2	2	2.08	0.67

[a] *Factor A: Land Available for Forage Production.*
Option A1: Changes in land use will increase the amount of land available for forage production.
Option A2: Changes in land use will have little impact on the amount of land available.
Option A3: Changes in land use will decrease the amount of land available for grazing.

Factor B: Environmental Concerns and Government Policies.
Option B1: Regulations will increase on a national level, with lands on the margin being taken out of grazing use.
Option B2: Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.
Option B3: After initial minor changes, the impacts of regulation will subside.

Factor C: Livestock Utilization of Grazing Lands.
Option C1: Livestock utilization of grazing lands will increase.
Option C2: Livestock utilization of grazing lands will not change significantly.
Option C3: Livestock utilization of grazing lands will decrease.

Factor D: Wildlife Utilization of Grazing Lands.
Option D1: Wildlife utilization of grazing lands will increase.
Option D2: Wildlife utilization of grazing lands will not change significantly.
Option D3: Wildlife utilization of grazing lands will decrease.

Factor E: Technology Changes in Forage Production.
Option E1: There will not be significant changes in the development or use of forage production technologies.
Option E2: There will be significant changes in the development or use of forage production technologies.

[b] *1 = Will not occur together.*
2 = Low likelihood of occurring together.
3 = Neutral.
4 = Likely to occur together.
5 = Very likely to occur together.

Table A7. Compatibility levels and selected compatible scenarios, South Region.

Outcomes[a]					No. of Compatibility Level 1	No. of Compatibility Level 2	Average Compatibility Level	Comparable Scenario
A	B	C	D	E				
3	1	3	1	2	0	1	4.0	YES
3	3	3	1	2	0	1	3.9	YES
3	3	2	1	2	0	0	3.9	YES
3	3	1	1	2	0	1	3.9	YES
3	2	3	1	2	0	1	3.9	YES
2	3	2	1	2	0	0	3.9	YES
3	3	3	1	1	0	0	3.8	YES
3	3	1	2	2	0	0	3.8	YES
3	2	3	1	1	0	0	3.8	YES
3	2	2	1	2	0	0	3.8	YES
3	2	1	1	2	0	1	3.8	YES
3	1	3	1	1	0	1	3.8	YES
2	3	1	1	2	0	1	3.8	YES
3	3	2	2	2	0	0	3.7	YES
3	2	1	2	2	0	0	3.7	YES
3	1	2	1	2	0	1	3.7	YES
3	1	1	1	2	0	2	3.7	YES
2	3	2	2	2	0	0	3.7	YES
2	3	2	1	1	0	0	3.7	YES
2	3	1	2	2	0	0	3.7	YES
2	2	2	1	2	0	0	3.7	YES
3	3	2	1	1	0	0	3.6	YES
3	2	2	2	2	0	0	3.6	YES
2	3	3	1	2	0	2	3.6	YES
2	3	3	1	1	0	1	3.6	YES
2	2	1	1	2	0	1	3.6	YES
1	3	1	2	2	0	1	3.6	YES
1	3	1	1	2	0	2	3.6	YES
3	3	1	3	2	0	3	3.5	YES
3	2	2	1	1	0	0	3.5	YES
3	1	1	2	2	0	2	3.5	YES
2	2	3	1	2	0	2	3.5	YES
2	2	3	1	1	0	1	3.5	YES
2	2	2	2	2	0	0	3.5	YES
2	2	2	1	1	0	0	3.5	YES
2	2	1	2	2	0	0	3.5	YES
2	1	3	1	2	0	3	3.5	YES
2	1	2	1	2	0	2	3.5	YES
1	3	2	1	2	0	2	3.5	YES
3	3	3	2	2	0	2	3.4	YES
3	3	1	1	1	0	2	3.4	YES
3	2	3	2	2	0	2	3.4	YES
3	2	1	3	2	0	3	3.4	YES
3	1	3	2	2	0	3	3.4	YES
3	1	2	2	2	0	2	3.4	YES
2	3	2	2	1	0	0	3.4	YES
2	3	1	3	2	0	3	3.4	YES
2	3	1	1	1	0	2	3.4	YES
2	1	3	1	1	0	3	3.4	YES
2	1	1	1	2	0	3	3.4	YES
1	3	2	2	2	0	2	3.4	YES
1	3	1	3	2	0	3	3.4	YES
1	2	1	2	2	0	2	3.4	YES
1	2	1	1	2	0	3	3.4	YES
3	3	2	2	1	0	0	3.3	YES
3	2	1	1	1	0	2	3.3	YES
3	1	2	1	1	0	2	3.3	YES
3	1	1	3	2	0	4	3.3	YES
1	3	3	1	2	0	3	3.3	YES
1	2	2	1	2	0	3	3.3	YES
3	3	3	2	1	0	1	3.2	YES

(cont'd.)

Table A7. (Cont'd.)

Outcomes[a]					No. of Compatibility Level 1	No. of Compatibility Level 2	Average Compatibility Level	Comparable Scenario
A	B	C	D	E				
3	3	2	3	2	0	3	3.2	YES
3	3	1	2	1	0	1	3.2	YES
3	2	3	2	1	0	1	3.2	YES
3	2	2	2	1	0	0	3.2	YES
2	3	2	3	2	0	3	3.2	YES
2	3	1	2	1	0	1	3.2	YES
2	2	2	2	1	0	0	3.2	YES
2	2	1	3	2	0	3	3.2	YES
2	2	1	1	1	0	2	3.2	YES
2	1	2	2	2	0	3	3.2	YES
2	1	2	1	1	0	3	3.2	YES
2	1	1	2	2	0	3	3.2	YES
1	2	3	1	2	0	4	3.2	YES
1	2	2	2	2	0	3	3.2	YES
1	2	1	3	2	0	4	3.2	YES
3	2	2	3	2	0	3	3.1	YES
3	2	1	2	1	0	1	3.1	YES
3	1	3	2	1	0	3	3.1	YES
3	1	1	1	1	0	4	3.1	YES
2	3	3	2	2	0	3	3.1	YES
1	3	3	1	1	0	3	3.1	YES
1	3	2	1	1	0	3	3.1	YES
1	1	3	1	2	1	3	3.2	NO
1	1	1	1	2	1	3	3.2	NO
1	1	2	1	2	1	3	3.1	NO
1	1	1	2	2	1	3	3.1	NO
3	3	1	3	1	0	4	3.0	NO
3	1	3	3	2	1	4	3.0	NO
3	1	2	3	2	0	4	3.0	NO
2	3	3	2	1	0	2	3.0	NO
2	3	2	3	1	0	3	3.0	NO
2	3	1	3	1	0	4	3.0	NO
2	2	3	2	2	0	3	3.0	NO
2	2	2	3	2	0	3	3.0	NO
2	2	1	2	1	0	1	3.0	NO
2	1	1	3	2	0	5	3.0	NO
1	3	2	3	2	0	4	3.0	NO
1	3	1	1	1	0	4	3.0	NO
1	2	3	1	1	0	4	3.0	NO
1	1	1	3	2	1	4	3.0	NO
3	3	3	3	2	1	4	2.9	NO
3	3	2	3	1	0	3	2.9	NO
3	2	3	3	2	1	4	2.9	NO
3	2	1	3	1	0	4	2.9	NO
3	1	2	2	1	0	3	2.9	NO
2	2	3	2	1	0	2	2.9	NO
2	1	3	2	2	0	5	2.9	NO
2	1	1	1	1	0	5	2.9	NO
1	3	3	2	2	0	4	2.9	NO
1	3	2	2	1	0	3	2.9	NO
1	3	1	2	1	0	3	2.9	NO
1	2	2	1	1	0	4	2.9	NO
1	1	3	1	1	1	4	2.9	NO
1	1	2	2	2	1	4	2.9	NO
3	3	3	3	1	1	3	2.8	NO
3	2	3	3	1	1	3	2.8	NO
3	2	2	3	1	0	3	2.8	NO
3	1	3	3	1	1	4	2.8	NO
3	1	1	2	1	0	4	2.8	NO
2	2	2	3	1	0	3	2.8	NO
2	2	1	3	1	0	4	2.8	NO

(cont'd.)

Table A7. (Cont'd.)

Outcomes[a]					No. of Compatibility Level 1	No. of Compatibility Level 2	Average Compatibility Level	Comparable Scenario
A	B	C	D	E				
2	1	2	3	2	0	5	2.8	NO
2	1	2	2	1	0	4	2.8	NO
1	3	1	3	1	0	5	2.8	NO
1	2	3	2	2	0	5	2.8	NO
1	2	2	3	2	0	5	2.8	NO
1	2	1	1	1	0	5	2.8	NO
3	1	1	3	1	0	6	2.7	NO
2	1	3	2	1	0	5	2.7	NO
1	2	2	2	1	0	4	2.7	NO
1	2	1	2	1	0	4	2.7	NO
1	1	3	2	2	1	5	2.7	NO
3	1	2	3	1	0	5	2.6	NO
2	3	3	3	2	1	5	2.6	NO
2	3	3	3	1	1	4	2.6	NO
2	1	1	2	1	0	5	2.6	NO
1	3	3	2	1	0	4	2.6	NO
1	3	2	3	1	0	5	2.6	NO
1	2	1	3	1	0	6	2.6	NO
1	1	2	3	2	1	5	2.6	NO
1	1	2	1	1	1	5	2.6	NO
2	2	3	3	2	1	5	2.5	NO
2	2	3	3	1	1	4	2.5	NO
2	1	3	3	2	1	6	2.5	NO
2	1	2	3	1	0	6	2.5	NO
2	1	1	3	1	0	7	2.5	NO
1	3	3	3	2	1	5	2.5	NO
1	2	3	2	1	0	5	2.5	NO
1	1	1	1	1	1	6	2.5	NO
2	1	3	3	1	1	6	2.4	NO
1	2	3	3	2	1	6	2.4	NO
1	2	2	3	1	0	6	2.4	NO
1	1	3	3	2	2	5	2.4	NO
1	3	3	3	1	1	5	2.3	NO
1	1	3	2	1	1	6	2.3	NO
1	1	2	2	1	1	6	2.3	NO
1	1	1	3	1	1	7	2.3	NO
1	1	1	2	1	1	6	2.3	NO
1	2	3	3	1	1	6	2.2	NO
1	1	3	3	1	2	6	2.1	NO
1	1	2	3	1	1	7	2.1	NO

[a]*Factor A: Land Available for Forage Production.*
Option A1: Changes in land use will increase the amount of land available for forage production.
Option A2: Changes in land use will have little impact on the amount of land available.
Option A3: Changes in land use will decrease the amount of land available for grazing.

Factor B: Environmental Concerns and Government Policies.
Option B1: Regulations will increase on a national level, with lands on the margin being taken out of grazing use.
Option B2: Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.
Option B3: After initial minor changes, the impacts of regulation will subside.

Factor C: Livestock Utilization of Grazing Lands.
Option C1: Livestock utilization of grazing lands will increase.
Option C2: Livestock utilization of grazing lands will not change significantly.
Option C3: Livestock utilization of grazing lands will decrease.

Factor D: Wildlife Utilization of Grazing Lands.
Option D1: Wildlife utilization of grazing lands will increase.
Option D2: Wildlife utilization of grazing lands will not change significantly.
Option D3: Wildlife utilization of grazing lands will decrease.

Factor E: Technology Changes in Forage Production.
Option E1: There will not be significant changes in the development or use of forage production technologies.
Option E2: There will be significant changes in the development or use of forage production technologies.

Table A8. Compatibility levels and selected compatible scenarios, North Region.

Outcomes[a]					No. of Compatibility Level 1	No. of Compatibility Level 2	Average Compatibility Level	Comparable Scenario
A	B	C	D	E				
1	3	1	1	2	00	0	4.3	YES
1	2	1	1	2	00	00	4.2	YES
3	1	3	1	1	00	00	3.9	YES
1	2	2	1	2	00	00	3.9	YES
3	2	3	1	1	00	00	3.8	YES
2	3	1	1	2	00	00	3.8	YES
1	3	2	1	2	00	00	3.8	YES
3	1	3	1	2	00	2	3.7	YES
2	2	2	1	2	00	00	3.7	YES
2	2	1	1	2	00	00	3.7	YES
1	3	1	2	2	00	1	3.7	YES
1	3	1	1	1	00	2	3.7	YES
1	2	2	1	1	00	1	3.7	YES
3	3	3	1	1	00	0	3.6	YES
3	2	3	1	2	00	2	3.6	YES
3	1	3	2	1	00	00	3.6	YES
2	3	2	1	2	00	00	3.6	YES
2	2	2	1	1	00	1	3.6	YES
1	3	2	1	1	00	1	3.6	YES
1	3	1	3	2	00	2	3.6	YES
1	2	1	2	2	00	1	3.6	YES
1	2	1	1	1	00	2	3.6	YES
3	2	3	2	1	0	00	3.5	YES
3	2	2	1	1	00	1	3.5	YES
3	1	2	1	1	00	1	3.5	YES
2	3	2	1	1	00	1	3.5	YES
2	1	2	1	2	00	1	3.5	YES
2	1	1	1	2	00	2	3.5	YES
3	3	3	1	2	00	2	3.4	YES
3	2	2	1	2	00	2	3.4	YES
3	1	3	2	2	00	2	3.4	YES
3	1	2	1	2	0	2	3.4	YES
2	3	1	2	2	00	00	3.4	YES
2	2	3	1	2	00	2	3.4	YES
2	2	3	1	1	00	2	3.4	YES
2	2	2	2	2	00	00	3.4	YES
2	1	2	1	1	00	2	3.4	YES
1	2	2	2	2	00	1	3.4	YES
1	2	1	3	2	00	3	3.4	YES
3	3	3	2	1	00	00	3.3	YES
3	3	2	1	1	00	1	3.3	YES
3	2	3	2	2	00	2	3.3	YES
3	2	2	2	1	00	1	3.3	YES
3	1	2	2	1	00	1	3.3	YES
2	3	3	1	2	00	2	3.3	YES
2	3	3	1	1	00	2	3.3	YES
2	3	2	2	2	00	00	3.3	YES
2	3	1	1	1	0	2	3.3	YES
2	2	2	2	1	00	1	3.3	YES
2	2	1	2	2	00	00	3.3	YES
2	1	3	1	2	00	3	3.3	YES
2	1	3	1	1	00	3	3.3	YES
1	3	2	2	2	00	1	3.3	YES
3	3	2	1	2	00	2	3.2	YES
3	2	2	2	2	00	2	3.2	YES
3	1	2	2	2	00	2	3.2	YES
2	3	2	2	1	00	1	3.2	YES
2	3	1	3	2	00	2	3.2	YES
2	2	1	1	1	00	2	3.2	YES
2	1	2	2	2	00	1	3.2	YES
1	2	2	2	1	00	2	3.2	YES

(cont'd.)

Table A8. (Cont'd.)

Outcomes[a]					No. of Compatibility Level 1	No. of Compatibility Level 2	Average Compatibility Level	Comparable Scenario
A	B	C	D	E				
3	3	3	2	2	00	2	3.1	YES
3	3	2	2	1	00	1	3.1	YES
2	1	2	2	1	00	2	3.1	YES
2	1	1	2	2	00	2	3.1	YES
1	3	2	2	1	0	2	3.1	YES
1	3	1	3	1	00	3	3.1	YES
1	3	1	2	1	00	3	3.1	YES
1	1	1	1	2	1	1	3.8	NO
1	2	3	1	2	1	1	3.6	NO
1	3	3	1	2	1	1	3.5	NO
1	2	3	1	1	1	1	3.5	NO
1	1	2	1	2	1	00	3.5	NO
3	3	1	1	2	1	1	3.4	NO
3	2	1	1	2	1	1	3.4	NO
3	1	1	1	2	1	2	3.4	NO
1	3	3	1	1	1	1	3.4	NO
3	1	3	3	1	1	1	3.3	NO
1	1	3	1	2	2	1	3.3	NO
1	1	2	1	1	1	1	3.3	NO
3	2	3	3	1	1	1	3.2	NO
1	1	3	1	1	2	1	3.2	NO
1	1	1	2	2	1	2	3.2	NO
1	1	1	1	1	1	3	3.2	NO
3	3	3	3	1	1	00	3.1	NO
3	3	1	2	2	1	1	3.1	NO
3	3	1	1	1	1	1	3.1	NO
3	2	1	2	2	1	1	3.1	NO
3	2	1	1	1	1	1	3.1	NO
3	1	1	2	2	1	2	3.1	NO
3	1	1	1	1	1	2	3.1	NO
3	3	2	2	2	00	2	3.0	NO
3	3	1	3	2	1	2	3.0	NO
3	2	2	3	1	00	3	3.0	NO
3	1	3	3	2	1	4	3.0	NO
3	1	2	3	1	00	3	3.0	NO
2	2	3	2	2	00	2	3.0	NO
2	2	3	2	1	00	2	3.0	NO
2	2	1	3	2	0	3	3.0	NO
2	1	1	1	1	00	4	3.0	NO
1	3	2	3	2	00	3	3.0	NO
1	2	3	2	2	1	2	3.0	NO
1	2	2	3	2	00	4	3.0	NO
1	2	1	2	1	00	3	3.0	NO
1	1	2	2	2	1	1	3.0	NO
1	1	1	3	2	1	4	3.0	NO
3	3	2	3	1	00	2	2.9	NO
3	2	3	3	2	1	4	2.9	NO
3	2	1	3	2	1	3	2.9	NO
3	1	1	3	2	1	4	2.9	NO
2	3	3	2	2	00	2	2.9	NO
2	3	3	2	1	00	2	2.9	NO
2	3	2	3	2	00	3	2.9	NO
2	3	2	3	1	00	3	2.9	NO
2	3	1	2	1	00	2	2.9	NO
2	2	2	3	2	00	4	2.9	NO
2	2	2	3	1	00	4	2.9	NO
2	1	3	2	2	0	3	2.9	NO
2	1	3	2	1	00	3	2.9	NO
1	3	3	2	2	1	2	2.9	NO
1	3	2	3	1	00	3	2.9	NO
1	2	3	2	1	1	2	2.9	NO

(cont"d.)

Table A8. (Cont'd.)

Outcomes[a]					No. of Compatibility Level 1	No. of Compatibility Level 2	Average Compatibility Level	Comparable Scenario
A	B	C	D	E				
1	2	2	3	1	00	4	2.9	NO
1	2	1	3	1	00	4	2.9	NO
3	3	3	3	2	1	3	2.8	NO
3	3	1	3	1	1	1	2.8	NO
3	2	2	3	2	00	5	2.8	NO
3	2	1	2	1	1	1	2.8	NO
3	1	2	3	2	00	5	2.8	NO
3	1	1	2	1	1	2	2.8	NO
2	3	1	3	1	0	3	2.8	NO
2	2	1	2	1	00	2	2.8	NO
2	1	1	3	2	00	5	2.8	NO
1	3	3	2	1	1	2	2.8	NO
1	1	2	2	1	1	2	2.8	NO
3	3	2	3	2	00	4	2.7	NO
3	2	1	3	1	1	2	2.7	NO
3	1	1	3	1	1	3	2.7	NO
2	1	2	3	2	00	5	2.7	NO
2	1	2	3	1	00	5	2.7	NO
1	1	3	2	2	2	2	2.7	NO
2	3	3	3	1	1	3	2.6	NO
2	2	3	3	1	1	4	2.6	NO
2	2	1	3	1	0	4	2.6	NO
2	1	1	2	1	00	4	2.6	NO
1	3	3	3	2	2	3	2.6	NO
1	3	3	3	1	2	2	2.6	NO
1	2	3	3	2	2	4	2.6	NO
1	2	3	3	1	2	3	2.6	NO
1	1	3	2	1	2	2	2.6	NO
1	1	2	3	2	1	4	2.6	NO
1	1	1	2	1	1	4	2.6	NO
2	3	3	3	2	1	4	2.5	NO
2	2	3	3	2	1	5	2.5	NO
2	1	3	3	1	1	5	2.5	NO
1	1	2	3	1	1	4	2.5	NO
1	1	1	3	1	1	5	2.5	NO
2	1	3	3	2	1	6	2.4	NO
2	1	1	3	1	00	6	2.4	NO
2	1	3	3	2	3	4	2.3	NO
1	1	3	3	1	3	3	2.3	NO

[a]*Factor A: Land Available for Forage Production.*
Option A1: Changes in land use will increase the amount of land available for forage production.
Option A2: Changes in land use will have little impact on the amount of land available.
Option A3: Changes in land use will decrease the amount of land available for grazing.

Factor B: Environmental Concerns and Government Policies.
Option B1: Regulations will increase on a national level, with lands on the margin being taken out of grazing use.
Option B2: Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.
Option B3: After initial minor changes, the impacts of regulation will subside.

Factor C: Livestock Utilization of Grazing Lands.
Option C1: Livestock utilization of grazing lands will increase.
Option C2: Livestock utilization of grazing lands will not change significantly.
Option C3: Livestock utilization of grazing lands will decrease.

Factor D: Wildlife Utilization of Grazing Lands.
Option D1: Wildlife utilization of grazing lands will increase.
Option D2: Wildlife utilization of grazing lands will not change significantly.
Option D3: Wildlife utilization of grazing lands will decrease.

Factor E: Technology Changes in Forage Production.
Option E1: There will not be significant changes in the development or use of forage production technologies.
Option E2: There will be significant changes in the development or use of forage production technologies.

Table A9. Compatibility levels and selected compatible scenarios, West Region.

Outcomes[a]					No. of Compatibility Level 1	No. of Compatibility Level 2	Average Compatibility Level	Comparable Scenario
A	B	C	D	E				
3	1	3	1	2	00	00	4.4	YES
3	2	3	1	2	00	00	4.3	YES
3	1	3	1	1	00	00	4.3	YES
3	2	3	1	1	00	00	4.1	YES
3	1	3	2	2	00	00	4.1	YES
3	1	3	2	1	00	00	4.1	YES
3	3	3	1	2	00	00	3.9	YES
3	2	3	2	2	00	0	3.9	YES
3	2	2	1	2	00	1	3.9	YES
2	3	2	1	2	00	00	3.9	YES
3	3	3	1	1	00	00	3.8	YES
3	2	3	2	1	00	00	3.8	YES
3	1	2	1	2	00	2	3.8	YES
2	2	3	1	2	00	00	3.8	YES
2	2	2	1	2	00	00	3.8	YES
2	1	3	1	2	00	1	3.8	YES
3	3	2	1	2	0	1	3.7	YES
2	3	3	1	2	00	00	3.7	YES
2	1	3	1	1	00	1	3.7	YES
2	3	3	1	1	00	00	3.6	YES
2	3	2	2	2	00	00	3.6	YES
2	3	2	1	1	00	00	3.6	YES
2	2	3	1	1	00	00	3.6	YES
2	1	3	2	2	0	1	3.6	YES
2	1	3	2	1	00	1	3.6	YES
2	1	2	1	2	00	2	3.6	YES
3	3	3	2	2	00	00	3.5	YES
3	3	3	2	1	00	00	3.5	YES
3	2	2	2	2	00	1	3.5	YES
3	2	2	1	1	00	1	3.5	YES
3	1	3	3	2	00	3	3.5	YES
3	1	3	3	1	00	3	3.5	YES
3	1	2	2	2	00	2	3.5	YES
3	1	2	1	1	00	2	3.5	YES
2	2	3	2	2	00	00	3.5	YES
2	2	2	2	2	00	00	3.5	YES
3	3	2	1	1	00	1	3.4	YES
3	2	3	3	2	00	3	3.4	YES
2	3	3	2	2	00	00	3.4	YES
2	3	3	2	1	0	00	3.4	YES
2	3	2	2	1	00	00	3.4	YES
2	3	1	1	2	00	2	3.4	YES
2	2	3	2	1	00	00	3.4	YES
2	2	2	1	1	00	00	3.4	YES
2	2	1	1	2	00	2	3.4	YES
2	1	2	2	2	00	2	3.4	YES
3	3	2	2	2	00	1	3.3	YES
3	2	3	3	1	00	3	3.3	YES
3	1	2	2	1	00	2	3.3	YES
2	1	2	1	1	00	2	3.3	YES
2	1	1	1	2	00	3	3.3	YES
3	2	2	2	1	00	1	3.2	YES
2	3	2	3	2	00	3	3.2	YES
2	3	1	2	2	00	2	3.2	YES
2	2	2	2	1	00	00	3.2	YES
2	2	1	2	2	0	2	3.2	YES
2	1	2	2	1	00	2	3.2	YES
2	1	1	2	2	00	3	3.2	YES
1	3	2	1	2	00	3	3.2	YES
1	2	3	1	2	00	4	3.2	YES
3	3	2	2	1	00	1	3.1	YES

(cont'd.)

Table A9. (Cont'd.)

Outcomes[a]					No. of Compatibility Level 1	No. of Compatibility Level 2	Average Compatibility Level	Comparable Scenario
A	B	C	D	E				
3	2	2	3	2	00	4	3.1	YES
2	2	2	3	2	00	3	3.1	YES
1	3	3	1	2	00	3	3.1	YES
1	3	3	1	1	0	3	3.1	YES
1	2	3	1	1	00	4	3.1	YES
1	2	2	1	2	00	4	3.1	YES
3	2	1	1	2	1	2	3.5	NO
3	1	1	1	2	1	2	3.5	NO
3	1	1	2	2	1	2	3.3	NO
3	3	1	1	2	1	2	3.2	NO
3	2	1	2	2	1	2	3.2	NO
1	1	3	1	2	1	3	3.2	NO
1	1	3	1	1	1	3	3.2	NO
3	1	1	1	1	1	3	3.1	NO
1	1	3	2	1	1	3	3.1	NO
3	3	3	3	2	00	3	3.0	NO
3	3	3	3	1	00	3	3.0	NO
3	2	1	1	1	1	3	3.0	NO
3	1	2	3	2	00	5	3.0	NO
3	1	1	2	1	1	3	3.0	NO
2	3	2	3	1	00	3	3.0	NO
2	3	1	1	1	00	3	3.0	NO
2	2	3	3	2	00	3	3.0	NO
2	1	3	3	2	00	4	3.0	NO
2	1	3	3	1	00	4	3.0	NO
1	3	2	1	1	00	3	3.0	NO
1	3	1	1	2	00	4	3.0	NO
1	2	1	1	2	00	5	3.0	NO
1	1	3	2	2	1	3	3.0	NO
3	3	2	3	2	00	4	2.9	NO
3	3	1	2	2	1	2	2.9	NO
3	2	1	3	2	1	4	2.9	NO
3	1	1	3	2	1	4	2.9	NO
2	3	3	3	2	00	3	2.9	NO
2	3	3	3	1	00	3	2.9	NO
2	3	1	3	2	00	4	2.9	NO
2	3	1	2	1	00	3	2.9	NO
2	2	3	3	1	00	3	2.9	NO
2	2	1	3	2	00	4	2.9	NO
2	2	1	1	1	00	3	2.9	NO
2	1	2	3	2	00	5	2.9	NO
2	1	1	2	1	00	4	2.9	NO
2	1	1	1	1	00	4	2.9	NO
1	3	3	2	1	00	3	2.9	NO
1	3	2	2	2	00	3	2.9	NO
1	2	3	2	2	00	4	2.9	NO
1	2	3	2	1	00	4	2.9	NO
1	1	2	1	2	1	4	2.9	NO
1	1	1	1	2	1	4	2.9	NO
3	3	1	1	1	1	3	2.8	NO
3	2	2	3	1	00	4	2.8	NO
3	2	1	2	1	1	3	2.8	NO
3	1	2	3	1	00	5	2.8	NO
2	2	2	3	1	00	3	2.8	NO
2	2	1	2	1	00	3	2.8	NO
2	1	1	3	2	00	5	2.8	NO
1	3	3	2	2	00	3	2.8	NO
1	3	2	2	1	00	3	2.8	NO
1	3	1	2	2	00	4	2.8	NO
1	2	2	2	2	00	4	2.8	NO
1	2	2	1	1	00	4	2.8	NO

(cont'd.)

Table A9. (Cont'd.)

Outcomes[a]					No. of Compatibility Level 1	No. of Compatibility Level 2	Average Compatibility Level	Comparable Scenario
A	B	C	D	E				
1	2	1	2	2	00	5	2.8	NO
1	1	1	2	2	1	4	2.8	NO
3	3	2	3	1	00	4	2.7	NO
2	1	2	3	1	00	5	2.7	NO
1	3	1	1	1	00	5	2.7	NO
1	1	2	2	2	1	4	2.7	NO
1	1	2	1	1	1	4	2.7	NO
3	3	1	3	2	1	4	2.6	NO
3	3	1	2	1	1	3	2.6	NO
3	1	1	3	1	1	5	2.6	NO
2	3	1	3	1	00	5	2.6	NO
1	3	2	3	2	00	6	2.6	NO
1	3	1	3	2	00	6	2.6	NO
1	3	1	2	1	00	5	2.6	NO
1	2	2	2	1	00	4	2.6	NO
1	2	1	3	2	00	7	2.6	NO
1	2	1	1	1	00	6	2.6	NO
1	1	3	3	1	1	6	2.6	NO
1	1	2	2	1	1	4	2.6	NO
1	1	1	2	1	1	5	2.6	NO
1	1	1	1	1	1	5	2.6	NO
3	2	1	3	1	1	5	2.5	NO
2	2	1	3	1	00	5	2.5	NO
2	1	1	3	1	00	6	2.5	NO
1	3	3	3	1	00	6	2.5	NO
1	3	2	3	1	0	6	2.5	NO
1	2	3	3	2	00	7	2.5	NO
1	2	3	3	1	00	7	2.5	NO
1	2	2	3	2	00	7	2.5	NO
1	2	1	2	1	00	6	2.5	NO
1	1	3	3	2	1	6	2.5	NO
1	1	1	3	2	1	6	2.5	NO
1	3	3	3	2	00	6	2.4	NO
1	3	1	3	1	00	7	2.4	NO
3	3	1	3	1	1	5	2.3	NO
1	2	2	3	1	00	7	2.3	NO
1	2	1	3	1	00	8	2.3	NO
1	1	2	3	2	1	7	2.3	NO
1	1	1	3	1	1	7	2.3	NO
1	1	2	3	1	1	7	2.2	NO

[a]*Factor A: Land Available for Forage Production.*
Option A1: Changes in land use will increase the amount of land available for forage production.
Option A2: Changes in land use will have little impact on the amount of land available.
Option A3: Changes in land use will decrease the amount of land available for grazing.

Factor B: Environmental Concerns and Government Policies.
Option B1: Regulations will increase on a national level, with lands on the margin being taken out of grazing use.
Option B2: Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.
Option B3: After initial minor changes, the impacts of regulation will subside.

Factor C: Livestock Utilization of Grazing Lands.
Option C1: Livestock utilization of grazing lands will increase.
Option C2: Livestock utilization of grazing lands will not change significantly.
Option C3: Livestock utilization of grazing lands will decrease.

Factor D: Wildlife Utilization of Grazing Lands.
Option D1: Wildlife utilization of grazing lands will increase.
Option D2: Wildlife utilization of grazing lands will not change significantly.
Option D3: Wildlife utilization of grazing lands will decrease.

Factor E: Technology Changes in Forage Production.
Option E1: There will not be significant changes in the development or use of forage production technologies.
Option E2: There will be significant changes in the development or use of forage production technologies.

Table A10. Factor statistics and representative scenario as selected from cluster analysis with two clusters, South Region.

Factor	Factor Outcomes[a]			
	Mean	Mode	Median	Representative Scenario
- - - - - - - Cluster 1[b] - - - - - - -				
A. Land Available for Forage Production	2.52	3	3	3
B. Environmental Concerns and Government Policies	2.10	3	2	2
C. Livestock Utilization of Grazing Lands	2.22	3	2	2
D. Wildlife Utilization of Grazing Lands	1.24	1	1	1
E. Technology Changes in Forage Production	1.54	2	2	2
- - - - - - - Cluster 2[c]- - - - - - -				
A. Land Available for Forage Production	1.97	2	2	2
B. Environmental Concerns and Government Policies	2.36	3	2	2
C. Livestock Utilization of Grazing Lands	1.39	1	1	1
D. Wildlife Utilization of Grazing Lands	2.15	2	2	2
E. Technology Changes in Forage Production	1.82	2	2	2

[a]*Factor outcome definitions can be found in Table 1.*
[b]*50 scenarios with an average scenario compatibility rating of 3.53 were in Cluster 1. The representative scenario had a compatibility rating of 3.80.*
[c]*33 scenarios with an average scenario compatibility rating of 3.37 were in Cluster 2. The representative scenario had a compatibility rating of 3.50.*

Table A11. Factor statistics and representative scenario as selected from cluster analysis with two clusters, North Region.

Factor	Factor Outcomes[a]			
	Mean	Mode	Median	Representative Scenario
- - - - - - - Cluster 1[b] - - - - - - -				
A. Land Available for Forage Production	1.58	1,2	2	2
B. Environmental Concerns and Government Policies	2.42	3	2,3	3
C. Livestock Utilization of Grazing Lands	1.55	1	1,2	1
D. Wildlife Utilization of Grazing Lands	1.53	1	1	1
E. Technology Changes in Forage Production	1.68	2	2	2
- - - - - - - Cluster 2[c] - - - - - - -				
A. Land Available for Forage Production	2.70	3	3	3
B. Environmental Concerns and Government Policies	1.83	1	2	2
C. Livestock Utilization of Grazing Lands	2.53	3	3	3
D. Wildlife Utilization of Grazing Lands	1.50	1,2	1,2	1
E. Technology Changes in Forage Production	1.37	1	1	1

[a]*Factor outcome definitions can be found in Table 1.*
[b]*38 scenarios with an average scenario compatibility rating of 3.49 were in Cluster 1. The representative scenario had a compatibility rating of 3.80.*
[c]*30 scenarios with an average scenario compatibility rating of 3.39 were in Cluster 2. The representative scenario had a compatibility rating of 3.80.*

Table A12. Factor statistics and representative scenario as selected from cluster analysis with two clusters, West Region.

Factor	Factor Outcomes[a]			
	Mean	Mode	Median	Representative Scenario
- - - - - - - Cluster 1[b] - - - - - - -				
A. Land Available for Forage Production	2.61	3	3	3
B. Environmental Concerns and Government Policies	1.83	1,2	2	2
C. Livestock Utilization of Grazing Lands	2.68	3	3	3
D. Wildlife Utilization of Grazing Lands	1.56	1	1	1
E. Technology Changes in Forage Production	1.54	2	2	2
- - - - - - - Cluster 2[c] - - - - - - -				
A. Land Available for Forage Production	1.92	2	2	2
B. Environmental Concerns and Government Policies	2.35	3	2,3	3
C. Livestock Utilization of Grazing Lands	1.92	2	2	2
D. Wildlife Utilization of Grazing Lands	1.69	2	2	2
E. Technology Changes in Forage Production	1.65	2	2	2

[a]*Factor outcome definitions can be found in Table 1.*
[b]*41 scenarios with an average scenario compatibility rating of 3.70 were in Cluster 1. The representative scenario had a compatibility rating of 4.30.*
[c]*26 scenarios with an average scenario compatibility rating of 3.30 were in Cluster 2. The representative scenario had a compatibility rating of 3.60.*

Table A13. Factor statistics and representative scenarios as selected from cluster analysis with three clusters, South Region.

Factor	Factor Outcomes[a]			
	Mean	Mode	Median	Representative Scenario
- - - - - - - Cluster 1[b] - - - - - - -				
A. Land Available for Forage Production	2.48	3	3	3
B. Environmental Concerns and Government Policies	2.32	3	2	2
C. Livestock Utilization of Grazing Lands	1.84	2	2	2
D. Wildlife Utilization of Grazing Lands	1.29	1	1	1
E. Technology Changes in Forage Production	1.87	2	2	2
- - - - - - - Cluster 2[c] - - - - - - -				
A. Land Available for Forage Production	2.37	3	3	3
B. Environmental Concerns and Government Policies	1.96	2	2	2
C. Livestock Utilization of Grazing Lands	2.52	3	3	3
D. Wildlife Utilization of Grazing Lands	1.29	1	1	1
E. Technology Changes in Forage Production	1.22	1	1	1
- - - - - - - Cluster 3[d] - - - - - - -				
A. Land Available for Forage Production	2.00	2	2	2
B. Environmental Concerns and Government Policies	2.32	3	2	3
C. Livestock Utilization of Grazing Lands	1.28	1	1	1
D. Wildlife Utilization of Grazing Lands	2.32	2	2	2
E. Technology Changes in Forage Production	1.84	2	2	2

[a]*Factor outcome definitions are found in Table 1.*
[b]*31 scenarios with an average scenario compatibility rating of 3.64 were in Cluster 1. The representative scenario had a compatibility rating of 3.80.*
[c]*27 scenarios with an average scenario compatibility rating of 3.39 were in Cluster 2. The representative scenario had a compatibility rating of 3.80.*
[d]*25 scenarios with an average scenario compatibility rating of 3.35 were in Cluster 3. The representative scenario had a compatibility rating of 3.70.*

Table A14. Factor statistics and representative scenarios as selected from cluster analysis with three clusters, North Region.

Factor	Factor Outcomes[a]			
	Mean	Mode	Median	Representative Scenario
- - - - - - - Cluster 1[b] - - - - - - -				
A. Land Available for Forage Production	1.36	1	1	1
B. Environmental Concerns and Government Policies	2.55	3	3	3
C. Livestock Utilization of Grazing Lands	1.23	1	1	1
D. Wildlife Utilization of Grazing Lands	1.68	1	1,2	1
E. Technology Changes in Forage Production	1.77	2	2	2
- - - - - - - Cluster 2[c] - - - - - - -				
A. Land Available for Forage Production	2.88	3	3	3
B. Environmental Concerns and Government Policies	1.71	1	1	1
C. Livestock Utilization of Grazing Lands	2.65	3	3	3
D. Wildlife Utilization of Grazing Lands	1.65	2	2	2
E. Technology Changes in Forage Production	1.29	1	1	1
- - - - - - - Cluster 3[d] - - - - - - -				
A. Land Available for Forage Production	2.14	2	2	2
B. Environmental Concerns and Government Policies	2.14	2	2	2
C. Livestock Utilization of Grazing Lands	2.17	2	2	2
D. Wildlife Utilization of Grazing Lands	1.31	1	1	1
E. Technology Changes in Forage Production	1.52	2	2	2

[a]*Factor outcome definitions are found in Table 1.*
[b]*22 scenarios with an average scenario compatibility rating of 3.60 were in Cluster 1. The representative scenario had a compatibility rating of 4.30.*
[c]*17 scenarios with an average scenario compatibility rating of 3.43 were in Cluster 2. The representative scenario had a compatibility rating of 3.60.*
[d]*29 scenarios with an average scenario compatibility rating of 3.41 were in Cluster 3. The representative scenario had a compatibility rating of 3.70.*

Table A15. Factor statistics and representative scenarios as selected from cluster analysis with three clusters, West Region.

	Factor Outcomes[a]			
Factor	**Mean**	**Mode**	**Median**	**Representative Scenario**
- - - - - - - Cluster 1[b] - - - - - - -				
A. Land Available for Forage Production	1.94	2	2	2
B. Environmental Concerns and Government Policies	2.44	3	2,3	3
C. Livestock Utilization of Grazing Lands	1.69	2	2	2
D. Wildlife Utilization of Grazing Lands	1.81	2	2	2
E. Technology Changes in Forage Production	1.81	2	2	2
- - - - - - - Cluster 2[c] - - - - - - -				
A. Land Available for Forage Production	2.26	3	2	3
B. Environmental Concerns and Government Policies	2.00	1,3	2	2
C. Livestock Utilization of Grazing Lands	2.52	3	3	3
D. Wildlife Utilization of Grazing Lands	1.83	2	2	2
E. Technology Changes in Forage Production	1.35	1	1	1
- - - - - - - Cluster 3[d] - - - - - - -				
A. Land Available for Forage Production	2.64	3	3	3
B. Environmental Concerns and Government Policies	1.82	1,2	2	2
C. Livestock Utilization of Grazing Lands	2.68	3	3	3
D. Wildlife Utilization of Grazing Lands	1.32	1	1	1
E. Technology Changes in Forage Production	1.64	2	2	2

[a]*Factor outcome definitions are found in Table 1.*
[b]*16 scenarios with an average scenario compatibility rating of 3.33 were in Cluster 1. The representative scenario had a compatibility rating of 3.60.*
[c]*23 scenarios with an average scenario compatibility rating of 3.38 were in Cluster 2. The representative scenario had a compatibility rating of 3.80.*
[d]*28 scenarios with an average scenario compatibility rating of 3.83 were in Cluster 3. The representative scenario had a compatibility rating of 4.30*

APPENDIX B

USE OF GRAZED FORAGES†

FORM A

Listed below are **5 major factors** we have identified that will influence the use of grazed forages over the next 50 years (demand and/or supply). These factors are:

1. Land Available for Forage Production
2. Environmental Impacts and Government Policies
3. Livestock Utilization of Grazing Lands
4. Wildlife Utilization of Grazing Lands
5. Technology Changes in Forage Production

The following is a list of **issues** associated with each of the above **factors** that could impact the use of grazed forages over the *next 50 years*. Please indicate the *direction of change* you believe each issue will take and also rate the *influence* each issue will have on the use of grazed forages via the **factor** the event is listed under. Please use the scale identified at the top of each page for rating the direction of change and influence. **Circle** the number rating to the right of each event for both direction of change and influence which most closely reflects your attitude of each issue.

Please **fill the survey out for your region** (see accompanying map). If an issue does not fit your region (e.g., BLM lands in the north region), just leave the response to that issue blank.

Please feel free to write in the margins to clarify any ratings you desire.

Please see the example on the back page for more information on properly completing this form.

Thank You.

† Grazed forages include annual pasture, seeded perennial pasture, native pasture, small grain pasture, native pasture and range, hay aftermath, and crop residue.

USE OF GRAZED FORAGES

FORM A: EXAMPLE

You have been asked to indicate the *direction of change* you believe each issue will take and to also rate the *influence* each issue will have on the use of grazed forages by way of the **factor** the event is listed under.

Take for example,

Factor #2: **Environmental Impacts and Government Policies**

Issue #a. **Regulations regarding wetland and riparian area conservation.**

For direction of change, if you feel regulations regarding wetland and riparian area conservation *in your region* will increase, the direction of change would be (+1) increase or (+2) significant increase, depending upon how strongly you feel about the change. If you feel regulations will decrease, the direction of change would be (-1) decrease or (-2) significant decrease. If you feel there will not be much change in regulations regarding wetland and riparian area conservation, the direction of change would be (0), no change.

For the influence of the issue, lets assume you marked direction of change (+1) increase. If you feel the increase in these regulations will have a negative effect on (will decrease) the amount of grazed forages† *in your region*, mark (-1) or (-2), but if you feel the increase in these regulations will have a positive effect on (will increase) the use of grazed forages *in your region*, mark (+1) or (+2).

† Grazed forages include annual pasture, seeded perennial pasture, native pasture, small grain pasture, native pasture and range, hay aftermath, and crop residue.

Scales									
Direction of Change of Issue					Influence of Issue				
significant decrease (-2)	decrease (-1)	no change (0)	increase (+1)	significant increase (+2)	very negative (-2)	negative (-1)	neutral (0)	positive (+1)	very positive (+2)

Please indicate the **direction** of change you believe each issue will take and also rate the **influence** each issue will have on the use of grazed forages via the factor, Land Available for Forage Production.

Factor #1: Land Available for Forage Production

Issues	Direction	Influence
a. Suburbanization (ranchettes, etc.)	-2 -1 0 +1 +2	-2 -1 0 +1 +2
b. Expansion of population centers (urban sprawl)	-2 -1 0 +1 +2	-2 -1 0 +1 +2
c. Building "second" homes in rural settings	-2 -1 0 +1 +2	-2 -1 0 +1 +2
d. Use of conservation easements and similar programs	-2 -1 0 +1 +2	-2 -1 0 +1 +2
e. "Open space" or "green space" promotion	-2 -1 0 +1 +2	-2 -1 0 +1 +2
f. Recreational demands on grazing lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
g. Land in crop production vs. grazed forages	-2 -1 0 +1 +2	-2 -1 0 +1 +2
h. Use of U.S. Forest Service lands for livestock grazing	-2 -1 0 +1 +2	-2 -1 0 +1 +2
i. Use of Bureau of Land Management lands for livestock grazing	-2 -1 0 +1 +2	-2 -1 0 +1 +2
j. Natural and planned reforestation	-2 -1 0 +1 +2	-2 -1 0 +1 +2
k. Allocation of lands for other uses such as local parks and watershed districts	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Scales									
Direction of Change of Issue					**Influence of Issue**				
significant decrease (-2)	decrease (-1)	no change (0)	increase (+1)	significant increase (+2)	very negative (-2)	negative (-1)	neutral (0)	positive (+1)	very positive (+2)

Please indicate the **direction** of change you believe each issue will take and also rate the **influence** each issue will have on the use of grazed forages via the factor, Environmental Impacts and Government Policies.

Factor #2: Environmental Impacts and Government Policies

Issues	**Direction**	**Influence**
a. Regulations regarding wetland and riparian area conservation	-2 -1 0 +1 +2	-2 -1 0 +1 +2
b. Regulations due to the Endangered Species Act	-2 -1 0 +1 +2	-2 -1 0 +1 +2
c. Regulations due to the Clean Water Act	-2 -1 0 +1 +2	-2 -1 0 +1 +2
d. Conservation programs (e.g. CRP)	-2 -1 0 +1 +2	-2 -1 0 +1 +2
e. Quantity of water available for agricultural (vs. residential) use	-2 -1 0 +1 +2	-2 -1 0 +1 +2
f. Wilderness area and other preservation programs	-2 -1 0 +1 +2	-2 -1 0 +1 +2
g. Predator control laws and regulations	-2 -1 0 +1 +2	-2 -1 0 +1 +2
h. BLM and USFS grazing regulations (standards and guidelines, rangeland monitoring, etc.)	-2 -1 0 +1 +2	-2 -1 0 +1 +2
i. Range improvement cost share programs	-2 -1 0 +1 +2	-2 -1 0 +1 +2
j. Government commodity programs	-2 -1 0 +1 +2	-2 -1 0 +1 +2
k. Pesticide and animal health product restrictions	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Scales									
Direction of Change of Issue					**Influence of Issue**				
significant decrease (-2)	decrease (-1)	no change (0)	increase (+1)	significant increase (+2)	very negative (-2)	negative (-1)	neutral (0)	positive (+1)	very positive (+2)

Please indicate the **direction** of change you believe each issue will take and also rate the **influence** each issue will have on the use of grazed forages via the factor, Livestock Utilization of Grazing Lands.

Factor #3: Livestock Utilization of Grazing Lands

Issues	Direction	Influence
a. Number of breeding beef cattle in your region	-2 -1 0 +1 +2	-2 -1 0 +1 +2
b. Number of stocker cattle in your region	-2 -1 0 +1 +2	-2 -1 0 +1 +2
c. Number of dairy cattle in your region	-2 -1 0 +1 +2	-2 -1 0 +1 +2
d. Number of sheep in your region	-2 -1 0 +1 +2	-2 -1 0 +1 +2
e. Number of goats in your region	-2 -1 0 +1 +2	-2 -1 0 +1 +2
f. Number of horses in your region	-2 -1 0 +1 +2	-2 -1 0 +1 +2
g. Time breeding beef cattle spend on grazed forages	-2 -1 0 +1 +2	-2 -1 0 +1 +2
h. Time stocker cattle spend on grazed forages	-2 -1 0 +1 +2	-2 -1 0 +1 +2
i. Time dairy cattle spend on grazed forages	-2 -1 0 +1 +2	-2 -1 0 +1 +2
j. Time sheep spend on grazed forages	-2 -1 0 +1 +2	-2 -1 0 +1 +2
k. Time goats spend on grazed forages	-2 -1 0 +1 +2	-2 -1 0 +1 +2
l. Time horses spend on grazed forages	-2 -1 0 +1 +2	-2 -1 0 +1 +2
m. Alternative feed sources for livestock in lieu of grazed forages	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Scales

Direction of Change of Issue					Influence of Issue				
significant decrease (-2)	decrease (-1)	no change (0)	increase (+1)	significant increase (+2)	very negative (-2)	negative (-1)	neutral (0)	positive (+1)	very positive (+2)

Please indicate the **direction** of change you believe each issue will take and also rate the **influence** each issue will have on the use of grazed forages via the factor, Livestock Utilization of Grazing lands.

Factor #3: Livestock Utilization of Grazing Lands (continued)

Issues	Direction	Influence
n. Use of grazing livestock to combat weed infestations	-2 -1 0 +1 +2	-2 -1 0 +1 +2
o. Advances in livestock production technology so as to decrease the number of livestock required for food	-2 -1 0 +1 +2	-2 -1 0 +1 +2
p. Fee and non-fee costs of operating on public lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
q. Fee and non-fee costs of operating on private lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
r. Profit margins of cow/calf producers	-2 -1 0 +1 +2	-2 -1 0 +1 +2
s. Profit margins of stocker cattle producers	-2 -1 0 +1 +2	-2 -1 0 +1 +2
t. Profit margins of dairy cattle producers	-2 -1 0 +1 +2	-2 -1 0 +1 +2
u. Profit margins of sheep producers	-2 -1 0 +1 +2	-2 -1 0 +1 +2
v. Profit margins of goad producers	-2 -1 0 +1 +2	-2 -1 0 +1 +2
w. Profit margins of horse producers	-2 -1 0 +1 +2	-2 -1 0 +1 +2
x. Use by alternative livestock (bison, elk, deer)	-2 -1 0 +1 +2	-2 -1 0 +1 +2
y. Public concern for animal health/rights	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Scales									
Direction of Change of Issue					**Influence of Issue**				
significant decrease (-2)	decrease (-1)	no change (0)	increase (+1)	significant increase (+2)	very negative (-2)	negative (-1)	neutral (0)	positive (+1)	very positive (+2)

Please indicate the **direction** of change you believe each issue will take and also rate the **influence** each issue will have on the use of grazed forages via the factor, Wildlife Utilization of Grazing Lands.

Factor #4: Wildlife Utilization of Grazing Land

Issues	Direction	Influence
a. Demand for wildlife for hunting purposes	-2 -1 0 +1 +2	-2 -1 0 +1 +2
b. Non-consumptive† demand for wildlife	-2 -1 0 +1 +2	-2 -1 0 +1 +2
c. Demand for wildlife occurring from existence, option or bequest values‡	-2 -1 0 +1 +2	-2 -1 0 +1 +2
d. Number of grazing lands purchased and/or set-aside for wildlife use/habitat	-2 -1 0 +1 +2	-2 -1 0 +1 +2
e. Wildlife utilization of private lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
f. Wildlife utilization of public lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2

† **Non-consumptive use** is use of a resource in a manner that does not diminish the available total stock (e.g., bird-watching or photography).

‡ **Existence value** is the external benefit that accrues to individuals having no intention of ever visiting or using the site or environment in question. These individuals are willing to give up resources simply to know that the good exists in a particular condition.

Option value is the amount an individual would be willing to pay to preserve the option to participate in some activity or use some resource at some future time, whether or not that individual ever actually participates or uses the resource.

Bequest value is the amount an individual would be willing to pay to preserve a resource so it will be available for future generations to use.

Scales									
Direction of Change of Issue					Influence of Issue				
significant decrease (-2)	decrease (-1)	no change (0)	increase (+1)	significant increase (+2)	very negative (-2)	negative (-1)	neutral (0)	positive (+1)	very positive (+2)

Please indicate the **direction** of change you believe each issue will take and also rate the **influence** each issue will have on the use of grazed forages via the factor, Technology Changes in Forage Production.

Factor #5: Technology Changes in Forage Production

Issues	Direction	Influence
a. Use of brush control on grazing lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
b. Use of weed control on grazing lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
c. Development of new chemicals for brush and weed control on grazing lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
d. Use of existing chemicals for brush and weed control	-2 -1 0 +1 +2	-2 -1 0 +1 +2
e. Use of biological control methods for brush and weed control on grazing lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
f. Development of new forage species and varieties	-2 -1 0 +1 +2	-2 -1 0 +1 +2
g. Use of fertilization on grazing lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
h. Use of irrigation on grazing lands	-2 -1 0 +1 +2	-2 -1 0 +1 +2
i. Development of grazing management methods (e.g., grazing systems)	-2 -1 0 +1 +2	-2 -1 0 +1 +2
j. Advances in technology for livestock distribution, monitoring and handling	-2 -1 0 +1 +2	-2 -1 0 +1 +2
k. Water development for animal use	-2 -1 0 +1 +2	-2 -1 0 +1 +2
l. Technology transfer and education programs	-2 -1 0 +1 +2	-2 -1 0 +1 +2

USE OF GRAZED FORAGES

FORM B

Listed below are the 5 major factors we have identified that will influence the use of grazed forages over the next 50 years (demand and/or supply)

1. Land Available for Forage production

2. Environmental Concerns and Government Policies

3. Livestock Utilization of Grazing Lands

4. Wildlife Utilization of Grazing Lands

5. Technology Changes in Forage Production

The rationale for including each factor is stated on the following pages. We also have identified 2 or 3 mutually exclusive alternatives under each factor that describe the *major direction* each factor may take over the *next 50 years.*

Please read the rationale and possible future alternatives for each factor, then assign a probability of occurrence (0.0 to 1.0) to each future alternative under each factor for your region. The probabilities for the future alternatives under each factor must add up to 1.0. For example, under factor #5, "Technology Changes in Forage Production", two states are listed: "A. There will not be significant changes in forage production technologies" and "B. There will be significant changes in forage production technologies". If you feel that there is a 60% probability that A will occur over the next 50 years and a 40% probability that B will occur, put 0.60 in the area for A and 0.40 in the area for B (A + B = 1.0).

Thank You.

1. Land Available for Forage Production.

Rationale: To take into account the impact changing land use may have upon the availability of lands for forage production. Issues include those listed in Form A under this factor.

Mutually Exclusive Options	Probability of Occurrence
A. Changes in land use will increase the amount of land available for forage production.	A.
B. Changes in land use will have little impact on the amount of land available for grazing.	B.
C. Changes in land use will decrease the amount of land available for grazing.	C.
	A + B + C = 1

2. Environmental Concerns and Government Policies.

Rationale: To consider the effect environmental regulations and government policies will have upon the availability of grazing lands and the opportunity of stocking them to their economic or biological capacity. Issues to be considered were listed in Form A under this factor.

Mutually Exclusive Options	Probability of Occurrence
A. Regulations will increase on a national level, with lands on the margin being taken out of grazing use.	A.
B. Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.	B.
C. After initial minor changes, the impacts of regulation will subside.	C.
	A + B + C = 1

3. Livestock Utilization of Grazing Lands.

Rationale: To evaluate the trends in livestock numbers and their utilization of, and demand for, grazing lands. Utilization includes the amount of forage consumed and habitat used. Issues to be considered are those listed under this factor in Form A.

Mutually Exclusive Options	Probability of Occurrence
A. Livestock utilization of grazing lands will increase.	A.
B. Livestock utilization of grazing lands will not change significantly.	B.
C. Livestock utilization of grazing lands will decrease.	C.
	A + B + C = 1

4. Wildlife Utilization of Grazing Lands.

Rationale: To evaluate the trends in wildlife numbers and their utilization of, and demand for, grazing lands. Utilization includes forage consumed and habitat used. Consumptive and non-consumptive demands on wildlife should both be considered.

Mutually Exclusive Options	Probability of Occurrence
A. Wildlife utilization of grazing lands will increase.	A.
B. Wildlife utilization of grazing lands will not change significantly.	B.
C. Wildlife utilization of grazing lands will decrease.	C.
	A + B + C = 1

5. Technology Changes in Forage Production.

Rationale: To determine impacts on grazing resources from development and/or use of technology that would enhance the use of grazed forages. Issues include those listed in Form A under this factor.

Mutually Exclusive Options	Probability of Occurrence
A. There will not be significant changes in the development and/or use of forage production technologies.	A.
B. There will be significant changes in the development and/or use of forage production technologies.	B.
	A + B = 1

USE OF GRAZED FORAGES

COMPATIBILITY OF SIMULTANEOUS OCCURRENCE

FORM C

You have been working with five factors that are hypothesized to influence the grazed forage industry over the next 50 years. Two or three mutually exclusive options also have been identified under each of the five factors. The final step in the analysis is to determine the likelihood of each mutually exclusive option from one factor, occurring in the presence of the mutually exclusive options of another factor. This is important to ensure that we have scenarios that include compatible events.

On the following pages, the mutually exclusive options under one factor level are presented along with the mutually exclusive options of another factor. You are asked to state, for your region, the likelihood that each option under one factor, will occur with each alternative level of the other factor. The levels of likelihood (compatibility) are presented on the scale above each table. **Please circle the likelihood level in each box that best describes your estimate of the compatibility between the two factor options. An example is included on the back page.** First impressions are usually the best. We do not expect you to spend a lot of time pondering over these.

Please remember we are *not* inferring that one factor level will *cause* another factor level to occur. We are simply looking for the *likelihood that the two factor levels could occur simultaneously*. We are also assuming symmetry, i.e., the likelihood that A and B will occur together is the same as the likelihood that B and A will occur together.

Please feel free to write in the margins or include another sheet of paper to qualify any likelihood ratings you desire.

Thank You.

USE OF GRAZED FORAGES

COMPATIBILITY OF SIMULTANEOUS OCCURRENCE

FORM C: EXAMPLE

This form assists us in making sure we don't develop scenarios that have factors that are not compatible. You are asked to state, for your region, the likelihood that each option under one factor, will occur with each alternative level of the other factor. The options for each factor are those listed in Form B.

Take for example,

Factor #1: **Land Available for Forage Production**
Option #C: **Changes in land use will decrease the amount of land that is available for grazing.**

and

Factor #2: **Environmental Concerns and Government Policies**
Option #C: **After initial minor changes, the impacts of regulation will subside.**

How compatible are these two options? If the trends in land available for forage production was such that the amount of land available for grazing decreases, could this occur along with a political and environmental climate where future impacts of regulation will subside. If the likelihood of these two occurring together is low (negative correlation), mark (-2) or (-1). If you feel it is very likely they could occur together (positive correlation), mark (+1) or (+2). Neutral (0) would be comparable to a correlation of 0.

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #1 with the mutually exclusive options under Factor #2.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #2: Environmental Concerns and Government Policies	**Factor #1: Land Available for Forage Production**		
	A. Changes in land use will increase the amount of land available for forage production.	B. Changes in land use will have little impact on the amount of land available for grazing	C. Changes in land use will decrease the amount of land available for grazing.
A. Regulations will increase on a national level, with lands on the margin being taken out of grazing use.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
C. After initial minor changes, the impacts of regulation will subside.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #1 with the mutually exclusive options under Factor #3.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #3: Livestock Utilization of Grazing Lands	**Factor #1: Land Available for Forage Production**		
	A. Changes in land use will increase the amount of land available for forage production.	B. Changes in land use will have little impact on the amount of land available for grazing	C. Changes in land use will decrease the amount of land available for grazing.
A. Livestock utilization of grazing lands will increase.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. Livestock utilization of grazing lands will not change significantly.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
C. Livestock utilization of grazing lands will decrease.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #1 with the mutually exclusive options under Factor #4.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #4: Wildlife Utilization of Grazing Lands	**Factor #1: Land Available for Forage Production**		
	A. Changes in land use will increase the amount of land available for forage production.	B. Changes in land use will have little impact on the amount of land available for grazing	C. Changes in land use will decrease the amount of land available for grazing.
A. Wildlife utilization of grazing lands will increase.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. Wildlife utilization of grazing lands will not change significantly.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
C. Wildlife utilization of grazing lands will decrease.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #1 with the mutually exclusive options under Factor #5.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #5: Technology Changes in Forage Production	**Factor #1: Land Available for Forage Production**		
	A. Changes in land use will increase the amount of land available for forage production.	B. Changes in land use will have little impact on the amount of land available for grazing	C. Changes in land use will decrease the amount of land available for grazing.
A. There will not be significant changes in the development and/or use of forage production technologies.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. There will be significant changes in the development and/or use of forage production technologies.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #2 with the mutually exclusive options under Factor #3.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #3: Livestock Utilization of Grazing Lands	**Factor #2: Environmental Concerns and Government Policies**		
	A. Regulations will increase on a national level, with lands on the margin being taken out of grazing use.	B. Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.	C. After initial minor changes, the impacts of regulation will subside.
A. Livestock utilization of grazing lands will increase.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. Livestock utilization of grazing lands will not change significantly.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
C. Livestock utilization of grazing lands will decrease.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #2

with the mutually exclusive options under Factor #4.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #4: Wildlife Utilization of Grazing Lands	**Factor #2: Environmental Concerns and Government Policies**		
	A. Regulations will increase on a national level, with lands on the margin being taken out of grazing use.	B. Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.	C. After initial minor changes, the impacts of regulation will subside.
A. Wildlife utilization of grazing lands will increase.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. Wildlife utilization of grazing lands will not change significantly.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
C. Wildlife utilization of grazing lands will decrease.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #2 with the mutually exclusive options under Factor #5.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #5: Technology Changes in Forage Production	**Factor #2: Environmental Concerns and Government Policies**		
	A. Regulations will increase on a national level, with lands on the margin being taken out of grazing use.	B. Nationally, a significant effect will not be seen, but local effects will be significant in areas where resource concerns have already emerged.	C. After initial minor changes, the impacts of regulation will subside
A. There will not be significant changes in the development and/or use of forage production technologies.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. There will be significant changes in the development and/or use of forage production technologies.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #3 with the mutually exclusive options under Factor #4.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #4: Wildlife Utilization of Grazing Lands	**Factor #3: Livestock Utilization of Grazing Lands**		
	A. Livestock utilization of grazing lands will increase.	B. Livestock utilization of grazing lands will not change significantly.	C. Livestock utilization of grazing lands will decrease.
A. Wildlife utilization of grazing lands will increase.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. Wildlife utilization of grazing lands will not change significantly.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
C. Wildlife utilization of grazing lands will decrease.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #3 with the mutually exclusive options under Factor #5.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #5: Technology Changes in Forage Production	**Factor #3: Livestock Utilization of Grazing Lands**		
	A. Livestock utilization of grazing lands will increase.	B. Livestock utilization of grazing lands will not change significantly.	C. Livestock utilization of grazing lands will decrease.
A. There will not be significant changes in the development and/or use of forage production technologies.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. There will be significant changes in the development and/or use of forage production technologies.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Please fill out the compatibility ratings in **each box**. These ratings compare the compatibility of the mutually exclusive options under Factor #4 with the mutually exclusive options under Factor #5.

Key				
-2	-1	0	+1	+2
will not occur together	low likelihood of occurring together	neutral	likely to occur together	very likely to occur together

Factor #5: Technology Changes in Forage Production	**Factor #4: Wildlife Utilization of Grazing Lands**		
	A. Wildlife utilization of grazing lands will increase.	B. Wildlife utilization of grazing lands will not change significantly.	C. Wildlife utilization of grazing lands will decrease.
A. There will not be significant changes in the development and/or use of forage production technologies.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
B. There will be significant changes in the development and/or use of forage production technologies.	-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

USE OF GRAZED FORAGES

Projection Survey

As you recall, we developed the following list of 5 major factors that will influence the use of grazed forages over the next 50 years.

1. Land Available for Forage Production
2. Environmental Concerns and Government Policies
3. Livestock Utilization of Grazing Lands
5. Technology Changes in Forage Production

The two scenarios listed on the following pages were developed from your previous survey response as the most likely events to occur over the next 50 years. Our final step is to get your projection of grazed forage use in the years 2010 and 2050 based upon the occurrence of these scenarios.

The consumption of forage by livestock is difficult to estimate because no direct measurements are made in national inventories. The 1989 forage assessment based this estimate upon cattle and sheep enterprise budgets developed by ERS, USFS and BLM. Cattle and sheep January 1 inventory numbers were used along with estimates of grazed forage consumption from the enterprise budgets. The unit of measurement is animal unit months (AUMs), i.e., the amount of forage required to feed 1 cow or equivalent for 1 month. Using the range assessment methodology, grazed forage use for 1968-1998 was estimated for your region as shown on the accompanying graphs.

As you will notice, the influence of the cattle cycle is evident. Assuming a 10 to 12-year cattle cycle, the 2010 and 2050 estimates should place us at approximately the same stage of the cycle as we are now. Your estimates should therefore not have to account for the cyclical impact of livestock numbers, but only the general trend of grazed forage use.

On the following pages, we would like you to estimate grazed forage use (AUMs) for the years 2010 and 2050 for each scenario. Rather than giving a point estimate, please provide a distribution of expected grazed forage use. You can do this by placing 10 dots where you think grazed forage use may be each year. You can assume that each dot represents a 10% probability of occurrence. For example, if you put 3 dots on the same estimate, it implies a 30% probability that AUM use will occur at that estimate. We would also like you to write the approximate AUM number associated with each dot so we will not have any interpretation problems. An example is located on the first graph. The example was not developed for any particular scenario so please do not let our example bias your projections.

Remember, if you have any questions, please email, write or phone.

Thanks!

RMRS
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