Department of Agricultural Economics and Agricultural Business

The Value of Public Land Forage and the Implications for Grazing Fee Policy

A summary of the
Bureau of Land Management and U.S. Forest Service
incentive-based grazing fee study,
Grazing Fee Task Group

Agricultural Experiment Station • Bulletin 767

NEW MEXICO STATE UNIVERSITY
College of
Agriculture and Home Economics

CONTENTS

ACKNOWLEDGMENTS

This information was compiled for an incentive-based grazing fee report to the Director of the Bureau of Land Management (BLM). A Grazing Fee Task Group (GFTG) that included the authors of this summary, as well as BLM and U.S. Forest Service (USFS) appraisers, Ron Appel, John DeVilbiss, Tim Heisler, and Gerald Stoebig, was assigned to conduct this study. Additional consultation was provided by Don Waite with the BLM Washington Office. We thank the other members of the GFTG for their significant input to this study.

We wish to thank many people who either provided information or helped compile information for this report. First, we thank the 397 private and public land ranchers who took 1 1/2–4 hours of their time to provide detailed information about the costs and inputs used on their ranch operations. We also thank colleagues, graduate students, and Extension agents including Ron Hillman and Lee Sharp in Idaho; Larry Brence, Tracy Drummond, and Marc Kincaid in New Mexico; and Les Burrough, Ron Cunningham, Gerald Fink, Jim Gill, Scott Hininger, Jay Jenkins, and Eric Peterson in Wyoming, for their assistance in data collection and analysis. Other staff personnel, including Theresa Araquistain, Sue Rimbey, and Mark Coen, helped with data entry. Dr. Morris Southward of New Mexico State University gave valuable advice on statistical analyses. We also thank a peer review panel who reviewed earlier drafts of this grazing fee study: Drs. Thomas Quigley, Gerhard Rostvold, Norman Whittlesey, and John Workman.

We thank BLM and USFS personnel in various district and regional offices who helped compile allotment statistics for rancher interviews. A major effort was necessary by agency personnel to search for federal subleases and provide data on federal allotments.

K. Lynn Bennett provided invaluable leadership to the GFTG as well as the Incentive Based Grazing Fee Task Force. Carol Hadley of the Nevada State Office of the Bureau of Land Management was always available to make arrangements for equipment and facilities. The persistence of Dave Goicechea in obtaining funding for university personnel was appreciated.

The Western Regional Coordinating Committee for Range Economics assisted in research coordination and implementation, and committee members assisted in the review of research publications. The Cooperative States Research Service of USDA is acknowledged for their assistance in grant negotiations.

SUMMARY

A total cost comparison of the fee and non-fee costs of grazing private and public lands was made. These costs included expenses for herding and moving livestock, travel to and from allotments, supplemental feeding, lost animals, maintenance and depreciation of range improvements, and others. Other forage valuation methods were also considered, including a market appraisal, a statistical analysis of private leases, and using grazing permit values to give a direct estimate of the value of public land forage. Alternative methods for indexing market values through time were also explored. These studies were conducted in New Mexico, Wyoming, and Idaho.

The total cost analysis demonstrated that many public land ranchers have been willing to pay more for grazing public lands than the apparent value implied from the private forage market. Considering the 1992 grazing fee of $1.92/AUM, and other non-fee grazing costs, 34% of cattle producers on BLM land, 62% of USFS cattle producers, 60% of BLM sheep producers, and 92% of USFS sheep producers paid more for grazing public lands than did those grazing privately leased lands. Total grazing costs were found to be higher on USFS and for sheep leases when compared to private leases. Forage values estimated using the total cost approach were in the range of $3 to $4/AUM for cattle grazing BLM land, and -$2.86/AUM for cattle on USFS land.

Grazing permit values imply a forage value of $3-5/AUM in the three test states. This value represents the additional amount public

land ranchers have paid for the grazing privilege and is a direct estimate of the willingness to pay for grazing on public lands.

The market rental appraisal approach estimated 1992 forage value to be $3.40/AUM in New Mexico and $7.19/AUM in Wyoming. This approach was not done in Idaho because comparable private leases were lacking. The number of private leases comparable to public lands without major adjustments limits the potential to use this approach to set a value for public land grazing.

Statistically separating the value of forage from the value of lessor-provided services resulted in a net forage value estimate on private leases of $8.42/AUM in Idaho, $4.79/AUM in New Mexico, and $6.93/AUM in Wyoming. These estimates represent non-serviced private leases, not non-serviced public leases. It is not possible to do this type of analysis on public land permits because services are not provided by the federal land agencies.

Similar to the findings of a similar 1966 grazing cost survey, we found variability in costs and lease rates within specific areas to be as large as the variability between areas. The forage market is not a highly refined, price discriminating market. There is no economic basis to regionalize grazing fees.

Including the "ability-to-pay" indices [Beef Cattle Price Index (BCPI) and Prices Paid Index (PPI)] in the Public Rangeland Improvement Act (PRIA) fee formula has caused the calculated grazing fee to fall behind forage value through time. Adding the BCPI and PPI to the PRIA formula did not improve the tracking ability of the formula as anticipated by the Grazing Fee Technical Committee assigned to evaluate grazing fees in the 1960s. The FVI will adequately update the grazing fee on an annual basis.

The Grazing Fee Dilemma

The federal government is not collecting the full market value for grazing public lands, but ranchers are paying full value through the current fee, non-fee grazing costs, and investments in grazing permits. Past grazing fee policy has contributed to the value of grazing permits and current ranchers have paid this cost. Some of the value for public land grazing has been capitalized into the value of public land ranches and is bought and sold in the ranch real estate market. Legal precedent says permit value need not be considered

in setting grazing fee policy, but the allocation of permit value remains a central policy issue.

There is a strong theoretical linkage between grazing fees and permit value. As fees go up, permit values should erode and wealth will be transferred from ranchers to the government. This is the dilemma that policy makers face. The GFTG does not imply that this transfer is right or wrong, but the concern about the fairness of reallocating wealth is obvious.

Recommendations

We concluded that the value of public land forage in the three test states is not different and lies somewhere between $3/AUM and $5/AUM. This assessment relies heavily on the values implied from grazing permit values that give a direct estimate of ranchers' willingness to pay for public land grazing. We recommend:

1. The grazing fee should be administratively or legislatively determined within the range of $3-5/AUM. This recommended range assumes past legal precedent will continue and no allowance or recognition will be given for the investment ranchers have in grazing permits. The current grazing fee, or even a lower fee, would be justified in all cases if even a minimal allowance were made for ranchers' grazing permit investments. Entitlement to grazing permit value remains a key issue of the grazing fee controversy.

2. Any base grazing value should be applied throughout the West.

3. Any base grazing value should be updated annually with the forage value index (FVI) calculated from the previous year.

4. The BLM and USFS should investigate the potential of implementing a competitive bid system that would create a market for public land grazing.

5. Additional studies to define the market value of public land grazing using market price comparisons are not justified.

The Value of Public Land Forage and the Implications for Grazing Fee Policy

L. Allen Torell,[1] Larry W. Van Tassell,[2] Neil R. Rimbey,[3] E. Tom Bartlett,[4] Tom Bagwell,[5] Paul Burgener,[6] and Juli Coen[7]

In May 1992, a task force was formed by the Bureau of Land Management (BLM) and U.S. Forest Service (USFS) to recommend an incentive-based grazing fee for public lands. The task was divided into two topics: 1) incentives for enhanced rangeland stewardship, and 2) evaluating grazing fee issues. The Grazing Fee Task Group (GFTG) was formed and assigned the second topic. The GFTG was to 1) recommend a method for establishing grazing fees, which includes a procedure for periodically updating grazing fees, and 2) recommend pricing areas to use in establishing fees. The primary evaluation criterion was that the grazing fee should be based on the economic value of the forage.

The GFTG was composed of university researchers from four western universities and appraisers from the BLM and USFS. A more complete report that presents a more detailed analysis and description of the study results was submitted to the BLM by the GFTG (Bartlett et al. 1993). This report summarizes the major findings of the study.

---

[1]New Mexico State University; [2] University of Wyoming; [3] University of Idaho; [4] Colorado State University; [5]New Mexico State University; [6] University of Wyoming; [7] University of Idaho.

The GFTG initially reviewed past grazing fee studies and prepared a background document that provided the basis for future work. Procedures were developed to evaluate alternatives for determining the value of public land forage. Limited studies and data collection were conducted in Idaho, New Mexico, and Wyoming. Grazing values were estimated in this three-state test area and compared to previous work and value estimates determined using market appraisal techniques. Various regional pricing areas and methods for determining and updating the value of public land forage were also tested and reported.

STUDY OBJECTIVES

The major study objective was to evaluate alternative methods that could be used to determine the market value of public land forage. This value was defined to be the "most probable price in cash, terms equivalent to cash, or in other precisely revealed terms, for which public land forage would rent in a competitive market under all requisites to fair negotiation, with buyers and sellers each acting prudently, knowledgeably and with self interest" (American Institute of Real Estate Appraisers 1983).

Specific study objectives were to:

1. Determine the basis for establishing current forage values.

2. Determine the basis for establishing grazing fees.

3. Define appropriate pricing areas.

4. Determine an appropriate procedure for updating grazing fees.

ALTERNATIVE WAYS TO VALUE PUBLIC LAND FORAGE

Because federal grazing fees are set by a formula[8] and not by open market transactions between willing buyers and sellers, no direct estimate of market value is obtainable[9]; other indirect valuation procedures must be used. Past federal grazing fee studies have used market prices for alternative forages, after making adjustments for the differences in services, facilities, and lease terms and conditions, to indicate the apparent grazing value for public lands.

Several methods have been used or proposed for valuing public land forage. Some of these methods include market-price comparison to the private forage market (Torell et al. 1989, Torell and Bledsoe 1990, Rimbey et al. 1992); competitive bidding for public land forage (Gardner 1963, USDA/USDI 1992, Gallacher 1992); economic production analyses (income approach), including ranch budgets and linear programs (Olson and Jackson 1975, Cook et al. 1980, Torell et al. 1981, Kehmeier et al. 1987); willingness-to-pay estimates (Hof et al. 1989); and amortized permit prices, whereby the observed market price (capital value) of federal grazing permits is amortized to estimate annual forage value (Roberts 1963, Roberts and Topham 1965, Jensen and Thomas 1967, Torell and Doll 1991).

Theoretical justification for the various valuation techniques is based on the premise that ranchers are profit maximizers and the forces of supply and demand operate to establish range forage prices. If private and public forages are substitutes, a rational and

---

[8] The current grazing fee formula was established under the Public Rangeland Improvement Act (PRIA) of 1978. The PRIA fee formula is:

$$Fee = \$1.23 \left(\frac{FVI + BCPI - PPI}{100}\right)$$

The formula uses a $1.23 base forage value established in 1966, and is adjusted by annual changes in private grazing land lease rates (FVI), prices received for beef cattle (BCPI), and costs of beef production (PPI).

[9] Public land grazing permits are bought and sold in the competitive ranch real estate market. The market value of grazing permits provides a direct estimate of the value of public land forage. Thus, an observable market price for public land forage is available from permit values as well as legal leasing and livestock pasture agreements on federal lands (e.g., McGregor Range and Ft. Meade).

economically motivated rancher should be willing to pay equal amounts for the two sources of forage. These principles were highlighted in economic models developed as a part of grazing fee research conducted in the 1960s at Utah State University (Roberts 1963, Jensen and Thomas 1967, Nielsen and Wennergren 1970). Each of the forage valuation methods described below is justified based on the Utah grazing fee model. They theoretically estimate an economically efficient grazing fee and are consistent with the conditions of profit maximization.

Total Cost Approach

By the total cost approach to valuation, total fee and non-fee grazing costs are estimated for both private and public rangelands. Total private grazing costs define the total amount willingly paid for grazing within a competitive market. Subtracting non-fee grazing costs on public lands from this cost estimate results in a residual amount: an estimate of the grazing fee that would equate total private and public grazing costs. Higher grazing costs on public lands because of location, distance, terrain, productivity, and multiple use provisions and regulations are directly considered using the total cost approach to valuation.

The total cost approach was used to derive the $1.23/AUM base charge in the current PRIA fee formula (USDA/USDI 1977). Total fee and non-fee costs of grazing private and public rangelands were compared using data collected by a 1966 Western Livestock Grazing Survey. The estimated difference in total grazing costs was considered to be the value of public land forage and the grazing fee that should be charged (USDA/USDI 1977, p. 2-22). A major point of controversy was excluding permit investment as a cost item.

Market Appraisal Approach

The market rental appraisal valuation method is based on the alternative cost doctrine whereby a rational lessee of forage will not pay in excess of the amount that must be paid for the next best alternative. The price paid for alternative forages in a competitive market can be used to imply the value of public land forage, provided adjustments are made to account for differences in non-fee grazing costs and lease arrangements.

Using a market comparison to value forage relies on standards and procedures of professional appraisers to determine forage value. The major assumptions are: 1) the private land lease rate can be satisfactorily separated using appraisal or statistical techniques to estimate the value of lessor services and the net value of private land forage, and 2) differences in lease terms and conditions between private and public lands can be accounted for in the lease comparison.

Permit Valuation

Historically, economists have claimed the fee charged to graze public lands has been less than the value of the forage and the rancher who controlled the grazing realized an economic value. Because control of grazing is embodied in the grazing permit, this value became a marketable item that has been transferred with the permit (Nielsen and Wennergren 1970). Others have argued that the reason for permit value is not a capitalized cost advantage, but rather the capitalized value of cost savings realized through economies of size when federal grazing permits are attached to the ranch unit (Obermiller 1992b).

Economists, including Roberts (1963), Gardner (1962, 1963), Jensen and Thomas (1967), Nielsen and Wennergren (1970), Torell and Doll (1991), Torell et al. (1992), and Workman (1988), have explored theoretical reasons for permit value and have highlighted the importance of permit value to the grazing fee issue. Permit value has at least partially explained the apparent capitalized cost advantage that public land ranchers have over those grazing on private lands. As the cost differential between public and private grazing fluctuates, the changing value of the grazing permit theoretically eliminates the cost advantage that public land ranchers have. When a public land rancher buys the grazing permit, total grazing costs are equated (Workman 1988, Torell et al. 1992).

The Utah grazing fee model suggests a strong theoretical linkage between the level of grazing fees and permit value. As grazing fees or non-fee grazing costs fluctuate and change the differential between public and private grazing costs, permit values should adjust as well.[10] Theoretically, it is only at the fee level where

[10] The theoretical linkage between grazing fees and permit value has not been widely

permit value is zero or very near zero that the government is collecting full market value of the forage. As long as ranchers are willing to pay each other for permits, the government is not extracting all the value of the forage (Nielsen and Wennergren 1970).[11] An obvious equity question arises as to how, or if, ranchers should be compensated for the loss in their wealth position as higher grazing fees erode the value of public-land ranches. The entitlement of permit value remains a central issue in the grazing fee debate.

Because a competitive market exists for western ranches with grazing permits, and federal grazing permits add value to a ranch, a direct estimate of the annual value of public land grazing can be obtained by computing a rate of return on the grazing permit part of the ranch investment and adding this to the current grazing fee (Nielsen and Wennergren 1970). Differences in production rates, costs, and livestock returns between grazing allotments should be captured as observed differences in the market value of public-land grazing permits. Grazing permit values should give site-specific estimates of forage value while directly considering the costs, forage quality, range improvements, and characteristics of specific public-land allotments.

Production Analysis

Various production function analyses and budgeting techniques can be used to estimate the value of public land forage (Bartlett 1983). However, range forage is only one factor in range livestock operations, and estimating necessary production relationships has produced only limited success because of the complexity, variability, and limits of biological data.

Enterprise budgeting is another production analysis technique for valuing public land forage. In this approach, the total gross value

---

observed on an empirical basis. After public land grazing fees increased from $0.33/AUM to a base value of $1.23/AUM in the 1960s, permit values continued to increase. Various market forces interact to determine value, and permit value may have increased still more if grazing fees had not increased. Torell and Doll (1991) did find that as grazing fees on New Mexico state trust lands increased, capital values of grazing leases decreased. Yet, lease value for New Mexico state trust land has now increased to levels comparable with BLM and USFS permit values.

[11] It would be expected that grazing permits would maintain some value because of the long-term tenure of the permit and the seasonal complement that public forage provides.

of the ranch output is calculated, and all costs except range forage are deducted. The remaining value is the residual return to the grazing resource.[12] Dividing the residual return by the number of AUMs grazed yields the apparent per-unit value of the unpriced forage input (Bartlett 1983). The residual return is the economic return to the grazing resource once all other productive inputs have been paid a market rate of return.

Linear programming (LP) is a technique that has been used to analyze budget data (Gee 1983, Kehmeier et al. 1987). A linear profit function is defined for the ranch business, and this function is maximized subject to linear constraints that define seasonal resource limitations, forage use rates, production relationships, and transfer rates between the various production and sale activities. In addition to estimating what production scheme would maximize profit, LP provides an estimate of what an additional unit of each of the scarce resources would add to profit. This "shadow price" has been used to estimate the marginal value of forage for livestock production.

Production analyses can be used to derive forage values without data on private and public lease costs. However, ranch production cost data are still required. These approaches can be explicit to individual operators and conditions, or can be developed for representative ranches and conditions over a broad area. Many enterprise budgets and LP analyses are available throughout the West from many different sources.

Because subjective values must be assigned to unpaid resources, the residual return to the grazing resource (the forage value estimate using this method) can vary greatly. Numerous budgets exist throughout the West with dramatic differences in the value assigned to unpaid production factors.

Competitive Bid

Through a competitive bid, a direct market for public land forage would be created and the interaction of potential buyers and sellers would lead to discovery of the market value of public land forage.

---

[12] This is different than the standard budget analysis where grazing costs are included and a residual return is calculated to land, management, capital, and risk. For forage valuation, a cost must be assigned to these items.

Individuals with the highest potential net value from the forage would bid the most for the forage, and public land forage would be allocated to its highest and best use. Assuming non-livestock users could also bid, the discovered value for public land forage would in some cases reflect a recreation or preservation value rather than its value for livestock production.

If a competitive bid system were used to establish forage value, the necessity to address pricing areas, ecological differences, and administrative boundaries would be removed. Variability in bids is expected due to the differences in lease conditions, quality, access, and production costs. It circumvents the ability-to-pay issue and should theoretically result in an efficient and equitable fee system.

Contingent Valuation

The contingent valuation (CV) method has received considerable attention in the resource economics literature and has been applied to many different goods, most commonly aesthetic, environmental, and recreational activities (Hof et al. 1989). By this method, those who use a good or service are surveyed to determine what they would be willing to pay for that good or service in order to derive the demand function.

Recommended Forage Valuation Method

All the above methods of valuing rangeland forage are consistent with profit maximization and can be justified on theoretical grounds. Each valuation method has specific limitations:

1. A market price comparison, including either the market appraisal approach or the total cost approach, would be the preferred valuation method on theoretical and historical grounds. It has been widely accepted as a valid method of valuing forage. All cost items are explicitly defined and understandable. This method has been criticized, however, for relying on public land ranchers to provide necessary data.

2. Permit investments provide a direct and site-specific estimate of value, but this value has been influenced by factors other than ranch production value, i.e., transfer restrictions, expect-

ed capital gains, resource complementarity, and tax benefits (Jensen and Thomas 1967, Torell and Doll 1991, Martin and Jeffries 1966, Obermiller 1992b). While it might be argued that the government is entitled to the total forage value, the willingness of ranchers to pay a permit purchase price in excess of apparent forage value highlights the debate over entitlement to grazing permit value. Another limitation is that the implied annual value from grazing permits depends on the selection of a subjective interest rate to use in the calculation. A minimal change in the interest rate chosen can produce a wide range of estimated values.

3. Production analysis requires subjective judgment in valuing ranch investments, labor, management, and risk. A wide range of forage values can be justified depending on values assigned to the unpaid factors of production. Data requirements are immense.

4. Competitive bidding would be the preferred alternative for setting grazing fees in the long run because the market place remains the final arbiter of value, and the inherent differences in quality and productivity between grazing allotments would be accounted for in the bidding process. Theoretically, the market value of forage on each public land parcel would be collected. However, existing permit structure, regulations, and staffing might limit its immediate applicability. The equity question remains whether existing permit holders should be compensated for permits and investments made prior to instituting a competitive bid system. Few opportunities exist to test this procedure in the short run without dramatic changes in existing regulations and policies. Also, certain leases (i.e., landlocked properties) may have a limited number of prospective bidders and thus have little applicability in a bidding system.

5. The contingent valuation method has limited use for valuing public land forage when the respondent (public land rancher) has a vested interest in the derived value (Hof et al. 1989), creating a built-in response bias.

Recognizing the limitations of each of the methods and the criterion that total grazing costs on private and public lands should be equal, we considered market price comparison, permit valuation, and production analysis to be potential ways to value public land forage. As such, we tested the total cost, market rental appraisal, and permit valuation approaches.

METHODS AND PROCEDURES

The GFTG concluded that obtaining the market value of forage was the primary criterion for determining the grazing fee. An evaluation of alternative methods for valuing public land forage indicated that a comparison with the private forage market would provide the best estimate of the market value for forage. This market comparison must consider the differences between fee and non-fee grazing costs when leasing private and public lands.

Total Grazing Costs

Ranch survey data were collected in Idaho, New Mexico, and Wyoming to identify public and private fee and non-fee grazing costs, similar to the 1966 Western Livestock Grazing Survey (USDA/USDI 1977). These states were selected to take advantage of previous research on private grazing leases, ranch sales data, and cost-of-production data collected as a part of state land grazing fee studies or university research efforts. Collected cost data were compared to university livestock enterprise budgets, updated cost data from the 1966 Western Livestock Grazing Survey using price indices (USDA/USDI 1992, Nielsen 1992), and university grazing cost studies (Redmond et al. 1993, Obermiller 1992a) where possible. Results of these comparisons are not presented in this summary report but are presented in Bartlett et al. (1993).

Non-fee grazing cost data were gathered on cost items identified in the 1966 grazing fee study (table 1) using a random sample of public permittees and private lessees in the three-state test area. Range improvement investments (development depreciation) on public lands were determined from BLM and USFS records in the selected test areas. Ranchers interviewed in the survey also defined additional range improvement investments they had made on public lands and supplied details about investments on private and state lands that also service federal allotments and private leased lands. Only the rancher's share of cost was considered, and investments on non-federal land were prorated by the percentage of time or use on the federal allotment.

The grazing cost survey was administered to 77 Idaho ranchers, 85 New Mexico ranchers, and 99 Wyoming ranchers. All participants were randomly selected from a larger list defining those

Table 1. Description of non-fee cost categories.

Cost Category	Description
Lost animals	Value of livestock that die or disappear on the lease or allotment.
Association fees	Dues, fees, and assessments by grazing associations.
Veterinary	Veterinary and medicine expenses for sick or injured animals grazing on the lease.
Moving livestock	Expenses to move livestock to and from the lease, including hired trucking, labor, and vehicle expenses.
Herding	Labor and vehicle expenses to check on animals and to move livestock to new pastures or areas within the lease.
Miscellaneous labor and mileage	Labor and vehicle expenses to go to meetings, round up strays, or deal with various problems associated with the lease.
Salt and feed	Salt and feed expenses while livestock are on the lease.
Water	Cost of pumping and hauling water to the lease.
Horse	Cost of using horses on the lease.
Improvement maintenance	Labor, vehicle expenses, materials, and equipment used to maintain improvements on the lease.
Development depreciation	
Federal land	Annual depreciation allowance for range improvements located on federal land and used on the allotment or lease. Only the rancher's share of cost is considered.
Private land	Annual depreciation allowance for range improvements located on private, state, or other uncontrolled lands but used totally or partially on the allotment or lease. Only the rancher's share of cost is considered. Improvements used to service both private and federal lands are prorated based on the estimated percentage of use on the lease.
Other	Miscellaneous expenses including insect control, predator control, and other undefined items.
Private lease rate	Fee paid to private lessors for forage and services provided.
Total labor	Total labor costs summed across various categories defined above.
Total vehicle mileage	Total vehicle costs summed across various categories defined above.

leasing private or public lands in the three-state test area.

Two public land leases (one each in Idaho and New Mexico) were excluded from the analysis because the costs reported were about three times the next highest cost per AUM reported in the study. Both leases were small and the interviewers may have misunderstood and underestimated the herd size upon which costs were reported. In addition, one private land lessee with two leases in Idaho was excluded because only horses were grazed; this was not comparable to the cattle and sheep leases considered in the analysis. After these exclusions, grazing costs were estimated with data supplied by 75 ranchers in Idaho, 84 in New Mexico, and 99 in Wyoming.

Figure 1 presents the number of leases, by county and ownership (BLM, USFS, private), included in the final analysis for Idaho, Wyoming, and New Mexico. The three-state data base included information on 173 BLM allotments, 72 USFS allotments, and 151 private leases.

Sheep grazing on private rangeland was not common. Private leases included only 3 sheep leases in Idaho, 3 in New Mexico, and 9 in Wyoming. The sample of public land sheep allotments totalled 19 in Wyoming and Idaho and 6 in New Mexico. The sample size was too small to provide statistically valid grazing cost estimates for private land sheep leases at the state level. Also, sheep grazing costs on USFS lands in New Mexico could not be estimated because none were included in the sample. Only a broad estimate of forage value for sheep production was possible by combining data across all three test states. Limited sample size should be recognized when interpreting sheep grazing costs and forage values.

Total grazing costs were calculated for each lease using survey data and the labor and mileage rates and other assumptions detailed in Bartlett et al. (1993). Calculations and analysis were completed using appropriate statistical routines found in the SAS statistical program (SAS Institute, Inc. 1985, 1988). Variation in grazing costs were analyzed using an unbalanced[13] analysis of variance (ANOVA) with a three-way design and interaction.

The average cost reported below for a particular state, livestock class, and land ownership is not the simple average for each

[13] In this context "unbalanced" refers to an unequal number of observations for different states, livestock classes, and land ownership types.

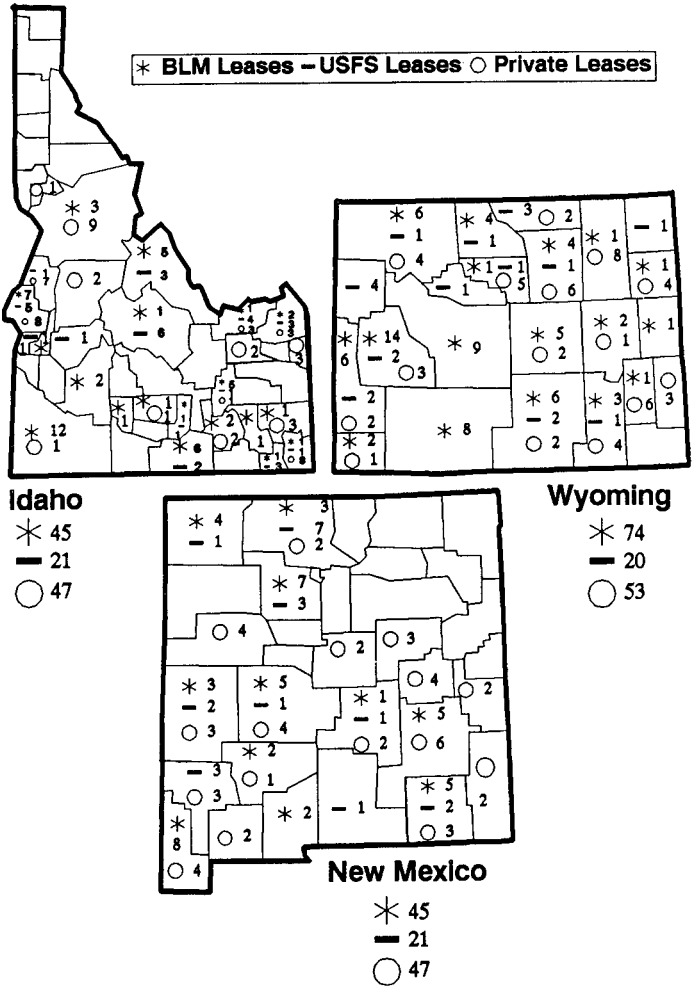

Fig. 1. Number of leases and allotments sampled by land ownership, county, and state.

particular cost categorization. Rather, reported averages, along with standard errors (SE) of the estimates, were generated from a linear statistical model. Reported means are least-squares means (LSM), or population marginal means. A least-square mean was determined to provide the best estimate of value in this application because differences in the size of leases and sample size between states and classes of livestock were accounted for in the statistical model.

Forage value estimates are presented as mean values followed by 90% confidence limits about the mean. This procedure provides an estimated interval assumed to contain the true population mean at the specified level of confidence. This range of values gives additional information because it is highly unlikely that any particular sample mean will be exactly equal to the population mean that was estimated. All reported means were weighted by the number of AUMs leased.

Market Appraisal Approach

To provide a direct market-based check of the total cost approach, appraisers searched the market for comparable leases of public forage. To ensure a high degree of comparability, the market search was conducted in the same states as the total cost approach test — Idaho, New Mexico, and Wyoming. Market data were based on competitive bidding or negotiation within the normal bargaining of the marketplace, as opposed to those that were set administratively.

In addition to the limited number of competitive leases used as a market rental comparison, data obtained from interviews with private land lessees included information on lease rates and terms and conditions of private land leases. Some leases where little if anything other than forage was provided with the lease and other leases where the lessor provided numerous services to the lessee were included. The variation in lease rates as lessors provided different bundles of services to the lessee was analyzed using regression procedures similar to Torell and Bledsoe (1990) and Rimbey et al. (1992). Dummy variables for major services including maintenance of the property, daily care of livestock, watering of livestock, and liability insurance were defined to be 1 when the lessor provided these services as part of the lease, 0.5 when they were done jointly by the lessor and lessee, and 0 when they were

provided by the lessee. Additional dummy variables were used to test whether statistically significant differences existed between states. The private lease rate and non-fee costs were regressed against the defined dummy variables to estimate how the dependent variable changed as different combinations of services were provided.

Permit Value Approach

Different methods were used to estimate grazing permit values in the three test states. First, in Idaho and Wyoming, ranch sales data were collected from Farm Credit Services (FCS) for 1985-1992. Summary statistics were compiled from 129 BLM and 38 USFS permit ranch sales in Idaho, and 290 BLM and 35 USFS sales in Wyoming. This included ranches from all areas in Idaho and Wyoming and with varying levels of federal land dependency. Regional differences in value were not considered.

Sales data compiled included an appraiser's allocation of the contribution that public and state AUMs made to the market value of recent ranch sales. These estimates of permit value were recorded from FCS sales sheets and averaged over the 1985-92 period.[14] The reported averages were weighted by the number of federal AUMs leased.

In New Mexico, ranch values and permit values have been studied for a number of years (Fowler and Gray 1981; Torell and Fowler 1985, 1986; Torell and Doll 1989). Most recently, ranch sales data have been collected from FCS and regression analyses used to estimate the value of New Mexico ranches with different characteristics. Factors determined to influence value include ranch size, rangeland productivity, and the percentage of grazing capacity coming from leased public and state trust lands.

A regression analysis was used to estimate New Mexico grazing permit values. Ranch sales data for 1987-March 1993 were collected from FCS. Data included sales price and definition of the terms, and sale conditions. Data for 378 ranch sales from all parts of New Mexico and for all levels of federal and state land dependencies were included in the analysis. Average 1992 permit values were

[14] Averaging over the seven-year period was necessary to obtain an adequate sample size. This procedure is justified because the ranch real estate market was relatively constant over this time period.

determined using the estimated regression equation.[15] This was done by estimating the January 1992 market value of a 300 AUY ranch totally dependent on BLM or USFS for grazing capacity.

Annual forage value was estimated by multiplying average permit values by a capitalization rate of 3.35% and adding this to the 1992 grazing fee of $1.92/AUM.[16] The result is the annual amount ranchers have paid in the competitive ranch real estate market for public land grazing. Obviously, estimated forage value will vary considerably depending on the interest rate, a limitation for using permit values to imply forage value.

Pricing Areas

Many believe that geographic differences exist in public land forage values and grazing fees should be different by geographic area. It seems logical that more productive or higher-quality rangelands would lease for more (Robertson 1978). Pricing areas have been suggested as a way of identifying these differences so that site-specific forage values and grazing fees could be determined.

Various pricing areas that recognize social, ecological, physiographic, economic, and political differences have been suggested over the years. The advantage of a single pricing area is ease of value determination and administration, including periodic updating. The disadvantage is some users will be overcharged while others will be undercharged when a nationwide average is used. This holds true for all pricing areas other than individual allotments. Eco-physiographic regions and individual state boundaries, as well as a single pricing area were examined, in this study. Bartlett et al. (1993) provides a more detailed definition and discussion of the pricing area analysis.

---

[15] The regression equation updated statistical models developed by Torell and Doll (1989). The updated model is available from the authors.

[16] Torell and Doll (1991) found that as grazing fees on New Mexico state trust lands increased from $1.60/AUM in 1986 to $3.13/AUM in 1989, the value of state land grazing leases decreased by $29.81/AUM for every $1/AUM increase in the grazing fee. The implied capitalization rate was 3.35% (1/29.81). This rate is consistent with long-term rates of return realized from western public land ranches (Agee 1972, Madsen et al. 1982, Workman 1986).

RESULTS

Three-State Average Grazing Costs

Grazing costs were estimated for BLM and USFS combined, and compared to costs for private leased lands in the three test states (table 2). Different cost categories are shown for both cattle and sheep and are estimated across states after adjusting for differences in lease size. Total costs were estimated to be $18.15/AUM for cattle on public land and $25.87/AUM for sheep on public land. By comparison, the same costs on private leased lands were $19.04/AUM for cattle and $20.46/AUM for sheep.

Nearly all cost categories, defined in table 1, were significantly higher on public lands than on private leased lands (table 2). This is consistent with public land ranchers' belief that non-fee costs for grazing public lands are higher than on private lands. Many have suggested that multiple-use objectives of land agencies and added regulations on public lands have contributed to these higher costs.

Some of the cost categories, while significantly different between public and private lands, were relatively unimportant to total grazing costs because of the small dollar amount involved. Major cost items for private and public land grazing included lost animals, moving and herding livestock, salt and feed, and range improvement maintenance. The private lease rate averaged $7.71/AUM for cattle producers and $7.18/AUM for sheep producers. It was a major part of the total cost of grazing on private leased lands, accounting for over 34% of total grazing costs on private land. Total grazing costs were not significantly different between private and public cattle producers or between private and public sheep producers (table 2).

Rancher-funded range improvements contributed relatively little to total grazing costs on public lands. Including only the ranchers' investment share and considering all range improvements made between 1971 and 1992, total rancher investments on federal rangelands, including the value of paid and unpaid labor contributions, averaged $4.73/AUM in Idaho, $4.72/AUM in New Mexico, and $2.00/AUM in Wyoming (table 3).[17] This represents an average

[17] All ranchers had additional investments in the grazing permit and most ranchers had range improvement investments made prior to 1971.

Table 2. Average grazing costs on public and private leased lands in Idaho, New Mexico, and Wyoming combined (adjusted for differences in lease size), 1992.

	Cattle		Sheep	
	Public	Private	Public	Private
Sample size (n)	201	134	44	15
Lost animals	3.65[a]	2.10[b]	5.39[c]	2.63[a,b]
	(0.25)	(0.29)	(0.56)	(0.90)
Association fees	0.48[a]	0.00[b]	0.04[b]	0.00[b]
	(0.07)	(0.08)	(0.15)	(0.09)
Veterinary	0.10[a,b]	0.12[a]	0.22[a]	0.20[a,b]
	(0.03)	(0.03)	(0.06)	(0.09)
Moving livestock	3.35[a]	1.93[b]	4.74[a]	2.51[a,b]
	(0.24)	(0.27)	(0.52)	(0.83)
Herding	4.31[a]	2.94[b]	8.89[c]	3.05[a,b]
	(0.32)	(0.36)	(0.70)	(1.13)
Misc. labor and mileage	0.69[a]	0.18[b]	0.77[a]	0.34[a,b]
	(0.06)	(0.07)	(0.13)	(0.22)
Salt and feed	1.29[a]	1.80[a]	1.62[a]	1.53[a]
	(0.21)	(0.24)	(0.46)	(0.75)
Water	0.39[a]	0.11[b]	0.39[a]	0.16[a,b]
	(0.06)	(0.06)	(0.12)	(0.20)
Horse	0.31[a]	0.15[b]	0.47[c]	0.22[a,b]
	(0.03)	(0.03)	(0.06)	(0.13)

Improvement maintenance	3.18^{a}	1.84^{b}	2.12^{b}	$2.22^{a,b}$
	(0.23)	(0.26)	(0.50)	(0.81)
Development depreciation				
Federal land	0.33^{a}	0.00^{b}	0.17^{c}	$0.02^{b,c}$
	(0.03)	(0.03)	(0.06)	(0.10)
Private land	0.12^{a}	0.15^{a}	0.09^{a}	0.22^{a}
	(0.04)	(0.04)	(0.08)	(0.13)
Other costs	0.34^{a}	0.11^{b}	1.36^{c}	$0.35^{a,b}$
	(0.07)	(0.08)	(0.15)	(0.25)
Private land lease rate	—	7.71^{a}	—	7.18^{a}
		(0.34)		(1.07)
Total cost	18.15^{a}	19.04^{a}	25.87^{b}	$20.46^{a,b}$
	(0.82)	(0.93)	(1.80)	(2.89)
Forage value	$0.89^{a} \pm 2.06$		$-5.41^{a} \pm 3.52$	
	(1.26)		(5.87)	
Combined cattle and sheep (weighted average)*	0.13			

Note: Means on the same row followed by the same letter are not statistically different at the $\alpha = 0.10$ level. The number in parentheses is the standard error of the mean. Individual cost items may not add up to the total cost because the mean for each cost item was estimated using an independent linear statistical model and is not the simple average for the cost category. Forage value is shown as the mean value with 90% confidence limits about the mean.

*Sheep and cattle were weighted by the proportion of leased AUMs included in the grazing cost survey: 88% cattle and 12% sheep.

Table 3. Rancher-funded range improvement investments on federal and private lands from 1971 to 1992.

	Sample size (n)	Rancher investments ($/AUM)	
		Federal lands	Private/state lands
Public land ranchers			
Idaho	85	4.73[a] (0.83)	0.29[a] (1.09)
New Mexico	66	4.72[a] (0.83)	3.54[b,d] (1.09)
Wyoming	94	2.00[b] (0.88)	1.16[a,d] (1.16)
All states	245	3.82 (0.49)	1.66 (0.64)
Private land ranchers			
Idaho	49	0.06[b] (1.36)	2.40[a,b] (1.78)
New Mexico	47	0.90[b] (0.83)	4.49[b] (1.09)
Wyoming	53	0.00[b] (1.19)	1.00[a,d] (1.57)
All states	149	0.32 (0.67)	2.63 (0.87)

Note: Means in the same column followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Means in the same row are not compared statistically. The number in parentheses is the standard error of the mean.

annual investment of about $0.35/AUM in Idaho and New Mexico and $0.09/AUM in Wyoming.

Additional range improvement investments on private and state trust lands were also made to service federal allotments and private leases. These improvements were made by both public and private land lessors. The average investment on non-federal rangelands ranged from $0.29/AUM for public land ranchers in Idaho to $4.49/AUM for those leasing private forage in New Mexico (table 3). Some private forage lessees made substantial range improvement investments on the leased property, especially when the lease was negotiated for a number of years or when the lessee planned to eventually buy or inherit the leased property. Additionally, some private leases included federal land. Lessees occasionally made investments on federal land in these cases.

Depreciation of range improvements on federal lands averaged $0.33/AUM for cattle producers and $0.17/AUM for sheep producers (table 2). This does not include a return or cost allowance for investments in the grazing permit or range improvements made prior to 1971.

BLM Versus USFS

Cattle grazing costs were estimated to be higher on USFS land than BLM land (table 4). In fact, the average cost of grazing cattle on USFS lands was higher than private grazing costs in Idaho (table 5) and New Mexico (table 6), and when averaged over all three states. This implies a negative forage value for USFS grazing in these cases [-$3.78/AUM in Idaho (table 5), -$5.13/AUM in New Mexico (table 6), +$2.13/AUM in Wyoming (table 7), and -$2.86/AUM when averaged across all three test states (table 4)]. This is similar to what Obermiller (1992a) found for eastern Oregon where USFS was found to be the most expensive lease, followed by private land, and then BLM.

The 1966 grazing cost survey did not find USFS grazing costs to be higher than private land leases when averaged across all forests and BLM districts. Similar to the findings reported here, the 1966 grazing cost survey found positive average forage values for USFS lands in Wyoming, but negative values for several forests in Idaho, New Mexico, and other western states. The 1966 study found the average cost of grazing USFS land was $0.62/AUM higher than BLM land, but this difference was not significant (Houseman 1968).

Table 4. Average grazing costs on BLM, USFS, and private leased lands in Idaho, New Mexico, and Wyoming combined (adjusted for differences in lease size), 1992.

	Cattle			Sheep		
	BLM	USFS	Private	BLM	USFS	Private
Sample size (n)	141	60	134	32	12	15
Lost animals	3.09[a]	4.49[b]	2.10[c]	5.16[b]	6.05[b]	2.63[a,c]
	(0.31)	(0.41)	(0.28)	(0.69)	(0.95)	(0.87)
Association fees	0.20[a]	1.07[c]	0.01[b]	0.17[a]	0.00[b]	0.00[a,b]
	(0.08)	(0.10)	(0.07)	(0.17)	(0.24)	(0.22)
Veterinary	0.08[a]	0.12[a]	0.12[a]	0.16[a]	0.37[b]	0.20[a]
	(0.03)	(0.04)	(0.03)	(0.07)	(0.10)	(0.09)
Moving livestock	2.61[a]	4.49[b]	1.93[c]	3.97[b]	5.97[d]	2.51[a,b,c]
	(0.29)	(0.38)	(0.26)	(0.64)	(0.88)	(0.81)
Herding	3.63[a]	5.00[c]	2.94[a]	7.30[b]	13.49[d]	3.05[a]
	(0.37)	(0.49)	(0.33)	(0.83)	(1.13)	(1.04)
Misc. labor and mileage	0.61[a]	0.77[a]	0.18[b]	0.73[a]	1.13[c]	0.34[a,b]
	(0.08)	(0.10)	(0.07)	(0.17)	(0.23)	(0.21)
Salt and feed	1.41[a]	1.12[a]	1.80[a]	1.81[a]	1.06[a]	1.53[a]
	(0.27)	(0.36)	(0.24)	(0.60)	(0.82)	(0.75)
Water	0.47[a]	0.24[b]	0.11[b]	0.51[a,b]	0.38[a]	0.16[a,b]
	(0.07)	(0.09)	(0.06)	(0.16)	(0.22)	(0.20)
Horse	0.22[a]	0.45[b]	0.15[a]	0.34[a]	0.78[c]	0.22[a]
	(0.03)	(0.04)	(0.03)	(0.07)	(0.10)	(0.09)

Improvement maintenance	2.86[a]	3.41[a]	1.84[b]	2.33[a,b]	2.26[a,b]	2.22[a,b]
	(0.29)	(0.37)	(0.25)	(0.63)	(0.86)	(0.79)
Development depreciation						
Federal land	0.30[a]	0.39[d]	0.00[c]	0.14[b]	0.24[a,b,d]	0.02[b,c]
	(0.03)	(0.04)	(0.03)	(0.07)	(0.10)	(0.09)
Private land	0.16[a]	0.07[a]	0.15[a]	0.11[a]	0.02[a]	0.22[a]
	(0.05)	(0.06)	(0.04)	(0.11)	(0.15)	(0.13)
Other costs	0.23[a]	0.50[c]	0.11[a]	1.01[b]	1.89[d]	0.35[a]
	(0.09)	(0.11)	(0.08)	(0.19)	(0.26)	(0.24)
Private land lease rate	—	—	7.71[a]	—	—	7.18[a]
			(0.34)			(1.07)
Total cost	15.41[a]	21.89[b]	19.04[c]	23.23[b]	32.68[d]	20.46[b]
	(0.99)	(1.30)	(0.88)	(2.19)	(3.00)	(2.74)
Forage Value	3.63 ±2.42	-2.86 ±2.59		-2.77 ±6.22	-12.22 ± 6.94	
	(1.47)	(1.58)		(3.71)	(4.07)	

Note: Means on the same row followed by the same letter are not statistically different at the $\alpha = 0.10$ level. The number in parentheses is the standard error of the mean. Individual cost items may not add up to the total cost because the mean for each cost item was estimated using an independent linear statistical model and is not the simple average for the cost category. Forage value is shown as the mean value with 90% confidence limits about the mean.

Table 5. Average grazing costs on BLM, USFS, and private leased lands in Idaho (not adjusted for differences in lease size), 1992.

	Cattle			Sheep		
	BLM	USFS	Private	BLM	USFS	Private
Sample size (n)	43	23	46	11	8	3
Lost animals	2.69[a,d]	5.00[b]	1.90[a]	4.47[b]	7.28[c]	4.05[b,d]
	(0.39)	(0.73)	(0.56)	(0.97)	(0.84)	(1.03)
Association fees	0.23[a]	1.97[b]	0.03[a]	0.48[a]	0.00[a]	0.00[a]
	(0.10)	(0.19)	(0.14)	(0.25)	(0.21)	(0.26)
Veterinary	0.08[a]	0.04[a]	0.12[a,b]	0.28[b]	0.26[b]	0.10[a,b]
	(0.04)	(0.08)	(0.06)	(0.10)	(0.08)	(0.11)
Moving livestock	2.08[a]	4.56[b]	1.99[a]	8.48[c]	2.90[a]	5.73[b]
	(0.36)	(0.68)	(0.52)	(0.90)	(0.77)	(0.96)
Herding	2.73[a]	4.78[b]	1.76[a]	9.90[c]	13.36[d]	3.11[a,b]
	(0.48)	(0.91)	(0.70)	(1.21)	(1.03)	(1.29)
Misc. labor and mileage	0.81[a]	0.72[a]	0.17[b]	0.75[a]	1.25[c]	0.46[a,b]
	(0.09)	(0.18)	(0.13)	(0.23)	(0.20)	(0.25)
Salt and feed	0.69[a]	0.16[a]	1.03[a]	2.77[b]	0.32[a]	0.14[a]
	(0.34)	(0.64)	(0.49)	(0.85)	(0.73)	(0.90)
Water	0.26[a]	0.17[a]	0.05[a]	1.05[b]	0.42[a]	0.03[a]
	(0.09)	(0.16)	(0.12)	(0.22)	(0.18)	(0.23)
Horse	0.06[a]	0.22[c]	0.07[a]	0.51[b]	0.51[b]	0.32[b,c]
	(0.04)	(0.08)	(0.06)	(0.10)	(0.09)	(0.11)

Improvement maintenance	2.36^{a}	$2.18^{a,b}$	0.95^{b}	2.61^{a}	0.82^{b}	$1.95^{a,b}$
	(0.35)	(0.65)	(0.50)	(0.86)	(0.74)	(0.92)
Development depreciation						
Federal land	0.39^{a}	0.31^{a}	0.00^{b}	0.06^{b}	0.13^{b}	0.01^{b}
	(0.04)	(0.08)	(0.06)	(0.10)	(0.09)	(0.11)
Private land	0.01^{a}	0.03^{a}	0.13^{a}	0.03^{a}	0.00^{a}	0.11^{a}
	(0.06)	(0.11)	(0.08)	(0.15)	(0.12)	(0.16)
Other costs	0.42^{a}	0.92^{b}	0.24^{a}	1.99^{c}	1.82^{c}	$0.68^{a,b}$
	(0.11)	(0.20)	(0.16)	(0.27)	(0.23)	(0.29)
Private land lease rate	—	—	8.70^{a}	—	—	4.74^{b}
			(0.67)			(1.23)
Total cost	12.55^{a}	20.88^{b}	17.10^{b}	32.32^{c}	28.64^{c}	21.40^{b}
	(1.25)	(2.36)	(1.80)	(3.12)	(2.66)	(3.32)
Forage Value	4.55 ±3.69	-3.78 ±5.09		-10.92 ±11.16	-7.24 ±8.69	
	(2.22)	(3.04)		(6.34)	(4.85)	

Note: Means on the same row followed by the same letter are not statistically different at the $\alpha = 0.10$ level. The number in parentheses is the standard error of the mean. Individual cost items may not add up to the total cost because the mean for each cost item was estimated using an independent linear statistical model and is not the simple average for the cost category. Forage value is shown as the mean value with 90% confidence limits about the mean.

Table 6. Average grazing costs on BLM, USFS, and private leased lands in New Mexico (not adjusted for differences in lease size), 1992.

	Cattle			Sheep		
	BLM	USFS	Private	BLM	USFS	Private
Sample size (n)	39	21	44	6	0	3
Lost animals	2.48[a]	3.76[b]	2.03[a,c]	1.18[c]		1.16[c]
	(0.42)	(0.45)	(0.25)	(0.65)		(0.67)
Association fees	0.00[a]	0.03[a]	0.00[a]	0.00[a]		0.00[a]
	(0.10)	(0.11)	(0.06)	(0.16)		(0.17)
Veterinary	0.10[a,b]	0.15[a]	0.11[a,b]	0.01[b]		0.31[c]
	(0.04)	(0.05)	(0.03)	(0.07)		(0.07)
Moving livestock	1.64[a]	3.78[b]	1.16[a]	1.30[a]		3.02[b]
	(0.39)	(0.42)	(0.24)	(0.60)		(0.62)
Herding	3.12[a]	5.11[b]	2.70[a,c]	1.52[c]		4.11[a,b]
	(0.52)	(0.56)	(0.32)	(0.81)		(0.83)
Misc. labor and mileage	0.39[a]	1.04[b]	0.27[a]	0.50[a]		0.51[a]
	(0.10)	(0.11)	(0.06)	(0.16)		(0.16)
Salt and feed	3.50[a]	3.14[a,b]	2.94[a,b]	2.57[a,b]		1.99[b]
	(0.37)	(0.39)	(0.22)	(0.57)		(0.59)
Water	0.66[a]	0.59[a,b]	0.22[b]	0.12[b]		0.34[b]
	(0.09)	(0.10)	(0.06)	(0.14)		(0.15)
Horse	0.22[a,c]	0.52[b]	0.25[a]	0.10[c]		0.13[a,c]
	(0.04)	(0.05)	(0.03)	(0.07)		(0.07)

Improvement maintenance	4.02^{a}	6.36^{c}	3.05^{b}	2.24^{b}	$3.11^{a,b}$
	(0.37)	(0.40)	(0.23)	(0.58)	(0.60)
Development depreciation					
Federal land	0.17^{a}	0.68^{c}	0.00^{b}	$0.07^{a,b}$	$0.09^{a,b}$
	(0.04)	(0.05)	(0.03)	(0.07)	(0.07)
Private land	0.45^{a}	$0.17^{b,c}$	0.24^{b}	0.04^{c}	$0.21^{b,c}$
	(0.06)	(0.07)	(0.04)	(0.10)	(0.10)
Other costs	0.08^{a}	0.05^{a}	0.04^{a}	0.08^{a}	0.29^{a}
	(0.12)	(0.13)	(0.07)	(0.18)	(0.19)
Private land lease rate	—	—	6.88^{a}	—	7.00^{a}
			(0.30)		(0.80)
Total cost	16.16^{a}	24.81^{c}	19.68^{b}	9.59^{d}	$21.93^{b,c}$
	(1.34)	(1.44)	(0.82)	(2.09)	(2.15)
Forage Value	3.52 ±2.54	-5.13 ±2.58		12.34 ±6.14	
	(1.53)	(1.55)		(3.35)	

Note: Means on the same row followed by the same letter are not statistically different at the $\alpha = 0.10$ level. The number in parentheses is the standard error of the mean. Individual cost items may not add up to the total cost because the mean for each cost item was estimated using an independent linear statistical model and is not the simple average for the cost category. Forage value is shown as the mean value with 90% confidence limits about the mean.

Table 7. Average grazing costs on BLM, USFS, and private leased lands in Wyoming (not adjusted for differences in lease size), 1992.

	Cattle			Sheep		
	BLM	USFS	Private	BLM	USFS	Private
Sample size (n)	59	16	44	15	4	9
Lost animals	3.45[a]	4.50[a,b]	1.64[c]	5.32[b]	5.32[a,b]	2.74[a,c]
	(0.45)	(0.75)	(0.44)	(0.73)	(1.53)	(0.93)
Association fees	0.00[a]	1.74[b]	0.00[a]	0.00[a]	0.00[a]	0.00[a]
	(0.11)	(0.19)	(0.11)	(0.19)	(0.39)	(0.24)
Veterinary	0.04[a]	0.13[a,b]	0.09[a,b]	0.08[a,b]	0.35[b]	0.00[a]
	(0.05)	(0.08)	(0.04)	(0.08)	(0.16)	(0.10)
Moving livestock	2.69[a]	3.87[a]	1.71[a]	1.72[a]	9.88[b]	0.90[a]
	(0.41)	(0.70)	(0.41)	(0.68)	(1.42)	(0.87)
Herding	3.47[a]	2.71[a]	2.91[a]	4.78[a,b]	7.23[b]	2.11[a]
	(0.56)	(0.94)	(0.55)	(0.91)	(1.91)	(1.16)
Misc. labor and mileage	0.35[a]	0.43[b]	0.07[b]	0.67[a]	0.27[a,b]	0.18[b]
	(0.11)	(0.18)	(0.11)	(0.18)	(0.37)	(0.22)
Salt and feed	0.74[a]	0.13[a]	1.61[a]	1.95[a]	0.26[a]	1.75[a]
	(0.39)	(0.66)	(0.38)	(0.64)	(1.34)	(0.82)
Water	0.23[a]	0.00[a]	0.08[a]	0.29[a]	0.00[a]	0.08[a]
	(0.10)	(0.16)	(0.10)	(0.16)	(0.34)	(0.20)
Horse	0.19[a]	0.46[b]	0.10[a]	0.27[a]	0.74[b]	0.12[a]
	(0.05)	(0.08)	(0.05)	(0.08)	(0.16)	(0.10)

Improvement maintenance	2.59[a]	0.83[b]	1.32[b]	1.29[b]	0.39[a]	0.75[b]
	(0.40)	(0.67)	(0.39)	(0.65)	(1.37)	(0.83)
Development depreciation						
Federal land	0.06[a]	0.15[a]	0.00[a]	0.07[a]	0.33[a]	0.00[a]
	(0.05)	(0.08)	(0.05)	(0.08)	(0.17)	(0.10)
Private land	0.10[a]	0.00[a]	0.03[a]	0.05[a]	0.00[a]	0.07[a]
	(0.07)	(0.11)	(0.07)	(0.11)	(0.23)	(0.14)
Other costs	0.08[a]	0.13[a]	0.03[a]	0.15[a]	0.64[a]	0.00[a]
	(0.12)	(0.21)	(0.12)	(0.20)	(0.43)	(0.26)
Private land lease rate	—	—	7.71[a]	—	—	9.30[a]
			(0.52)			(1.12)
Total cost	13.76[a]	15.09[a,b]	17.22[a,b]	16.28[a]	25.40[b]	17.93[a,b]
	(1.44)	(2.42)	(1.41)	(2.36)	(4.94)	(3.01)
Forage Value	3.46 ±3.43	2.13 ±4.60		1.65 ± 6.82	-7.47 ±8.60	
	(2.07)	(2.76)		(4.01)	(4.86)	

Note: Means on the same row followed by the same letter are not statistically different at the $\alpha = 0.10$ level. The number in parentheses is the standard error of the mean. Individual cost items may not add up to the total cost because the mean for each cost item was estimated using an independent linear statistical model and is not the simple average for the cost category. Forage value is shown as the mean value with 90% confidence limits about the mean.

Major cost categories explaining the higher cost of grazing USFS lands included lost animals, association fees, moving and herding livestock, miscellaneous labor, vehicle expenses, and horse costs. Other cost categories, including miscellaneous expenses and development depreciation on federal lands, were significantly higher on USFS in some cases but did not greatly contribute to the higher cost of USFS grazing.

Several explanations are possible for the relatively high cost estimated for grazing USFS lands, and the negative estimate of forage value for these lands.

1. The estimate of cost is correct and USFS permittees are in fact spending more to graze than their counterparts leasing private lands. Any differentials in grazing costs should be equalized by differences in grazing permit value. When permit value is considered (not considered in the above comparison), total grazing costs between land types should be equalized. Rational, profit-motivated ranchers should not be willing to pay more for grazing on public lands if lower cost alternatives exist in the private forage market. But, the total cost approach may not capture all elements of value associated with USFS permits. For example, USFS permittees may be willing to pay higher costs to graze in scenic remote areas and maintain a way of life; or, as a corollary argument, accept a below-market wage rate and return on investment (Smith and Martin 1972, Young and Shumway 1991, Bartlett et al. 1989).

2. In New Mexico, some of the cost increases could be explained by cultural differences and the high value placed on the agrarian way of life. Of the 21 USFS ranchers interviewed in New Mexico, 10 had relatively small herds and were Hispanic ranchers, mostly in north-central New Mexico. Grazing costs, especially the value of unpaid family labor, were higher for these individuals.

3. Private leases included in the grazing cost survey are considered comparable to BLM and state trust lands with respect to proximity and physical characteristics. However, few of the leases were in the mountains and directly comparable to USFS lands. The survey included twice as many BLM leases as

compared to USFS (fig. 1), and the sample size for USFS may not have been adequate to derive valid estimates of value. However, it was not just a few high-cost USFS leases that raised the average. Rather, grazing costs were significantly higher for USFS, and costs were generally higher than BLM or private costs for all size categories.

4. Market-price comparisons for valuing forage assumes ranchers have numerous alternatives available to them. Private and public forage are assumed to be direct substitutes. In reality, most public and private forage remains leased and some ranchers are forced to use higher-cost alternatives if they want to be in the livestock business. However, this does not mean that USFS ranches are losing money or not profitable, only that their costs are higher.

Total grazing costs for cattle production on BLM, USFS, and private leases were estimated to be highest in New Mexico, but only significantly higher for public land grazing. Most leases and allotments studied in New Mexico practiced yearlong grazing, compared with seasonal grazing in Idaho and Wyoming. Because New Mexico ranchers used the lease yearlong, it was common for shipping, weaning, and calving to take place on the allotment. It was less common for these activities to occur on seasonal grazing leases in the northern states.

Estimated forage values for cattle grazing on BLM land—$4.55/AUM in Idaho, $3.52/AUM in New Mexico, and $3.46/AUM in Wyoming—were not significantly different between states. This suggests the average forage value estimated across all three states, $3.63/AUM, can be used as a single value estimate for BLM lands.

Cattle Versus Sheep

The total cost of grazing sheep on public lands was significantly higher than for cattle. As shown in table 2, the total cost of grazing sheep on public land was estimated to average $7.72/AUM more than grazing cattle on public land and $1.42/AUM more for private-land sheep producers compared to private-land cattle producers.

Sheep grazing costs were the most variable. Because of this variability and the relatively small sample size for sheep producers,

especially on private lands, the confidence interval estimated for sheep forage value is over twice that estimated for cattle production (table 2). As shown in tables 4, 5, and 6, some of the variability is explained by state-level differences and by differences between BLM and USFS.

The number of sheep producers included in the survey becomes limiting when disaggregated to state levels and across BLM and USFS; thus, caution should be used when interpreting the disaggregated numbers for sheep production. For example, sheep grazing costs are presented in tables 5, 6, and 7 for each test state, but we do not feel valid state-level comparisons of sheep production costs on private an public lands are possible, given the limited number of sheep producers included in the survey. Few sheep are produced on native rangeland that is privately leased. It is therefore not likely that the sample could be expanded to improve estimates of sheep grazing costs. The small number of private land forage users producing sheep limits the potential for using the total cost approach to value forage for sheep production.

Allotment Size

Allotment or lease size was found to be the major factor affecting grazing costs. Weighting average costs by the number of AUMs leased removed much of the variation caused by economies of size. Adjusting for differences in lease size between private and public lands using arbitrary size classifications generally increased the costs estimated. As shown in table 8, weighted average grazing costs tended to decrease as allotment or lease size increased. The classification with fewer than 500 AUMs on the grazing parcel had the highest grazing costs. In most cases, grazing costs for this smallest size category were significantly higher than the larger size categories. The spread in average grazing costs between the smallest and largest size classification generally exceeded $7/AUM. For sheep grazing on BLM and USFS lands, the difference in grazing costs between those with fewer than 500 AUMs on the grazing parcel and those with over 3,000 AUMs was over $20/AUM (table 8).

Forage value was estimated to be the least for the smallest allotments, as might be expected. However, forage value did not consistently increase as lease size increased. Forage value was not

Table 8. Comparison of total grazing costs per AUM for grazing cattle and sheep on private, BLM, and USFS lands with various size (S) classifications of total AUMs on the grazing parcel, 1992.

AUM Size (S) Category	Cattle					Sheep				
	Private	BLM	BLM Forage Value	USFS	USFS Forage Value	Private	BLM	BLM Forage Value	USFS	USFS Forage Value
S ≤ 500	21.55[a] (2.37,60)	20.00[a] (2.68,66)	1.55[a,b] ±5.99 (3.69)	29.80[a] (3.33,26)	-8.25[a] ±7.00 (4.22)	21.11[a] (8.32,4)	34.99[a] (6.39,9)	-13.88[a] ±19.69 (11.13)	45.36[a] (7.85,4)	-24.25[a] ±21.28 (11.44)
500 < S ≤ 1000	19.52[a] (2.01,27)	13.76[b] (2.27,28)	5.76[a,b] ±5.11 (3.04)	22.65[a,b] (2.92,15)	-3.13[a] ±5.75 (3.46)	19.17[a] (5.71,3)	21.20[b] (5.05,7)	-2.03[a] ±15.72 (8.68)	30.16[a,b] (6.11,3)	-10.99[a] ±16.22 (8.36)
1000 < S ≤ 3000	20.65[a] (1.25,33)	15.25[a,b] (1.60,26)	5.40[b] ± 3.34 (2.00)	19.53[b,c] (1.91,13)	1.12[b] ± 3.91 (2.33)	22.24[a] (3.86,3)	26.13[a,b] (2.72,8)	-3.89[a] ± 9.12 (5.06)	30.93[b] (3.55,4)	-8.69[a] ± 10.04 (5.30)
S > 3000	14.42[b] (1.16,14)	12.65[b] (1.01,20)	1.77[a] ± 2.62 (1.55)	15.58[c] (2.43,6)	-1.16[a,b] ±4.06 (2.36)	19.31[a] (1.78,5)	10.61[c] (1.78,8)	8.70[b] ± 4.72 (2.67)	24.28[b] (4.38,1)	-4.97[a] ± 8.46 (4.36)
All sizes	19.04 (0.88,134)	15.41 (0.99,141)	3.63 ± 2.42 (1.47)	21.89 (1.30,60)	-2.86 ±2.59 (1.58)	20.46 (2.74,15)	23.23 (2.19,32)	-2.77 ± 6.22 (3.71)	32.68 (3.00,12)	-12.22 ± 6.94 (4.07)

Note: Means in the same column followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Means in the same row are not compared statistically. The numbers in parentheses are the standard error of the mean and the sample size. Forage value is shown as the mean value with 90% confidence limits about the mean. Sample size precluded using contrasts to evaluate statistical differences between forage value estimates; differences were estimated using confidence limits.

estimated to be significantly different between most of the size classifications, but grazing costs were significantly less for larger leases and allotments. This same result was reported in the 1966 grazing cost survey and in other cost surveys in various western states reported by Obermiller and Lambert (1984).

Dispersion of Individual Forage Values

The variability of average forage values obtained from the total cost approach is reflected in the large standard errors of the estimates. This variability can be further examined in fig. 2 and fig. 3, which show cumulative distributions of forage value for the individual allotments in the three-state test area. Individual forage values were determined by subtracting the total cost per AUM of each public land grazing allotment from the average private grazing cost corresponding to the allotment's size (table 8). Forage value is shown separately for cattle and sheep, and for both BLM and USFS allotments. Approximately 30% of BLM cattle allotments, 50% of USFS cattle allotments, 50% of BLM sheep, and 90% of USFS sheep allotments have forage values less than zero. These individuals have paid more than private lessees for forage before the grazing fee or permit investment is considered, because the non-fee grazing costs for these individuals was high relative to comparably sized private leases. All the cost distributions are fairly steep after they reach a zero forage value. For example, 40% of all BLM cattle allotments have forage values between $0/AUM and $10/AUM (fig. 2).

Alternative Pricing Areas

In addition to state-level differences, other pricing areas, including regions defined by ecological, physiographic, and economic differences were evaluated.

Similar to the findings of the 1966 grazing fee study (Houseman et al. 1968), regional- and state-level grazing costs and forage values were not significantly different. Varying grazing fees based on quality or regional differences were not supported from the statistical analysis of grazing costs. There was wide variation in grazing costs both between and within the states and regions considered.

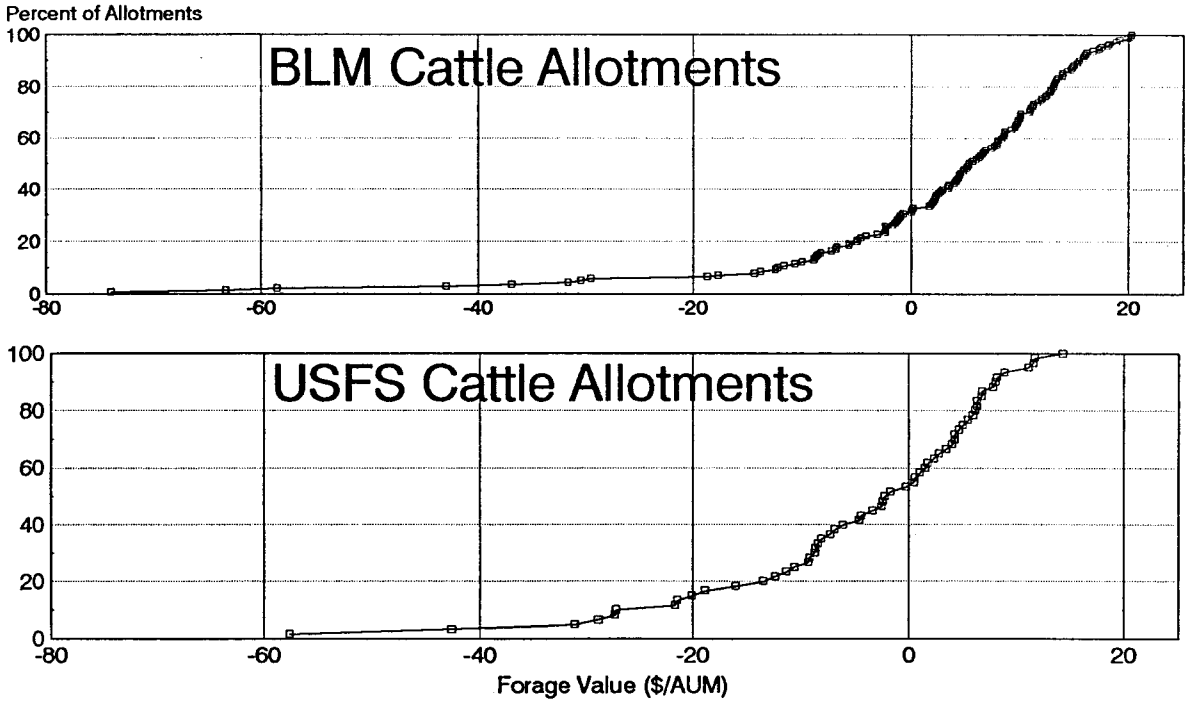

Fig. 2. Cumulative distribution of forage value for cattle allotments in the three-state area.

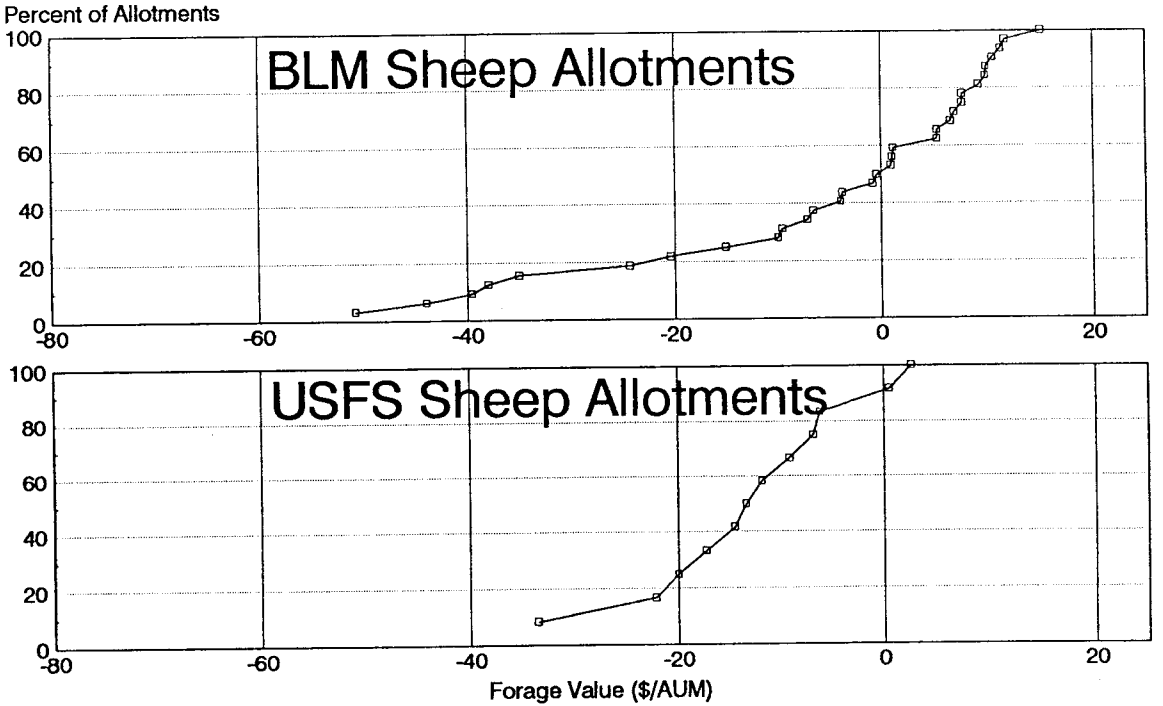

Fig. 3. Cumulative distribution of forage value for sheep allotments in the three-state area.

Permit Value Approach

Permit values for Idaho, New Mexico, and Wyoming and the 1992 forage value implied from these values were estimated (table 9). Average permit values ranged from $36/AUM for BLM in Wyoming to $89/AUM for BLM in New Mexico. BLM and USFS permit values were significantly different in Wyoming but not in Idaho or New Mexico. Statistical differences between states were not evaluated because different procedures were used to estimate permit value in New Mexico as opposed to Idaho and Wyoming.

Permit value is the estimated average market value of federal grazing permits, including the value of range improvements on federal land. Average rancher-funded range improvements on federal land since 1971 (table 3) amounted to less than 10% of the estimated 1992 permit value in each state. Other functional range improvements constructed prior to 1971 also contributed to the value of grazing permits.

Because permit value was estimated to be highest for the year-long permits common in New Mexico, the implied forage value using the permit valuation method was highest in New Mexico ($4.90/AUM for BLM and $4.33/AUM for USFS). Forage value

Table 9. Grazing permit value and forage value implied from average permit values in Idaho, New Mexico, and Wyoming ($/AUM), 1992.

State	Permit value		Forage value*	
	BLM	USFS	BLM	USFS
Idaho	37[a]	42[a]	3.16	3.32
	(1.31, 129)	(2.71, 38)		
New Mexico	89[a]	72[a]	4.90	4.33
Wyoming	36[a]	47[b]	3.13	3.50
	(1.01, 359)	(3.47, 43)		

Note: Means in the same row followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Means in the same column are compared statistically. The numbers in parentheses are the standard error of the mean and the sample size. The standard error is not shown for New Mexico because the mean value is estimated from a regression model.

* Estimated as permit value times 3.35% + $1.92/AUM 1992 grazing fee. Grazing permit value and forage value implied from average permit values in Idaho, New Mexico, and Wyoming ($/AUM), 1992.

was estimated to be about $3.00 to $3.50/AUM for the seasonal permits in Idaho and Wyoming.

Theoretically, grazing fees equal to the forage value estimates in table 9 should eliminate permit value; yet permit value estimates in New Mexico for state trust lands indicate this may not be the case. Torell and Doll (1991) estimated that as New Mexico state land grazing fees went from $1.60/AUM in 1986 to $3.13/AUM in 1989, the value of state land grazing permits decreased by about $30/AUM for every $1/AUM increase in the fee. State land permits went from the most valuable to the least valuable permit in 6 years.

New regression estimates conducted for this study indicate New Mexico state land permits have recently increased in value relative to BLM and USFS. This is true even though New Mexico state land fees are nearly double those on federal lands and USFS total grazing costs were estimated to be considerably higher than BLM (tables 4–7). This apparent inconsistency might be explained, however, because grazing fee policy is defined on New Mexico state lands, removing the uncertainty still present with BLM and USFS lands.

Market Appraisal Approach

BLM appraisers searched the three-state market for comparable leases of public forage. They located and documented leases of public forage based on competitively bid or negotiated rental agreements. To this end, federal, state, county, and tribal leases were investigated as well as "subleases" of BLM allotments and state lands. To maximize comparability with public lands, non-serviced leases were sought. Given that 100% non-serviced leases were difficult to find, nominally serviced leases were included in the data search. These leases were then adjusted to a non-serviced basis using cost figures obtained from regression equations detailed in the next section.

No comparable lease data were obtained in Idaho. However, suitable data were located in New Mexico and Wyoming. Wyoming leases included those administered by the Wyoming Game and Fish Department, the Bureau of Reclamation, and the Wyoming State Land Office. The New Mexico survey yielded 11 suitable BLM subleases, the 1992–1993 bid results for the McGregor Range, several competitively bid New Mexico State Land Office leases,

one small USFWS lease on a wildlife refuge, and a large ranch recently purchased by the Acoma Tribe and leased on a nonserviced basis. Further analysis of this data indicated that only the McGregor Range data and eight of the eleven BLM subleases were suitable for further analysis and comparison with the total-cost approach.

After adjusting for lessor-provided services and improvements, the AUM-weighted average value of forage was estimated to be $3.40/AUM in New Mexico and $7.19/AUM in Wyoming (table 10). These values were estimated from leases with over 80% public land included in the lease so as to minimize differences and maintain comparability.

Statistical Market Approach

To complement the market rental comparison, private leases used in the 1992 grazing cost survey were examined further to see

Table 10. Market rental values in New Mexico and Wyoming as determined using an appraisal valuation, 1992.

State	Sample size (n)	Total number of AUMs	$/AUM Average lease price	$/AUM Adjustment for services	$/AUM Average net forage value
New Mexico					
Comparable leases	8	12,854	6.22 (12.64)	1.58	4.64 (11.83)
McGregor Range leases	12	26,579	4.80 (9.99)	1.96	2.84 (9.99)
Average	20	39,433	5.26 (10.21)	1.86	3.40 (11.49)
Wyoming					
Fish and Game/ Bureau of Reclamation	12	1,412	7.71 (4.97)	0.15	7.56 (4.67)
State subleases	11	4,017	7.93 (10.03)	0.87	7.06 (9.45)
Average	23	5,429	7.88 (5.33)	0.69	7.19 (5.06)

Note: Numbers in parentheses are the standard error of the mean.

if the value of services provided by the lessor could be estimated and subtracted from the private land lease rate to estimate net forage value. These data presented a unique opportunity to evaluate factors influencing grazing lease rates and grazing costs on private lands.

Summary statistics for private leases contained in the 1992 grazing cost survey are shown in table 11. A relatively large range exists in the price paid per AUM for private leases. The most expensive lease was $21.11 per AUM in Idaho; the least expensive was $0.75 per AUM in New Mexico. When compared to the average, non-serviced rates reported in the market appraisal approach, the range of lease rates obtained from the grazing cost survey was greater and the mean price of the leases tended to be higher, especially in New Mexico. This would be expected because the appraisal comparison was limited to leases that were mostly public lands and provided few lessor services. By comparison, no attempt was made to limit leases included in the statistical comparison. The regression analysis included private leases ranging from all services provided to no services provided.

The lease rate distribution was different for each of the three test states (fig. 4). While the ranges were chosen arbitrarily, the majority of the lease rates fell in the $3-12/AUM range, with most distributions skewed to the left. The median rate was $9.38/AUM for Idaho, $5.40/AUM for New Mexico, and $8.02/AUM for Wyoming. Average lease rates were $8.70/AUM in Idaho, $6.88/AUM in New Mexico, and $7.71/AUM in Wyoming.

Table 11. Average private lease rates and size of leases for cattle operations in the three-state test area.

State	Number of leases	Mean ($/AUM)	Minimum ($/AUM)	Maximum ($/AUM)	Standard error
Idaho					
Lease rate	46	8.70	2.33	21.11	0.67
AUMs		596	30	5,102	
New Mexico					
Lease rate	44	6.88	0.75	15.39	0.30
AUMs		2,997	120	43,937	
Wyoming					
Lease rate	44	7.71	1.87	13.26	0.52
AUMs		924	33	4,866	

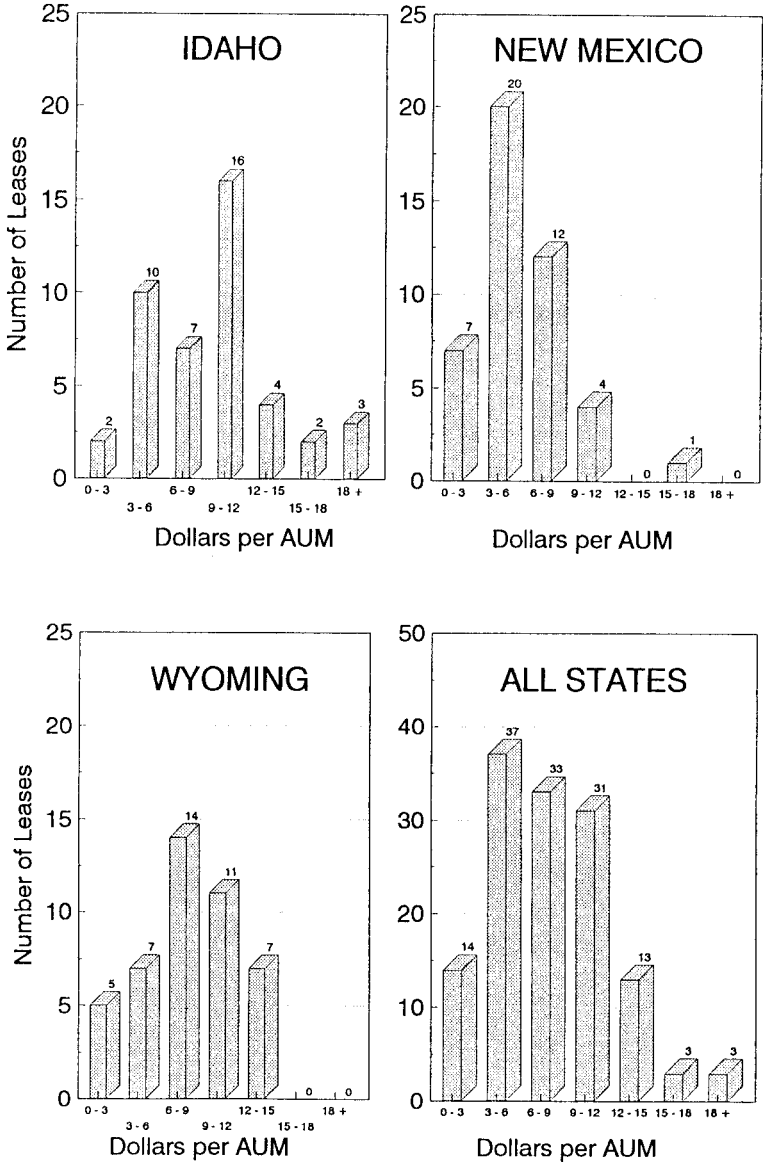

Fig. 4. Distribution of private rangeland lease rates in Idaho, New Mexico, Wyoming, and all test states combined.

The total cost of utilizing forage from private leases comprises the private lease rate and non-fee costs associated with harvesting forage. The division of responsibilities between the lessor and lessee is shown in table 12. Except for paying real estate taxes, the lessee provided most of the services for most of the leases studied.

We hypothesized that much of the variability in the private lease rate and non-fee costs associated with harvesting forage could be attributed to services provided by the lessor, the distance from the lessee's ranch headquarters to the leased land, and the number of AUMs leased. Dummy variables were also used to evaluate differences between states. To be consistent with the leases used in the appraisal approach, only cattle leases were analyzed.

Because of the problem of multicollinearity and minimal variability related to who provided services associated with the lease, all services reported (table 12) could not be incorporated into the regression analysis. Torell and Bledsoe (1990) found daily care of the livestock and development and maintenance of the water supply were major variables influencing the lease rate per AUM in New Mexico. Preliminary analysis indicated the same results for the three-state test area; therefore, daily livestock care and water supply were the only two service variables included in the regression analysis.

Regression techniques were used to identify how lease prices and the lessee's non-fee grazing costs varied as services were or were not provided by the lessor. This provided an estimate of the value of services provided by the lessor and the net forage value of a non-

Table 12. Provider of services for private land leases.

	Relative frequency (%)			
Lessee responsibility	Provided by lessee	Provided by landlord	Provided by both	Not defined or none
Maintenance of ranch property	49	36	15	0
Daily care of cattle	83	8	9	0
Supply water	47	40	13	2
Receive and ship livestock	91	2	7	0
Provide liability insurance	59	31	10	0
Pay livestock taxes	99	1	0	0
Pay utilities	66	33	1	0
Absorbs death losses	61	1	5	33
Real estate taxes	9	90	1	0

serviced lease. The hypothesis was that as services were provided by the lessor, the lease rate would increase but the lessee's non-fee grazing costs would be reduced by an equal amount. The estimated equation parameters presented in Bartlett et al. (1993) are summarized here (tables 13 and 14).

Average non-fee grazing costs (excluding the private lease fee) were calculated from the regression results for each of the three states (table 13). Average non-fee grazing costs were $11.19/AUM in Wyoming, $13.26/AUM in Idaho, and $17.31/AUM in New

Table 13. Average total private lessee grazing costs (excluding the private lease fee) in Idaho, New Mexico, and Wyoming when lessor services were and were not provided, 1992.

State	Base value	Adjustment for average distance	Adjustment for average size	Avg. cost no lessor services	Care of cattle provided	Water provided	Avg. cost with lessor services
Idaho	13.26	1.86	-0.16	14.96	-6.16	-2.67	6.13
New Mexico	17.31	1.22	-0.82	17.71	-6.16	-2.67	8.88
Wyoming	11.19	1.59	-0.28	12.50	-6.16	-2.67	3.67

Note: Average distance from the ranch (weighted by number of AUMs on the grazing parcel) was 35 miles for Idaho, 23 miles for New Mexico, and 30 miles for Wyoming. Average size of lease was 543 AUMs for Idaho, 2,749 AUMs for New Mexico and 924 AUMs for Wyoming.

Table 14. Average private lease rate in Idaho, New Mexico, and Wyoming when lessor services were and were not provided, 1992.

State	Intercept	Adjustment for average distance	Adjustment for average size	No lessor services	Care of cattle provided	Water provided	With lessor services
Idaho	8.14	0.32	-0.04	8.42	2.42	1.96	12.80
New Mexico	4.77	0.21	-0.19	4.79	2.42	1.96	9.17
Wyoming	6.72	0.27	-0.06	6.93	2.42	1.96	11.31

Note: Average distance from the ranch (weighted by number of AUMs on the grazing parcel) was 35 miles for Idaho, 23 miles for New Mexico, and 30 miles for Wyoming. Average size of lease was 543 AUMs for Idaho, 2,749 AUMs for New Mexico and 924 AUMs for Wyoming.

Mexico. Non-fee costs were not significantly different between Idaho and Wyoming, but New Mexico was significantly higher.

After adjusting for the average size and distance of leases from the ranch headquarters, the average non-fee grazing costs incurred when no lessor services were provided were $14.96/AUM for Idaho, $17.71/AUM for New Mexico, and $12.50/AUM for Wyoming (table 13). The lessee's non-fee grazing costs were significantly less when the lessor provided livestock care as part of the lease agreement; non-fee costs decreased by an average of $6.16/AUM when livestock care was provided. When the lessor provided water to livestock on a daily basis the lessee's non-fee costs were reduced by $2.67/AUM. These values were the same for all states.

When no livestock care or water maintenance was provided, the average private lease rate per AUM was $6.93 in Wyoming, $8.42 in Idaho and $4.79 in New Mexico (table 14). If the lessor provided daily livestock care, the private lease rate went up by $2.42/AUM. When the lessor maintained the water supply, the lease rate increased by $1.96/AUM. There was no significant discount to the lessee if the lease was not conveniently located to the ranch headquarters. There also appeared to be no significant relationship between the size of the lease in AUMs and the lease price.

It is interesting to note the difference in the average value paid and received by lessees and lessors for the major services provided by the lessor. The lessee's non-fee grazing costs decrease as lessor services are added (table 13); whereas payments to the lessor vary when the lessor provides services with the lease (table 14). Regression parameter estimates for care of cattle and providing water indicate that lessees generally pay less than the value of services received. Lessee grazing costs are estimated to decrease by an average of $6.16/AUM when the lessor tends to the livestock on a daily basis (table 13). The average payment to the lessor for this service was only $2.42/AUM (table 14). Thus, lessees' grazing costs decreased by over twice what it cost for the service. The disparity between reduced lessee costs and payments to the lessor is not as large for providing water. The lessor received an average payment of $1.96/AUM for providing water, while the average reduction in lessee non-fee grazing costs was $2.67/AUM. This disparity might be expected because the lessor generally lives at or

near the lease; thus, it is likely that in many instances the lessor could provide some services cheaper than the lessee could because of the location advantage.

METHODS FOR UPDATING GRAZING FEES

It has traditionally been held that a desirable grazing fee system should: 1) maintain the fee at current market value and 2) consider ranchers' ability to pay. The private grazing land lease rate (FVI) captures variations in the private lease market and the other two PRIA indices (BCPI and PPI) measure profitability or ability to pay. However, this interpretation was not the original reason for including the BCPI and PPI in the current grazing fee formula. It was originally believed that the FVI would adequately track the long-term trend in grazing values. However, an Interdepartmental Grazing Fee Technical Committee assigned to study grazing fee alternatives in the 1960s questioned the ability of the FVI to account for short-term demand, supply, and price disequilibrium (USDA/USDI 1977, p. 3-34). For this reason, the Technical Committee recommended adding the BCPI and PPI to the fee formula.

Over 25 years of data are now available to evaluate which indices have been important in explaining annual variation in forage values and to evaluate whether adding the BCPI and PPI indices to the PRIA fee formula did in fact help explain short-term market fluctuations. Analyses of this type were conducted by Brokken and McCarl (1985), Rimbey (1990), and Torell et al. (1989). Regression results generally showed FVI has been the most important factor in explaining annual variation in private lease rates, but changes in BCPI and PPI further explained short-term variation in forage value in some of the western states (Brokken and McCarl 1985).

Including BCPI and PPI in the PRIA formula has caused the calculated grazing fee to fall further and further behind reported private land lease rates through time (USDA/USDI 1992). With an equal weighting of 1.0 for each of the indices and the continued upward movement of the PPI index, grazing fees derived through the PRIA formula do not track private land lease rates (USDA/USDI 1992). Had the $1.23 base fee in the current formula been indexed by only the FVI, the grazing fee would have been $3.26/AUM in 1992 (USDA/USDI 1992), 70% higher than the 1992 grazing fee of $1.92/AUM.

CONCLUSIONS AND DISCUSSION

Standard economic models and principles for describing the motives of profit-maximizing firms (ranches) apply to the forage market. Theoretical justification for traditional forage valuation methods come from the standard economic model of profit maximization. These methods are justified based on certain limiting assumptions: 1) ranchers are profit maximizers, 2) ranchers have at their disposal numerous alternative forage sources and leasing alternatives (i.e., private and public forage are direct substitutes), and 3) rational and economically motivated livestock producers are willing to pay a price equal to the value of forage in production. It would be expected that if the competitive forage market were efficient, public and private grazing costs would be equal and the capitalized value of the grazing permit would remove any existing cost differentials.

If only forage values for cattle grazing BLM land are considered, this economic scenario would appear to hold. Specifically considering the total cost approach, non-fee grazing costs on BLM lands were found to average $3.63/AUM less than grazing costs on private leased lands after adjusting to the same lease size and averaging across all three test states. With the 1992 public land grazing fee at $1.92/AUM, an excess value of $1.71/AUM ($3.63/AUM - $1.92/AUM = $1.71/AUM) was apparently capitalized into a grazing permit value, and ranchers were paying equal amounts for grazing public and private lands.[18] The major question in this situation is allocating this excess value. The 1992 grazing fee of $1.92/AUM captured the market value of the forage if the rancher's investment in the grazing permit is recognized; yet, legal precedence says that permit value (cost) need not be considered when setting grazing fee policy (Pankey Land and Cattle Co. v. Hardin and Hickel, Cite 427 F.2d 43 1970).

Negative forage value estimates found for USFS and BLM sheep allotments were not economically logical. In these cases, grazing costs were found to be higher, on average, than for private lands. Yet, profit-motivated ranchers should not be willing to pay more for

[18] However, much variability was found and grazing cost estimates for individual grazing allotments ranged from - $74/AUM to + $20/AUM (fig. 2 and fig. 3). Permit values also varied considerably.

grazing public lands if alternative forage sources (private leases) are available at a lower cost. The fact that USFS permits and some sheep permits continue to have real estate value furthers the argument that profit is not ranchers' only motive for leasing public lands.[19]

We perceive data collected for the grazing cost survey were valid and cost estimates as presented do in fact reflect the current situation. Grazing costs are extremely variable and many public land ranchers are paying more than private land lessees for grazing, even before considering grazing permit investments. The validity of forage values derived using the total cost approach, and other methods that make comparisons with the private forage market, must be questioned if ranchers are not motivated primarily by profit. It is not possible to know what price ranchers would pay for grazing public lands if a framework such as profit maximization cannot be assumed. In this case, a comparison to the private forage market does not provide public land forage value because the motives of ranchers are not adequately incorporated. What ranchers would or would not pay for public land forage cannot be determined without establishing a competitive market.

Questioning the total-cost approach as a way of valuing forage does not mean that grazing cost comparisons made between private and public land ranchers are not useful. The findings are significant. We estimate that with the 1992 grazing fee of $1.92/AUM, 34% of cattle producers on BLM land, 62% of USFS cattle producers, 60% of BLM sheep producers, and 92% of USFS sheep producers paid more, in total, for grazing public lands than did those leasing private lands (fig. 2,3). Additional investments were also made to buy the grazing permit. In most cases, the common belief that public land ranchers pay less than those leasing private lands is not justified.

The market appraisal approach and the market statistical approach are based on the alternative cost doctrine: a rational and profit motivated rancher will not pay more to lease forage than to lease the next best alternative. To use these valuation methods again requires the assumption that ranchers' economic decisions are consistent with profit maximization and that they are knowledgeable about the costs of using public forage. Further, private leases

[19] It appears that some sheep permits do not have economic value. Vacant sheep permits exist in nearly all of the western states. The uncertainty about grazing fee policy and other public land policies has reduced permit values (Torell and Doll 1991).

must be directly comparable in location and other attributes that affect value and numerous leasing alternatives must exist. This was not found to be the case when compared to USFS lands. Very few comparable leases could be found for the market appraisal valuation, and none were considered comparable to USFS lands.

The limited number of private leases truly comparable to public lands, without major adjustment, limits the use of the market appraisal approach. Further, even if differences in the value of lessor-provided services can be accounted for using regression techniques, the estimate of net forage value is still not necessarily comparable to public lands. The market statistical approach does not require that only non-serviced leases, similar to public land leases, be considered; rather, it can include serviced and non-serviced private leases. Variations in the lease price as services are and are not provided give a direct estimate of the value of these services and net forage value. The estimate of forage value, however, is for non-serviced private leases, not non-serviced public leases. In addition to services provided, if location, terrain, or other attributes affecting value are different between private and public lands, an appropriate adjustment must still be made.

Average forage values estimated from the market statistical approach were $4.79/AUM in New Mexico, $8.42/AUM in Idaho, and $6.93/AUM in Wyoming, and forage values estimated from the market appraisal approach were $3.40/AUM for New Mexico and $7.19/AUM for Wyoming (table 10).

Amortized grazing permit values added to the 1992 grazing fee indicated the market value of forage was in the $3/AUM range in Idaho and Wyoming and in the $5/AUM range in New Mexico (table 9). These estimates are comparable to the $3–4/AUM value estimated using the total-cost approach for BLM cattle grazing. These values are a direct estimate of how much ranchers were willing to pay for public land forage in 1992.

As was true for other valuation methods described above, justification for the permit value method comes from standard economic models of profit maximization. Permit value should be the factor that equates total grazing costs to value, and there is a strong theoretical linkage between grazing fees and permit value.

Two critical factors limit using permit values to estimate forage value. First, while permit value can be estimated by analyzing ranch sales data or by querying knowledgeable individuals, a subjective

interest rate is used to compute an annual forage value. Wide variations in this value will be obtained, depending on the selected interest rate. Second, permit values have not been a consistent indicator of value, and factors associated with livestock grazing explain only part of the variation in the value of grazing permits (Jensen and Thomas 1967, Torell and Doll 1991).

Federal agencies contend that permit value belongs to the federal government; therefore they have not considered permit value in setting grazing fee policy. Yet, allocation of permit value lies at the heart of the grazing fee debate. Private markets and past policies have allocated this value to ranchers; higher grazing fees would reallocate this value to the government. Concerns about the fairness of this reallocation are obvious.

We began this study thinking a comparison to the private forage market was the best way to value public land forage. We concluded the study with the renewed realization that public land ranchers participate in the livestock business for a number of reasons not necessarily related to profit. Other factors, including the way of life, are important in the decisions western ranchers make (Smith and Martin 1972). This being the case, there is no theoretical justification for setting grazing fees based on a comparison to the private forage market. These valuation approaches do not consistently meet the criterion of collecting the market value of forage, leaving competitive bidding or a politically negotiated fee as the only alternatives.

We did not study competitive bidding in detail because no test or evaluation can be made without major changes in existing policy. Except for the few existing areas using competitive bidding (e.g. McGregor Range and Fort Meade), moving to this system could mean a major reallocation of grazing permits. The variability we found in grazing costs, and the variability present in the 1966 grazing fee study suggest each grazing parcel has its own unique forage value. Establishing a competitive market through some type of bidding scheme appears to be the only way to discover these values.

Many questions come to mind in considering how a competitive bid system might be structured and implemented. What should be done with existing permit holders and the asset value of permits? What should be the terms of the lease, the length of the lease period, and what qualifications and requirements should be set before a bid

can be submitted? Should there be a commensurate property requirement? What provisions, if any, should be made for minimum and maximum bids? How should parcels with a limited number of prospective bidders be dealt with? Results of this study indicate the competitive lease option may provide an economically rational way to discover the market value for grazing on public lands.

Another option would be to negotiate a fee politically using our results as a guide to public forage values. Any regional differences in the negotiated fee would have to be based on non-economic criteria, as economic pricing regions were not apparent from our study results. A different fee for cattle and sheep and a different fee for BLM and USFS may be justified but wide variation in values precludes selection of an exact number.

There are advantages, disadvantages and limitations for each valuation method studied (table 15). As highlighted above, each method has limitations and inconsistencies that precludes determining an exact value for public land grazing.

Table 15. Summary of advantages, disadvantages, and limitations found for various forage valuation methods.

Valuation method	Major advantages	Major disadvantages	Estimates market value of public land forage?		Critical limitation
			In theory	In practice	
Total cost approach	1. Considers grazing costs on both private and public lands. 2. Recognizes differences in characteristics and quality between public and private lands to the degree that these differences are reflected in grazing costs.	1. Assumes ranchers make rational economic decisions that are consistent with profit maximization. This study did not find this to be true. Without the assumption of profit maximization, traditional models will not reveal how much ranchers would pay for public land forage under a competitive market system.	Yes	No	Empirical results are not consistent with the theoretical justification for the valuation approach.
Market appraisal approach	1. Data only need be collected on comparable private land leases.	1. Does not directly consider the characteristics of public lands but rather assumes private leases are comparable or that differences can be adjusted for. Requires that only nonserviced and comparable private land leases be used in the appraisal of value. 2. Relies on subjective appraisal adjustments to arrive at public forage value. 3. Requires the assumption of profit maximization.	Yes When adjusted for differences	No	Few private land leases are comparable to public lands. Subjective adjustments must be made. Profit maximizing behavior must be assumed.

Market statistical approach	1. Data only need be collected on comparable private land leases. 2. Does not rely on subjective appraisal techniques to adjust to nonserviced lease basis. 3. Sample size is larger because serviced and non-serviced private leases can be included in the statistical evaluation.	1. The statistical evaluation adjusts values to a non-serviced basis but makes no adjustment for additional differences between private and public lands. 2. Requires the assumption that ranchers are profit maximizers.	Yes When adjusted for differences	No	Estimated forage value is for a nonserviced private lease not public lands.
Permit value	1. Provides a direct and site specific estimate of the amount public land ranchers have been willing to pay for public land grazing.	1. Requires a subjective selection of an interest rate to use in determining value. 2. Ranchers have paid more for grazing permits than justified from potential ranch profits, i.e., value estimates have been inconsistent.	Yes	No	Subjective selection of interest rate to use
Indexing of 1966 values	1. Large sample of private and public land ranchers were used to estimate 1966 forage value. Data were included from all western states.	1. Assumes 1966 forage value of $1.23/AUM was correct and can be indexed to current value. 2. Requires assumption that ranchers are profit maximizers.	Yes	No	Uses the total cost approach and is therefore limited by the same theoretical/empirical limitations.
Competitive bidding	1. The marketplace provides the final determination of value. A competitive bid would create a direct market for public land forage. 2. The need to define pricing areas and develop an adjustment mechanism would be eliminated.	1. Moving to a competitive bid system represents a major change in policy. Public land grazing permits have been allocated and permits have value to the current holder. A way of equitably reallocating permits to other potential lessee's must be devised. 2. There must be ample competition for individual parcels of public land to assure a true market price is established. Yet, some public land is scattered with other private and state trust lands. Few people other than the current lessee could potentially bid for the forage.	Yes	Unknown	Represents a major policy shift that will not be equitable in all cases. Many questions arise as to how a competitive system would work.

RECOMMENDATIONS

It is important to move forward on the grazing fee issue. The controversy surrounding the fee has disrupted the ranch real estate market, created uncertainty for ranchers, lenders, and rural communities in the West; occupied an inordinate amount of time for policy makers; and detracted from the management of public lands. Resolving the grazing fee issue would lead to more stability within the livestock industry and dependent rural communities and would allow the BLM and USFS to concentrate on managing natural resources.

Given the variability of results in this study, the GFTG had difficulty making an absolute recommendation concerning the appropriate method for determining forage value for both land agencies and livestock types. Several of the methods examined produced comparable results for BLM cattle allotments, but inconsistent results for USFS and sheep allotments. The following recommendations deal with alternative forage valuation methods, pricing areas, and ways to update fees over time.

Each method examined for valuing public forage has limitations, and it is futile to apply any one method in an attempt to derive an absolute value for public forage. Historically, a comparison to the private forage market has been used to estimate the value of public land forage, and we originally thought this method had the greatest potential for updating public land grazing fees. This method requires the assumption that 1) ranchers are profit maximizers; 2) alternatives to public land grazing are available; and 3) public and private leasing arrangements, terms, conditions, and rangeland quality are comparable, or adjustments for these differences can be made. The results of this study led the GFTG to conclude that private forage comparison methods fail to meet at least one of the assumptions about competitive markets. There are obviously many factors in addition to profit that enter into the decision to use public and private land. The complementary value of public and private resources and the personal utility from ranching as a way of life are obvious examples.

Economists, appraisers and politicians have not been able to resolve the grazing fee issue, nor can they be expected to resolve the issue completely in the future. A competitive market value is the only way to reveal public land grazing values, especially on an

allotment-by-allotment basis. Without the benefits of such a market, current methods for valuing public land grazing have many inadequacies—so many so that a defensible absolute value of public grazing cannot be determined. Thus, for the short-run, the GFTG recommends that no particular methodology be used to establish forage value.

The GFTG concluded that when taken together, all of the methodologies examined suggest a market value for grazing public lands somewhere between $3 and $5/AUM, a guideline for negotiation a grazing fee. This recommendation relies heavily upon the permit value approach, as permit value is the only estimate of value for grazing on public lands that is determined in a competitive market. The total cost approach results for cattle on BLM allotments are also within this range. Theoretically, increasing grazing fees reallocates permit value (or some portion of permit value) to federal land agencies, with the implication that it belongs there. The fairness of this reallocation will be an obvious topic of future discussion.

Our study results and the earlier 1966 grazing cost study indicates no economic justification for setting fees based on geographic or ecological boundaries. To reiterate what was stated nearly 25 years ago by Houseman et al. (1968, p. 2), and reinforced by our study results:

> "Differences among ranching areas, as shown by the data, were not large enough in relation to the wide variation that existed within areas to provide a basis for recommending differential base fees among ranching areas."

Evaluation of the PRIA indices revealed that the previous year's Forage Value Index (FVI) is the best predictor of private lease market changes. The BCPI and PPI have not helped explain short-term variation in forage value as originally envisioned. The FVI considers the rancher's ability to pay because expected beef prices and production costs influence private lease rates when lessees and lessors negotiate the terms and conditions of a private lease.

The FVI will need to be set using a new base period. The period 1987–1991, which includes values near the top and bottom of the beef price cycle, could be used.

The GFTG visualizes a grazing fee formula as follows:

(1) $Fee_t = Base \times FVI_{t-1}$

Where:

Fee_t = grazing fee in the current year

FVI_{t-1} = the Forage Value Index during the previous year with a base period of 1987–91

Base = a politically negotiated rate between $3 and $5/AUM

The GFTG also concurred with the suggestion made in the 1986 grazing fee study (USDA/USDI 1986) that the FVI be derived by weighting individual state lease rates by the number of federal AUMs in the state rather than by the number of private lease observations, as is presently done. This would give a higher weighting to lease rates in states with the most public lands. Adjustments in the weighting scheme would need to be made for states that have an inadequate number of private leases from which a proper sample can be drawn. There is a need and the potential for improving the sample size and reliability of the private lease rate data collected each year.

This study and others show the value of grazing public lands varies greatly between allotments. The costs associated with each allotment as well as the benefits derived are unique. A competitive market is necessary to determine the actual market value of grazing public lands. Creating a market for public land grazing though a competitive bid system may accomplish this objective. A competitive bid approach for valuing public grazing was suggested thirty years ago by Gardner (1963) and was proposed by the Office of Management and Budget in the 1980s. However, competitive bidding was not explored and tested in this study and would require substantial examination before a recommendation to implement a competitive bidding process could be made.

Under a competitive bidding system, bids for public land forage would be based on site-specific allotments and the need for pricing areas would be eliminated. The length of each lease would need to

be determined, but if a reasonably short time frame were used, it would not be necessary to index or update grazing fees.

We recognize competitive bidding would require major changes in policy and that there would be many problems to address. Some of the major concerns about a competitive bidding system include:

1. How to equitably reallocate value from current ranchers?

2. Should present permittees have the right to match the highest bid?

3. How to determine terms and conditions of competitive leases? Specifically, items to be addressed from a policy perspective include duration of lease, provisions for minimum bids to cover administrative costs or handle small scattered parcels, qualifying bidders, commensurate property requirements, common or group allotments, and control of range improvements by existing permit holders (e.g., water rights).

Evaluating the competitive bid option further may show this method is politically unacceptable, that it will not be cost effective, or that it will not work for many small scattered land parcels.

It should be recognized that the cost of government administration does not determine or influence the value of the forage for productive uses. Comparisons should be made between any forage valuation method and government administration costs to strive for administrative efficiency in the management process.[20]

We do not feel additional studies to define the apparent market value of forage by state or geographic area are justified. The results of the 1966 and 1992 grazing cost surveys demonstrate that little additional insight would be gained and that large variability would preclude refining regionalized grazing values further.

[20] Some members of the Peer Review Committee and the GFTG felt the cost of administration should be used to calculate a minimum grazing fee. If this were the case, a consistent procedure for determining the cost of administration would need to be developed on an AUM basis, comparing costs with and without livestock grazing.

LITERATURE CITED

Agee, D. E. 1972. Rates of return to investment for Western cattle ranches. J. Amer. Soc. of Farm Managers and Rural Appraisers. 36:53-58.

American Institute of Real Estate Appraisers. 1983. The appraisal of rural property. Chicago, Il. 424 p.

Bartlett, E. T. 1983. Valuing range forage on public rangelands. *In:* Wagstaff, F. J., Proceedings: Range Economics Symposium and Workshop, Aug. 31-Sept 2, 1982, Salt Lake City. USDA Forest Service Gen. Tech. Report INT-149. pp. 92-99.

Bartlett, E. T., R. G. Taylor, J. R. McKean and J. G. Hof. 1989. Motivation of Colorado ranchers with federal grazing allotments. J. Range Manage. 42(6):454-457.

Bartlett, E.T., N.R. Rimbey, L.A. Torell, L.W. Van Tassell, J. DeVilbiss, R. Appel, T. Heisler, G. Stoebig, T. Bagwell, P. Burgener, and J. Coen. 1993. The Federal Grazing Fee: 1993. *In* Incentive-Based Grazing Fee System for Public Rangeland Administered by the Bureau of Land Management and United States Forest Service, Part I. Washington, D.C.

Brokken, R. F. and B. A. McCarl. 1985. A theoretical evaluation of fee systems for private grazing on federal lands. USDA Econ Res Serv. PB85-128-320. 136 pp.

Cook, C. W., R. G. Taylor, and E. T. Bartlett. 1980. Impacts of federal range forage on ranches and regional economies of Colorado. Colorado State Univ. Ag. Exp. Sta. Bulletin 576S.

Fowler, J. M. and J. R. Gray. 1981. Grazing-land values in New Mexico. New Mexico State Univ. Res. Rpt. 456.

Gallacher, W. G. 1992. Grazing fee evaluation on McGregor Range: a competitive market situation. New Mexico State Univ. unpublished Master of Science Thesis.

Gardner, B. D. 1962. Transfer restrictions and misallocation in grazing public range. J. Farm Econ. 44(1):50-63.

Gardner, B. D. 1963. A proposal to reduce misallocation of livestock grazing permits. J. Farm Econ. 45:109-120.

Gee, C. K. 1983. The use of linear programming to estimate range forage values. *In*: Wagstaff, F. J., Proceedings: Range Economics Symposium and Workshop, Aug. 31-Sept 2, 1982, Salt Lake City. USDA Forest Service Gen. Tech. Report INT-149. pp. 89-91.

Hof, J. G., J. R. McKean, R. G. Taylor and E. T. Bartlett. 1989. Contingent valuation of a quasi-market good: an exploratory case study of federal range forage. USDA Forest Service Research Paper RM-283. 7 p.

Houseman, C. E., and others. 1968. Special report on the grazing fee survey. Unpublished report. U.S. Department of Agriculture, Statistical Reporting Service, November 12, 1968.

Jensen, B. C. and D. Thomas. 1967. Determining grazing fees on National Forests: range and ranch problems, policy implications and alternatives for future economic research in the use and development. Utah State University, WAERC Report No. 9.

Kehmeier, P. N., T. M. Quigley, R. G. Taylor, and E. T. Bartlett. 1987. Demand for Forest Service grazing in Colorado. J. Range Manage. 40:560-564.

Madsen, A. G., C. K. Gee and J. B. Keffeler. 1982. Market vs. productive value of Colorado ranches. Amer. J. of Farm Man. and Rural Appraisers 46:19-23.

Martin, W. E. and G. L. Jeffries. 1966. Relating ranch prices and grazing permit values to ranch productivity. J. Farm Econ. 48:233-242.

Nielsen, D. B. 1992. Comments on nonfee cost update. *In*: U. S. Department of Agriculture, Forest Service, U. S. Department of Interior, Bureau of Land Management. 1992. Grazing fee review and evaluation update of the 1986 final report: A report from The Secretaries of Agriculture and Interior. Washington, D.C.

Nielsen, D. B. and E. B. Wennergren. 1970. Public policy and grazing fees on federal lands: some unsolved issues. Land and Water Law Review, Univ. of Wyoming, Vol. V:293-320.

Obermiller, F. W. 1992a. Costs incurred by permittees in grazing cattle on public and private rangelands and pastures in Eastern Oregon: 1982 and 1990. Oregon State Univ., Coop. Exten. Ser. Sp. Rpt. 903, 32p.

Obermiller, F. W. 1992b. In search of reason: the federal grazing (fee) debate. Congressional Record-Senate. August 6. S11703-S11719.

Obermiller, F. W. and D. K. Lambert. 1984. Costs incurred by permittees in grazing livestock in various western states. EM 8283. Oregon State University Extension Service.

Olson, C. E. and J. W. Jackson. 1975. The impact of change in federal grazing policies on south-central Wyoming mountain valley cattle ranches. Univ. of Wyoming Agr. Exp. Sta. Res. J. 96.

Redmond, J. T., E. T. Bartlett and P. Gutierrez. In press. Costs of grazing on federal lands and private leases: A 1991 Colorado Comparison. Colo. State Univ. Coop. Ext. Serv. Bul.

Rimbey, N.R. 1990. Idaho State Land Grazing Fee Issues. Progress report presented to the State of Idaho Land Board Subcommittee on Grazing Fees, July 30, 1990, Boise, Idaho.

Rimbey, N. R., R. Krebill-Prather, and J. E. Carlson. 1992. Range and pasture forage: What's it worth? Univ. of Idaho Agr. Econ. Res. Series 92-3.

Roberts, N. K. 1963. Economic foundations for grazing use fees on public lands. J. Farm Econ. 45(4):721-731.

Roberts, N. K. and M. Topham. 1965. Discovering grazing values. Utah Agr. Exp. Sta. Agr. Econ. Ser. 65-3, Bureau of Land Management and Forest Service cooperating. 29 p.

Robertson, J. H. 1978. The grazing fee as an incentive for range management. Rangeman's J. 5:19-21.

SAS Institute Inc. 1985. SAS/STAT™ Guide for Personal Computers, Version 6 Edition. Cary, NC: SAS Institute Inc. 378 p.

SAS Institute Inc. 1988. SAS™ Procedures Guide, Version 6.03 Edition. Cary, NC: SAS Institute Inc. 378 p.

Smith, A. H. and W. E. Martin. 1972. Socioeconomic behavior of cattle ranchers with implications for rural community development in the West. Amer. J. Agr. Econ. 54:217-225.

Torell, L. A. and F. N. Bledsoe. 1990. 1989 New Mexico private grazing lease arrangements and costs. New Mexico State Univ. Agr. Exp. Sta. Res. Rpt. 651.

Torell, L. A. and J. P. Doll. 1989. The market value of New Mexico ranches, 1980-88. New Mexico State Univ. Agr. Exp. Sta. Res. Bul. 748.

Torell, L. A. and J. P. Doll. 1991. Public land policy and the value of grazing permits. West. J. Agr. Econ. 16(1):174-184.

Torell, L. A. and J. M. Fowler. 1985. Market values of ranches and grazing permits in New Mexico. New Mexico State Univ. Res. Rpt. 570.

Torell, L. A. and J. M. Fowler. 1986. A model for predicting trends of New Mexico grazing land values. New Mexico State Univ. Res. Bul. 723.

Torell, L. A. and J. M Fowler. 1992. Grazing fees: How much is fair? New Mexico State Univ. Agr. Exp. Sta. Rpt. 666.

Torell, L. A., E. T. Bartlett, and F. W. Obermiller. 1992. The value of public land grazing permits and the grazing fee dilemma. New Mexico State Univ. Range Improvement Task Force Report 31. 7 p.

Torell, L. A., J. R. Garrett, and C.T.K. Ching. 1981. The economic effects of three changes in public lands grazing policies. J. Range Manage. 34:373-376.

Torell, L. A., S. Ghosh, and J. M. Fowler. 1989. Economic considerations for setting grazing fees on New Mexico State Trust Lands. New Mexico State Univ. Agr. Exp. Sta. Spec. Rpt. 81.

U. S. Department of Agriculture, Forest Service, and U. S. Department of Interior, Bureau of Land Management (USDA/USDI). 1977. Study of fees for grazing livestock on federal lands. A report from the Secretaries of Agriculture and Interior. Washington, D.C. October, 1977.

U. S. Department of Agriculture, Forest Service, and U. S. Department of Interior, Bureau of Land Management (USDA/USDI). 1986. Grazing fee review and evaluation final report 1979-1985: A report from the Secretaries of Agriculture and Interior. Washington, D.C.

U. S. Department of Agriculture, Forest Service, U. S. Department of Interior, Bureau of Land Management (USDA/USDI). 1992. Grazing fee review and evaluation update of the 1986 final report: A report from The Secretaries of Agriculture and Interior. Washington, D.C.

Workman, J. P. 1986. Range economics. MacMillan Publ. Co., New York.

Workman, J. P. 1988. Federal grazing fees: a controversy that won't go away. Rangelands 10:128-30.

Young, K. D. and C. D. Shumway. 1991. Cow-calf producers perceived profit maximization objective: A logic analysis. So. J. Agr. Econ. 23(1):129-136.

December 1993 **Las Cruces, NM**
1M