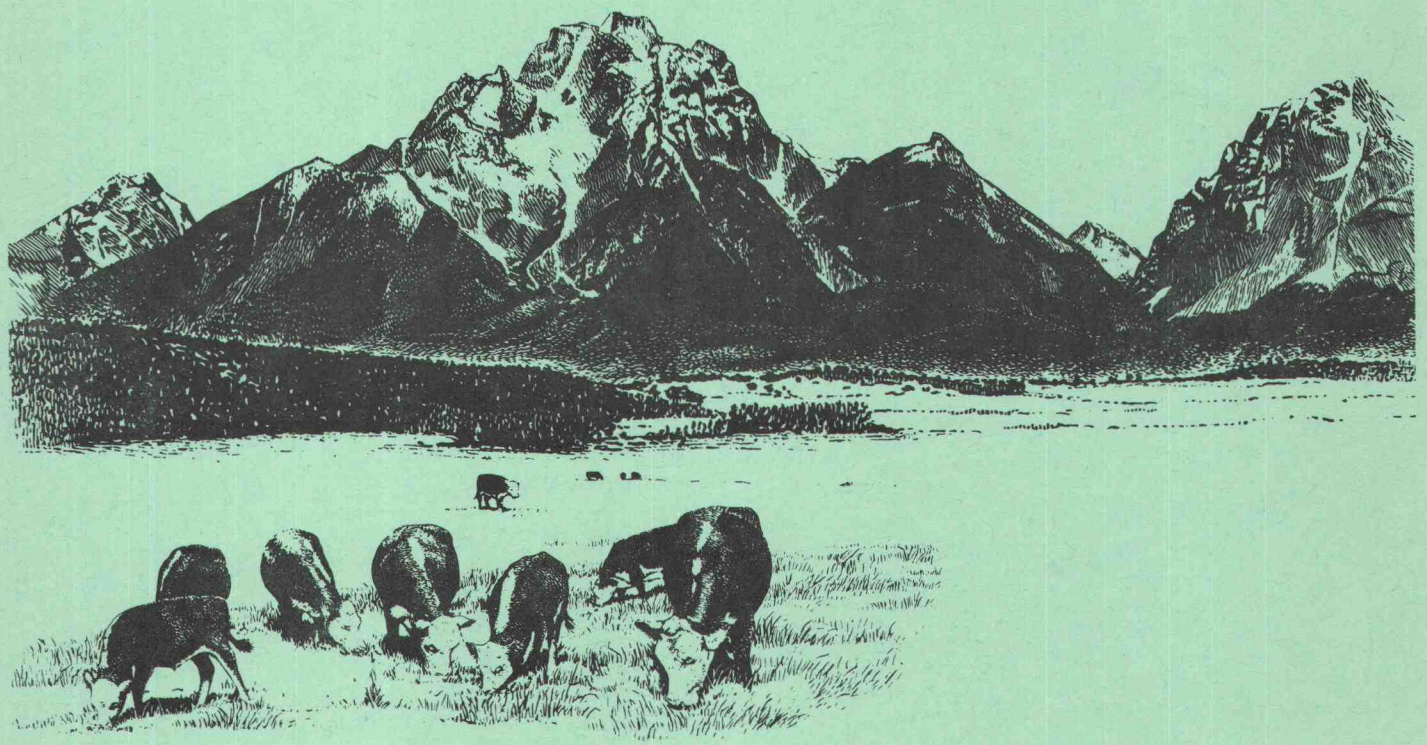
Costs and Benefits of BLM Range Improvements: Private and Public Perspectives



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OREGON STATE UNIVERSITY EXTENSION SERVICE

Much of the rangeland the Bureau of Land Management (BLM) manages in the 11 Western States could be improved through investments in rangeland improvements or through the adoption of different management practices. Of the over 170,000,000 acres of public land classified as rangeland, fully 135,000,000 acres -- nearly 80 percent -- were in fair or poor condition in 1974.

In 1979, it was estimated that the forage production on these 135 million acres could be doubled over the next 20 years, from 5.6 to 11.2 million tons of forage. Assuming a 6 month grazing season, this potential increase could results in an additional 2.3 million head of cattle using the western public lands by the year 2000.

Unfortunately, range improvements do not come cheaply. The amount of funding required to realize these potential increases in forage production is quite large, and we cannot be sure about congressional authorization of the required sums.

In addition to the financial constraints to improving forage productivity, political and social pressures may prohibit the allocation of all of the available forage to the production of livestock. Society's desire for healthy wildlife populations, undistrubed natural areas, and recreational opportunities cannot always be met without imposing some costs on the other users of the resource (such as rangeland livestock producers).

Because of the economic, social, and political issues involved in the management of the public lands, the BLM has had to develop a planning system that incorporates the interests of all of the user groups and allows the bureau to make decisions in as rational a manner as possible.

During the fall of 1982 the BLM published its Final Rangeland Improvement Policy, including the procedures used for evaluating, ranking, and budgeting for improvements. We'll discuss these policies and procedures. Our second purpose is to provide ranchers with useful guidance in assessing the financial feasibility, to them, of range investments and of their assumption of maintenance responsibilities.

The report has four parts. The first contains a brief description of current bureau policies regarding rangeland improvements. Part two goes into more detail on the three stages of analysis the bureau uses in deciding which improvements will ultimately be undertaken.

In the third part the use of benefit-cost analysis in judging the economic merits of a variety of investment possibilities is described. The purpose of the fourth part is to assist the permittee in conducting his or her own economic analysis of any investment or maintenance responsibility required on the allotment.

The analysis procedure used in this final part is the calculation of the internal rate of return to the rancher when funds are committed to a range improvement. Although geared to analyzing investments on public

lands, you could use the procedures to assess any investment possibility, whether on public lands or on your own deeded properties.

1. The Bureau's rangeland investment policy

The purposes of the current BLM rangeland improvement policy are to:

1. ensure that range betterment funds (8100/8200 accounts) are spent for on-the-ground rangeland improvements;

2. encourage private contributions toward rangeland improvements;

3. reduce the Bureau's maintenance costs by assigning as much maintenance responsibility as possible to the primary beneficiaries of rangeland improvements; and

4. allocate available rangeland improvement funds according to a rational process that considers all benefits and costs (economic, social, political and biological), and places rangeland improvements where they are most needed and will achieve the greatest return with the least expenditure of public funds.

Little needs to be added to futher clarify the bureau's improvement policy. Range betterment funds (8100/8200 account) are composed of one-half of all of the grazing fees collected from livestock operators using public lands. The policy assures that these funds are spent for projects designed to improve the forage productivity of the lands the bureau administers.

Funds are to be distributed among districts in roughly the same proportion in which they are collected. To further assure that these funds are used for projects designed to enhance forage production, the 8100/8200 account funds will not be used to pay for maintenance expenses on range facilities after September 30, 1984.

However, the funds appropriated by Congress for grazing administration, 4322 account, may still be used to maintain those facilities where no single resource user group clearly receives over 50 percent of the benefits from an improvement project.

The second objective of the bureau's improvement policy is to encourage permittees and other user groups to contribute money and/or labor to the construction of range improvements. Priority will be given to those investments that are partially or fully funded by private contributors. Procedures will be devised to assure that private investments will be given appropriate recognition and protection.

The third objective of the improvement policy directs that the user groups deriving over 50 percent of the benefits from an improvement will be

responsibile for the maintenance costs. In addition to reducing government expenditures, this objective is designed to release more money for the construction of new improvements. Maintenance responsibilities will become one of the conditions written into the grazing permit.

The exact nature of the permittee's contribution to maintenance will be decided at the local level through consultations among bureau personnel, the Grazing District Advisory Board, and the permittee.

The allocation of rangeland improvement funds is to be decided through a rational decisionmaking process. This fourth goal of the improvement policy attempts to ensure that public and private funding is invested in those projects yielding the greatest return. This decisionmaking process deserves greater mention and thus is the subject of the next part of this report.

2. BLM procedures for range improvement analysis

The Bureau of Land Management's decisionmaking process regarding investments in rangeland projects and practices consists of three stages of analysis, as illustrated in figure 1. Current BLM policies identify these stages as:

Component Analysis #1: Allotment Categorization

Component Analysis #2: Ranking Investments

Component Analysis #3: Budgeting and Implementation

Although BLM districts around the West are in various stages in the planning process, the intent of the bureau's investment procedures is to conduct component analysis #1 early in the planning process. This component would be concluded before the publication of a planning area's environmental impact statement (EIS), while resource objectives in an allotment still are being decided.

Component Analysis #2 would be conducted during the writing of the EIS and the determination of the final land use plan for an area. Component Analysis #3 would follow the completion and publication of the final land use plan, and would coincide with the drafting of the allotment management plan.

In those districts where the final land use plans have been completed, we assume that allotment categorization has already been done, either explicitly or implicitly. Detailed investment analyses of the type conducted in Analysis Components #2 and #3 would presumably be done in the districts' preparations of allotment management plans and in their annual budget requests.

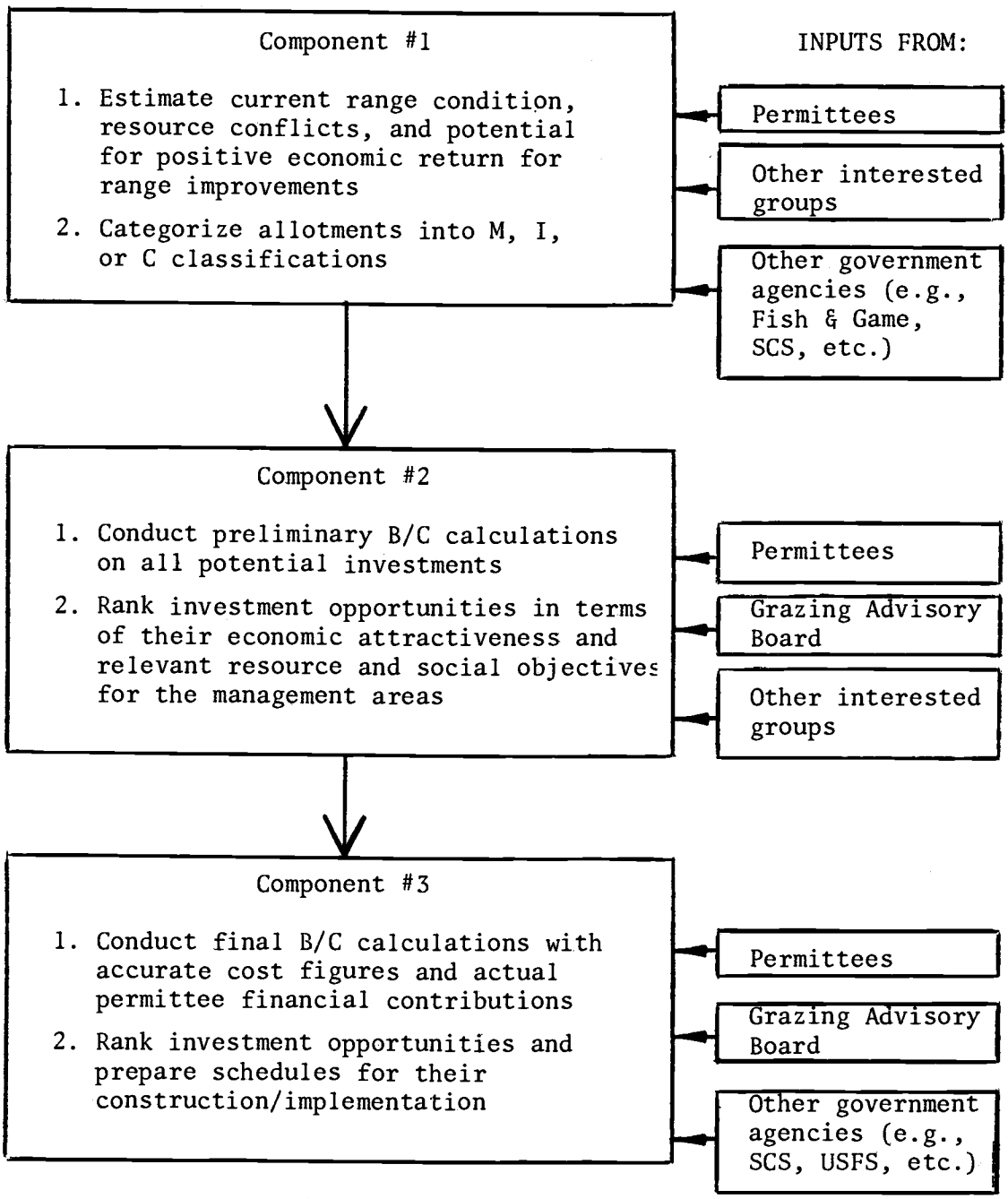

Figure 1.--BLM Range Investment Analysis Components

Following is a brief overview of each of these steps in the investment analysis. You can address specific questions regarding these steps to the local BLM office or to your county Extension Office.

Component Analysis #1: Allotment categorization

Individual allotments within a planning area are initially classified into one of three groups. Criteria considered in assigning an allotment into any particular group are: present range condition of the allotment, the potential for improvement of the allotment's resources, extent of any serious conflicts among the uses of the resources, characteristics of the present management of the allotment, and the opportunity for a positive net economic return on range investments.

The classifications used in categorizing the allotments are I (for improve), M (for maintain), and C (for custodial). Roughly speaking, those allotments that are presently in poor or fair condition, yet have good potential for improvement, would fall into the improve category.

Allotments in which past management has resulted in good current range conditions such that the allotments are already producing at or near their resource potential would probably be classified in the maintain grouping.

The custodial category would contain those allotments not currently producing at their optimal potential, yet for which some uncertainy exists as to whether improvements in resource productivity could be made in an effective manner.

The potential for a positive economic return on public and private investment in improvements is not the sole criterion for categorization of the allotments. As already noted, conflicts among competing resource uses, physical characteristics, and the present management of the allotment are also considered in classifying the allotments.

However, it is at this stage that economic analysis enters the decisionmaking process. The initial step in the evaluation should involve both the bureau range manager and the livestock permittee(s) in forming a rough estimate of the production potential of the allotment.

In making this initial assessment, the bureau manager and the permittee may work together with local Extension agents and Soil Conservation Service personnel to develop ideas about investment and management practices that would improve the productivity of the allotment. Keep an eye on those improvements that would relieve any constraints that currently prohibit the full use of the resources.

For example, if portions of the range are producing large amounts of forage that aren't being used, improvements leading to better distribution of livestock might be in order (such as water developments or fencing).

Lower-cost alternatives should also be considered, where possible, such as herding or salting. Changes in season of use or changing to a different management system (such as deferred-rotation or rest-rotation) may also contribute to making better use of the existing forage and possibly lead to increased production over time.

Bureau policy currently grants greater priority to those investments generating the greatest forage production increases for the least amount of money. Innovative thinking by the range manager can, therefore, be important at the allotment categorization stage.

If the possibility exists of improving the allotment's forage productivity, think first about achieving improvement through the least costly method. By attaining a desired productivity increase at the lowest possible cost, you should improve the chances of the bureau's committing itself to an investment.

This first stage in the management process may be done before the decision is made on how much of the allotment's production is to be allocated to the various uses. Emphasizing the production of red meat may or may not be the final objective chosen for the allotment. Enhancement or protection of other resource values, such as recreation, wildlife populations, archeological sites, or mining may be a major goal in the management of an area.

Therefore, it is important that the permittee becomes involved in the resource allocation phase of planning, which generally will occur at the same time (but separate from) the categorization of allotments.

Familiarity with the physical nature of the allotment will permit the rancher to work more closely with the bureau in suggesting measures to improve the use of the allotment's forage supplies without adversely affecting the other resource uses.

Component Analysis #2: Ranking investments

The purpose of the second analysis component is to combine considerations of economic, resource, and social objectives to select and rank investments in rangeland improvements. This second stage of the analysis is more detailed than the first in terms of the information required. It is at this stage that the different investment and management alternatives in a planning area's allotments undergo tough economic analysis.

The ranking process does not depend solely on the economic attractiveness of the investment programs. The bureau resource managers are to balance the resource and social objectives, along with the economic analysis, in their selection of investment programs. Noneconomic considerations include:

1. the presence of critical resource values and any conflicts among the resource uses;

2. the percentage of the allotment in unsatisfactory condition relative to the planned objectives for the allotment;

3. the bureau-determined changes that may occur in the numbers of the forage AUM's presently allocated to livestock;

4. the ability of the permittee(s) in the allotment to maintain a viable ranching operation if any reductions are made in their permits;

5. the willingness of the permittee to pledge contributions of money and/or labor to the investment program; and

6. any other issues that might be relevant to the allotment in question.

The first step in this second analysis component requires the BLM manager to conduct an economic efficiency analysis of each of the investment alternatives being considered. The central feature of this efficiency analysis is the benefit/cost (B/C) calculation.

The essence of the B/C analysis is to estimate a dollar value for all of those project benefits for which measurable values can be calculated and to compare these benefits with the project's costs. If the value of the benefits exceeds the costs, the ratio of the benefits to the costs will be greater than 1:1; and the project may be worth undertaking.

The third part of this report describes the B/C analysis procedures the bureau uses in more detail. You may want to read this section before proceeding with the rest of the description of the bureau's range investment analysis procedures.

The B/C ratios are calculated by the BLM's computerized analysis program, SageRam. The B/C ratios of primary concern are those calculated at the Federal Government's recommended discount rate, which was 7.875 percent in 1982.

The alternative investment possibilities, both within each allotment if more than one package of improvements is being considered and among the different allotments in the planning area, are next ranked on the basis of the economic efficiency analysis. In general, the rankings will be made from the investment with the highest B/C ratio to the lowest. The various noneconomic characteristics of the allotments then are considered.

At this point, it is up to the BLM area manager to integrate the economic considerations of the investments, as summarized in the efficiency analyses, with the noneconomic concerns. After considering all of this information, the area manager ranks the investment for a second time. Following this, the area manager's recommendations are presented to the Grazing District Advisory Board. The advisory board reviews the area

manager's recommendations and makes its own observations and recommendations.

The final decision in the selection and the ranking of investment alternatives rests with the BLM district manager. Considering the area manager's and the advisory board's findings and recommendations, the district manager constructs a final list of investment programs, from the highest priority to the lowest. In general, investments proposed in those allotments designated in Analysis Component #1 as being in the improve category will be given highest priority. Investments in the maintain category allotments will be given the next priority, and those in the custodial category will be given the lowest priority for funding.

Component Analysis #3: Budgeting and implementation

The purpose of the third and final component in the investment analysis procedure is to once again rank the investment alternatives in terms of their economic, resource, and social attractiveness -- and to determine which projects are to actually receive funding in the upcoming fiscal year.

The bureau recalculates the benefits and costs of the investment programs and determines the efficiency analysis results. The analysis in this third stage differs from that conducted earlier in the level of detailed information used. Estimates of the amount and of the timing of the projects' benefits and costs are made as precisely as possible.

Of special interest to the permittee is the following additional piece of information used in this component: The bureau incorporates the actual amount of money and/or labor that the permittee has offered to contribute to the various improvement programans into the B/C analysis.

Current bureau policy is to transfer much of the maintenance expenses to the permittee and to encourage rancher contribtuions for construction and renovation costs.

Therefore, the greater the rancher's willingness to share in a project's costs, the greater is the chance that the improvement project will be undertaken.

Before offering to help share in the expenses of a project, you should determine just how much the offer is going to cost and what sorts of benefits will be received. At this point, the rancher becomes a financial anaylyst. The fourth part of this report is designed to assist you decide whether or not the investment is worth your time and money.

The responsibility for the economic analysis to this point has been the area manager's, in consultation with the permittee. Following the completion of the area manager's recommended rankings and scheduling of investments, the Grazing District Advisory Board reviews the rankings and

makes any further comments that they might have. The district manager then establishes the final priorities of the various investment projects and decides, subject to the BLM state director's approval, which projects to fund for the upcoming year.

3. BLM's range investment analysis

Before committing capital and labor to any project, the wise investor makes a detailed assessment of all of the costs of the project and all of the benefits the project is expected to generate. The listing of both costs and benefits should be as complete as possible. Factors to consider in determining the costs include the amount of the initial investment, the interest rate on borrowed money, any maintenance and/or costs of operation associated with the facilities, and the number of years following the initial construction before major renovations or complete reconstruction would be required.

In determining the benefits of the project, estimate any changes in gross revenues caused by the investment. Increased revenues from a range improvement project might result from an increase in herd size, or from improved livestock performance through weight gains, reduced death losses, or improved calf crop percentages.

The requirements of the financial analyses conducted by a government agency, such as the Bureau of Land Management, are similar to, but broader than, those involved in private decisionmaking. The Government must consider the effects of a public land investment project on not only fairly easily measured benefits such as increases in livestock forage supply, but also on the values of direct and indirect impacts on all other resources as well.

Since the bureau manages the public lands for all of its resource values, it must consider the implications of a range improvement program for recreational users, wildlife populations, and soil and water protection. For example, what sort of an impact will a crested wheatgrass seeding have on antelope kidding grounds? Will a spray project adversely affect a local sage grouse population? Will better livestock distribution practices increase the amount of browse available for deer?

These additional benefits and costs enter into the bureau's analysis along with the estimates of forage production changes. Many of these benefits and costs are difficult to measure. For example, how can the values of a 10-percent increase in forage supply be meaningfully compared with a 10-percent increase in the deer population in an area?

Willingness-to-pay measures of value

In order to place a value on an increase in, say, the deer population, the bureau must first determine what the change means to the user groups interested in the deer population. Specialists in wildlife, recreation, and economics will work together to determine whether a potential change in deer numbers may attract more hunters to the area. If so, it is the value placed by hunters on the increased hunting opportunities that enters into the economic efficiency analysis. The problem now is to determine the dollar value of the increased hunting opportunities.

Economists have developed a technique for estimating the value of recreational use that occurs within an area. It attempts to answer the question, "how much would the public be willing to pay to either enjoy an increase in a particular recreational opportunity or to avoid a decline?"

The concept rests on the assumption that the amount of use that an area receives will depend upon the cost of getting to and using that site as well as on some subjective values that users place on the area and the particular recreational activity. Some individuals will be willing to pay a large amount of money to be able to take advantage of a recreational activity.

However, if the bureau should actually charge this high amount of money, many people would either seek out other locations at which to participate in the activity or they would do without the activity altogether. In other words, if a high cost were required to participate, fewer people would be willing to pay this cost, and the level of recreational use at the site would be low.

This relationship between the amount of money that recreationists would be willing to spend and the amount of use that an area would receive is illustrated graphically in figure 2.

Although the numbers used are arbitrary, figure 2 shows that a certain number of people would be willing to pay more than $150 per day to participate in up to a total of 100 days of recreational use at the site. Quite a few more people would be willing to pay between $150 and $50 to experience an increase from 100 days up to 900 days, for example. The downward sloping line thus represents the relationship between how much the public would be willing to pay to be able to participate in each additional day.

The next item to include in this assessment of the value of the recreational experience is the actual cost of participating in the activity. Lets suppose that at the same time the information on how much people would be willing to pay was being collected, questions also were asked concerning the actual cash expenses incurred for transportation and supplies required to participate in the activity.

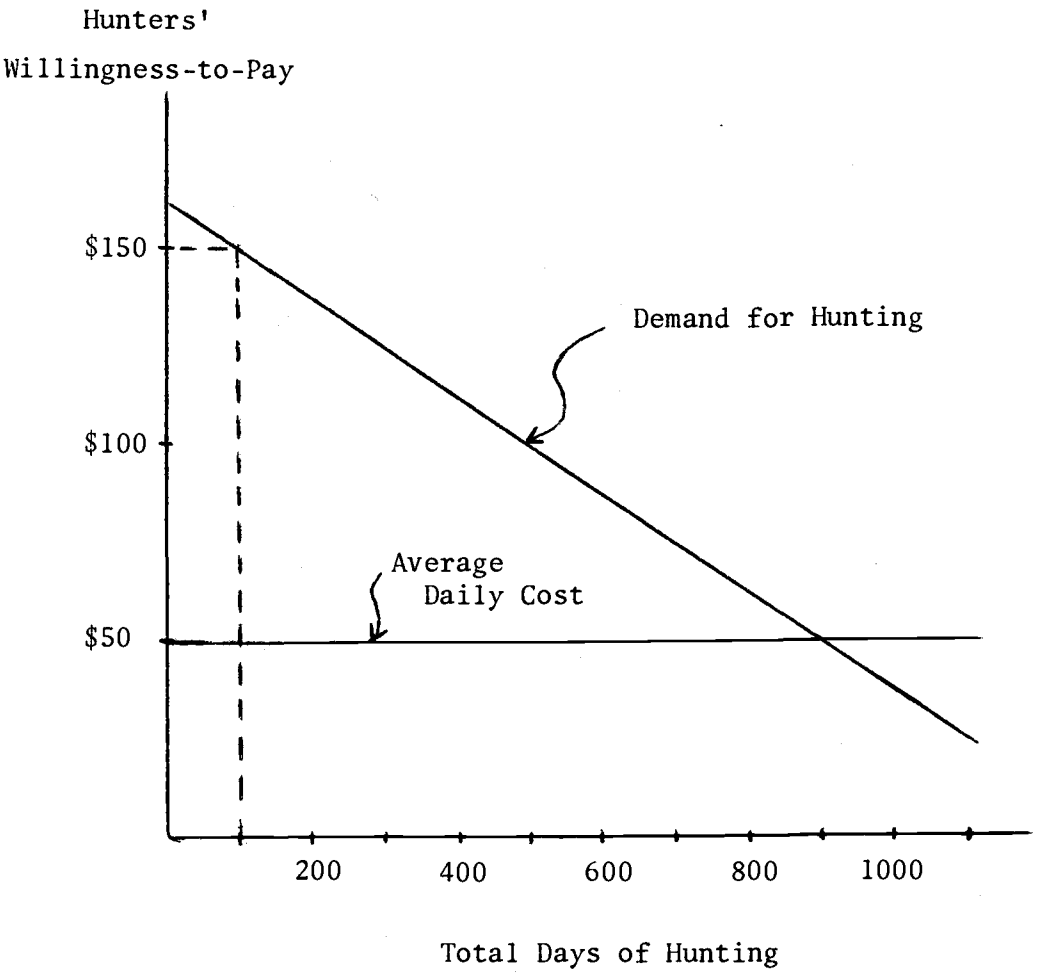

Figure 2.--Willingness-to-pay for additional hunting days

The total expenditures made by all of the recreationists using the site would then be calculated. Dividing this dollar amount by the total number of recreational days spent at the site would yield the average daily cost of participation. If this figure should be $50, the horizontal line in figure 2 would represent this daily cost.

Let's continue our consideration of this example, assuming that we are talking about hunting use. The information in figure 2 is now sufficient to allow an estimation of the value of hunting use at this location. Corresponding to the point of 100 hunter days on the horizontal axis is a value of $150, as read on the willingness-to-pay line.

This latter value means that if 99 days of hunting were originally permitted to occur in the area, and if an additional one-day license were to be sold to allow 100 days of use, some individual would be willing to pay up to $150 to get that extra day.

However willing that person may be to pay $150 for the hundredth day, it was already pointed out in this example that the actual average cost to participate was only $50 per day. Therefore, under the assumptions of this economic model, the hunter is receiving $100 in value over and above the $50 he actually had to pay.

If it were possible to put a fence around the entire hunting area, up to $100 could theoretically be collected from this last hunter let through the gate. Keeping this imaginary fence in place, suppose that this surplus between what is actually paid to go on the hunting trip and the amount that the public would be willing to pay for each additional day they are permitted to hunt within the fence were actually collected.

The total amount of money that could thus be collected for allowing, say, 400 hunting days to occur within the fence would be the area in figure 3 below the willingness-to-pay line, above the actual average costs paid line, and to the left of the vertical line going upwards from the 400-day mark on the horizontal axis.

If the fence were to be torn down and no tolls collected for entry, this area would still represent the value to the hunters of those 400 hunting days. Even though money no longer changes hands, the hunters should still be willing to pay this surplus. This surplus, then, is the value to the hunters of being able to participate in these 400 days of hunting.

It is important to note the difference between the actual expenditures by the hunters and the additional amount that they would be willing to pay. The $50 per day represents actual purchases the individual makes. There are $50 being pumped into the economy of his or her hometown, or into the region where he or she actually hunts, somewhere in between, or in all three areas. On the other hand, the net surplus to the hunters does not reflect any transfer of money. The sum measures the net value to the hunters in the sense that they should theoretically be willing to part with some or all of the surplus to enjoy hunting. It is a measure of value, but of direct value only to the hunters themselves.

Now suppose one of the investment projects the Bureau is considering is expected to improve the wildlife habitat, leading to a larger deer population. Specialists project that the larger deer population could result in more tags being issued in the area so that more hunters could use the area. The value of the habitat improvement then can be calculated from the graph.

If the number of hunting days spent in the area were to increase from 400 to 500, the net benefit of the change would be represented by area A in figure 3. This is the area above each hunter's share of the increased expenditures, but below what those hunters would have been willing to pay for the increase from 400 to 500 hunter days. The dollar amount represented by area A is included as one of the net benefits of the range improvement.

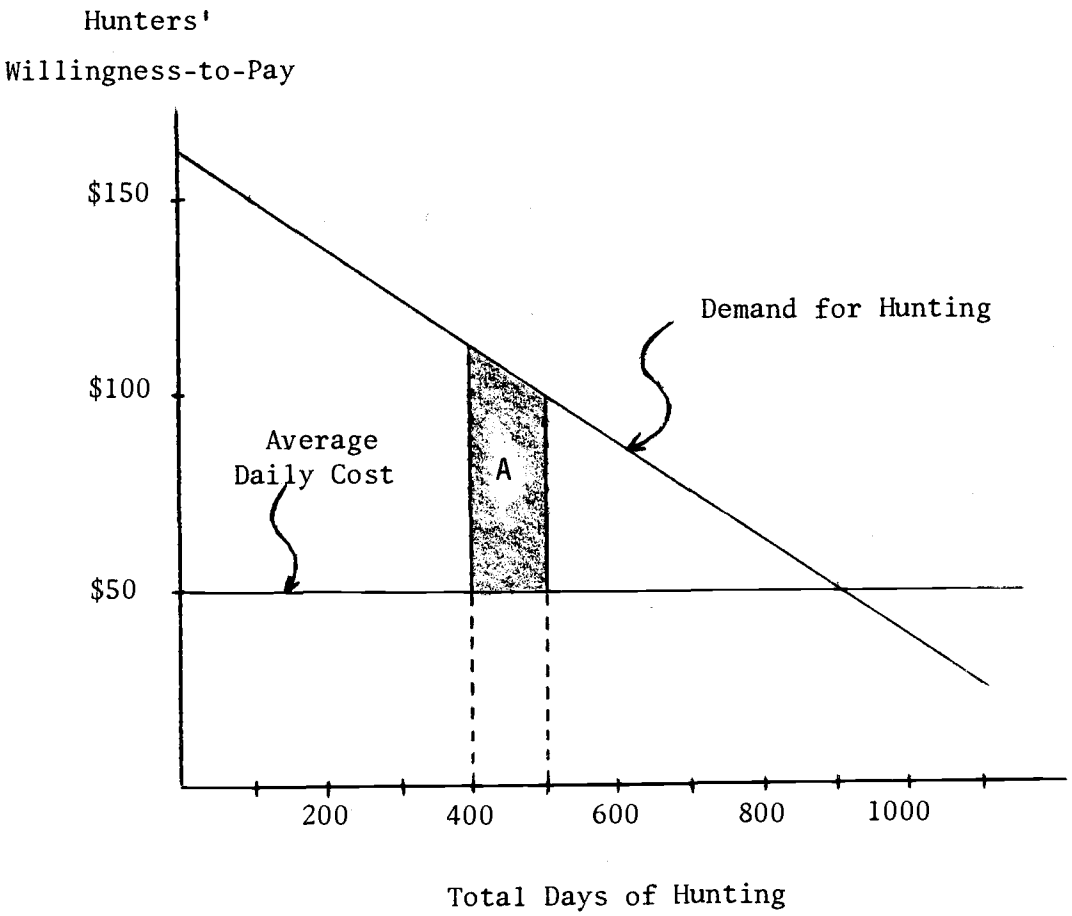

Figure 3.--Total willingness-to-pay versus expenditures for additional hunting

Actually, it would be prohibitively expensive for the BLM to conduct the studies necessary for deriving demand curves for all of the recreational uses enjoyed on the public lands. To avoid this problem, the bureau uses average per-day willingness to pay values that have been calculated by other sources.

The same sort of analysis is used to estimate the benefits to other recreational users (which can be negative in those instances where recreational use would decline) resulting from a range improvement practice. Total net dollar benefits are calculated for all nonlivestock user groups affected by the improvement. These "nonmarket" benefits are added, on a year-by-year basis, to the estimated changes in livestock related benefits resulting from the project. Following this, each year's total benefits are discounted back to current dollars so that the net present value of all benefits can be calculated.

Discounting and present value calculations

Discounting is a procedure used to express income streams occurring in different time periods in current or present dollar terms. A dollar received a year from now is not worth as much as a dollar received today. The degree to which the value of next year's dollar is reduced depends upon the individual's or on society's rate of "time preference" for money.

For example, a dollar received today can be put into a bank account that earns 5-percent interest. A year from now that dollar can be withdrawn with interest, for a total of $1.05. Therefore, to convince someone to give up the chance to receive $1.00 today and instead to accept some amount a year from now, the amount offered a year hence would have to be at least $1.05. If it were less than $1.05, the offer of $1.00 today would be preferred.

To account for this "time preference," future receipts are discounted to reflect their lower relative value. The percentage rate of discount used represents the relative importance the investor places on near-term as opposed to longer-term returns. The higher the discount rate, the lower the value placed on returns occurring in the future.

In the case of the bureau's estimated values of benefits received by both livestock and nonlivestock resource improvements, each year's gross benefits are discounted. These discounted values are then summed to yield the total present value of the benefits over the entire planning horizon the bureau uses (the length of this planning horizon is 50 years for most range programs).

The resulting number is the present value of all of the benefits that would result if the improvement were to be implemented. The present value of the benefits expected without the improvement is subtracted from the present value of benefits with the improvement to give the net benefits resulting from the program.

All that is left is to calculate the additional costs that would result from the improvement program over the 50-year planning span. Calculation of the costs is much more straightforward than the calculation of the benefits. As mentioned earlier, the costs to be considered include the initial construction costs of the improvements, "interest" on capital, any required maintenance and/or operating expenses, and the costs of any major renovation or complete reconstruction of the improvements that may be needed in the future.

Estimates of the costs are made by the local bureau personnel based on past experiences with similar projects and on the particular characteristics of the local area (for example, distance from roads or nature of the terrain). The costs are calculated for each year of the planning horizon, and are then discounted just like the benefits to account for

interest on capital costs. The discounted values are then added together to yield an estimate of the present value of all costs.

At this point the bureau has two numbers: the present value of all of the benefits resulting from the improvement and the present value of all of the improvement costs. By simply dividing the present value of the benefits by the present value of the costs, the bureau attains the benefit-cost ratio. Table 1 provides an easy example of how benefit-cost ratios are compared for alternative investments or improvements.

Table 1.--Examples of benefits and costs for three investment alternatives

	Investment #1	Investment #2	Investment #3
Present value of all improvement benefits	$200,000	$ 75,000	$ 50,000
Present value of all improvement costs	$100,000	$ 75,000	$100,000
Benefit/cost ratio	2/1	1/1	0.5/1

One of the objectives in choosing among different range improvement projects is to choose the investment that yields the highest ratio of benefits to costs. Based on this criterion, investment #1 above would be preferred to investment #2 or #3. The 2:1 benefit-cost ratio means that, for $1.00 spent on the project over the 50 year planning horizon, $2.00 in net present benefits will result. The present value of the benefits exactly equals the present value of the costs under investment #2, so that the benefit-cost ratio is 1:1.

This implies that $1.00 spent will return only $1.00 in net present benefits. It is very unlikely that the program represented by investment #3 would be adopted. With a benefit-cost ratio of less than one, every $1.00 spent will return just 50¢ in net present benefits. Unless there are very important overriding concerns associated with investments #2 or #3 (such as the control of serious erosion problems or protection of a critical watershed), investment #1 would be the preferred use of Federal investment monies.

4. Investment analysis from the rancher perspective

The management concerns of the rancher are different from those of the Bureau of Land Management. Unlike the bureau, the rancher may not intentionally manage the operation to provide a mixture of multiple use outputs. You may be interested in keeping a fishing hole on the property in good shape or in seeing a deer or an elk from time to time. Still, your primary goal usually is to maintain a viable ranching operation for the production of red meat.

As a consequence, when you analyze an investment possibility, your primary concern is with the livestock production benefits you will receive. Rather than being concerned with an increase in benefits resulting from improved hunting or backpacking use, you, as a private investor, are interested in any increase in ranch revenues that might result. The purpose of this section is to detail how you can gather the cost and revenue information that you'll need and how to determine the percentage rate of return an investment will yield.

The internal rate of return: An example

An example may illustrate how this rate of return is calculated. Suppose that all of the improvements that the bureau and the permittee have decided are necessary to improve the forage production in an allotment are as listed in table 2. (Blank worksheets corresponding to the following three tables are provided in Appendix 1.) This table contains all of the information necessary for you as a permittee to estimate your share of the costs of the proposed improvement program. You can transfer the information bearing on your costs to another worksheet (table 3), then add the information on revenues you expect to receive.

Estimates of increases in annual revenues resulting from the improvement program are based on your best judgment. You must determine whether there will be any changes in receipts if the range improvements are made, over and above the revenues that would occur if the improvements were not made.

This is called "with/without analysis" and is comparable to the bureau's benefit/cost analysis discussed earlier. There is an important difference between this sort of process and a "before and after" type analysis. A before-and-after analysis of revenue changes would compare the income expected in the future after an improvement is made with revenues currently received.

It should be easy to see in a case like this that the revenues to compare are those occurring in the future with the proposed improvement and those occurring without the improvements. If you don't use the with/

Table 2. Proposed Range Improvement Program for the XYZ Allotment.

Improvement	Year of Construction	Construction Cost		Annual Maintenance and/or Operating Costs		Years of Useful Life	Year of Necessary Reconstruction	Reconstruction	
		Total Cost	Cost to Permittee	Total Cost	Cost to Permittee			Total Cost	Cost to Permittee
Spring Development #1	1983	$ 1,500	$ 750	$ 50	$ 50	15	1998	$ 1,500	$ 1,500
Spring Development #2	1985	$ 1,500	$ 750	$ 50	$ 50	15	2000	$ 1,500	$ 1,500
Spray 2000 acres	1983	$20,000	$10,000	0	0	20	2003	$20,000	$20,000
Seed 2000 acres	1984	$40,000	$20,000	0	0	40	2024	$20,000	0
Fence 2 miles	1983	$ 5,000	$ 5,000	$100	$100	50	2033	$ 5,000	$ 5,000
Windmill	1985	$10,000	$ 5,000	$500	$500	30	2015	$10,000	$10,000
Pipeline 10 miles	1985	$ 2,000	$ 2,000	$400	$400	10	1995	$ 2,000	$ 2,000

Table 3. Rancher Cost and Revenue Information for the XYZ Allotment Range Improvement Program.

Year	Construction	Annual Maintenance and/or Operating Costs	Added Management Costs	Reconstruction	Total Costs (By Year)	Change in Gross Revenues	Net Change in Revenues
0	$16,500	0			$16,500	0	-$16,500
1	$20,000	$ 150			$20,150	0	-$20,150
2	$13,500	$ 150			$13,650	0	-$13,650
3		$1,100			$ 1,100	$10,375	$ 9,275
4		$1,100			$ 1,100	$10,375	$ 9,275
5		$1,100			$ 1,100	$10,375	$ 9,275
6		$1,100			$ 1,100	$10,375	$ 9,275
7		$1,100			$ 1,100	$10,375	$ 9,275
8		$1,100			$ 1,100	$10,375	$ 9,275
9		$1,100			$ 1,100	$10,375	$ 9,275
10		$1,100			$ 1,100	$10,375	$ 9,275
11		$1,100			$ 1,100	$10,375	$ 9,275
12		$ 700		$ 2,000	$ 2,700	$10,375	$ 7,675
13		$1,100			$ 1,100	$10,375	$ 9,275
14		$1,100			$ 1,100	$10,375	$ 9,275
15		$1,050		$ 1,500	$ 2,550	$10,375	$ 7,825
16		$1,100			$ 1,100	$10,375	$ 9,275
17		$1,050		$ 1,500	$ 2,550	$10,375	$ 7,825
18		$1,100			$ 1,100	$10,375	$ 9,275
19		$1,100			$ 1,100	$10,375	$ 9,275
20		$1,100		$20,000	$21,100	$10,375	-$10,725

without analysis, you could overlook the loss in net rancher revenues that would occur if permitted use were reduced.

In the hypothetical example, let's assume that the purpose of the investment is to increase forage production on the allotment. A format for analyzing the resulting effects on the rancher's livestock is provided in table 4. Without the improvement program listed in table 2, we'll expect no change in herd size or in animal performance.

The herd size would remain stable at 400 cows; the calf crop would remain at 80 percent; steer and heifer calf weights would not change from 450 to 400 pounds, respectively; and there would be no change in death losses.

With the improvement program, you expect an increase in calf crop and reductions in both calf and cow death loss. However, as is noted in table 4, none of these beneficial effects will be realized until the third year of the program, after use of the proposed seeding begins.

The expected rancher revenues with and without the improvement program are calculated in table 5. When you subtract the total revenues expected (if the project were not adopted) from those expected in year three onwards with the improvements, you obtain a total net revenue gain of $10,375 ($95,375 - $85,000) per year. Enter this figure in the "Change in Gross Revenue" column in table 3. The last column in the table is the additional annual net revenue generated by the improvements, or gross revenue minus the associated rancher costs.

You can now calculate your internal rate of return, using one of several different methods. The calculation procedure is easy if a home computer or programmable calculator is available.

Appendix 2 contains a copy of a program written in the BASIC language for use on an Apple II computer. This program can be typed directly into an Apple II terminal. In running the program, the computer will ask for the number of years to be considered in the analysis and for the net annual changes (revenues minus costs) for each of the years. The internal rate of return will then be printed on the computer screen. Although written for the Apple II computer, the program can be rewritten, if necessary, to work on any computer or programmable calculator system.

Although more difficult, the internal rate of return can be calculated by hand (discount rate tables may be available from local bankers). (Appendix 3 provides a table of discounting factors for several different rates of return.)

The technique involves a trial and error search for the appropriate discount rate that, when used to discount each year's net returns, will yield a present net value of $0. At this rate of discounting, the present value of the investment's costs will be exactly equal to the present value

Table 4. Herd Size and Livestock Performance Data With the Range Improvements Proposed for the XYZ Allotment.

				Year														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Cow Herd Size	With Project	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
			Without Project	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
		Calf Crop	With Project	80%	80%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
			Without Project	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Calf Weights	Weaners	Steers	With Project	450	450	475	475	475	475	475	475	475	475	475	475	475	475	475
			Without Project	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450
		Heifers	With Project	400	400	425	425	425	425	425	425	425	425	425	425	425	425	425
			Without Project	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
	Yearlings	Steers	With Project	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Without Project	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Heifers	With Project	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Without Project	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Death Loss		Cows	With Project	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1
			Without Project	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		Calves	With Project	8	8	5	5	5	5	5	5	5	5	5	5	5	5	5
			Without Project	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
		Replacement Heifers	With Project	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Without Project	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Bulls	With Project	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Without Project	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5.--Calculating livestock performance effects and rancher revenues with and without the proposed range improvements for the XYZ allotment.

	Without improvements	With improvements
Cow herd size	400	400
Calf crop	.80	.85
Calves born alive	320	340
Calf death loss	8	5
Total calves weaned	312	355
Heifers	156	168
Steers	156	167
Heifers held for replacement (15%)	60	60
Heifers held to cover cow death loss	3	1
Calves available for sale	259	274
Heifers	103	106
Steers	156	168
Revenues	$85,000	$95,375
Heifers (400 lbs @ $0.70/lb)	$28,840	$31,535
Steers (450 lbs @ $0.80/lb)	$56,160	$63,840

of the increase in total annual revenues. This discount rate will represent the internal rate of return resulting from the project.

The calculations for determining the rate of return from the example used in this study are given in table 6. The trial and error method is used. In column 2 of table 6, the annual changes in net revenues from the last column in table 5 are repeated. Now suppose that the first discounting rate tried is 10 percent. The discounting factor for each year at the 10-percent rate is listed in column 3 of table 6. This is the factor that, when multiplied by the dollar amount of net returns in each year, gives the present value of those returns.

Column 4 contains the present value of each year's net returns at the 10-percent rate. Adding these up over the 20 years considered in the investment analysis yields a total net present value of a positive $12,660.

The next step requires a bit of skill and practice in applying the internal rate of return analysis. Since the present net value of the investment at 10 percent is positive, you should next test a higher discount rate to reduce (to zero) the present value of the increased net revenues. A higher discount rate will reduce the present value of those future net benefits.

Therefore, try a discount rate of 16 percent next. Proceeding as before, multiply each year's net returns by the appropriate discounting factor (column 5). Again add up the resulting present value figures. The sum, the present total value of the investment at 16 percent, is a negative $5,486. This indicates that a 16 percent discounting rate is too high. The actual internal rate of return must therefore lie between 10 and 16 percent.

Try a rate of 14 percent next (columns 7 and 8). After doing all of the calculations, the total present value is a negative $631. Since this value is negative, the actual rate of return must lie below 14 percent. However, since the value ($631) is relatively small, the analysis can stop here.

The internal rate of return for the permittee's investment in the XYZ range improvement program therefore is slightly less than 14 percent (the actual rate calculated on the computer program was 13.7 percent). To restate the meaning of the internal rate of return, each dollar invested by the rancher will yield that dollar in extra sales receipts, plus a 14 percent return over and above that dollar.

It is now up to you to decide on your commitment to the investment. A 14-percent return on an investment seems to be quite good. However, there are other factors to consider in your decisionmaking.

Table 6. Present Value Calculations Using the Trial and Error Method for XYZ Allotment Improvements.

Year	Undiscounted Net Change in Revenues	Calculations at 10%		Calculations at 16%		Calculations at 14%	
		Discount Factor	Present Value	Discount Factor	Present Value	Discount Factor	Present Value
0	-16,500	1.0	-16,500	1.0	-16,500	1.0	-16,500
1	-20,150	.909	-18,316	.862	-17,369	.877	-17,672
2	-13,650	.826	-11,275	.743	-10,142	.769	-10,497
3	9,275	.751	6,966	.641	5,945	.675	6,261
4	9,275	.683	6,335	.552	5,120	.592	5,491
5	9,275	.621	5,760	.476	4,415	.519	4,814
6	9,275	.564	5,231	.410	3,803	.456	4,229
7	9,275	.513	4,758	.354	3,283	.400	3,710
8	9,275	.467	4,331	.305	2,829	.351	3,256
9	9,275	.424	3,933	.263	2,439	.308	2,857
10	9,275	.386	3,580	.227	2,105	.270	2,504
11	9,275	.350	3,246	.195	1,809	.237	2,198
12	7,675	3.19	2,448	.168	1,289	.208	1,596
13	9,275	.290	2,690	.145	1,345	.182	1,688
14	9,275	.263	2,439	.125	1,159	.160	1,484
15	7,825	.239	1,870	.108	845	.140	1,096
16	9,275	.218	2,022	.093	863	.123	1,141
17	7,825	.198	1,549	.080	626	.108	845
18	9,275	.180	1,670	.069	640	.095	881
19	9,275	.164	1,521	.060	557	.083	770
20	-10,725	.149	- 1,598	.051	- 547	.073	- 783
TOTAL NET PRESENT VALUE		-----	+12,660	-----	- 5,486	-----	- 631

Opportunity cost of investment capital

Since the commitment of time and money to one project means that you can't use those resources elsewhere (such as in other range improvement projects, in ranch expansion, or in money market certificates, for example), you must compare the costs and benefits of the project with potential earnings in alternative investments. The economic term for this practice of considering the different uses of available resources is opportunity cost.

The opportunity cost concept is often used in everyday life. By going to the movies tonight, I can't go bowling - not bowling is the opportunity cost of going to the movies. By buying a new car, we won't be able to take a vacation this year - not taking a vacation is the opportunity cost of buying a new car.

The concept applies equally well to ranch decisionmaking: by buying stockers this year, I won't be able to raise the money for putting in irrigated pasture - foregoing the irrigated pasture is the opportunity cost of buying stockers. By putting in some new water developments on my deeded rangelands, I won't be able to get a 10-percent return on a money market certificate from the local bank - giving up an assured 10-percent return from the certificate is the opportunity cost of the water developments.

This last example is ideally suited to rangeland investment decisionmaking. Before investing capital in an improvement, you would like to be able to realize a return on the investment at least as large as the one you could receive in the best alternative use for your money. In the hypothetical situation described above, you would want the internal rate of return from a range investment to be greater than the opportunity cost of the capital, or the 10-percent return that you could obtain from, say, the money market certificate.

A word of warning is in order. If the water developments are just one part of your long range plans to increase the total productivity of your operation, consider the rate of return on the entire long range program. Analyzing just the water developments, in isolation from the entire ranch plan, may underestimate its contribution to the total increase in net revenues that you hope to attain.

Sources of funding

Your capital requirement for the initial construction of the projects is about $40,000 in the first 3 years. Where is this money to come from? If you were to borrow it from a lending institution, the timing of the principal payments might change each year's costs as reported in table 3. You would have to add the interest payments to the costs of the project.

Similar considerations apply to the annual maintenance and operating expenses resulting from the investment. If the amount of your annual operating loan must increase by the amount of the added costs, you must add interest payments to the project's maintenance and operating costs.

Even if you do not draw on outside money to finance the investment, consider the opportunity cost of the money used to cover the extra expenses. Will the family's household budget be reduced to cover the added maintenance costs? Will you have to shift money from some other aspect of the ranching operation to finance the new improvements? Although it is hard to put a dollar value on these opportunity costs of the project, they should be a factor in your investment decision.

Tax incentives

Since the initial construction expenses are an investment in capital improvements, the rancher should explore the possibility of tax advantages from the investment project. Investment tax credits may be possible, as well as claiming depreciation on the investment. If you can claim these, you can add them to the value to the projected annual gross benefits. This will help to offset some of the costs of the project.

Alternative investments

Although the project used here as an example yielded an internal rate of return of about 14 percent, you may have other investment opportunities available to you that might give a better return to your money. Potential investments in other BLM allotments or on deeded lands may be possible. If these alternatives exist, analyze them all at the same time and select for investment those that give the highest return.

Short term management changes

Some improvement practices may require the operator to change the livestock management system for a short period. For example, a range seeding may require 2 years of partial or complete nonuse in that allotment. If this occurs, consider the increased costs experienced as you find alternative sources of forage for your displaced livestock. For example, if you must lease private pasture, include the cost of the lease in the calculations.

There may be other concerns that are specific to your individual operation. The closer your estimates come to the actual costs and benefits that are likely to result, the better will be your analysis. Although if

may seem difficult and tedious at first, the internal rate of return calculation process becomes easier with practice.

Once mastered, the procedure will allow you to work more effectively and in concert with bureau personnel in choosing among all of the alternative investment possibilities, and in selecting that one program that yields the highest rate of return to your investment dollars.

APPENDIX 1

WORKSHEETS

Worksheet 1. Used in Calculating Annual Construction, Maintenance, and Reconstruction Costs.

Improvement	Year of Construction	Construction Cost		Annual Maintenance and/or Operating Costs		Years of Useful Life	Year of Necessary Reconstruction	Reconstruction	
		Total Cost	Cost to Permittee	Total Cost	Cost to Permittee			Total Cost	Cost to Permittee

Worksheet 2. Used in Calculating Annual Costs and Revenues.

Year	Construction	Annual Maintenance and/or Operating Costs	Added Management Costs	Reconstruction	Total Costs (By Year)	Change in Gross Revenues	Net Change in Revenues

Worksheet 3. Used in Estimating Livestock Performance and Herd Size Changes.

				Year														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Cow Herd Size	With Project															
			Without Project															
		Calf Crop	With Project															
			Without Project															
Calf Weights	Weaners	Steers	With Project															
			Without Project															
		Heifers	With Project															
			Without Project															
	Yearlings	Steers	With Project															
			Without Project															
		Heifers	With Project															
			Without Project															
Death Loss		Cows	With Project															
			Without Project															
		Calves	With Project															
			Without Project															
		Replacement Heifers	With Project															
			Without Project															
		Bulls	With Project															
			Without Project															

APPENDIX 2

INTERNAL RATE OF RETURN ROUTINE

APPENDIX 2
BASIC Language Program for Calculating Internal Rate of Return

```
5 DIM A(50)
10 REM INTERNAL RATE OF RETURN ANALYSIS
20 R = 0.1
30 INPUT "ENTER NUMBER OF YEARS OF ANALYSIS";T
40 PRINT
50 FOR I = 0 TO T
60 PRINT "NET INCOME DURING YEAR  ";I
70 INPUT A(I)
80 NEXT I
90 FOR J = 1 TO 10
100 S1 = A(0)
105 S3 = 0
110 FOR I = 1 TO T
120 S1 = S1 + A(I) * ((1 + R) ** (-I))
130 S2 = (-I) * ((I + R) ** (-I -1))
140 S3 = S3 + S2 * A(I)
150 NEXT I
160 R1 = S1 / S3
170 R2 = R - R1
180 R = R2
190 NEXT J
192 R= INT (1000 * R)
194 R = R / 10
200 PRINT "THE INTERNAL RATE OF RETURN IS  "; R ; "%"
210 END
```

APPENDIX 3

DISCOUNT FACTORS

Table 3-1.--Present value of $1.00

Time period	1%	2%	3%	4%	5%	6%	7%	8%
1	.990	.980	.971	.962	.952	.943	.935	.926
2	.980	.961	.943	.925	.907	.890	.873	.857
3	.971	.942	.915	.889	.864	.840	.816	.794
4	.961	.924	.888	.855	.823	.792	.763	.735
5	.951	.906	.863	.822	.784	.747	.713	.681
6	.942	.888	.837	.790	.746	.705	.666	.630
7	.933	.871	.813	.760	.711	.665	.623	.583
8	.923	.853	.789	.731	.677	.627	.582	.540
9	.914	.837	.766	.703	.645	.592	.544	.500
10	.905	.820	.744	.676	.614	.558	.508	.463
11	.896	.804	.722	.650	.585	.527	.475	.429
12	.887	.788	.701	.625	.557	.497	.444	.397
13	.879	.773	.681	.601	.530	.469	.415	.368
14	.870	.758	.661	.577	.505	.442	.368	.340
15	.861	.743	.642	.555	.481	.417	.362	.315
16	.853	.728	.623	.534	.458	.394	.339	.292
17	.844	.714	.605	.513	.436	.371	.317	.270
18	.836	.700	.587	.494	.416	.350	.296	.250
19	.828	.686	.570	.475	.396	.331	.277	.232
20	.820	.673	.554	.456	.377	.312	.258	.215
25	.780	.610	.478	.375	.295	.233	.184	.146
30	.742	.552	.412	.308	.231	.174	.131	.099
40	.672	.453	.307	.208	.142	.097	.067	.046
50	.608	.372	.228	.141	.087	.054	.034	.021

(Continued)

Table 3-1.--Present value of $1.00 (continued)

Time Period	9%	10%	12%	14%	16%	20%	25%
1	.917	.909	.893	.877	.862	.833	.800
2	.842	.826	.797	.769	.743	.694	.640
3	.772	.751	.712	.675	.641	.579	.512
4	.708	.683	.636	.592	.552	.482	.410
5	.650	.621	.567	.519	.476	.402	.328
6	.596	.564	.507	.456	.410	.335	.262
7	.547	.513	.452	.400	.354	.279	.210
8	.502	.467	.404	.351	.305	.233	.168
9	.460	.424	.361	.308	.263	.194	.134
10	.422	.386	.322	.270	.227	.162	.107
11	.388	.350	.287	.237	.195	.135	.086
12	.356	.319	.257	.208	.168	.112	.069
13	.326	.290	.229	.182	.145	.093	.055
14	.299	.263	.205	.160	.125	.078	.044
15	.275	.239	.183	.140	.108	.065	.035
16	.252	.218	.163	.123	.093	.054	.028
17	.231	.198	.146	.108	.080	.045	.023
18	.212	.180	.130	.095	.069	.038	.018
19	.194	.164	.116	.083	.060	.031	.014
20	.178	.149	.104	.073	.051	.026	.012
25	.116	.092	.059	.038	.024	.010	.004
30	.075	.057	.033	.020	.012	.004	.001
40	.032	.022	.011	.005	.003	.001	.000
50	.013	.009	.004	.001	.001	.000	.000

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