Chapter 10 Grazing Lands Economics

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600.1000 General

The grazing lands manager must be concerned with choosing among economically feasible alternatives for the economic survival and prosperity of a grazing lands enterprise. The conservationist must present alternatives that are ecologically sound resource management systems. Economic analysis tools can be used to evaluate and select possible alternatives.

Economic evaluation of conservation practices and systems can be a sensitive subject because it must involve personal information about costs, returns, and production. The conservationist's objective is not to tell the manager whether an alternative is the correct economic choice for them. The conservationist's responsibility is to offer the manager assistance in evaluation of the economic feasibility of the alternative land uses, conservation practices, and systems.

Economic evaluation of a conservation practice or resource management system (RMS) can be estimated with partial budgeting. Partial budgeting examines only the **change in** costs, returns, and benefits resulting from the practice or RMS.

Knowledge of the science and application of the conservation technologies gives the conservationist and the decisionmaker the various alternative practices that will work for the resource problem or opportunity that exists. Knowledge of economic analysis techniques provides the tools to determine which alternatives are economically feasible (alternatives that will pay). An economically feasible alternative has a net present value (NPV) greater than or equal to zero, a benefit cost ratio (B/C) greater than or equal to one, and an internal rate of return (IRR) greater than or equal to the appropriate discount rate.

Failure to meet economic feasibility criteria does not mean the practice or RMS should not be chosen. Economic feasibility is only one criterion to use in decisionmaking. A landowner may choose to forego one economically feasible practice and implement another that is not economically feasible because of other extenuating circumstances, personal desires, or resource concerns.

Conservation economic information reflects variable planning periods, which are dependent upon physical or economic life of the practice or system, variable managerial ability, and risk factors. The starting point is the present condition. Future conditions reflect costs incurred and anticipated returns based on the land use and conservation practices or resource management systems being applied. In situations where resources are declining or improving under current management, future without conditions must also be included in the analysis.

600.1001 Policy

NRCS policy allows the use of economic evaluations as one of the tools in planning alternative conservation practices and systems. Economic evaluations are to be used to the extent necessary to help owners and managers of grazing lands select feasible alternatives.

The economic analysis portion of the Grazing Land Applications (GLA) software is the tool predominantly used to conduct economic evaluations on grazing lands conservation practices and resource management systems. For complete instructions and assistance in using the GLA Economic Analysis program, refer to the *Grazing Land Applications User's Guide* or the *Grazing Land Applications Tutorial.*

600.1002 Purpose

The purpose of economic evaluations is to:

- Make decisionmaker(s) aware of the present and potential values of grazing lands.
- Encourage the application of conservation plans by pointing out the economic advantage of applying conservation management systems in the proper sequence.
- Encourage everyone concerned with planning and development of conservation programs to consider the economic impact that alternative land uses and conservation management systems will have on individuals, groups, communities, or regions.
- Help clients and interested publics to understand and appreciate the economic and environmental tradeoffs involved with alternative conservation decisions.

600.1003 Terms and definitions

The Time Value of Money—Money has value today and in the future. Thus, the value of money is measured for some number of periods in the future. These periods may be years, months, weeks, or days.

Interest—Interest is the earning power of money; what someone will pay for the use of money. Interest is usually expressed as an annual percentage rate (APR) and is most often compounded. Simple interest is not commonly used. Money can be invested and used to earn more money through accumulation of interest over time.

Simple Interest—Simple interest is money paid or received for the use of money, generally calculated over a base period of 1 year at a set interest rate.

$$SI = (p)(i)(n)$$

where:
SI = Interest
p = Principal
i = Rate of interest
n = Number of periods (years)

Compound Interest—Compound interest is computed for one period and immediately added to the principal, thus resulting in a larger principal on which interest is computed for the following period.

$$CI = P(1 + i)^n - P$$

where:
CI = Compound interest
n = Number of periods
i = Periodic rate of interest
P = Principal amount of loan or investment

Discount Rate—Discount rate is the interest rate for the opportunity cost of money. The discount rate is determined by summing the time value of money (the rate someone is willing to pay to use someone else's money or the rate someone is willing to take to allow someone else to use their money for 1 year), the rate of inflation, and the rate of risk. The real discount rate consists of the time value of money and does not include risk and the rate of inflation.

Opportunity Cost—When money is used for a particular purpose, the opportunity to use it or invest it in some other way is foregone. The expected return from the lost opportunity from another investment (i.e., savings account, certificate of deposit, IRA) is the opportunity cost of using it in the manner chosen. When a land user considers applying a conservation practice, the opportunity cost is equal to the expected return that could have been earned on some other investment.

Risk—Risk refers to the variability of outcomes. In evaluating the economics of a conservation practice or RMS, risk is the probability that a conservation practice or RMS will be unsuccessful. If a particular practice has failed 1 in 25 times in the past, then the risk is calculated to be 4 percent. The land user needs to consider risk and take the management steps necessary to minimize potential failure of any conservation system the landowner chooses to install.

Real versus Nominal Terms—In economics one often hears the terms *real* and *nominal.* Real terms do not include inflation, whereas nominal terms include inflation. A price quoted today that is also used for the future price of the same input or output is said to be a *real* price. If the future price is estimated at a level different from today's price because of expected inflation, then the future price is said to be a projected *nominal* price. The rate of interest quoted by a lending institution is a *nominal* rate because it includes the time value of money, inflation, and risk. A *real* discount rate is calculated by subtracting the desired risk and the expected inflation rate from the nominal borrowing rate.

Amortization—Amortization is also called partial payment or the capital recovery factor. It is the "paying off" of a financial obligation in equal installments over time. The amortization factor determines what annual payment must be made to pay off the principle and interest over a given number of years (average annual cost). Also, it is an investment that yields fixed payments over a stated period.

600.1004 Amortization of cost of a conservation practice

A landowner may wish to know what a given conservation practice or system will cost on an annual basis over a given period of years. This can be determined by amortizing the initial cost of the practice over the specified number of years at a given interest rate (see example 10–1). The period of amortization should not exceed the life of the conservation measure or structure. If money is borrowed to make an improvement, the length of the loan determines the period of amortization. If the landowner uses his or her own money, the real or potential alternative uses of capital determines the period of amortization. Generally, the landowner wants to amortize the investment in the shortest time possible consistent with the benefits received. The interest rate is determined by the going rate charged by the lending institutions.

The amortization factors given in table 10–1 are for given rates of interest for given periods of time to retire a debt of $1.

Exhibit 10–1 is a worksheet for amortizing costs of conservation practices. It is available in the exhibits section of this chapter.

Example 10–1 Amortization

Given: A landowner borrows money to build a fence costing $5,000. The landowner borrows this money for 5 years at 8 percent interest and wishes to know what the annual return needs to be to cover the payments.

Solution: $5,000 x 0.25046 (from table 10–1) = $1,252.30 (the required annual payment). The landowner would need to add the expected operation and maintenance costs to this for the total annual returns needed to cover total annual cost of the fence.

600.1005 Economic analysis using net present value and internal rate of return

The economics module of Grazing Land Applications (GLA), as well as other economic software, calculates the Internal Rate of Return (IRR) and the Net Present Value (NPV) for a selected improvement practice based on the inputs provided. Refer to the GLA User's Guide or the GLA Tutorial for instructions to run the program.

The following sections are intended to assist in understanding and interpreting the primary economic analysis outputs from GLA. These are IRR and NPV.

(a) Understanding NPV and IRR

Most of the inputs are not economic terms; they are physical inputs. The inputs are numbers of animal units, calving percentages, calf weights, and other items relative to forage production and animal numbers, and how they are predicted to change because of the improvement practice.

Economic inputs include variable costs, cost of the improvement practice, prices received for products, and a discount rate.

When all the physical and economic inputs are properly made, the software programs take all the **added costs** incurred as a result of the improvement practice and all the **added returns** resulting from the improvement practice, and calculates the NPV and IRR.

Table 10–1 Amortization factors for common interest rates

Number of years	Interest rates 6%	7%	8%	9%	10%	12%
1	1.06000	1.07000	1.08000	1.09000	1.10000	1.12000
2	.54544	.55309	.56077	.56847	.57619	.59170
3	.37411	.38105	.38803	.39505	.40211	.41635
4	.28859	.29523	.30192	.30867	.31547	.32923
5	.23740	.24389	.25046	.25709	.26380	.27741
6	.20336	.20980	.21632	.22292	.22961	.24323
7	.17914	.18555	.19207	.19869	.20541	.21912
8	.16104	.16747	.17401	.18067	.18744	.20130
9	.14702	.15349	.16008	.16680	.17364	.18768
10	.13588	.14238	.14903	.15582	.16275	.17698
11	.12679	.13336	.14008	.14695	.15396	.16842
12	.11928	.12590	.13270	.13965	.14676	.16144
13	.11296	.11965	.12652	.13357	.14078	.15568
14	.10758	.11434	.12130	.12843	.13575	.15087
15	.10296	.10979	.11683	.12406	.13147	.14682
16	.09895	.10586	.11298	.12030	.12782	.14339
17	.09544	.10243	.10963	.11705	.12466	.14046
18	.09236	.09941	.10670	.11421	.12193	.13794
19	.08962	.09675	.10413	.11173	.11955	.13576
20	.08718	.09439	.10185	.10955	.11746	.13388

Net present value and internal rate of return provide land managers with information that helps them to decide:

- Whether the potential returns are acceptable to them.
- Whether the practice or system of practices is how they wish to invest their resources.

NPV and IRR do not provide the answer to the grazing lands manager as to whether to apply the improvement practice.

(1) Break even

An improvement practice breaks even when added returns equal added costs at an acceptable rate of return. In other words, the improvement practice will pay for itself. This is determined by computing the NPV and/or IRR values.

(2) Net present value

The net present value is the difference between returns and costs when compared in present dollars; therefore, if the NPV is zero, then the practice will exactly break even. If NPV is positive, then the practice will have a positive return to the investment in the practice.

Value of today's dollar = Present value

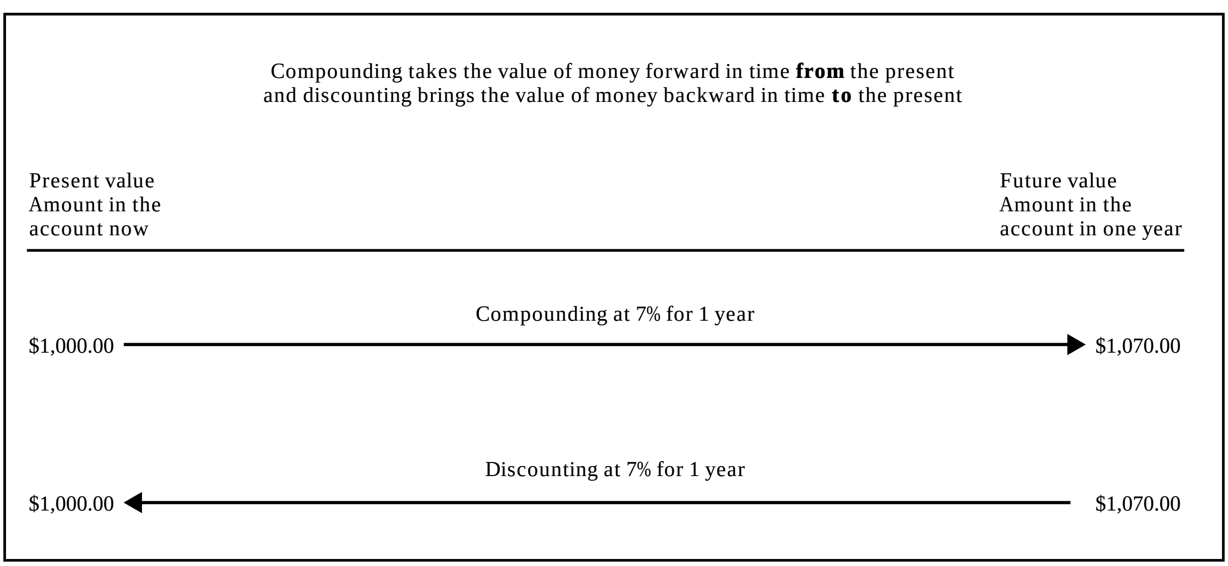
Total returns from an improvement practice calculated in today's dollars minus the total costs resulting from the improvement practice calculated in today's dollars equals the net value in today's dollars, which is the same thing as net present value.

Dollars expected to be received in the future are equal to today's dollars when discounted back to the present. Discounting is the reverse of compounding interest in a savings account that has a current balance of $1,000.00 and earns 7 percent compound interest obtaining a balance of $1,070.00 at the end of 1 year (fig. 10–1).

For example, if you are told you will have $1,070 in an account 1 year from now because the account will earn 7 percent interest and you want to know how much you have in the account now, you essentially remove the interest by the economic process of discounting. You will find that you currently have $1,000 in the account. This means the present value of $1,070 a year from now, at a 7 percent discount rate, is $1,000 (fig. 10–1).

Examples 10–2 illustrates one method to obtain net present value.

Figure 10–1 Net present value



Example 10–2 Net present value

Given: An improvement practice that costs $10,000 to implement today is expected to return $1,000 to the grazing lands operator each year for 20 years. The operator chooses a 7 percent discount rate because that is the rate at which money will be borrowed (see Acceptable return later in this chapter).

A total of $20,000 will be returned to the operation. However; this $20,000 is not worth $20,000 today because the $1,000 received each year is not worth the same amount of today's dollars. Each year's $1,000 return must be discounted and summed to find the total present value of the returns.

Solution: Table 10–2 illustrates the discounting of each year's return and sums them to calculate the net present value.

Table 10–2 Discounting of returns of example improvement practice

Year	Expected future return ($)	Discount rate (%)	Present value ($)
1	$1,000	7	$934.60
2	1,000	7	873.40
3	1,000	7	816.30
4	1,000	7	762.90
5	1,000	7	713.00
6	1,000	7	666.30
7	1,000	7	622.70
8	1,000	7	582.00
9	1,000	7	543.90
10	1,000	7	508.30
11	1,000	7	475.10
12	1,000	7	444.00
13	1,000	7	415.00
14	1,000	7	387.80
15	1,000	7	362.40
16	1,000	7	338.70
17	1,000	7	316.60
18	1,000	7	295.90
19	1,000	7	276.50
20	1,000	7	258.40

Total present value of returns resulting from improvement practice	$10,593.80
Cost of improvement practice today (already in present value)	–10,000.00
Net present value	**$ 593.80**

The improvement practice in example 10–2 has an NPV of $593.80. It does better than break even. Today's value of the added returns are $593.80 greater than the added costs. In other words, the practice is expected to pay for itself and is worth an additional $593.80 in today's dollars.

The NPV can be calculated by discounting the added costs and added revenues separately each year and subtracting their sums or by discounting each year's net cash flow and adding them for the total NPV. See tables 10–3 and 10–4 for examples.

Table 10–3 Example net present value (NPV) calculation discounting added costs and added returns separately

Year	Added costs	Added returns	Discount factor (10% rate)	Present value of added costs	Present value of added returns	Net present value
0	5,000		1.00	5,000		
1		500	.91		455	
2		1,500	.83	1,245		
3		2,000	.75	1,500		
4	2,500	3,000	.68	1,700	2,040	
5		2,000	.62	1,240		
6		2,000	.56	1,120		
7		1,643	.51	838		
8		1,000	.47		470	
Total	**7,500**	**13,643**		**6,700**	**8,908**	**2,208**

Table 10–4 Example net present value (NPV) calculation using net cash flow

Year	Added costs	Added returns	Net cash flow	Discount factor (10% rate)	Present value of cash flow	Net present value
0	5,000		–5,000	1.00	–5,000	
1		500	500	.91	455	
2		1,500	1,500	.83	1,245	
3		2,000	2,000	.75	1,500	
4	2,500	3,000	500	.68	340	
5		2,000	2,000	.62	1,240	
6		2,000	2,000	.56	1,120	
7		1,643	1,643	.51	838	
8		1,000	1,000	.47	470	
Total	**7,500**	**13,643**	**6,143**			**2,208**

(3) Internal rate of return

The internal rate of return (IRR) is the compounded interest rate the practice will return based upon the inputs provided. **If the IRR is equal to the borrowing rate (or the rate of an alternative investment opportunity), then the practice will exactly break even.** If it is higher, the practice will have a positive return. In example 10–2 the IRR is greater than the borrowing rate of 7 percent. Hint: An easy way to tell if the IRR is greater than the borrowing rate is to look at the NPV. If the NPV is greater than zero, the IRR will be greater than the borrowing rate. The actual IRR in the example is 7.75 percent. The example does better than break even since NPV is positive and IRR is greater than the borrowing rate.

(i) What is an acceptable return?—The landowner or manager must decide what is acceptable. This differs from person to person. Generally speaking, an acceptable return (an acceptable IRR) is one that meets or exceeds the rate at which the manager would have to borrow money to carry out the practice or a rate which at least equals the rate of return on other investment options.

When land managers set the discount rate in the NPV calculations, they are setting their minimum acceptable rate of return. Therefore, any NPV that equals or exceeds zero is acceptable.

(ii) Where is the best place to spend the money?—In an economic sense, the best place to spend the money is where the largest return will be received. In other words, "Where you get the biggest bang for the buck." All things being equal (capital investment and time period), this is where the NPV or the IRR, or both, is the greatest. Example 10–3 illustrates five improvement practice options and their associated net present values and internal rates of return.

Example 10–3 Net present values for five improvement practice options

Given: An economic software package calculates returns IRR and NPV for the following five improvement practice options. In this example, the land manager will borrow money at a rate of 8 percent.

Improvement practice	Internal rate of return (%)	Net present value ($)
A	9.3	750
B	8.0	0
C	5.3	–600
D	0	–750
E	–2.4	–1,286

Interpretation of the example IRRs and NPVs

Practice A IRR = 9.3% and NPV = $750
- Does better than break even. (IRR is greater than the borrowing rate of 8%.)
- Exceeds manager's acceptable rate of return. (NPV is greater than zero.)
- Is the best place to spend the money, all things being equal, among the five options.

Practice B IRR = 8.0% and NPV = $0
- Exactly breaks even. (IRR is equal to the borrowing rate of 8%.)
- Exactly equals the manager's acceptable rate of return. (NPV is equal to zero.)

Practice C IRR = 5.3% and NPV = –$600
- Does not break even. (IRR is less than the borrowing rate of 8%.)
- Does not meet the manager's acceptable rate of return. (NPV is less than zero.)

Practice D IRR = 0% and NPV = –$750
- Does not break even. (IRR equals zero, which is less than the cost of borrowing.)
- Does not meet the manager's acceptable rate of return. (NPV is less than zero.)

Practice E IRR = –2.4% and NPV = -$1,286
- Does not break even. (IRR is less than the cost of borrowing; in fact, it is negative.)
- Does not meet the manager's acceptable rate of return. (NPV is less than zero)

(b) Key points to understanding NPV and IRR

- Present value is simply the value of today's dollar.
- Net present value (NPV) is the difference between today's value of the added returns and today's value of the added costs.
- An improvement practice is an economically viable option if it, at least, breaks even (NPV is equal to or greater than zero).
- The break-even point hinges around the landowner's or manager's acceptable rate of return (the discount rate).
- If the NPV is equal to or greater than zero, then the internal rate of return (IRR) will be equal to or greater than the land manager's acceptable rate of return (the discount rate).

An understanding of net present value and internal rate of return helps the land manager to make informed decisions regarding application of ecologically sound conservation practices. With these tools, the land manager can also be assured that economically sound practices are selected and applied.

NPV and IRR are decision aid tools. Economics alone does not generally dictate which improvement practice, if any, the land manager will apply. Many other social, political, institutional, and personal preference reasons dictate why the land manager might choose an option that may not break even and may not be the best place to spend the money.