Part 645 – National Range and Pastureland Handbook

Subpart L – Grazing Land Economics

645.1201 General

A. Grazing land managers make choices from a range of alternatives for the survival and prosperity of their farm or ranch enterprise. The conservationist's duty is to present ecologically and economically sound resource management system alternatives to the land managers to assist them in making informed decisions. Economic analysis tools are available to help clients evaluate and select the best alternative(s) for them.

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

C. Economic evaluation of a conservation practice or resource management system (RMS) can be estimated through ***partial budgeting***. Partial budgeting examines only the change in costs, returns, and benefits resulting from the practice or RMS. Using the partial budget technique greatly reduces the amount of information that is needed to adequately evaluate the alternative conservation activities. This technique is one that planners should become familiar with!

D. Knowledge of the science and application of conservation technologies provides the conservationist and decisionmaker with a range of alternative practices that can address resource problems or opportunities. Knowledge of economic analysis techniques provides the tools to determine which alternatives are economically feasible.

E. Failure to meet economic feasibility criteria does not mean that the practice or RMS should not be chosen. Economic feasibility is only one criterion to use in decision making. 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 other resource concerns.

F. Conservation economic information reflects variable planning periods. These are dependent upon physical or economic life of the practice or system, funding sources, 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. Where resources are declining or improving under current management, future conditions without conservation applications should also be included in the analysis (future without condition).

645.1202 Application

A. The Natural Resources Conservation Service and the Society for Range Management have co-developed an online training course, utilizing live in-person interviews as a part of the training. It provides an excellent overview of the principles and considerations outlined in this Chapter. This can help teach and refine the skills in applying economic analysis to the field situations you may address.

The Economics of (Prescribed) Grazing is the study of the economic implications of alternative investments and management decisions that change the following:

(i) Grazing system structure

(ii) Grazing animal behavior

(iii) Grazing system performance
(iv) Combinations of these

B. Grazing land economics focus on efficiency, as measured in costs and returns, for informed decision making. These economic concepts can be applied to large and small grazing areas. The planner is trying to better utilize a resource and make it more efficient (and profitable). Scale (size) does not change these concepts.

Benefits and Costs Analysis

(i) Comparing benefits and costs is the basis for grazing land economics. Being able to evaluate the economics of a conservation system is an important evaluation measure. If benefits are greater than costs, it is deemed a good investment.
(ii) In order to make this economic evaluation, four steps are required:
- Estimate costs
- Estimate benefits
- Convert to like terms
- Compare costs and benefits

C. The most difficult part of this analysis is getting to ***Like Terms***. Some costs may be evaluated on a per-acre basis, others in costs per head, and some others in cost per ton, etc. Typically, the measure for comparison is in dollars per acre per year ($/ac/yr). In order to evaluate alternatives, all measures must be converted to the same denominator. If measures are not in like terms, they are difficult to compare and evaluate (think comparing apples and oranges).

Converting to Like Terms

(i) Costs of today ($/ac) are converted to future benefits ($/ac/yr) by using the concept known as the ***Time Value of Money***. To be able to make this evaluation, five variables are considered:
- Time period (years)
- Discount/interest rate (percent)
- Present value ($, installation costs)
- Future value ($, worth or return in future)
- Payment ($, annual benefit or cost)

(ii) Knowing three of the variables allows the 4th to be solved for. The most common calculation is for annual payments.

D. The basic formula, subject to manipulation, depending upon the variable to be solved for, is:

Payment = Present Value x "Time Period and Interest Rate"

(i) For example, consider installation of a fence in your grazing plan. The fence is expected to last for 15 years. The cost to borrow money is 6 percent interest, and it will cost $20,000 to install. What would the payment be?
- Time Period = 15 yrs.; Interest Rate = 6 percent; Present Value = $20,000.
- Expressing this in an equation yields: Payment = Present Value x (Years, percent).
- The next part requires an amortization table to find the numeric variable, a lookup function. For this example, 15 years at 6 percent is a 0.103 factor.
- $20,000 x 0.103 = $2,060. The payment would be $2,060 each year for 15 years.

(ii) Next step is to identify the acreage involved and convert to $/ac/yr. For this example, we will assume the benefit is for 240 Acres: $2,060/240 = $8.58/ac/yr in costs.
(iii) Do benefits of at least $8.58/ac/yr exist to determine if this is a good investment?

Table L-1. Amortization Table

LIFE YEARS	% INTEREST RATE											
	1	2	3	4	5	6	7	8	9	10	11	12
2	0.508	0.515	0.523	0.530	0.538	0.545	0.553	0.561	0.568	0.576	0.584	0.592
3	0.340	0.347	0.354	0.360	0.367	0.374	0.381	0.388	0.395	0.402	0.409	0.416
4	0.256	0.263	0.269	0.275	0.282	0.289	0.295	0.302	0.309	0.315	0.322	0.329
5	0.206	0.212	0.218	0.225	0.231	0.237	0.244	0.250	0.257	0.264	0.271	0.277
6	0.173	0.179	0.185	0.191	0.197	0.203	0.210	0.216	0.223	0.230	0.236	0.243
7	0.149	0.155	0.161	0.167	0.173	0.179	0.186	0.192	0.199	0.205	0.212	0.219
8	0.131	0.137	0.142	0.149	0.155	0.161	0.167	0.174	0.181	0.187	0.194	0.201
9	0.117	0.123	0.128	0.134	0.141	0.147	0.153	0.160	0.167	0.174	0.181	0.188
10	0.106	0.111	0.117	0.123	0.130	0.136	0.142	0.149	0.156	0.163	0.170	0.177
11	0.096	0.102	0.108	0.114	0.120	0.127	0.133	0.140	0.147	0.154	0.161	0.168
12	0.089	0.095	0.100	0.107	0.113	0.119	0.126	0.133	0.140	0.147	0.154	0.161
13	0.082	0.088	0.094	0.100	0.106	0.113	0.120	0.127	0.134	0.141	0.148	0.156
14	0.077	0.083	0.089	0.095	0.101	0.108	0.114	0.121	0.128	0.136	0.143	0.151
15	0.072	0.078	0.084	0.090	0.096	0.103	0.110	0.117	0.124	0.131	0.139	0.147
16	0.068	0.074	0.080	0.086	0.092	0.099	0.106	0.113	0.120	0.128	0.136	0.143

E. Partial Budgeting. As mentioned above, partial budgeting is a critical tool. Partial budget analysis looks at "what changes" with a change in the operation.

This method does not require extensive economic training or background and does not require knowledge of and access to full enterprise budgets. The method evaluates changes in variables and their direction of change if adopted or rejected.

(i) Partial budgeting is a relatively simple and effective measure. Only the things that change are considered. This simplifies data collection and has numerous applications, from budget outlines to T-Chart formats.

T-charts, named for the T-shaped presentation format, systematically identify only the benefits and costs of a conservation alternative. This technique simplifies data collection and analysis. The T-chart also describes the resource setting, resource concerns and the conservation system. The best information used in the T-chart comes from your client; followed by a discipline specialist's recommendations, and then, technical references. T-Charts are defined by their level and type of information.

- Level I T Chart: Includes only qualitative statements
- Level II T Chart: Qualitative statement plus units of measurement and dollars
- Level III T Chart: Complete economic or financial analysis

(ii) Some clients will only need the discussion and the narrative of the costs and benefits. These are well expressed in a Level I T-Chart format, as shown in the example in table L-2. Level I T-Charts for the majority of our conservation practices can be found here: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/data/?cid=nrcseprd1298864.

(iii) Planners should realize that the concepts being discussed in this chapter extend to all areas, and not just rangeland or pastureland. These concepts apply to cropland, forest land, and other resource areas. This is reflected in the following examples tables L-2. and L-3.

Table L-2. Example of a Level I T-Chart, showing effects of a conservation practice.

Prescribed Grazing (Ac) 528

Definition: Managing the harvest of vegetation with grazing or browsing animals.
Major Resource Concerns Addressed: Low plant and animal productivity and health.
Benchmark Condition: Native rangeland, poor livestock distribution, low forage yields.

Date: October, 2015. Developer/Location: Hal Gordon, OR

Positive Effects	Negative Effects
Soil • Sheet, rill, wind, and gully erosion reduced by improving the health and vigor of plant communities with increased vegetative cover and water infiltration. • Streambanks protected with an increase in riparian vegetation. • Increase in vegetative cover, deeper root systems, increased soil organic material and biological activity, and improved nutrient cycling. • Reduced soil compaction. • Increased cover reduces evaporative salt accumulation. **Water** • Spring and seep flows improved. • Runoff, flooding, or ponding are reduced, and infiltration increased with improved vegetative cover. • Soil moisture improved, less irrigation. • Reduced pesticides and fertilizer use with better plant health and vigor, improved surface and ground water. • Reduced risk of movement of pathogens in surface waters with increase in soil microbial activity. • Reduced sediment delivery to surface water. **Air** • Improved vegetative cover reduces the generation of particulates and removes CO_2 from the air and stores it as carbon in plants and soil. • Objectionable manure odor reduced. **Plants** • Improved plant and animal management enhances growing conditions of the desired plant community and reduces noxious and invasive plants. • Improved forage yields and access. • Reduced fuel loads and wildfire hazard. **Animals** • Improved fish and wildlife habitat, cover, shelter, water, habitat continuity and space.	**Land** • Slight increase in land in production with improved livestock distribution. • Protect buried cultural resources. **Capital** • Slight increase in equipment costs, some monitoring equipment may be required (camera, stakes, hoops, clippers, etc.) • Minor increase in annual operation and maintenance costs for herding and forage monitoring. **Labor** • Additional labor herding livestock between pastures. **Management** • Increase in field scouting to determine when to move livestock and manage forage, minerals, and water. • Increase record keeping. **Risk** • Possible foregone income from forage deferment during implementation.

Positive Effects	Negative Effects
• Livestock numbers are in balance with feed and forage that meets livestock nutritional and productive needs. • Grazing management considers animal shelter throughout the year. **Energy** • Opportunity to reduce herding requirements and fuel use. **Human** • Improved livestock distribution and management options. • Increased profitability in the long run.	
Net Effect: improved forage productivity and water quality, reduced erosion at a minor cost.	

Table L-3. Level II T-Chart Partial budget analysis of costs and effects for a conservation treatment.

Name: Dr. Joel Gruver and Andy Clayton **Location**: Western Illinois University, Macomb, Illinois **Site**: Allison Farm, Southwest Warren County. (18 miles Northwest of Macomb, IL.)	**Resource Concerns/Benchmark:** 77-acre certified organic and research demonstration farm. Principal method of controlling weeds and competing vegetation is done via tillage and hand rogueing. By agricultural measures, it would be considered tillage intensive farming.

Conservation Treatment:
The establishment of organic no-till soybeans. This is accomplished by planting a cover crop of cereal rye or triticale preceding soybeans planted without tillage. The cover crop reduces weed germination and growth and buffers soil temperature and moisture fluctuations. In addition, the cover crop reduces labor and time expended for weed control and reduces the number of passes across the field with a tractor and tillage tool. All of these factors combined provide improved timeliness of operations and increases the weather resilience of the soybean crop.

Positive Effects	**Negative Effects**
• Reduced weed pressure significantly in subsequent years. • Improved soil structure and crop resilience. • Increased timeliness.	• Soil moisture depletion by the cover crop can be a concern in dry springs. • Inconsistent cover crop establishment[3]

Increased Revenue (per acre)[1]		**Increased Cost (per acre)[4]**	
2.5 bu/ac x $22.61/bu[2]	$56.52	Cover crop seed mix	$26.70
Reduced hand rogueing by1.5 hours per acre	$22.50	Cover crop seeding	$13.10
Reduced rotary hoeing by 2 passes	$11.00	Roller-crimper	$12.10
Reduced row cultivating by 2 passes	$21.20	Planting, no-till drill (additional above planter cost) Increased seeding rate	$ 5.70 $15.00
Total direct dollar benefits	$111.22/ac	Total direct dollar costs	$72.60/ac

Net Direct Dollar Benefits = $111.22 - $72.60 = $38.62/ac

Analysis of these costs and benefits shows that this conservation management strategy had a strong net return to the landowner, increased the conservation effects, and increased soil health; while still leaving a significant allowance for negative risk factors.

Indirect Benefits—A number of indirect benefits and costs are recognized but are not quantified or monetized. These factors are important, but due to a lack of values and standards for measurement, are only recognized in the Case Study, and are not a part of the direct costs and benefits. These may be considered as risk factors, which can be positive or negative for the operation.

Notes:

1 Averages were calculated using data provided by Western Illinois University; comparing organic tillage and no-till plots. No-tillage out yielded conventional 4 out of 6 years in comparison. (only 1 year significantly less).

2 Reported price per bushel of organic soybeans. This is a four-year average of prices received by WIU. Actual positive effect may have been higher if 2012 drought had not had such a negative effect on the no-tillage soybeans (due to moisture depletion by cover crop).

3 comparisons were not done in 2013 and 2014 due to a poor stand of cereal rye.

4 Actual costs reported by Joel Gruver and Andy Clayton for organic cereal rye seed, drill cost and other fieldwork costs based on prices at the University of Illinois FarmDoc.

This document is a companion to "No-Till Organic," released May, 2017 by USDA/NRCS, Illinois.

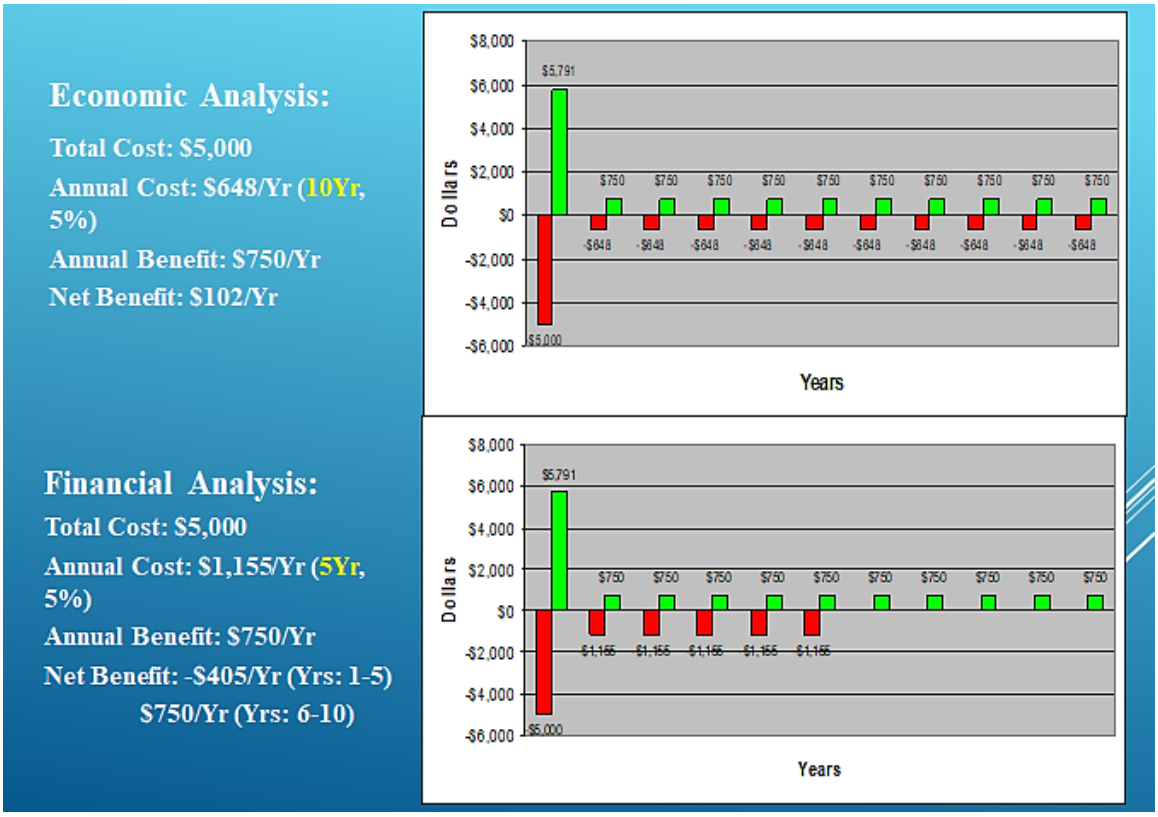
G. A key concern is whether or not the proposed management change will be profitable. These questions compare economic and financial analysis. They are not the same but use the same variables in the analysis. The difference in the analysis is the timeframe.

(1) Do the benefits of the change exceed the costs of the change over the given lifespan of the change?
(2) Is the proposed change affordable?
(3) Do the benefits of the change exceed the costs of the change over a given term of a loan or other payment period? If not, does the client have the cash flow or access to other capital that will support the investment?

H. Example

(1) A pasture fertilization and overseeding project that has a cost of $5,000, an expected life of 10 years, a 5 percent interest rate, and an annual benefit of $750 is being contemplated by the producer. The difference in the economic vs. financial analysis is shown in figure L-1.
(2) From an economic analysis, which considers the change over the entire 10 years, there is an annual net benefit of $102/yr. – a good investment.
(3) However, the financial analysis looks at the costs over the life of the 5-year loan that the client was able to get to finance the improvement. Over the first 5 years, the benefit is $405/yr. This means that the client must have access to the capital to cover the shortfall, or they cannot afford the improvement.

Figure L-1. Example of the difference between economic analysis and financial analysis of a conservation practice.



645.1203 Economic Analysis Tools

A. Other economic tools and analyses are available. NRCS Economists have developed multiple tools to evaluate various alternative practices from an economic and financial perspective. The tools can be found on the NRCS Economics Tools website at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/tools/?cid=nrcs143_009747.

B. A number of economic technical measures are available to a planner to utilize in evaluating alternatives. Some of them are detailed and complex. We acknowledge them here but reference the reader to specific other handbooks for further discussion of those techniques. Many of these techniques are spelled out in manuals and references found on the USDA/NRCS Economics Web Page, https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/. You may also wish to reach out to economic technical specialists within your area for additional assistance or more in-depth explanation of these tools and concepts.

645.1204 References and Technical Terms and Definitions

A. More detail on how to conduct various economic analyses for conservation decision-making can be found in the NRCS National Resource Economics Handbook, H_200_NREH_610: https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1257407&ext=pdf.

B. Some Important Definitions

(1) **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 the payment to pay off the principal and interest over a given time period. The time period can be months or years (average annual cost). Also, it is an investment that yields fixed payments over a stated period.

(2) **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.

(3) **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.

(4) **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 that someone is willing to take to allow someone else to use their money for one 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.

(5) **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.

(6) **Internal Rate of Return**–the compounded interest rate that the practice will return based upon the inputs provided.

(7) **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.

(8) **Net Present Value**–The net present value is the difference between returns and costs when compared in present dollars. Value of today's dollar = Present value.

(9) **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.

(10) **Simple Interest–**Simple interest is money paid or received for the use of money, generally calculated over a base period of one year at a set interest rate.

(11) **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.

(12) **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 once in 25 times in the past, then the risk is calculated to be 4 percent.