

People, Partnerships, and Communities

The purpose of the *People, Partnership, and Communities series* is to assist The Conservation Partnership to build capacity by transferring information about social science related topics.

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Cost Effectiveness Analysis

What is cost effectiveness analysis?

A typical cost effectiveness analysis determines the lowest cost ways to achieve desired outcomes. In the natural resources area, an "outcome" may involve some desired decrease in soil erosion, increase in water quality, reduction in project money spent, etc. An outcome may be more "cost effective" than another if it costs less, generates greater output for a given level of inputs, or somehow allocates resources (i.e. money, administrative time, skills, labor) better.

Cost effectiveness analyses are based on the economic concept of "marginal analysis". Marginal analysis examines the additional output (i.e. outcome) produced from using an additional amount of input.

For example, by applying one additional side dress application of fertilizer (i.e. or one additional 10 unit increment of Nitrogen -the increments can be defined flexibly) a farmer may increase corn yield by 25 bushels/acre.

In the natural resources field, a cost effectiveness analysis might use the concept of marginal analysis to study the efficiency of reducing increasing amounts of one or more resource concerns, such as sediment or sulfur dioxide. In general, it becomes more costly to reduce more of the concerns. For example, it may cost \$5/acre to reduce 50% of the sediment entering a stream. But \$100/acre may need to be spent to reduce sediment delivery from 50% to 100%. In almost all instances, a pollution reduction goal will reach a level where it becomes too "costly" to achieve any more reduction. Figures 1 and 2 illustrate this point.

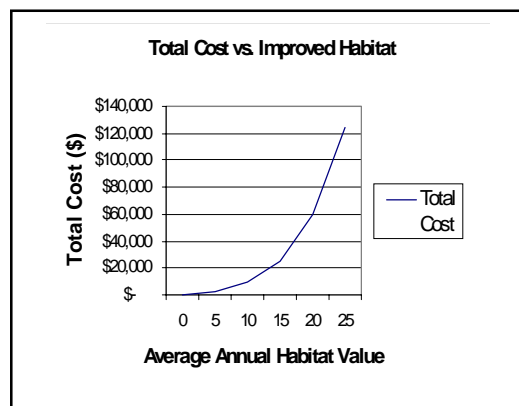


Figure 1 shows that the average annual habitat units for some species in a wetland can be increased by spending money on conservation activities. But greater and greater amounts of money must be spent to achieve greater and greater amounts of improvements.

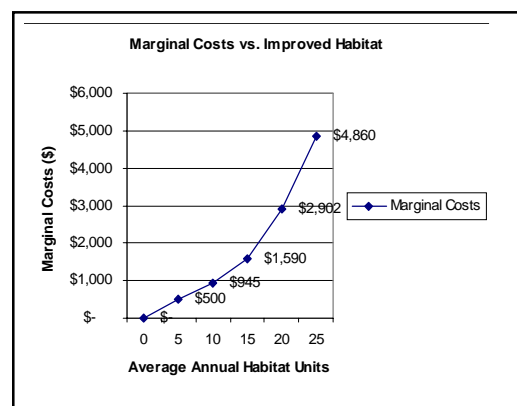


Figure 2 shows the marginal, or incremental, amounts of money that must be spent for each additional increment of habitat unit. The additional cost to increase average annual habitat values from 5 to 6 is \$500. This incremental cost increases to \$4,860 when increasing from 25 to 26 units. A logical question to ask for a habitat improvement project such as this would be: what is the level of habitat improvement that is cost effective?

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When is cost effectiveness analysis used in conservation planning?

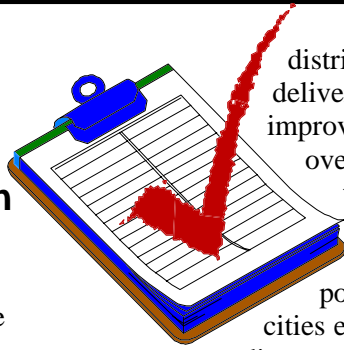
Cost effectiveness analysis is used in those conservation projects that include “efficiency” as an objective. Oftentimes, “efficiency” is not the term actually used in a conservation project. This objective may actually be referred to in several different ways:

- a) achieving desired natural resources conservation outcomes for the lowest cost
- b) allocating scarce resources, such as money, administrative time, and labor, to those uses which have the best results
- c) establishing priorities and targets for conservation efforts
- d) learning how to do more with less
- e) achieving the most bang for the buck
- f) “maximizing environmental benefits per dollar spent”

Although cost effectiveness analysis is not the only means for helping achieve these objectives, many analysts value it as a standard tool in this area.

What types of cost effectiveness analysis can be done?

The use of cost effectiveness analysis has a long history. For this reason, a large number of studies are available showing how to apply this method in the natural resources conservation field. Analyses are readily available showing how to: reduce pesticide damages to rural towns, allocate water in water



districts, reduce sediment delivery in watersheds, improve spotted owl habitat over a multi-state region, target conservation activities over regions, reduce air pollution in major urban cities etc. Most of these studies appear in economics and scientific natural resources journals.

What are the steps needed to carry out a cost effectiveness analysis?

A typical cost effectiveness analysis consists of the following steps:

- 1) Determine the “efficiency” objective. Examples include: minimize the cost of reducing pollutants being generated from a region; maximize the environmental benefits gained per dollar spent using EQIP funding; minimize pollution damages in a cost efficient way; minimize the production costs spent by farmers trying to comply with a new regulation.
- 2) Set a level, or constraint, on the variables being used to measure the efficiency objective. Examples include: minimum percent reductions in the pollutants being generated in a region; a maximum number of dollars that can be spent on EQIP in a region; maximum levels of damages being left untreated ...
- 3) Calculate the costs and effectiveness of the alterna-

tives being considered.

Examples include: conservation system 1 reduces sediment delivery by 20% and costs \$20/acre; bid number 64 is for \$32/acre and achieves 1,200 environmental points; alternative 4 reduces damages by 70% and costs \$3 million ...

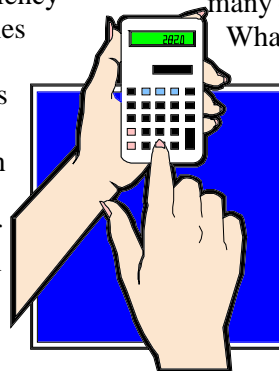
- 4) Determine whether any additional costs need to be calculated. These might include administrative or overhead costs, and opportunity costs, such as the foregone benefits associated with subsidized inputs.
- 5) Carry out the cost effectiveness analysis by sorting methods or mathematical routines. The simplest sorting can be done by first setting up a cost effectiveness ratio (ton of sediment reduced per dollar spent, environmental points earned per bid amount, amount of damage reduced per dollar spent...) and then sorting from the lowest ratio to the highest.

Caveats

The objectives of cost effectiveness analysis have an intuitive appeal to many conservation planners.

What planner does not want to “maximize environmental benefits per dollar spent”, or “achieve the most bang for the buck”? So why isn’t cost effectiveness analysis used more often?

At least two reasons stand out. The first, and most obvious, involves the mechanics of actually completing an analysis. In the past, an analyst, economist, or researcher has been needed to collect, format,



Source of Information

Information about obtaining *IWR-Plan* or carrying out the cost effectiveness method used in this software can be obtained from:

- Army Corps of Engineers, Institute for Water Resources, 703-428-6786 or by visiting their web site at: www.wrc-ndc.usace.army.mil/iwr/iwrplan/iwrplan.htm
- USDA, NRCS Social Sciences Institute, 608-262-1516 or by visiting the economics portion of our web site at people.nrcs.wisc.edu/SocSciInstitute

Information about *LandTrt*, the *Conservation Points Builder* and general information about cost effectiveness analysis can be obtained from the NRCS Social Sciences Institute or your state economist.

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and analyze the data used in a cost effectiveness analysis. The analysis has been beyond the ability of most conservation planners to complete. The last section of this report will introduce several new tools under development that will help planners use cost effectiveness analysis.

The second reason is that most cost effectiveness analyses are extremely “mechanistic”.

Sure, the analysis says to go out and treat these resource concerns at these locations. But try it in the field. You may quickly find that the analysis overlooked several critical points: what types of people are being targeted? Is there any political consensus for doing what the model says to do? What types of organizations are in place for carrying out the cost effectiveness objective? Few cost effectiveness models do a good job of dealing with the complexities of human nature or of nature. For this reason, the solutions suggested by an analysis need to be viewed, at the very least, objectively, and in many instances, skeptically.

Nevertheless, cost effectiveness has several definite advantages that can not be matched by alternative analytic methods. The solutions offered by a cost effectiveness analysis can really point to concrete ways to save money. Cost effectiveness analysis alleviates the need to value items that are difficult, or impossible, to value, such as many of the “benefits” accompanying natural resources conservation. Instead of claiming that a species is worth so many dollars, cost effectiveness allows an analyst to skirt the valuation issue by showing the least cost ways to improve the species’ habitat.

How do I carry out cost effectiveness analysis?

NRCS has the following models available for carrying out cost effectiveness analysis:

IWR-Plan: the Army Corps of Engineers, Institute for Water Resources has developed this Windows software application in

cooperation with NRCS. The software automates most of the analysis needed to carry out cost effectiveness analysis

and produces a wide assortment of decision support reports. This software is still under development, with an official first release scheduled for early 1998. The Army Corps is building a substantial support network for the software, including training manuals, training courses, technical contacts, and a web site.

LandTrt: This NRCS model employs Excel spreadsheets to carry out cost effectiveness analysis. The model can carry out fairly sophisticated cost effectiveness analyses (using mathematical programming), but has not yet been automated.

Conservation Points Builder (Cpoints): This Windows software application uses major NRCS programs, such as CRP, WRP, and EQIP, as the basis for cost effectiveness analysis. The software is one tool within a larger conservation planning software project known as the *Community Conservation Toolbox (CTools 98)*. Beta versions of this toolbox are available.

Use cost effectiveness analysis in those conservation projects that include “efficiency” as an objective.

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