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## ECONOMICS TECHNICAL NOTE

# Basic Economic Analysis Using T-Charts

**By**
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NRCS assists land owners in managing natural resources on private land. Our core "product" is a conservation plan that provides a roadmap to solve natural resource problems on private land. The most successful conservation plans address the landowner's resource concerns while maintaining farm or ranch viability. Therefore, it is the policy of the NRCS that economic principles are included in all planning and agency resource allocation activities (Title 200, General Manual, Part 400, Subpart A).

Most landowners want to know the benefits and costs of their conservation plan before they make important land use decisions. The level of economic detail depends upon the client, but basic economic information is something most NRCS employees can easily provide.

A good conservation plan utilizing the "nine steps" planning process clearly and concisely presents technical and economic information to the landowner. To fully inform the landowner of the potential benefits and costs of the plan, the conservation planner's responsibilities include—

- Documenting environmental, social and economic effects in the planning process.
- Identifying physical and monetary benefits of implementing conservation systems.
- Identifying negative impacts and costs of conservation systems.

**Benefit and Cost Analysis**
The goal of a conservation plan is for benefits to exceed costs. Benefits and costs can be quantitative and qualitative. If a monetary value cannot be assigned, the environmental or social benefit or cost should be quantified and included in the analysis. Economic analysis requires four steps:

1. Estimate Costs
2. Estimate Benefits
3. Convert to "Like Terms"
4. Compare Costs and Benefits

There are two benefit subcategories: *Increased Revenue* and *Reduced Costs*. Increased revenue may include increased crop yields, livestock production, and hunting fees. Reduced costs may include fewer passes over the field or less labor. There are two cost subcategories: *Increased Costs* and *Reduced Revenue*. Increased costs include purchasing equipment, materials, or hiring more labor. Reduced revenue may include land taken out of production or reduced crop yields. Be

aware that some nonmonetary values, such as improved wildlife habitat or pretty landscapes, may be a benefit to one individual and a cost to another. For example, an increase in waterfowl may be a benefit to a bird watcher or duck hunter, but a cost to a farmer experiencing excessive crop losses, trespass, or land lost to wetland. Once costs and benefits are estimated, convert them to the same units over the same time period. You cannot compare benefits and costs unless they are reduced to the same terms. Typically, benefits and costs are summarized as dollars per acre per year ($/acre/year).

## Partial Budgeting

Partial budgeting is a method that systematically displays the benefits and costs of an alternative where only changes from the baseline (or current) condition are considered. This technique simplifies data collection. For example, only the costs and beneficial impacts of installing a conservation practice are considered in the analysis, rather than gathering information about the whole farm enterprise where the practice is installed.

## T-Chart

A simple way to conduct economic analysis through partial budgeting is with a T-chart. A T-chart systematically identifies 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, a discipline specialist's recommendations, and technical references.

## T-Chart

| **Name:**<br>**Location:**<br>**Date:** | **Resource Concerns/Benchmark Condition:** |
|---|---|
| **Conservation Treatment:** | |
| **Positive Effects** | **Negative Effects** |

There can be three levels of analysis using the T-chart:

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

The conservation planner should complete as many T-chart levels as they are comfortable with and then request assistance if the decision maker needs additional analysis. The planner only develops enough information for the client to make an informed decision. The decision maker may lose interest if too much irrelevant information is provided and waste planner's time. A T-chart can be developed on whatever media the decision maker finds most useful.

**T-Chart Example**

The following example demonstrates how to use a T-chart to analyze the benefits and costs of a conservation system. The level-I T-chart below displays a list of benefits and costs without units of measure or dollars. The qualitative statements identify the "effects" of the conservation system on addressing the resource concerns. Level I may contain enough information for some decision makers to make a decision, but most land users ask for more information.

**T-Chart, Level I, Cropland – Soil Quality Improvement**

<table>
<tr><td>Name: Sandy Clayton<br>Location: Columbia Basin, Oregon<br>Date: 2008</td><td>Resource Concerns/Benchmark Condition:<br>600 acres of cropland producing 70 bushels wheat and 50 bushels barley per acre in a two year rotation. Conventional tillage, nutrient and pest management. Resource concerns include: Sheet & Rill Soil Erosion, Organic Matter Depletion, Compaction, Surface Water Contaminants, Plant Productivity, and Wildlife.</td></tr>
<tr><td colspan="2">Conservation Treatment:<br>Conservation Crop Rotation (Winter Wheat/Canola/Spring Barley)<br>Residue Management (Direct Seed/No-Till)<br>Pest Management (Annual Grasses and Aphids)<br>Nutrient Management (Fertilizer Management)</td></tr>
<tr><td><u>Positive Effects</u><br><br><u>Reduced Costs</u><br>Change in Crop Rotation<br>Decreased fertilizer applied<br>Reduce six tillage passes over the field<br>Reduce fuel and labor<br><br><u>Increased Revenue</u><br>Wheat yield increase<br>Financial Assistance Payment<br><br><u>Other</u><br>Improved soil and water quality<br>Upland bird habitat improvement</td><td><u>Negative Effects</u><br><br><u>Increased Costs</u><br>No-Till Drill<br>Pest Management<br>Nutrient/Fertilizer Management<br><br><u>Reduced Revenue</u><br>Possible lost grazing opportunities</td></tr>
</table>

Level II includes units of measure and dollar estimates of the conservation "effects." The decisionmaker may still not be able to make a decision because all the units are not in similar terms (same denominator). The cost of the No-Till Drill is in $/each while the other values are in $/acre/year.

**T-Chart, Level II, Cropland – Soil Quality Improvement**

<table>
<tr><td>Name: Sandy Clayton<br>Location: Columbia Basin, Oregon<br>Date: 2008</td><td>Resource Concerns/Benchmark Condition:<br>600 acres of cropland producing 70 bushels wheat and 50 bushels barley per acre in a two year rotation. Conventional tillage, nutrient and pest management. Resource concerns include: Sheet & Rill Soil Erosion, Organic Matter Depletion, Compaction, Surface Water Contaminants, Plant Productivity, and Wildlife.</td></tr>
<tr><td colspan="2">Conservation Treatment:<br>Conservation Crop Rotation (Winter Wheat/Canola/Spring Barley)<br>Residue Management (Direct Seed/No-Till)<br>Pest Management (Annual Grasses and Aphids)<br>Nutrient Management (Fertilizer Management)</td></tr>
<tr><td><u>Positive Effects</u><br><br><u>Reduced Costs</u><br>• Change in Crop Rotation = $25/ac/yr<br><u>2 -year Conventional Rotation</u> <u>Net Returns</u><br>Winter Wheat $100/ac/yr<br>Spring Barley <u>$50/ac/yr</u><br>$75/ac/yr<br><u>3-year No-Till Rotation</u><br>Winter Wheat $130/ac/yr<br>Canola $100/ac/yr<br>Spring Barley <u>$70/ac/yr</u><br>$100/ac/yr<br>Decreased fertilizer applied 20 Lbs N/ac<br>Reduce six tillage passes over the field<br>Reduce fuel and labor<br><br><u>Increased Revenue</u><br>• Wheat yield increase (no estimate available)<br>• Financial Assistance Payment $10/ac/yr<br><br><u>Other</u><br>• Improved soil and water quality<br>• Upland bird habitat improvement<br><br>Total Dollar Benefits = $35/ac/yr</td><td><u>Negative Effects</u><br><br><u>Increased Costs</u><br>• No-till drill equipment = $25,000/Drill<br>(not included in crop budgets)<br>• Pest Management $10.10/ac/yr<br>• Nutrient/Fertilizer Management = $2/ac/yr<br><br><u>Reduced Revenue</u><br>• Possible lost aftermath grazing<br><br>Total Dollar Costs = $2/ac/yr plus $25,000/Drill</td></tr>
</table>

Level III has converted all benefits and costs to similar terms. The cost of the No-Till Drill has been amortized from a one-time cost to an annual payment. Now all costs and benefits are in similar terms and can be compared by the decision maker.

### T-Chart, Level III, Cropland – Soil Quality Improvement

**Name:** Sandy Clayton
**Location:** Columbia Basin, Oregon
**Date:** 2008

**Resource Concerns/Benchmark Condition:**
600 acres of cropland producing 70 bushels wheat and 50 bushels barley per acre in a two year rotation. Conventional tillage, nutrient and pest management. Resource concerns include: Sheet & Rill Soil Erosion, Organic Matter Depletion, Compaction, Surface Water Contaminants, Plant Productivity, and Wildlife.

**Conservation Treatment:**
Conservation Crop Rotation (Winter Wheat/Canola/Spring Barley)
Residue Management (Direct Seed/No-Till)
Pest Management (Annual Grasses and Aphids)
Nutrient Management (Fertilizer Management)

## Positive Effects

***Reduced Costs***

- Change in Crop Rotation = **$25/ac/yr**

| 2-year Conventional Rotation | Net Returns |
|---|---|
| Winter Wheat | $100/ac/yr |
| Spring Barley | $50/ac/yr |
| | $75/ac/yr |
| **3-year No-Till Rotation** | |
| Winter Wheat | $130/ac/yr |
| Canola | $100/ac/yr |
| Spring Barley | $70/ac/yr |
| | $100/ac/yr |

Decreased fertilizer applied 20 Lbs N/Ac
20 Lbs/Ac * $.75/Lb / 3 Yrs = $5/ac/yr
Reduce six tillage passes over the field:
$10/Pass * 6 Passes / 3 Yrs = $20/ac/yr
Reduce fuel and labor
(included in the reduced tillage passes)

***Increased Revenue***

- Wheat yield increase (no estimate available)
- Financial Assistance Payment **$10/ac/yr**

***Other***

- Improved soil and water quality
- Upland bird habitat improvement

**Total Dollar Benefits = $35**/ac/yr

## Negative Effects

***Increased Costs***

- No-Till Drill = $25,000, amortized at 5 Yr. loan, 6% interest, 600 Acres = **$9.90/ac/yr** (not included in crop budgets, amortization explained below)
- Pest Management **$10.10/ac/yr**
- Nutrient/Fertilizer Management = **$2/ac/yr**

***Reduced Revenue***

- Possible lost grazing opportunities

**Total Dollar Costs = $22**/ac/yr

*$35*/ac/yr *Total Benefits* - *$22*/ac/yr *Total Costs* = ***$13*/ac/yr** ***Net Benefits***

Now that all the conservation "effects" are in similar terms, the decisionmaker can compare the benefits and costs and make an informed decision. In this case, the monetary benefits are greater than the costs (net benefits are positive) and the decisionmaker should feel comfortable adopting the example conservation system from an economic perspective. However, economics is only one factor in decisionmaking. The land user should also consider environmental and social effects and how this conservation system fits into the overall agricultural operation before making a decision.

**Amortization**

The process of amortization is simply converting a one-time value to an annual value. Four pieces of information are required for amortization: 1) initial cost, 2) interest (bank loan) rate, 3) life of the loan (years), and 4) an amortization table (or equation). In our example the No-Till Drill cost $25,000. If the farmer could get a loan for $25,000 from the bank at 6-percent interest, over 5 years, the amortization factor would be 0.237 (from the amortization table below where the interest column intersects with the year row). Multiplying 0.237 by $25,000 results in an annual cost of $5,940/year. Dividing the $5,940 by 600 acres gives the No-Till Dill a cost of $9.90/acre/year. (Note: this table is for "yearly" payments; a similar table is available for "monthly" payments).

**Amortization Table - Yearly**

| LIFE | % INTEREST RATE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEARS | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 2 | 0.523 | 0.530 | 0.538 | 0.545 | 0.553 | 0.561 | 0.568 | 0.576 | 0.584 | 0.592 | 0.599 | 0.607 | 0.615 |
| 3 | 0.354 | 0.360 | 0.367 | 0.374 | 0.381 | 0.388 | 0.395 | 0.402 | 0.409 | 0.416 | 0.424 | 0.431 | 0.438 |
| 4 | 0.269 | 0.275 | 0.282 | 0.289 | 0.295 | 0.302 | 0.309 | 0.315 | 0.322 | 0.329 | 0.336 | 0.343 | 0.350 |
| 5 | 0.218 | 0.225 | 0.231 | 0.237 | 0.244 | 0.250 | 0.257 | 0.264 | 0.271 | 0.277 | 0.284 | 0.291 | 0.298 |
| 6 | 0.185 | 0.191 | 0.197 | 0.203 | 0.210 | 0.216 | 0.223 | 0.230 | 0.236 | 0.243 | 0.250 | 0.257 | 0.264 |
| 7 | 0.161 | 0.167 | 0.173 | 0.179 | 0.186 | 0.192 | 0.199 | 0.205 | 0.212 | 0.219 | 0.226 | 0.233 | 0.240 |
| 8 | 0.142 | 0.149 | 0.155 | 0.161 | 0.167 | 0.174 | 0.181 | 0.187 | 0.194 | 0.201 | 0.208 | 0.216 | 0.223 |
| 9 | 0.128 | 0.134 | 0.141 | 0.147 | 0.153 | 0.160 | 0.167 | 0.174 | 0.181 | 0.188 | 0.195 | 0.202 | 0.210 |
| 10 | 0.117 | 0.123 | 0.130 | 0.136 | 0.142 | 0.149 | 0.156 | 0.163 | 0.170 | 0.177 | 0.184 | 0.192 | 0.199 |
| 11 | 0.108 | 0.114 | 0.120 | 0.127 | 0.133 | 0.140 | 0.147 | 0.154 | 0.161 | 0.168 | 0.176 | 0.183 | 0.191 |
| 12 | 0.100 | 0.107 | 0.113 | 0.119 | 0.126 | 0.133 | 0.140 | 0.147 | 0.154 | 0.161 | 0.169 | 0.177 | 0.184 |
| 13 | 0.094 | 0.100 | 0.106 | 0.113 | 0.120 | 0.127 | 0.134 | 0.141 | 0.148 | 0.156 | 0.163 | 0.171 | 0.179 |
| 14 | 0.089 | 0.095 | 0.101 | 0.108 | 0.114 | 0.121 | 0.128 | 0.136 | 0.143 | 0.151 | 0.159 | 0.167 | 0.175 |
| 15 | 0.084 | 0.090 | 0.096 | 0.103 | 0.110 | 0.117 | 0.124 | 0.131 | 0.139 | 0.147 | 0.155 | 0.163 | 0.171 |
| 16 | 0.080 | 0.086 | 0.092 | 0.099 | 0.106 | 0.113 | 0.120 | 0.128 | 0.136 | 0.143 | 0.151 | 0.160 | 0.168 |
| 17 | 0.076 | 0.082 | 0.089 | 0.095 | 0.102 | 0.110 | 0.117 | 0.125 | 0.132 | 0.140 | 0.149 | 0.157 | 0.165 |
| 18 | 0.073 | 0.079 | 0.086 | 0.092 | 0.099 | 0.107 | 0.114 | 0.122 | 0.130 | 0.138 | 0.146 | 0.155 | 0.163 |
| 19 | 0.070 | 0.076 | 0.083 | 0.090 | 0.097 | 0.104 | 0.112 | 0.120 | 0.128 | 0.136 | 0.144 | 0.153 | 0.161 |
| 20 | 0.067 | 0.074 | 0.080 | 0.087 | 0.094 | 0.102 | 0.110 | 0.117 | 0.126 | 0.134 | 0.142 | 0.151 | 0.160 |
| 25 | 0.057 | 0.064 | 0.071 | 0.078 | 0.086 | 0.094 | 0.102 | 0.110 | 0.119 | 0.127 | 0.136 | 0.145 | 0.155 |
| 50 | 0.039 | 0.047 | 0.055 | 0.063 | 0.072 | 0.082 | 0.091 | 0.101 | 0.111 | 0.120 | 0.130 | 0.140 | 0.150 |
| 100 | 0.032 | 0.041 | 0.050 | 0.060 | 0.070 | 0.080 | 0.090 | 0.100 | 0.110 | 0.120 | 0.130 | 0.140 | 0.150 |

**Economic Analysis versus Financial Analysis**

Economic analysis answers the question: Is it profitable? Financial analysis determines if it is affordable. This distinction is important. An activity may be economically justified but not a financially wise thing to do. Economic analysis compares the benefits and costs over the life of the alternative, where financial analysis compares the benefits and costs over the life of the finance period (such as a bank loan).

For example, if a No-Till Drill has a useful farm life of 20 years and the farmer can get a bank loan (discount rate) at 6 percent (amortization factor = 0.087), then the "economic" cost of the drill is $2,175/year (or if divided by 600 acres in crop production $3.63/acre/year). If the bank offered a 5-year loan, the "financial" cost of the drill would be $9.90/acre/year (recognizing that the drill will continue to provide benefits for 15 years beyond when the loan is paid). If the No-Till Drill created benefits of $8.00/acre/year, the purchase of the drill would be "economical" but fall short "financially," and possibly create a cash flow concern until the 5-year loan is paid. Conservation program financial assistance may be available to minimize cash flow problems while adopting conservation activities.