On Farm Partial Budgeting Analysis for Practical Soil Health Specialists

John J. Hanchar
Extension Associate, Agricultural Economist
jjh6@cornell.edu
Cornell University/College of Agric. & Life Sciences/CCE/NWNY Dairy, Livestock & Field Crops Program*

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*The NWNY regional team is a Cornell Cooperative Extension (CCE) partnership between Cornell University and the CCE Associations in 9 counties
Messages

• Soil health management work benefits when the planner understands the decision making needs of the farm business owner including farm level economic considerations

• Partial budgeting as an economic model helps describe how farm business owners incorporate economic/financial objectives into decision making

• For some practices/systems, analysis that depicts a multi year planning horizon provides valuable information for decision making -- consider “... these benefits don’t typically happen in the first year ...”, no-till producer commenting on cover crops

• Conduct sensitivity analysis to better understand how changes in values of key factors affect expected change in profit estimates -- for example, low output price, unfavorable growing conditions
Soil Health Work on Farms is Guided by ...

FIGURE 3.01. The Comprehensive Assessment of Soil Health, used to determine soil health status, is an integral part of the Cornell Soil Health Management Planning and Implementation Framework.
Farmers’ Perspectives

• “Dave [Magos] derives satisfaction from the knowledge that he is building better soil while saving money ...” (USDA/NRCS. 2016, October. ECONOMIC CASE STUDY Farmer Profile: Dave Magos. 2 pp.)

• “… This focus has allowed them to increase their soil’s productivity while cutting costs, leading to more sustainable farming both economically and environmentally.” (USDA/NRCS. 2016, October. ECONOMIC CASE STUDY Farmer Profile: John Kemmeren Farm – Angel Rose Dairy. 2 pp.)
Farmers’ Attitudes toward Soil Health

• Farmers seek improved soil health outcomes while maintaining or improving the business’ ability to achieve economic, financial objectives
Definition
• Profit is a measure of economic performance
• Profit equals the total value of production, revenue minus costs of production

Characteristics
• Profit is a residual concept
• Profit is measured over a time period – year, quarter, month
• Numerous measures of profit, or return

Examples
• Return above, or over variable costs
• Return above total costs
• Return on investment, return on capital
• Return to land
• Return to management

Not Examples
• Revenue or costs in isolation
• Net worth and other measures from the balance sheet
Costs of Production

**Definition**
Value of inputs, resources, factors of production. -- e.g. land, labor, capital, fertilizer and lime, seeds and plants, fuel & lube, etc. -- used to produce crops, livestock products, etc.

**Characteristics**
- Fixed and Variable
- Cash and non cash
- Measured over a time period

**Fixed**
- Depreciation
- Interest on capital invested
- Repairs
- Taxes
- Insurance

**Variable Costs**
- Hired labor
- Machinery hire
- Repairs
- Fuel, lube oil
- Fertilizer & lime
- Seeds & plants
- etc.

**Non Cash**
- Depreciation
- Interest on investm’t
- Value of unpaid family and operator labor and management
Definition
Analysis that estimates the expected change in profit (available cash, other measures of economic performance) associated with a proposed change in the farm business

Partial Budget Analysis

Partial Budget Answers
What new or additional revenue will be received?
What current costs will be reduced or eliminated?
What current revenue will be lost or reduced?
What new or additional costs will be incurred?

Characteristics
• Analyzes a proposed change (challenger) compared to the present farm business (defender)
• Includes only the changes in revenues and costs -- not the total values -- marginal analysis
• Initially, often assumes an average future year
• Provides an estimate of the increase, or decrease in profit (or cash income above cash costs)
• Says nothing about the change relative to alternative uses of resources
Changes Analyzed

• Enterprise substitution or addition
• Input substitution or level, practice changes
• Technology adoption
• Other capital investments
**Partial Budget – Profit**

Proposed Change (Challenger): ... vs. Current (Defender): ...

**Assumptions:**

<table>
<thead>
<tr>
<th>Items that Increase Profit</th>
<th>Items that Decrease Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Value of Production, Revenue</td>
<td>Decreased Value of Production, Revenue</td>
</tr>
<tr>
<td>Reduced Costs</td>
<td>Increased Costs</td>
</tr>
</tbody>
</table>

**Sum of Items that Increase Profit (A):**

**Sum of Items that Decrease Profit (B):**

**Expected Change in Profit = (A) minus (B):**
Partial Budget – Cash Available (Cash Income Above Cash Costs)
Proposed Change (Challenger): ... vs. Current (Defender): ...

Assumptions:

<table>
<thead>
<tr>
<th>Items that Increase Cash Available</th>
<th>Items that Decrease Cash Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Cash Income</td>
<td>Decreased Cash Income</td>
</tr>
<tr>
<td>Reduced Cash Costs</td>
<td>Increased Cash Costs</td>
</tr>
</tbody>
</table>

Sum of Items that Increase Cash Available (A):

Sum of Items that Decrease Cash Available (B):

Expected Change in Cash Available = (A) minus (B):
What is it?
• Changing important item values to see how they affect resulting values – e.g. effect of a price change on the expected change in profit
• “What if ...?” scenarios -- worst, best, and average case

Examples
Analyses that examine different:
• Price levels for goods and services sold
• Production, yields, sale levels for goods and services
• Price levels of important inputs
• Input levels for important inputs, expense items
• Interest rates – costs of borrowed capital

Questions Answered
• What item values are projections most sensitive to?
• Do sensitivity analyses suggest that you need plans in place to handle financial uncertainties?
Partial Budget Example


• Background
  • WNY 500 cow dairy farm; corn silage, hay crop rotation; no till cropping system
  • Current practice: no cover, double crop for forage following corn silage
  • Proposed change in the farm business: winter cereal, triticale, double cropped for forage following corn silage
# Soil Health Practice Benefit-Cost Templates

## Cover Crop (Ac) 340

**Definition:** Grasses, legumes, and forbs planted for seasonal vegetative cover.

**Major Resource Concerns Addressed:** Soil Erosion, Water Quality, Plant Productivity.

**Benchmark Condition:** Cropland, rye crops, non-irrigated.

**Date:** October, 2017  **Developer/Location:** Conservation Planner, USA

<table>
<thead>
<tr>
<th>Positive Effects</th>
<th>Negative Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil</strong></td>
<td></td>
</tr>
<tr>
<td>Reduce erosion from <strong>wind and water</strong> and transport of sediment.</td>
<td></td>
</tr>
<tr>
<td>Maintain or increase soil health and organic matter content.</td>
<td></td>
</tr>
<tr>
<td>Improve soil moisture use efficiency.</td>
<td></td>
</tr>
<tr>
<td>Minimize soil compaction.</td>
<td></td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td></td>
</tr>
<tr>
<td>Reduce water quality degradation by utilizing excessive soil nutrients.</td>
<td></td>
</tr>
<tr>
<td>Reduce drainage, seepage and soil subsidence.</td>
<td></td>
</tr>
<tr>
<td>Increased organic matter will buffer salts.</td>
<td></td>
</tr>
<tr>
<td>Reduce runoff and increase infiltration.</td>
<td></td>
</tr>
<tr>
<td>Improves infiltration, soil structure, and soil water storage.</td>
<td></td>
</tr>
<tr>
<td>Increase soil biological activity.</td>
<td></td>
</tr>
<tr>
<td>Reduce runoff and transport of nutrients, pesticides, pathogens and soluble salts.</td>
<td></td>
</tr>
<tr>
<td><strong>Air</strong></td>
<td></td>
</tr>
<tr>
<td>Ground cover helps reduce wind erosion and generation of fugitive dust.</td>
<td></td>
</tr>
<tr>
<td>Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil.</td>
<td></td>
</tr>
<tr>
<td><strong>Plants</strong></td>
<td></td>
</tr>
<tr>
<td>Suppress excessive weed pressures and break pest cycles.</td>
<td></td>
</tr>
<tr>
<td>Improved plant health, productivity and crop yields.</td>
<td></td>
</tr>
<tr>
<td><strong>Land</strong></td>
<td></td>
</tr>
<tr>
<td>No change in landscape</td>
<td></td>
</tr>
<tr>
<td>Land utilized more intensely</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td></td>
</tr>
<tr>
<td>Materials &amp; planting costs.</td>
<td></td>
</tr>
<tr>
<td>Grass/legume seed.</td>
<td></td>
</tr>
<tr>
<td>Seeding Operation, No Till/Criss Drill.</td>
<td></td>
</tr>
<tr>
<td>Herbicide, ground application.</td>
<td></td>
</tr>
<tr>
<td>Mechanical or chemical crop kill.</td>
<td></td>
</tr>
<tr>
<td><strong>Labor</strong></td>
<td></td>
</tr>
<tr>
<td>Increase in labor to plant, manage, eliminate crop.</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td></td>
</tr>
<tr>
<td>Increase time managing crop production.</td>
<td></td>
</tr>
<tr>
<td>Risk</td>
<td></td>
</tr>
<tr>
<td>Other farm activities delayed while implementing the practice.</td>
<td></td>
</tr>
<tr>
<td>In dry climates (&lt;20 inches/year) will compete for crop moisture.</td>
<td></td>
</tr>
<tr>
<td>May recruit unwanted wildlife.</td>
<td></td>
</tr>
<tr>
<td>May have to convert to shorter season crops in northern latitudes.</td>
<td></td>
</tr>
</tbody>
</table>

**Animals**
- Increased food and cover for wildlife.
- Increased space and connectivity for wildlife.
- Supplemental forage for livestock.

**Human**
- Increase yields/reduce costs as land becomes more productive.
- Create sustainability of natural resources that support your business.
- Increase the property value (real estate) of your property.
- Create open space and improve habitat for wildlife.
- Conserve soil and water for periods of drought and future use.
- Prevent off site negative impacts.
- Comply with environmental regulations.
- Save time, money and labor.
- Promote family health and safety.
- Make land more attractive and promote good stewardship.
- May be eligible for cost share.
- Increased profitability in the long run.

**Energy**
- Cover crops can reduce nitrogen inputs.

**Net Effect:** Cover crop improves soil productivity, reduces erosion at a moderate cost.

the Conservation Practice Benefit-Cost Templates are located here: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/data/?cid=nrcseprd1298864
Here is a screenshot:
Partial Budget – Profit

Proposed Change (Challenger): Establish, grow and harvest triticale as a double cropped winter forage following corn silage vs.

Current (Defender): No winter forage double cropped

• Selected Assumptions
  • per acre, marginal, before tax analysis, average future year
  • expected winter forage price initially $129 per ton DM
  • expected winter forage yield 2 tons DM per acre
  • Expected corn silage price $55 per ton 35% DM (field yield)
  • expected change in corn silage yield 0 tons field yield
  • spring N addition 0 lbs. per acre
  • N price $0.57 per lb.
Value of Production and Cost Items

• Value of Production, Revenue Items
  • Milk
  • Livestock sold
  • Crops
  • Government Receipts
  • Other

• Farm Cost, Expense Items
  • Labor
  • Livestock inputs: feed, other production inputs, marketing
  • Machinery operating
  • Fertilizer & lime
  • Seeds & plants
  • Spray & other crop inputs
  • Other operating inputs
  • Machinery ownership
  • Building ownership
### Partial Budget -- continued

<table>
<thead>
<tr>
<th>Items that Increase Profit</th>
<th>Items that Decrease Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increased Value of Production, Revenue</strong></td>
<td><strong>Decreased Value of Production, Revenue</strong></td>
</tr>
<tr>
<td>Triticale</td>
<td>$258</td>
</tr>
<tr>
<td><strong>Reduced Costs</strong></td>
<td><strong>Increased Costs</strong></td>
</tr>
<tr>
<td>Labor</td>
<td>$15</td>
</tr>
<tr>
<td>Machinery operating</td>
<td>$26</td>
</tr>
<tr>
<td>Crop inputs and other</td>
<td>$63</td>
</tr>
<tr>
<td>Machinery depreciation</td>
<td>$31</td>
</tr>
<tr>
<td><strong>Sum of Items that Increase Profit (A):</strong></td>
<td><strong>Sum of Items that Decrease Profit (B):</strong></td>
</tr>
<tr>
<td>$258</td>
<td>$135</td>
</tr>
<tr>
<td><strong>Expected Change in Profit = (A) minus (B):</strong></td>
<td>$123</td>
</tr>
</tbody>
</table>
### Break-Even Winter Cereal Yields

<table>
<thead>
<tr>
<th>No impact on corn silage yield</th>
<th>1 ton DM/ac reduction in corn yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>No additional N fertilizer</td>
<td><strong>0.7</strong></td>
</tr>
<tr>
<td>With 75 lbs N/acre, MERN</td>
<td><strong>1.0</strong></td>
</tr>
</tbody>
</table>


MERN, most economic rate of nitrogen, that is, the profit maximizing level of N.

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Notes: 1) Value of triticale forage fixed at $180 per ton DM; 2) Price of N fixed at $0.57 per lb. (2015); 3) Value of corn silage fixed at $157 per ton DM
Economics of Double Cropping

Source: Kilcer, Hancher, Lyons and others. 2015. CCA Training.
Partial Budget Example, Zone Tillage -- Shearing (WNYCMA) and Hanchar (Cornell Univ./CALS/CCE)

- 700 to 750 cow dairy – 600 acres corn silage, 600 acres hay crop
- Proposed (Challenger): adoption of zone till for corn silage
- Current (Defender): conventional till corn silage
- Comparable yields
- 2003 prices (USDA, Equipment Dealers) updated to 2013 using USDA prices received and prices paid indices
- Average future year, before tax, marginal analysis
- Machinery complement
Machinery Complements – Key Items

• Conventional
  • 280 hp, 4wd tractor used
  • 215 hp tractor
  • 150 hp tractor
  • 9 bottom plow
  • 26 ft. disc
  • 25 ft. harrow
  • 6 row conventional planter

• Zone Tillage
  • 215 hp tractor
  • 150 hp tractor
  • 6 row zone builder
  • 6 row zone till planter
## Change in Labor Required

<table>
<thead>
<tr>
<th>Per Acre</th>
<th>600 Acres of Corn Silage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month of May</td>
<td>0.14 fewer hours</td>
</tr>
</tbody>
</table>
Partial Budget_Expected Change in Profit Associated with a Proposed Change in the Farm Business

**Proposed Change:** Zone tillage cropping system for corn silage production 700 to 750 cow dairy vs **Current:** Conventional tillage system for corn silage 700 to 750 cow dairy

### Assumptions
- Conventional tillage system currently used to produce corn silage, haycrop produced conventionally for current and proposed
- Dairy farm business produces corn silage for feed on 600 acres – assumed for both current and proposed
- Average future year, October 2008 prices (USDA) adjusted to 2013 using February 2013 Price Indices (USDA), comparable yields, farm machinery costs per acre include ownership and operating costs

Before tax, marginal analysis

<table>
<thead>
<tr>
<th>ITEMS THAT INCREASE PROFIT</th>
<th>ITEMS THAT REDUCE PROFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Added Value of Production:</strong></td>
<td><strong>Reduced Value of Production:</strong></td>
</tr>
<tr>
<td>1 Value of production attributed to added labor hrs available in May</td>
<td>$1,485</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
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<tr>
<td>5</td>
<td>5</td>
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<tr>
<td>6</td>
<td>6</td>
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<tr>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Total</strong></th>
<th>$1,485</th>
<th>$0</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Reduced Costs:</strong></th>
<th><strong>Added Costs:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Plow – tractor: 15.89($/ac); plow: 8.96($/ac)</td>
<td>$14,910</td>
</tr>
<tr>
<td>2 Disk – tractor: 7.30($/ac); disk: 6.03($/ac)</td>
<td>$7,998</td>
</tr>
<tr>
<td>3 Harrow – tractor: 15.64($/ac); harrow: 6.18($/ac)</td>
<td>$13,092</td>
</tr>
<tr>
<td>4 Plant conventionally – tractor: 8.83($/ac); planter: 6.66($/ac)</td>
<td>$9,894</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Total</strong></th>
<th>$45,894</th>
<th>$25,560</th>
</tr>
</thead>
</table>

**TOTAL OF ITEMS THAT INCREASE PROFIT (A)** $47,379 **TOTAL OF ITEMS THAT DECREASE PROFIT (B)** $25,560

**EXPECTED CHANGE IN PROFIT (A minus B)** $21,819

**Notes**
- Profit = Value of Production - Costs of Resources, Inputs Used

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Cornell University/College of Agric. & Life Sciences
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• Conduct sensitivity analysis to better understand how changes in values of key factors affect expected change in profit estimates -- for example, low output price, unfavorable growing conditions
Resources

• Partial budget template, blank spreadsheet – Iowa State University
• Machinery cost estimates – Lazarus, University of Minnesota
• Custom rates – USDA and Pennsylvania State; Ohio State University, Farm Office, Iowa State University
• Search web “partial budget ...”
• USDA/NRCS Conservation practice, benefits-costs templates, case studies, tools etc.
• Crop enterprise budgets – Ohio State University, Farm Office; Pennsylvania State University
Contact Information

• John Hanchar, Cornell University/College of Agriculture & Life Sciences/CCE/NWNY Dairy, Livestock & Field Crops Program
  • jjh6@cornell.edu
  • Mobile phone: (585) 233-9249
  • Website: <nwnyteam.cce.cornell.edu>