



Partial Budget Analysis Methodology Used by the Soil Health Institute

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Partial budget analysis is a farm management analytical method that can be applied to determine profitability of soil health management systems (SHMS) adoption. It involves estimating comparative financial returns by quantifying the net economic effect of only proposed changes in production systems. For example, converting from conventional tillage to no-till production with cover crops eliminates tillage operations which reduces all associated costs. Planting cover crops creates expenses for seed, as well as planting and terminating the cover crop. Potentially, other costs such as nutrient inputs may be reduced with cover crops. The following is a brief description of the partial budget analysis methodology employed by the Soil Health Institute when assessing the economics of SHMS.

Results of partial budget analysis do not involve current profitability levels of a farm but instead represent change in farm income due to ceasing an initial production practice and adopting an alternative production practice. A summary of methods applied in partial budget analysis is:

- The initial practice and the alternative SHMS practice are based on farm production practices.
- Partial budget results are derived from enterprise budget methodology which determines costs and benefits of the initial practice and the alternative practice.
- Expenses that are identical in the initial practice and the alternative practice are excluded.
- Change in farm income is calculated from the net change in costs and benefits.

Production Costs per Acre

Farm production practices are determined by field level data for field activities and inputs. Information includes seeds, fertilizers and amendments, pesticides, custom applications, equipment, and other inputs for each production practice. Seeds, fertilizers, pesticides, and custom applications are applied at recommended rates with established industry prices. Equipment is applied as field level inputs. Ownership costs, fuel, repairs, and labor costs are calculated using enterprise budget methodology (Kay and Edwards, 1999).

Ownership costs and repair expenses for machinery are estimated by applying standard formulas to representative prices of new equipment (Givan 1991; Lazarus and Selly 2002). Machinery performance rates of field activities are applied to estimate time requirement of an activity which is applied to an hourly wage rate for determining labor costs for field activities (USDA, NASS 2019). Costs for grain drying and hauling are average commercial rates. Farm operations with on-farm drying and/or having ownership of trucks for hauling realize these costs as corresponding operating expenses, labor costs, and ownership costs.

Ownership costs of machinery are determined by the capital recovery method which determines the amount of money that should be set aside each year to replace the value of equipment used in production. This measure differs from typical depreciation methods, as well as actual cash expenses for machinery. Amortization factors applied for capital recovery estimation coincide with prevailing long-term interest rates (Edwards 2005). Interest rates applied are from the Federal Reserve Bank of Kansas City (2019). Representative prices for machinery and equipment are based on industry list prices and other reference sources (Deere & Company 2019; MSU 2019; UI 2019).

Partial Budget Analysis

Partial budget analysis is based on the principle that incremental production changes have effects in one or more of the following components of farm profitability.

- 1) Reduced Expense as a Benefit
- 2) Additional Revenue as a Benefit
- 3) Additional Expense as a Cost
- 4) Reduced Revenue as a Cost

The summation of 1) and 2) minus the summation of 3) and 4) is the net impact of the production change. A positive net impact indicates that farm income increases due to the production change, while a negative net impact indicates that farm income decreases (ISU 2018).

Table 1 is an itemized example of the analytical procedure that compares *costs* and *benefits* of ceasing field activities and inputs of an initial practice and adopting an alternative SHMS. In this example, planting cover crops as a SHMS entails initial expenses for seed and planting. Termination of cover crops includes typical expenses for herbicide application or a roller-crimper field activity. In some circumstances, cover crop termination could occur with no expense, such as if winter killed. Other production inputs, labor, operating expenses, and equipment ownership could either decrease (*benefits*) or increase (*costs*). SHMS could result in increased revenue (*benefits*) by increasing yield or crop price received, providing cover crops for cattle grazing, or resulting in harvested forage from cover crops. Examples of potential crop price premiums increasing revenue in SHMS partial budget analysis are non-GMO production and crops produced with organic certification, if the price premiums are attributable to adopting a SHMS. Decreased yields due to cover crops reduce revenue as *costs*. *Cost/benefit* analysis applied to partial budgeting is the result of comparing the summation of *costs* and summation of *benefits*.

Table 1. Description of Costs and Benefits Analysis

BENEFITS	COSTS
Reduced Expense	Additional Expense
<i>Production Inputs</i>	<i>Production Inputs</i>
<i>Labor</i>	<i>Labor</i>
<i>Other Operating Expenses</i>	<i>Other Operating Expenses</i>
<i>Equipment Ownership</i>	<i>Equipment Ownership</i>
Additional Revenue	Reduced Revenue
<i>Increased Yield</i>	<i>Decreased Yield</i>
<i>Increased Crop Price</i>	
<i>Grazing Value</i>	
<i>Forage Harvested</i>	
Total Benefits	Total Costs
Benefits - Costs = Change in Net Farm Income	

Proper application of partial budget analysis requires that production practices entail similar technologies for calculating costs and benefits. Standardized technologies for comparison are inherent in research plot trials and farms which have ongoing conventional production practices for observation and data collection. Comparing current SHMS with discontinued conventional production practices necessitates approaches which standardize data collected for partial budget analysis.

Farmers who have adopted SHMS evaluate each production year whether to continue or to revert to a conventional production practice with increased tillage. Also, planting of cover crops is annually evaluated to determine its efficacy. Profit maximizing farmers maintain knowledge of the array of production methods, inputs, and machinery available to achieve economic efficiency in farm management.

SHI obtains information from farmers for comparing SHMS and conventional production practices with an interview approach of data collection. Questions for conventional production practices are directed to determine current methods, inputs, and machinery that would be applied in the absence of the presently employed SHMS. Historical methods, inputs, and machinery are not included in data collected during interviews for determining conventional production practices. Similarly, technological advances in crop yields must be accounted for when evaluating yield changes that might be attributed to SHMS. Farmers do not report yield increases that have occurred since adoption of SHMS but only report yield changes that are attributable to the SHMS. In some circumstances, farmers have comparable land tracts for reporting yield changes due to SHMS. Generally, yield changes due to SHMS are subjective reports based on observations from other farms and comparisons with county yields from secondary data sources. SHI partial budget methodology rectifies temporal issues for comparing initial production practices with adopted SHMS and applies standardized technologies which eliminate changes over time in methods, inputs, machinery, and crop yield.

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