USING CROP BUDGETING SPREADSHEETS CAN ASSIST PRODUCERS IN EVALUATING THE COST EFFECTIVENESS OF ADOPTION OF THE VARIOUS PRECISION AGRICULTURE TECHNOLOGIES

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ABSTRACT

Precision Agriculture Technologies permit flexibilities in producing crops. The use of easily modified crop budgets can provide producers with flexibilities when analyzing the profitability of their agricultural enterprise. The Excel workbook used to create the Nebraska Crop Budgets is available via the internet for those wanting to modify the assumptions used to create them. Each of 51 different crop/system combinations is included as a separate worksheet. There are two major sections in each budget: Field Operations where labor, fuel, repairs, and other ownership costs are estimated and materials where herbicide, fertilizer, custom operations, etc. are listed. Data used to calculate these two sections are entered in four separate worksheets called *Materials*, *Operations*, *Power Units*, and *General Variables*. Changes made to any item in these worksheets will be reflected in every budget where it is used. Estimates for each field operation are calculated using functions developed by the American Society of Agricultural and Biological Engineers (ASABE) and assumptions about individual field machines that are entered into the *Operations* worksheet. Each of these field operations is associated with a power unit such as a tractor, self propelled machine, or a stationary power unit that has been entered in the *Power Units* worksheet. Other information used to calculate crop budgets such as wage rates, fuel prices, interest rates, overhead costs, and real estate values and taxes are entered in the *General Variables* worksheet. Budgets may be modified by changing any of the above assumptions or adding or deleting individual field operations and materials used by an individual crop budget.

INTRODUCTION

The producer is challenged with selecting equipment, operations and practices which may increase the profitability of the operation. Many Precision Agriculture Technologies may increase yields and/or reduce costs but are these increases and/or decreases enough to pay for the cost of implementing the various Precision Agriculture Technologies?

The Excel workbook used to create the Nebraska Crop Budgets, which is available via the internet, permits modification of the assumptions used to create

them. Each of 51 different crop/system combinations (Table 1) is included as a separate worksheet.

Table 1. 2012 Nebraska Crop Budgets

Crop/Bdgt #	**Description**	
Alfalfa/1	Dryland	Fall Establishment
Alfalfa/2	Dryland	Spring-Seeded with Herbicides
Alfalfa/3	Pivot Irrig	Spring-Seeded with Herbicides
Alfalfa/4	Canal Irrig	Established with Oats
Alfalfa/5	Dryland	Large Round Bales
Alfalfa/6	Pivot Irrig	Large and Small Bales
Alfalfa/7	Gravity Irrig	Large Square Bales
Corn/8	Dryland	Conventional, Continuous, 90 bu Yield Goal
Corn/9	Dryland	No-Till, RR & Bt, RW & ECB, Continuous, 120 bu Yield Goal
Corn/10	Dryland	No-Till, SmartStax, Continuous, 125 bu Yield Goal
Corn/11	Dryland	No-Till, Bt ECB after Soybeans, 125 bu yield Goal
Corn/12	Dryland	Ecofallow Corn follows Wheat, 2 Crops in 3 Years, RR & Bt ECB, 125 bu Yield Goal
Corn/13	Gravity Irrig	Ridge-Till, Bt, ECB & RW, Continuous, 230 bu Yield Goal
Corn/14	Gravity Irrig	Ridge-Till, SmartStax, Continuous, 240 bu Yield Goal
Corn/15	Pivot Irrig	No-Till, Bt ECB & RW, Continuous, 235 bu Yield Goal
Corn/16	Pivot Irrig	No-Till, SmartStax, Continuous, 245 bu Yield Goal
Corn/17	Pivot Irrig	Bt ECB & RW, Continuous, 225 bu Yield Goal
Corn/18	Pivot Irrig	SmartStax, Continuous, 235 bu Yield Goal
Corn/19	Pivot Irrig	No-Till, Bt ECB, after Beans, 240 bu Yield Goal
Corn Silage/20	Pivot Irrig	No-Till following Corn
Dry Beans/21	Pivot Irrig	Conventional with Wheat Cover Crop
Dry Beans/22	Gravity Irrig	Conventional Using Canal Water
Dry Beans/23	Pivot Irrig	Conventional Using Pumped Water
Grain Sorg/24	Dryland	Conventional, 105 bu Yield Goal
Grain Sorg/25	Dryland	No-Till, 125 bu Yield Goal
Grain Sorg/26	Dryland	Ecofallow, after Wheat, 2 Crops in 3 Years, 115 bu Yield Goal
Grain Sorg/27	Pivot Irrig	No-Till, Limited Irrigation, 165 bu Yield Goal

Grass/28	Pivot Irrig	Fall Establishment
Grass Hay/29	Dryland	Large Round
Oats/30	Dryland	No-Till, 90 bu Yield goal
Pasture/31	Pivot Irrig	Grazing (11 AUM)
Millet/32	Dryland	Stubble Mulch Fallow, fb Wheat, 2 Crops in 3 Years, 22 cwt Yield
Sorg-Sudan/33	Dryland	Annually Planted, Large Round
Soybeans/34	Dryland	Tilled Seedbed, Roundup Ready®
Soybeans/35	Dryland	No-Till, Roundup Ready® after Corn
Soybeans/36	Dryland	No-Till Roundup Ready® Continuous
Soybeans/37	Pivot Irrig	Tilled Seedbed, Roundup Ready® after Corn
Soybeans/38	Gravity Irrig	Ridge-Till, RR after RR Corn
Soybeans/39	Pivot Irrig	No-Till Narrow Row, Roundup Ready® after Corn
Soybeans/40	Pivot Irrig	No-Till Narrow Row, Continuous
Soybeans/41	Pivot Irrig	No-Till Drilled, Roundup Ready® after corn
Sugar Beets/42	Canal Irrig	Roundup Ready®, One Pass Tillage
Sugar Beets/43	Pivot Irrig	Roundup Ready®, One Pass Tillage
Sunflower/44	Dryland	No-Till following Corn or Grain Sorghum
Sunflower/45	Dryland	Ecofallow after Wheat, 2 Crops in 3 Years
Wheat/46	Dryland	No-Till after Row Crop, 45 bu Yield Goal
Wheat/47	Dryland	No-Till Fallow, 1 Crop in 2 Years, 60 bu Yield Goal
Wheat/48	Dryland	Stubble Mulch Fallow, 1 Crop in 2 Years, 53 bu Yield Goal
Wheat/49	Dryland	Clean-Till Fallow, 1 Crop in 2 Years, 49 bu Yield Goal
Wheat/50	Dryland	No-till Wheat before corn, 2 Crops in 3 Years, 65 bu Yield Goal
Wheat/51	Pivot Irrig	No-Till after Beans, 100 bu Yield Goal

Each budget has two main sections (Figure 1), a *Field Operations* section and a *Materials and Services* section. This paper will discuss the *Materials and Services* section first even though it is located below the *Field Operations* section in the worksheet.

The *Materials and Services* section lists purchased inputs such as seed, chemicals, and fertilizers and purchased services such as custom hired operations, scouting services, and crop insurance. These inputs are entered in a worksheet

named “Materials” and included in this section using a drop-down menu. This approach allows the price of an input to be changed in one place on *Materials* worksheet and this new price to be applied to the *Materials & Services* section in every budget where it is used.

The entry of a material or service in the *Materials* worksheet is straight-forward. There is a column where the name is listed. For this system to work correctly each product or service must have a unique name. There are columns for Category, which is a name that will be seen on the individual budget when a product or service has been selected, Purchase Price, Purchase Unit, Applied Unit, Applied Units/Purchased Units, and Applied Price. Applied price is the only one of these that is calculated and the rest are simply entered. The reason for this calculation is many materials are purchased using a different unit than that used in the budget. For instance, the price of fertilizer is often given in dollars per ton but application rates in a budget may show it as pounds per acre. By entering the price per ton in the purchase price and entering 2000 in the Applied Units / Purchased Units column, the price per pound is calculated for that fertilizer.

The budget section called *Field Operations* is where labor, fuel, repairs, and other ownership costs are estimated. These estimates are calculated using functions from the American Society of Agricultural and Biological Engineers (ASABE) handbook and inputs for individual field machines that are entered into the *Operations* worksheet. Inputs include a machine’s cost, age, annual use, hourly fuel use, and acres covered per hour. Using these inputs and wage rates and fuel prices from the General Variables worksheet, the per acre cost of labor, fuel, repairs, and ownership costs are calculated. These costs are summed for each operation and for each cost category.

The Repairs and Ownership calculations are divided into subsections called “Power” and “Imp” (Implement). The “Imp” cost is for the implement used in a particular field operation. The “Power” cost is for the associated unit that is powering that operation.

Data used to calculate the “Power” costs are found in the *Power Units* worksheet. It is similar to the *Operations* worksheet in that prices, ages, and hours of use are used to obtain depreciation and repair costs using ASABE formulas. In order for the calculations from a power unit to show up on a budget, the power unit must be selected for an implement in the *Operations* worksheet.

Two other inputs must be entered in both the *Operations* and *Power Units* worksheets. They are “Repair Category” and “Depreciation Category”. These are categories used by ASABE functions to calculate repairs and depreciation and are entered using a drop-down menu.

While most of the cost information for the Nebraska budgets comes from the *Field Operations* and *Materials and Services* section discussed above, some other information such as interest, overhead, real estate opportunity costs and real estate taxes are also included. The information used to calculate these expenses are entered in the *General Variables* worksheet. They include interest rates, overhead costs, and real estate values and taxes.

After the entries have been made in the *General Variables, Power Units, Operations*, and *Materials* worksheets, the cost of field operations may be estimated by selecting the machine operations to include using drop-down menus and entering a value for Times or Qty. If an operation is done once, simply

entering a “1” will cause the labor, fuel, repairs, and ownership costs estimates to appear. The cost of Materials and Services will be calculated by choosing those to be included using drop-down menus, and entering a percentage for the Percent Acres Applied and an Application rate. All cost estimates will be made from those entries. There is a column called “Operation Index” which is used to show the operation associated with the material or service but its use is optional.

The final entry for calculating a budget is selecting the type of real estate. This is done using a drop down menu. If you want to change the types of real estate available for selection or the real estate prices associated with a land type, this can be done on the “General Variables” worksheet. Budgets may be modified by changing any of the above assumptions or adding or deleting operations and materials that are used by an individual crop budget.

Figure 1 shows Budget 16, Corn, No-Till, SmartStax, Continuous, 245 bu yield goal (230 bu Actual Yield). It shows the estimated expenses and cost per bu and cash cost per bu. To save space we did not include the column ”Your Estimate” in the figure. Let’s look at adding GPS-RTK to our sprayer when applying Balance Flexx and Bicep II Magnum which costs a total $45.18/acre. The cost of operating our sprayer for this operation (number 3 under field operations) is $4.45/acre. If we have a 60 foot sprayer and estimate that we have 7% overlap, one needs to increase the cost of materials by 0.07 of $45.18/acre or $3.16. Also the cost of application, $4.45/acre, would be increased by 0.07 or 31¢/acre. It is also possible that the reduced overlap may increase crop production from eliminating the double rate of the herbicides.

If the cost of adding the Precision Application Technology is $10,000 the producer in spraying this herbicide treatment would pay for it in 2,882 acres.

The above example shows one way that the Nebraska Crop Budgets can be used to analyze the impacts of Precision Application Technology. Another way is making several changes and examining how the cost of production is affected. Still another is to examine how relative changes in the prices of the inputs will affect all budgets.

The general principle is that for producers to maximize the benefits of increased flexibility in production due to technology gains, they should be looking for financial tools that provide increased flexibility in analysis.

Figure 1 Budget Example

2012 Budget 16. Corn, No-Till, SmartStax, Continuous, 245 bu yield goal (230 bu Actual Yield)
Pivot Irrigated, 800 GPM 35 PSI, 9 acre-inches

	Field Operations	Times or Qty	Unit	Labor @ $20.00 /Hr	Fuel @ $3.50 and Lube	Repairs Power	Repairs Imp.	Ownership Power	Ownership Imp.	Total
1	Spray	0.2		0.20	0.10	0.05	0.14	0.24	0.17	0.90
2	Anhydrous Apply	1		2.80	3.26	0.22	0.82	4.87	3.07	15.04
3	Spray	1		1.00	0.48	0.23	0.72	1.18	0.84	4.45
4	Plant	1		3.67	1.83	0.85	4.07	4.33	2.14	16.89
5	Spray	0.25		0.25	0.12	0.06	0.18	0.30	0.21	1.12
6	Spray	Custom								
7	Spray	Custom								
8	PivotD 125'Lift	9	ai	6.25	67.22	2.94	18.68	4.26	11.17	110.52
9	Combine Irr Corn	1		4.40	8.45	5.59	2.90	15.76	4.06	41.16
10	Cart	230	bu	1.95	2.49	0.45	0.26	2.30	4.86	12.31
11	Truck	Custom								
12	Dry Grain	Custom								
	Total for Field Operations			20.52	83.95	10.39	27.77	33.24	26.52	202.39

	Materials & Services		Operation Index	Percent Acres Applied	Application Rate	Application Unit	Applied Price	Total
	2,4-D Ester 4#	Herbicide	1	20%	1.5	pint	2.19	0.66
	Balance Flexx	Herbicide	4	100%	4	ounce	4.60	18.40
	82-0-0	Fertilizer	2	100%	245	lbs N	0.48	117.60
	Bicep II Magnum	Herbicide	3	100%	2.1	quart	12.75	26.78
	Corn SmartStax	Seed	4	95%	0.41	bag	325.00	126.59
*	Corn	Seed	4	5%	0.41	bag	185.00	3.79
	Regent 4 SC	Insecticide	4	5%	4.16	ounce	7.15	1.49
	10-34-0	Fertilizer	4	100%	6	gallon	4.70	28.20
	Spirit	Herbicide	5	25%	1	ounce	13.00	3.25
*	Crop Oil Concentrate	Herbicide	5	25%	2	pint	1.04	0.52
*	Spray	Custom	6	35%	1	acre	6.00	2.10
*	Lorsban 15 G	Insecticide	6	5%	5	pound	2.20	0.55
*	Brigade 2EC	Insecticide	6	10%	5.12	ounce	1.09	0.56
	Mustang Max EC	Insecticide	6	20%	2	ounce	1.84	0.73
	Spray	Custom	7	40%	1	acre	6.00	2.40
	Headline AMP	Fungicide	7	40%	10	ounce	1.80	7.20
	Haul Grain bu	Custom	11	100%	230	bushel	0.12	27.60
	Dry 4 Points Removed	Custom	12	100%	230	bushel	0.24	55.20
	Scouting Irrigated Corn	Scouting		100%	1	acre	10.00	10.00
	Irrigated Corn Premium	Crop Insurance		100%	1	acre	21.00	21.00
	Total Materials & Services		32,800	seeds per acre, 80,000 per bag,5% Refuge				454.62

*Insecticides for rootw orm (refuge), 1st brood European corn borer (10% of refuge), w estern bean cutw orm, and spider mites, respectively.

	Total listed costs for Field Operations and Materials & Services					657.01
	Interest on Opns Capital	$ 597.25	cash expense @	8.00%	for 6.0 mo.	23.89
	Total Operating and Use Related Ownership Costs					680.90
	Overhead (accounting, liability insurance, vehicle cost, office expense)					20.00
	Real Estate Opportunity	Pivot (State)	$ 4,343	per acre @	4.00%	173.72
	Real Estate Taxes		$ 4,343	per acre @	1.00%	43.43
	Total Cost per Acre Including Overhead					918.05
	Cost per bu					3.99
	Cash Cost per bu					2.89