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Agricultural
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Farm Management

Replant Wheat to Corn or Soybeans?

Break-Even Analyses Based on Expected Contribution Margins

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Introduction

Currently, farmers receive government payments independent of the crop mix they plant. In the past, Indiana farmers have planted from 600,000 acres to over 1,000,000 acres in wheat. Expected wheat yields are 55% of rotation corn yields on well-drained and sloping soils, 50% on somewhat poorly drained uplands, and 45% on poorly drained dark soils. Planted in the fall, wheat provides favorable erosion control on highly erodible soils, even if it is used only as a cover crop and then killed in the spring.

The question of when to replant wheat to corn or beans is important. Why? Wheat yields and quality are highly variable. While some of this variability is because of weather-related factors which occur in late May or June, wheat yields are often affected by events occurring before that time. Therefore, farmers can decide to switch from wheat to corn or soybeans as they finish planting their other acres to corn or soybeans.

Just how low can wheat yield be before a person would be better off replanting the field to corn or soybeans? This publication explains how the numbers look based on costs from the *Purdue Crop Guide* (ID 166), *B-95 Input Form Guide Book* (CEC-11), and yields from *Influence of Production Practices on Yield Estimates for Corn, Soybeans, and Wheat* (ID 152), when harvest prices are $3.50 for wheat, $2.50 for corn and $6.00 for soybeans. This publication then discusses how a farmer can use contribution margin analysis to determine how to increase land, labor, and machinery resources.

The Problem

The objective is to find the wheat yield that would be expected to produce the same per acre contribution margin as if the acre were replanted to corn or beans. Contribution margin is revenue minus variable costs. The contribution margin is the return to land, labor, and machinery resources. Therefore, to calculate the break-even wheat yield, make the per acre contribution margins from each crop equal.

The replant decision can be postponed until spring planting of corn and soybeans is about completed. At that date, the only variable costs remaining for wheat are the harvest fuel and repairs, say, $4 per acre. For corn or soybeans not yet planted, variable costs also include fertilizer, seed, chemicals, tillage and harvest fuel and repairs, dryer fuel, and interest. Corn and soybean fuel and repair costs are based on plow tillage. If the wheat is killed by herbicide and the corn and soybeans are no-tilled, increase chemical cost and decrease fuel and repairs. Since the wheat will be harvested four months earlier than corn, beans, or double crop beans, add $.10 interest to the wheat price to get the fall equivalent price.

[1] *The author thanks colleagues Alan Miller and Robert Taylor for their helpful suggestions.*

Wheat to Corn?

Assume a Crosby-type soil with an expected corn yield of 130 bushels if planted and harvested on ideal dates. If the wheat acreage is planted last after planned corn or soybean acreage on May 27 and harvested November 4, the expected corn yield is 75% of 130 = 97.5 bushels because of the late planting date. Example 1 shows that the per acre contribution margin for corn is $140.00.

Example 1
Expected revenue, variable costs, and contribution margin for corn are:

Revenue: 97.5 bu @ $2.50	$244
Less variable costs	
Fertilizer and Lime[1]	$19
Seed and Chemicals	43
Repairs and Fuel	26
Dryer Fuel	9
Interest	7
	$104

Per acre contribution margin for corn:
$244 - $104 = $140

[1]Corn fertilizer is $43 less $24 of the $30 wheat fertilizer which is assumed available for corn.

Example 2 shows how the break-even wheat yield, the unknown or "Y" in the algebraic formula, is found when the corn contribution margin is $140.

Thus, if your expected wheat yield is less than 40 bushels/acre, you would have a larger expected contribution margin by replanting wheat to corn.

Example 2
Per acre revenue minus variable costs = break-even wheat contribution margin

[(wheat price + interest to corn harvest) x (Y wheat yield)]
- (harvest fuel and repairs) = (corn contribution margin)
[($3.50 + $.10) x (Y)] - $4 = $140
3.60 Y - $4 = $140
3.6 Y = $144
Y = 40 bushel

Wheat to Soybeans?

What if you were to switch from wheat to soybeans? Suppose best plant/harvest date yields for rotation soybeans are 32% of rotation corn. Then 32% of 130 = 42 bushels. However, if planted May 27 and harvested November 4, the expected bean yield is 92.5% of 42 bushels or 39 bushels. Example 3 shows that the per acre contribution margin for soybeans is $166.00.

Example 3
Expected revenue, variable costs, and contribution margin for soybeans are:

Revenue: 39 bu @ $6.00	$234
Less variable costs	
Fertilizer and Lime[2]	$ 0
Seed and Chemicals	40
Fuel and Repairs	23
Interest	5
	$68

Per acre contribution margin for soybeans:
$234.00 - $68.00 = $166

[2]Soybean fertilizer is "0." Presumably, more phosphate and potash were applied for wheat than will be removed by soybeans.

Example 4 shows how the wheat yield needed to break even is found from the soybean contribution margin.

In these examples, the break-even yield for wheat is similar at 40 bushels when compared to corn and 47 bushels when compared to soybeans. Especially when planted around June 1, soybean yields are likely less variable than corn yields. Therefore, plant soybeans unless corn is needed in the current year or unless more acres of beans in the current year will adversely affect the crop rotation acreage for the next year.

Double Crop?

Suppose you plan to plant double crop soybeans after the wheat and expect a yield of 25 bushels @ $6.00/bu harvest price. How do you compute the break-even wheat yield compared to corn or single crop beans? First, you must find

Example 4
Per acre revenue minus variable costs = break-even wheat contribution margin

[(wheat price + interest to soybean harvest) x (Y wheat yield)]
- (harvest fuel and repairs) = (soybeans contribution margin)
[($3.50 = $0.10) x (Y)] - $4 = $166
3.60Y-$4 = $166
3.6Y = $170
Y = 47 bushel

Example 5

Revenue: 25 bu @ $6.00	$150
Less variable costs	
Fertilizer and Lime	$11
Seed and Chemicals	53
Fuel and Repairs	8
Wheat dryer fuel	2
Interest	4
	78.00

Per acre contribution margin for double crop soybeans: $150.00 - $78.00 = $72

the contribution margin from double crop soybeans as shown in Example 5.

Then you must subtract the double crop contribution margin (CM) of $72.00 from the corn or bean contribution margin as shown in Example 6.

Example 6

CM corn	=	$140
CM double crop	=	72
		$ 68
CM bean	=	$166
CM double crop	=	72
		$94

The result is the contribution margin the wheat will have to contribute to the double crop activity in order for the contribution margins from corn or beans and wheat-double crop beans to be equal. Example 7 (p. 4) shows how the break-even wheat yields are found.

Thus, if you expect more than a 20 or 27 bushel wheat crop, you'll have a larger contribution margin by producing wheat-double crop beans. With expected wheat yields of less than 20 bushels, replant to corn or beans.

Likely, you'll have different expected yields, costs, and/or prices. Try several combinations of expectations using the same math processes as above and you'll get appropriate answers for your situation. When deciding which crops to raise, and perhaps anything else except taxes, "past costs don't count." It's expected future revenue and costs that you consider in a decision.

The point in time when you make the decision will dictate which costs to consider. Before you plant wheat, you'll also want to use all the wheat variable costs in your calculations, not just the harvesting fuel and repairs.

Optimization Using Contribution Margin Analysis

Compare crop contribution margins as you select your crop mix. Recognize that you want to select acreage of crops so as to get the highest possible total contribution margins for your farming operation.

You want to select crops where you realize the highest contribution margin per unit of scarce resource. Strawberry per acre contribution margin

Example 7
Per acre revenue minus variable costs = break-even wheat contribution margin

[(wheat price + interest to corn/bean harevst) x (Y wheat yield)]
- (harvest fuel and repairs) = (corn or soybeans contribution margin)

[($3.50 + $0.10) x(Y)] -$4 = $68 corn CM
3.60Y-$4 = $68
3.6Y = $72
Y = 20 bushel

3.60Y-$4 = $94 soybean CM
3.6Y = $98
Y = 27 bushels

may be much higher than corn. However, you and your crew can't produce many acres of strawberries. You can realize much higher returns (total contribution margin) to your labor, land, and machinery resources by producing corn, soybeans, and perhaps wheat and beans or sorghum double crop.

For the total farm operation, acres may not be the most limiting resource. Therefore, a simple comparison of contribution margin per unit of a particular resource may produce misleading results. The business goal is to find the set of activities that maximizes the contribution margin to all scarce resources on the farm. This is the difference between what is essentially partial budgeting versus whole farm budgeting.

With your new "freedom to farm" opportunities, selecting the best crop rotation is again an important question. Your best crop rotation is partly dependent upon your machinery set.

Your corn planter is a very scarce resource on May 1 and on every other day until you get your crop planted. You can find out just how scarce (really how valuable) it is in terms of its per hour job contribution margin. By calculating such values for different size planters, you have useful information for selecting the best size machine for your needs.

With a pencil, it's time consuming to calculate all the possible contribution margins for your scarce resources each day of the season. In 1968, several persons at Purdue used a linear program math process to create a computer program to handle this in a few minutes. Improved versions of this program continue to be used in an annual Purdue Top Farmer Crop Workshop on campus or as requested. Farmers use the computer to "test before they invest" in changes in their crop mix, tillage system, machinery size, and/or farm size.

Since the first session, 7,000 mostly Cornbelt farmers have created 25,000 computer budgets. They've tested bigger machinery to improve timeliness, then tested adding land because they were too timely, then tested bigger machinery, then again added land, etc. Some bought one farm too many instead of just renting more land, but most were quite successful. That process is continuing.

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