Strategies for wheat producers facing climate change

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Climate change researchers project that fall and winter rainfall will increase in the Pacific Northwest. These changes pose interesting management decisions for wheat farmers in the low rainfall regions of the Pacific Northwest.

Wheat regions in the Pacific Northwest can be separated into three precipitation zones based on annual precipitation: less than 12 inches, 12 to 18 inches, and 18 to 24 inches. Where annual precipitation is less than 12 inches, a wheat/fallow rotation is followed. In the 18- to 24-inch zone, continuous cropping is practiced, with wheat as a crop option. In the 12- to 18-inch zone, crop options range from a wheat/fallow rotation to crops grown on an annual basis, depending on soils and management. The general trend toward increased winter precipitation increases the possibility of successfully planting on an annual basis within the 12- to 18-inch precipitation zone. Some farms within this zone already successfully plant on an annual basis and are interested in adding diversity to their operations by adding peas or biofuel crops such as canola and camelina into their rotations (Figures 1–3).

IMPACT

AgTools™ allows farmers to better understand financial and planting options, as well as associated impacts to farm profitability under uncertain future climates, technologies, and prices. With predicted increases in winter precipitation, there is a trend to diversify and add biofuel crops such as canola and camelina into rotations. Experiments with crop rotations that incorporate biofuel crops have shown promise for the potential of increased wheat yields and increased net returns. For the representative farm studied, the additional investment in machinery to switch to a continuous cropping system of winter wheat and canola would generate higher profits.

REACCH researchers recently set up a case study to demonstrate how AgTools™ software can be used to evaluate the profitability and feasibility of such changes in crop rotations at the individual farm level. This software is designed to analyze a farm's liquidity, solvency, profitability, and repayment capacity. This case study was set up to represent a plausible farm in eastern Oregon that receives an average of 16 inches of rainfall annually. It is representative of a 3,800-acre wheat farm that currently follows a winter wheat/fallow rotation on 1,425 acres each year using direct-seeding (no-till) practices. Half of the acreage is cropped each year, and the other half is left in chemical no-till fallow to conserve soil moisture, reduce soil erosion, and reduce fuel usage. Additionally, 475 acres are planted to spring wheat. Thus, each year, the farm has 1,425 acres in winter wheat and 475 acres in spring wheat following 1,900 acres of fallow.

Most farms in this zone practice summer fallowing to capture moisture in the fallow phase to increase crop yield in a dry year and reduce crop yield variability. On shallow soils that are unable to store substantial moisture, such as the north, east, and south fields from the case study, fields are not fallowed even though yields are low. Some farms in the same precipitation zone crop wheat annually on deeper soils, and climate change is expected to make this practice more common in the region.

The increased winter precipitation anticipated with climate change is expected to increase wheat yields. However, researchers in the REACCH project have estimated that the annual variability in wheat yields could increase by as much as 20 percent with higher incidences of insects and wheat diseases. Also, experiments with crop rotations that incorporate biofuel crops have shown promise for the potential of increased wheat yields and increased net returns.

In the past, the grower felt the added equipment expense for this farm, along with labor and input costs, did not justify the marginal annual sales generated from switching to annual cropping of wheat or other crops. However, costs have been rising over the past several years, and the farm's net income has been declining each year. Thus, the grower has decided to examine the feasibility of alternative cropping rotations.

University research and Extension faculty, industry representatives, and agricultural lenders were consulted to obtain current loan and balance sheet information, along with expected future yields and prices for winter wheat, spring dry peas, winter canola, and camelina over a 10-year period. This information was inputted into the AgTools™ software to conduct an economic assessment of the various cropping rotation options to determine how changes in input and output costs and changes in projected debt-

Figure 1. *Camelina is an ancient oilseed crop with new potential. Photo by Darrin Walenta.*

Figure 2. *Canola seed produces an oil that can be used for fuel or for cooking. Photo by Lynn Ketchum. Copyright Oregon State University.*

to-asset ratios would impact the financial position of this representative farm in the future. In addition to the changes in inputs and outputs associated with changing to a continuous cropping system, the farm also needs to obtain a $325,000 loan to purchase an additional tractor and combine to complete the farming operations in a timely manner. Three alternative crop rotations were considered: winter wheat followed by dry peas, winter wheat followed by canola, and winter wheat followed by camelina. The cash flow was estimated for each of the owned and leased fields on the farm to project net income on the farm.

The projected net incomes from each crop rotation are presented in Table 1. Using an 8% discount rate, the net present values were calculated to determine the most profitable crop rotation.

Table 1. *Projected net income by crop rotation.*

Year	Winter wheat after fallow ($)	Winter wheat after dry peas ($)	Winter wheat after canola ($)	Winter wheat after camelina ($)
1	244,906	522,832	664,281	397,894
2	298,928	561,775	707,287	432,717
3	215,082	475,814	618,582	346,946
4	365,832	636,995	783,688	503,615
5	161,414	433,013	577,182	299,976
6	279,959	560,404	708,352	422,441
7	123,757	411,458	557,113	273,998
8	263,903	549,945	699,222	407,118
9	131,694	414,753	561,984	272,601
10	227,091	514,298	664,987	366,313

The results are presented in Table 2. From a profitability perspective, a continuous winter wheat and canola cropping system was the most profitable across all field types on the farm. The second most profitable system on the north and east fields was winter wheat and camelina, while winter wheat after dry peas fared slightly better on the leased south and west fields. Looking at the feasibility of each cropping system on a whole-farm basis, the winter wheat following canola cropping system generated higher net incomes, lower debt-to-asset ratio, and higher current ratios over the 10 years. Thus, the additional investment in machinery to switch to a continuous cropping system of winter wheat and canola would generate higher profits for this farm then their current practices.

Table 2. *Net present value of 10 years' net returns for possible crop rotations by field.*

	Net present value at an 8% discount rate ($/acre)			
Crop rotation	North field	East field	West field (leased)	South field (leased)
Wheat after fallow	639	1,113	231	65
Wheat after dry peas	231	65	589	490
Wheat after canola	1,466	2,039	758	669
Wheat after camelina	953	1,490	431	319

As shown by this example, AgTools™ provides a useful decision tool for growers. It allows them to better understand financial and planting options, as well as associated impacts to farm profitability under uncertain future climates, technologies, and prices.

Figure 3. *Yellow fields of canola create a patchwork landscape where growers rotate crops to help reduce soil erosion and increase net returns. Photo by Brad Stokes.*