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1992 Alternative Crop Rotation Enterprise Budgets Eastern Whitman County, Washington

Kathleen Painter
David Granatstein
Baird Miller

COOPERATIVE EXTENSION
Washington State University

1992 ALTERNATIVE CROP ROTATION ENTERPRISE BUDGETS

EASTERN WHITMAN COUNTY

WASHINGTON STATE

Kathleen Painter
David Granatstein
Baird Miller

Department of Agricultural Economics
Department of Crop and Soil Sciences
Cooperative Extension
Washington State University

Table of Contents

Note

Enterprise costs and returns vary from one farm to the next and over time for any particular farm. Variability stems from differences in:

- Capital, labor, and management resources.
- Type, size, and age of machinery.
- Cultural practices.
- Size of farm and enterprise.
- Crop yields.
- Input prices.
- Commodity prices.
- Government farm program provisions.

Costs can also be calculated differently depending on the intended use of the cost estimate. The information in this publication serves as a general guide for a modern and well-managed eastern Whitman County farm as of 1992. To avoid drawing unwarranted conclusions about costs and returns for any particular farm or group of farms, you must examine closely the assumptions used in this publication. If they are not appropriate for your situation, adjust in the costs and/or returns.

1992 ALTERNATIVE CROP ROTATION ENTERPRISE BUDGETS, EASTERN WHITMAN COUNTY, WASHINGTON

Kathleen Painter, David Granatstein and Baird Miller[1]

ACKNOWLEDGMENTS

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INTRODUCTION

Dryland farmers in eastern Washington are under economic pressure from low commodity prices, increasing production costs, and declining government subsidies. Growers constantly examine innovative practices and alternative rotations to improve profitability and resource stewardship. In 1989, a team of scientists from Washington State University and University of Idaho conducted a study of 24 eastern Washington dryland farms using alternative practices or rotations considered uncommon.

Detailed descriptions of farm operations and associated costs were gathered from most of the farms. This information was the basis for three of the alternative systems. In addition to the farmer-based systems, a continuous wheat system was evaluated using data from the USDA Integrated Pest Management plots near Pullman, Washington. This publication compares enterprise budgets for these four alternative systems with two common conventional crop rotations: winter wheat/dry peas and winter wheat/spring barley/dry peas.

Costs and returns were standardized for conditions in the eastern region of Whitman County, Washington (Figure 1). Annual precipitation ranges from 18 to 22 inches in this region.

[1] Research Associate, Department of Agricultural Economics; Research Associate and Extension Agronomist, Department of Crop and Soil Sciences, Washington State University.

More than half of the precipitation occurs from November through April. Eighty-eight percent of the farmland in the region is classified as highly erodible by the Soil Conservation Service. As a result, nearly all farmers in this area are required to have an approved farm plan to control soil erosion if they participate in the government farm programs.

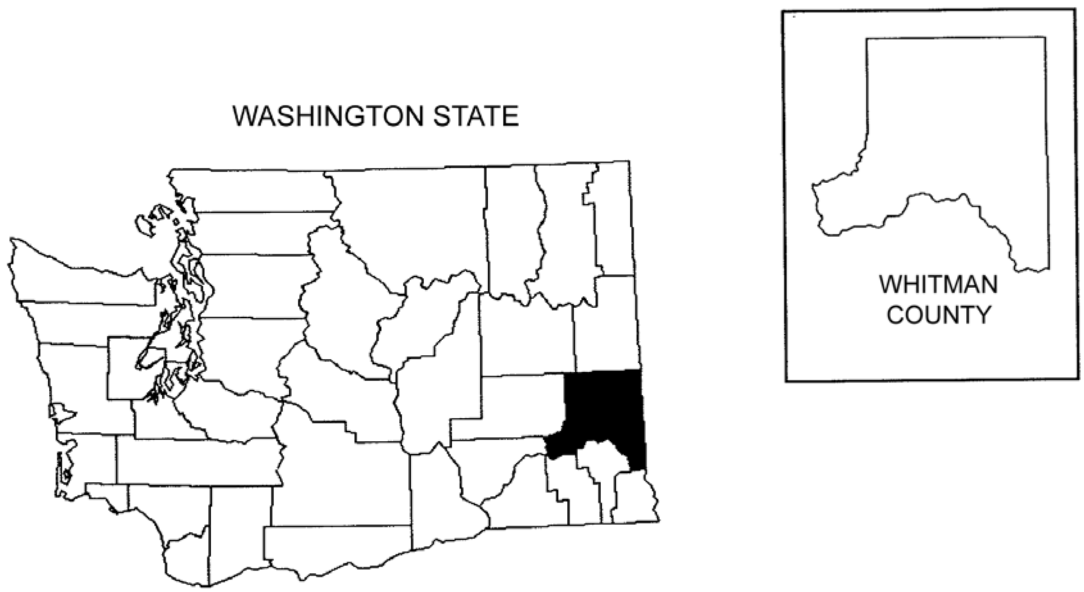

Figure 1. Area of study.

Both government payments and costs of complying with government commodity program restrictions are incorporated in these budgets, because most farmers in this region participate in the farm program. Furthermore, provisions of the 1990 Farm Bill (Food, Agriculture, Conservation and Trade Act of 1990), which reduce the base acreage eligible for payments by 15%, are reflected in the projected crop returns used in this publication.

When using these budgets, you are encouraged to tailor the information to your own situation. This will result in a much better estimate of the economic costs and returns of these various alternatives. You can use the blank spaces on the right-hand side of the itemized cost tables in the Appendix to revise input use. Producers, agricultural lenders, and others will find this information helpful to identify enterprise strengths and weaknesses, plan production adjustments, determine financial requirements, make marketing decisions, and resolve other business management problems.

DISCUSSION OF CROP ROTATIONS

Crop rotation is a well established agronomic practice for managing pests, improving nutrient cycling, and reducing economic risk. However, changing markets, weather, and federal farm policy regulations often are barriers to using more complex rotations and prompt many growers to continually adjust their cropping choices. The information presented in this bulletin is intended to help growers examine crop rotation alternatives by outlining specific production operations and their associated costs for several rotation alternatives.

In eastern Washington, dryland farmers rely on winter wheat as the principal source of income. Winter wheat is well adapted to the climatic conditions of the region. In addition, government commodity programs have provided generous price supports for wheat during the past 50 years, although these support payments have been declining in recent years. However, growers have other possible crop options including barley, lentils, chickpeas, grass seed, alfalfa, sweetclover, buckwheat, and rapeseed/canola. Farmers have tried these crops over the years, but the lack of established markets, economic risks due to volatile market prices, and restrictive government farm policy discourage widespread use of these crops.

Any crop or rotation option presents benefits and tradeoffs, both agronomic and economic, that a grower must consider. Research in test plots has shown yield improvements for wheat and peas by moving from a wheat/pea rotation to a wheat/barley/pea rotation, due to the reduction of soil-borne diseases. In addition, herbicide use is typically reduced in the 3-year rotation. Field-level comparisons of yields in a 2-year versus a 3-year rotation have been inconclusive, however, due to large variations in results. For this reason, this study uses equivalent wheat and pea yields for the 2- and 3-year rotations.

Farmers face a number of barriers to changing crop rotations. Lack of an adequate barley base can be a barrier to adopting a 3-year rotation. While rapeseed and canola contain bio-active compounds that show promise in controlling diseases, nematodes, and weeds, a limited market has slowed production of this crop. Perennial grass seed production can drastically reduce erosion, but volatile prices in recent years make it a risky investment. In addition, restrictions on the required field burning may become a problem in the future. Markets need to be developed for crops such as chickpeas and red lentils if these crops are to gain farmer acceptance. Forage legumes such as alfalfa and sweetclover are known for their soil improving qualities and were once widely grown. However, an inadequate number of local livestock operations and high transportation costs have discouraged forage legume production.

This study compares the economic performance of the two most common rotations in eastern Whitman County, wheat/pulse and wheat/barley/pulse, with four alternative rotations. Information for these crop rotations came from a variety of sources. Two farmer surveys conducted in the study area were the major source of information. One survey, conducted in 1989, interviewed farmers using alternative practices. The second survey interviewed a random sample of Palouse farmers, of which 92 farmed in the eastern Whitman County study area. Additional information for these rotations came from Washington State University research plots and consultation with Washington State University scientists and Extension personnel.

Conventional Rotations

Cl: Wheat/Pulse

A winter wheat/spring pea or lentil rotation maximizes the rotational acreage in the higher-value winter wheat crop. Fall and spring field operations are evenly distributed as well. However, high erosion potential exists on winter wheat planted in pulse residue, especially with conventional tillage. As a result, reduced or no-till winter wheat in pulse stubble may be necessary to meet conservation compliance. A recent survey in the study area showed that wheat/pea or wheat/lentils was the dominant rotation for 28% of the farmers. Dry peas are more commonly grown than lentils, possibly due to greater lentil price fluctuations.

This conventional rotation is the more profitable of the two conventional rotations under the assumptions of equivalent wheat and pea yields for both rotations. Overall, it had the second highest average annual returns over variable costs and the third highest returns over total costs (Table 4). Using min-till winter wheat and spring peas, this rotation has the highest predicted soil loss of 6.53 tons/acre/year (Table 5). Nitrogen loss through leaching beyond 0.25 meters was estimated at 12.54 lbs/acre/year, which is moderate.

C2: Wheat/Barley/Pulse

A winter wheat/spring barley/pulse rotation is being adopted by more growers for a number of reasons. Of farmers surveyed in the eastern Whitman County study area, 35% used wheat/barley/pulse as their dominant system. Fewer weed and disease problems can be expected in this rotation compared to the 2-year wheat/pulse rotation, translating into lower pesticide needs. Winter annual weeds are discouraged, but spring annuals are favored. Growers have an additional opportunity to plant a malting barley that will bring a premium price over feed types if the quality is acceptable. This rotation entails more spring field work than a wheat-pulse rotation, and extended wet conditions in the spring can be a problem.

Using the yield assumptions in Table 1, this rotation had lower average returns over total and variable costs than the wheat/pulse rotation. Overall, net returns for this rotation varied from third highest to last under the various price levels (Table 4). Soil erosion is estimated to be less than the wheat-pulse rotation because high erosion potential following the pulse crop is limited to one year in three. Using min-till winter wheat and conventional till spring barley and spring peas, annual erosion was estimated at 6.26 tons/acre. Leaching of nitrogen was estimated at 9.75 lbs/acre/year (Table 5). All alternative rotations have lower predicted erosion rates than either conventional rotation.

Alternative Rotations

A 1: Wheat/Barley/Sweetclover

Green manure crops, such as sweetclover, winter peas, or alfalfa, were a common part of rotations before the widespread use of nitrogen fertilizer. With adequate forage growth, these legumes can supply much or all of the nitrogen needs of a subsequent winter wheat crop. Several growers in this study hoped to slow soil acidification by using a green manure as a substitute for at least a portion of the nitrogen fertilizer. Among all rotations studied, this rotation had the lowest variable costs of production and lowest agrichemical use. However, a year of crop income is sacrificed. This must be weighed against the direct effect on costs and yields in the following wheat crop and the intangible benefits of long-term soil improvement.

A green manure crop is typically used once every 3 to 6 years in a rotation cycle. Legume green manures require special management, particularly for insects, soil fertility and pH, and inoculation. Time of incorporation will affect total nitrogen content, rate of N release, moisture use, and moisture availability to the following crop. Green manures have generally been incorporated with a moldboard plow or disc, but this poses problems in meeting residue requirements on the following wheat crop. Results using chemical kill/notill management have been inconsistent.

This rotation has the lowest average returns over variable costs of all the rotations. Returns over total costs, which include machinery and land costs, are slightly better, placing fourth or fifth overall. However, no land charge is made for the green manure crop. Interest on the costs of the fallow year is charged to the following wheat crop, as the success of this crop depends on the nitrogen produced by the sweetclover. (A similar budgeting procedure is used for the fallow year preceding rapeseed in rotation A2.) If rent is charged for this fallow year, the rotation would average about $15 less per year, placing it last in returns over total costs as well.

Using min-till winter wheat and conventional till spring barley underseeded with clover, this rotation has just two-thirds the predicted annual erosion of the wheat/pulse rotation. The nitrogen leaching estimate is very low, 3.79 lbs/acre/year. However, nitrogen leached from the green manure is not included. While winter wheat yields are comparable to those of the wheat/barley/pulse rotation due to the added nitrogen from the green manure, the barley yield is slightly lower due to the low fertilization levels used in this study.

A2: Rotations With Rapeseed or Canola

Rapeseed and canola differ in their chemical composition and resulting use. Canola has low levels of erucic acid and glucosinolates, making the oil suitable for human consumption and the meal usable as a livestock feed. In contrast, these compounds are present in high levels in rapeseed making the oil suitable for industrial uses only. Canola and rapeseed represent a plant family (Brassica) quite different from cereals and legumes. This fact allows them to reduce soil-borne diseases and nematodes, but they may face their own disease problems if grown more than once every 4 or 5 years in a field.

The rotation presented here assumes planting a winter rape or winter canola crop in August on summer fallow ground. With this system, a good stand and considerable plant growth can be achieved by winter, leading to good winter survival and effective weed suppression and erosion control. Large amounts of residue are left after rape harvest for the next winter wheat crop. Winter rape will produce a very deep and strong root system that can penetrate compacted layers and improve soil tilth, which benefit the growth of future crops. Winter rape typically requires an insecticide treatment for the cabbage seed pod weevil, but herbicides are seldom needed after planting. Several provisions of the 1990 Farm Bill make rapeseed/canola an attractive alternate crop, particularly the income support with a marketing loan.

A 6-year rotation of winter wheat/summer fallow/winter rapeseed/winter wheat/spring barley/peas has average net returns over variable costs close to those for C2, wheat/barley/peas. Average net returns over total costs are second highest for this rotation (Table 4). The annual erosion rate for this rotation is 5.74 tons/acre, which is exactly the weighted average T value, or soil tolerance factor, for the study area. This means that long-term productivity can be maintained with this level of soil erosion. Annual nitrogen leaching is estimated to be equivalent to the wheat/pulse conventional rotations at 12.46 lbs/acre/year (Table 5).

A3: Rotations With Perennial Grass

Much land currently devoted to dryland cereal production originally was covered with perennial grasses. These grasses helped develop the highly productive soils in the Palouse by adding organic matter and erosion protection. Conservation minded growers, Cooperative Extension and researchers have long recognized the value of including a perennial grass in the rotation to protect and rebuild the soil resource. By growing a grass with a marketable seed, growers receive an economic return (given favorable prices) for this excellent conservation practice. But grass seed markets are volatile and cannot support a large production acreage. This, as well as past government program penalties, has minimized the use of perennial grass in the Palouse.

A grass seed stand is typically kept for 6 or 7 years. Annual burning after harvest is necessary to stimulate adequate seed production, but future burning restrictions could pose a problem. With the advent of no-till management, many growers are using chem-kill and no-till to remove the grass crop and plant a spring crop for returning a field to grain production. This eliminates the potential erosion associated with moldboard plowing of the sod. The sod itself breaks down slowly and provides erosion protection for several years after removal.

A 24-year rotation consisting of 6 years of bluegrass, a 3-year no-till sequence of lentils, winter wheat, and lentils, and a 15-year conventional sequence of winter wheat/peas/winter wheat/spring barley/peas is used for this study. It is based on an actual farm in the study area. Net returns are highest for this rotation under all price level scenarios, given the price and yield assumptions in this study. The annual erosion rate is just 4.90 tons/acre, but nitrogen leaching is predicted to be nearly 17 lbs/acre/year due to high levels of fall nitrogen applied to bluegrass.

A4: Continuous Wheat Production

Growers and researchers have been experimenting with continuous wheat production, because wheat is the most consistently profitable crop in the region. Approaches include continuous no-till winter wheat (with and without burning), a mix of winter and spring wheat, and various tillage combinations. Continuous no-till wheat begins to resemble the perennial grass that was native to the region, and virtually eliminates erosion while increasing soil organic matter. However, disease and weed problems can increase in these systems. Eliminating straw residue, either through burning or moldboard plowing, can also cause management problems.

The budget presented here is derived from the USDA Integrated Pest Management research plots near Pullman, WA, where a winter wheat/winter wheat/spring wheat rotation was used with a combination of no-till and minimum till. This system has the highest variable cost of production and highest agrichemical use of all the rotations. Downy brome and jointed goatgrass can pose serious weed problems. Chisel plowing winter wheat stubble left 30-35% residue cover, versus 5% when the moldboard plow was used. Soil loss in a continuous winter wheat system using uphill plowing is estimated to be 40% of that in a wheat-pea system. Soil-borne diseases will damage roots in this type of system so that placement of fertilizer near the seed becomes critical.

Farm program participation prevents continuous wheat production over an entire farm due to base acreage constraints. Use of this rotation on a whole-farm basis would require growers to have a 100% wheat base Eastern Palouse farms surveyed during 1990 averaged 46% of their cropland in wheat base.

Average net returns for this rotation were fourth, fifth, and last overall under various price level scenarios (Table 4). Excellent erosion control is achieved with this rotation, with an estimated annual soil loss of just 2.61 tons/acre. Nitrogen leaching was estimated to be highest for this rotation, however, at 20.71 tons/acre/year.

ASSUMPTIONS

The following assumptions were used in developing the enterprise data:

Farm Size

These budgets are based on an average farm size of 1275 acres.

Yields

Expected yields are rotation specific and presented on a per-acre basis. These yields are based on farmer surveys in the study area, research trials, and consultation with Washington State University agronomists. A 1990 random sample survey of farmers in the Palouse, of which 92 were in the Eastern Whitman County study region, provided data for the conventional rotations, C1, winter wheat/spring pea, and C2, winter wheat/spring barley/spring pea. Additional budget data for these systems are available in Washington State University Cooperative Extension Bulletin EB1437, 1991 Crop Enterprise Budgets, Eastern Whitman County, Washington State. A 1989 survey of 24 farmers using alternative practices in the Palouse provided data for Rotation Al, winter wheat/spring barley/sweetclover green manure, and Rotation A3, a 24-year system including 6 years of bluegrass. A2, a rotation including rapeseed production, came from Washington State University Cooperative Extension data. The USDA Integrated Crop Management research plots at Washington State University provided the data for A4, no-till winter wheat/min-till winter wheat/min-till spring wheat.

Table 1: Expected Yield Per-Acre by Rotation, Tillage Method and Crop.

Rotations	Winter Wheat CT	Winter Wheat NT	Spring Wheat CT	Spring Barley	Dry Peas	Lentils	Rapeseed	Bluegrass
	(Bu/A)	(Bu/A)	(Bu/A)	(Tons/A)	(CWT/A)	(CWT/A)	(CWT/A)	(Lbs/A)
Conventional:								
C1: WW/DP	80				20			
C2: WW/SB/DP	80			1.9	20			
Alternative:								
A1: WW/SB/CL	80			1.7				
A2: WW/F/WR/WW/SB/DP	80			1.9	20		20	
A3: 6xBG + NTSL/NTWW/ NTSL + 3x (WW/DP/WW/SB/DP)	80	80			20	11		500
A4: NTWW/WW/SW	60	72	45					

Legend: WW = Winter Wheat, DP = Dry Peas, SW = Spring Wheat, SB = Spring Barley, CL = Sweetclover, F = Summer Fallow, WR = Winter Rapeseed, BG = Bluegrass, NTSL = To-Till Spring Lentils, NTWW = No-Till Winter Wheat, SL = Spring Lentils, CT = Conventional Tillage, NT = No-Till

Prices for Government Commodity Program Crops

Wheat and barley are eligible for deficiency payments under government commodity programs. Participating producers receive a per bushel government payment equal to the difference between the 5-month national average market price and the legislated target price for that commodity. In the Palouse, the local market price tends to be higher than the national average market prices for wheat, due to a transportation advantage for this region. The farmer is eligible for deficiency payments on the proven yield for a portion of the base acreage. In the past, proven yields reflected a farmer's average yield over time. However, these yields were frozen in the 1985 Farm Bill legislation. Farmers' proven yields tend to be about 15% lower than their proven yields.

No crop can be grown on a legislated "set-aside" proportion (5% for 1992) of the base. On "flex" acreage, which is an additional 15% reduction in paid base initiated by the 1990 Farm Bill, farmers are free to plant other program crops. Thus, wheat and barley prices are made up of the local market price plus the national deficiency payment on the proven yield on 85% of the planted acreage. In addition, a transportation charge of $0.45 per bushel for wheat and $18.00 per ton for barley is subtracted, as shown in the following formula:

Average Expected Price on Planted Base Acreage =

$$\text{Market Price} + \left(\frac{\text{Proven Yield}}{\text{Actual Yield}}\right)\left(\text{Deficiency Payment}\right)\left(\text{Base Acreage } - 15\% \text{ 'Flex'}\right) - \text{Transportation Charge}$$

$$= \text{Market Price} + \left(0.85\right)\left(\text{Deficiency Payment}\right)\left(0.85\right) - \text{ Transportation Charge}$$

Because winter wheat, the major cash crop for this region, has had wide price fluctuations over the last few years, low, moderate, and high price scenarios are examined. Local wheat prices are $3.25, $4.00, and $4.50 under these three scenarios. Smaller local market price fluctuations are predicted for barley, with prices under the low, medium, and high scenarios of $85, $95, and $105 per ton. The vast majority of farm operators participate in government commodity programs, so participation is assumed. Deficiency payment provisions tend to lessen these price swings. The following calculations were used to determine wheat and barley prices for the three price level scenarios:

CROP	WHEAT ($/BU)			BARLEY ($/TON)		
PRICE LEVEL:	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
	$/bu	$/bu	$/bu	$/bu	$/bu	$/bu
1. MARKET PRICE	3.25	4.00	4.50	85.00	95.00	105.00
2. DEFICIENCY PAYMENT						
CALCULATIONS:						
TARGET PRICE	4.00	4.00	4.00	94.84	94.84	94.84
NAT'L. MARKET PRICE	2.93	3.68	4.18	85.00	95.00	105.00
DIFFERENCE	1.07	0.32	< 0	9.84	< 0	< 0
x PROVEN YIELD/						
ACTUAL YIELD (0.85)	0.91	0.27	0.00	8.36	0.00	0.00
x BASE LESS FLEX (0.85)	0.77	0.23	0.00	7.11	0.00	0.00
3. TRANS. CHARGE	0.45	0.45	0.45	18.00	18.00	18.00
TOTAL PRICE (1+2+3)	**3.57**	**3.78**	**4.05**	**74.11**	**77.00**	**87.00**

Prices for Non-Program Crops

The following average expected market prices were used to calculate expected revenue and net returns. These prices represent what the farmer receives at the farm gate after all transportation costs are deducted.

Bluegrass, cwt.	$75.00
Dry Peas, cwt.	$ 9.00
Lentils, cwt.	$15.00
Rapeseed, cwt.	$10.00

Labor Costs

Labor cost, whether it represents hired labor or owner-operator labor, is valued at $10.00 per hour.

Land Tax

The land tax is estimated to be $4.00 per acre.

Fire and Hail Insurance

The per-acre crop insurance premiums are for hail and fire protection only. Premiums are calculated on the expected value of the crop. The premium is $0.90 per $100 of crop value insured for wheat and barley, $1.35 per $100 of crop insurance for peas and lentils, and $1.70 per $100 of insurance for bluegrass and rapeseed. This type of insurance is popular among farmers as it represents 100% coverage on all fields enrolled.

Interest Costs

The effective annual interest rate on operating capital and machinery is 9.5%. This interest rate represents both the direct cost of borrowed operating capital and the rate of return foregone on equity capital that could have been earned had it been invested elsewhere.

Overhead Costs

Overhead costs cover such items as shop cost, utilities, telephone, and legal and accounting fees. They are estimated to be 5% of total variable costs.

Rented Sprayer and Fertilizer Applicator

A 45-foot applicator is used for fertilizing. The rental fee is included in the cost of the fertilizer so no separate service charge is levied. A 60-foot sprayer is used for pesticide applications at a rental rate of $1.00 per acre exclusive of material cost.

Custom Work

The $25 per-acre charge for no-till seeding includes the costs for tractor, no-till drill, fuel, and operator. A custom rate of $4.00 per acre is assessed for aerial pesticide application.

Net Rent

Land costs are estimated using a net rent concept. Net rent represents the minimum return owner-operators must have to justify growing the crop themselves rather than renting the land to other operators. In this publication, land cost is an opportunity cost for the owner-operator, because it is a return that is foregone by producers as a result of choosing to grow the crop themselves. For the tenant farmer, net rent represents what the tenant must pay the land owner to use the land for producing a crop.

The typical lease agreement for wheat, barley and rapeseed in eastern Whitman County is one-third landowner and two-thirds lessee crop share, with the landowner paying land taxes plus one-third of the fertilizer and crop insurance expenses. The lessee covers all other production expenses. The landowner receives one-third of the crop returns, including deficiency payments, as estimated by the average expected price defined earlier. Net rent for wheat, barley and rapeseed is calculated by the following formula:

Net Rent = (1/3 expected yield x expected price) - 1/3 crop insurance expense -
1/3 fertilizer expense - land tax.

For dry peas and lentils the common lease arrangement is a one-fourth landowner and three-fourths lessee crop share, with the landowner paying land taxes, one-fourth the fertilizer, and one-fourth the crop insurance. Net rent for peas and lentils is calculated as follows:

Net Rent = (1/4 expected yield x expected price) - 1/4 crop insurance expense -
1/4 fertilizer expense - land tax.

A cash rent figure is used for bluegrass production, due to recent large fluctuations in bluegrass seed price and lack of data on crop share managements for bluegrass in this region. A recent survey of growers reported an average cash rent figure for Eastern Whitman County of $45.00 per acre.

No rent is charged for summer fallow or green manure land. Interest on the production costs for that year is assigned to the following crop, such as winter wheat in Rotation Al and rapeseed in Rotation A2, because the fallow or green manure is required to produce the following crop in that particular rotation.

Machinery Cost

Costs per hour of machinery use are the projected average hourly costs of new replacement machinery over its projected life. Although using projected cost of replacement machinery may overstate current production costs, it indicates the enterprise's ability to generate the earnings needed to replace depreciable assets. Increases in machinery prices result in depreciation claimed on assets purchased before price advances, which understates the amount of capital required for asset replacement. When an enterprise is evaluated to determine its long-run viability, it is important to consider its ability to replace depreciable assets on a replaceable cost basis.

Machinery costs were based on replacement prices and rates of annual use considered typical for each rotation on a 1,275-acre farm. The per-hour fixed and variable cost figures for each machine are determined by dividing the total fixed and variable cost figures by the typical annual hours of machine use for the representative farm (see example in Table A22). Machinery fixed and variable costs for a specific field operation are determined by multiplying the machine hours per acre times the per-hour fixed and variable cost.

Set-Aside Cost

For the conventional rotations, a budget for maintaining set-aside (fallow) land was computed to calculate set-aside costs on a per acre of crop planted basis. In 1992, for example, 5% of wheat base acreage must be placed in set-aside for farmers participating in government programs. This means that for every acre of planted wheat base, an additional 5.26% of an acre must be in set-aside. This figure is obtained by dividing one planted acre by that portion of base which is planted: 1/0.95 = 1.0526. Thus, the set-aside cost for an acre of wheat grown in 1991 is calculated to be 5.26% of the cost of maintaining an acre of set-aside. The same formula is used for calculating set-aside costs for an acre of barley.

For the alternative rotations in this bulletin, set-aside requirements were often fulfilled by a particular crop in the rotation. For Al (WW/SB/clover), the clover acreage fulfills set-aside requirements. For A2 (WW/SF/rapeseed/WW/SB/SP), the summer fallow acreage preceding rapeseed fulfills these requirements. In A3, the bluegrass rotation, the first-year bluegrass acreage can be used for set-aside because it is not harvested.' In A4, the continuous wheat rotation (NTWW/MTWW/MTSW), a separate min-till summer fallow (MTSF) budget was computed to calculate the cost of maintaining set-aside acreage.

COST AND RETURN SUMMARY

Total Production Costs by Crop and Rotation

Using the given assumptions, total production costs per acre (which include all variable and fixed costs except risk and management) and break-even selling prices for the various crop enterprises were estimated in Table 2. Note that the same crops may have different costs in different rotations. This is due mainly to varying machinery costs. Per hour fixed and variable costs will vary by rotation, because each rotation has different total annual hours. Also, set-aside costs fulfilled by summer fallow acreage are eliminated in those rotations which include summer fallow, a green manure, or grass establishment. If the break-even price is lower than or equal to the actual price, the producer will be covering total production costs, given the yield assumptions stated in the table.

Per-Acre Net Returns by Rotation

Net returns over variable costs and over total production costs were calculated using previously stated price and yield assumptions. Total costs include fixed and variable costs. Fixed costs are those costs that occur regardless of whether a crop is planted and produced. These costs include equipment depreciation, taxes, interest and housing costs, and land ownership costs. Variable costs are costs directly associated with the production of a crop, such as machine operation, hired labor, purchase of materials, and services. Table 3 lists net returns per acre over variable and over total costs for each crop option for the conventional and alternative rotations under the three price level scenarios.

Table 4 lists average net returns per acre over both variable and total costs for each rotation under the three price level scenarios. Rotation A3 (6 years of bluegrass/NT lentils/NT wheat/NT lentils/ 15 years of wheat/peas/wheat/barley/peas) is the most profitable under all price level and cost scenarios, given the assumptions in this study. This profitability can be attributed to bluegrass seed prices, which have rebounded following a slump in recent years. A conservative price of $0.75 per pound is used for this study. Rotation A2 (wheat/fallow/rapeseed/wheat/barley/peas) has the next highest returns over total costs at all price levels. The conventional wheat/pea rotation (C1) has the second highest returns over variable production costs under all price levels. In general, the alternative rotations A3 and A2 compete well with the conventional rotations, while the other two alternative rotations, Al (wheat/barley/ clover) and A4 (no-till wheat/wheat/spring wheat) do not. The conventional wheat/pea rotation (C1) performs better economically than the wheat/barley/pea rotation (C2), given the equivalent yield assumption used in this study.

Table 2. Total Production Costs and Break-Even Selling Prices.

Rotation/Tillage/Crop**	Total Cost	Expected Yield	Break-Even Price
	($/A)	(units/A)	($/unit)
CONVENTIONAL ROTATIONS			
Cl:			
CT Winter Wheat (bu)	269.50	80	3.37
Dry Peas (cwt)	256.66	20	12.83
C2:			
CT Winter Wheat (bu)	263.28	80	3.29
Spring Barley (tons)	210.85	1.9	110.97
Dry Peas (cwt)	259.74	20	12.99
ALTERNATIVE ROTATIONS			
A1:			
Winter Wheat (bu)	252.32	80	4.07*
Spring Barley (tons)	204.87	1.7	120.51
Sweet Clover	73.12	NA	NA
A2:			
Winter Wheat (bu)	256.73	80	3.21
Summer Fallow	101.90	NA	NA
Winter Rapeseed (cwt)	140.30	20	12.11*
Winter Wheat (bu)	256.73	80	3.21
Spring Barley (tons)	202.03	1.9	106.33
Dry Peas (cwt)	253.16	20	12.66
A3:			
Bluegrass, Year 1	218.15	NA	NA
Bluegrass, Years 2-6 (lbs)	250.63	500	0.50
NT Lentils (cwt)	187.44	11	17.04
NT Winter Wheat (bu)	275.55	80	3.44
NT Lentils (cwt)	194.78	11	17.71
Winter Wheat (bu)	271.36	80	3.39
Spring Barley (tons)	214.71	1.9	113.01
Dry Peas (cwt)	259.09	20	12.95
A4:			
NT Winter Wheat (bu)	272.88	72	3.79
Winter Wheat (bu)	251.64	60	4.19
Spring Wheat (bu)	239.56	45	5.32

* This break-even price represents the breakeven price required to reimburse the prod9cer for the production costs of the preceding year of sweet clover or summer fallow plus those of the current production year.
** NT=No-Till

Table 3. Net Returns Per Acre Over Variable and Total Costs ($/ac) by Rotation, Crop, and Price Level.

		RETURNS OVER VAR. COSTS			RETURNS OVER TOTAL COSTS		
ROTATION/ CROP	PERCENT OF LAND	HIGH PRICES*	MED. PRICES*	LOW PRICES*	HIGH PRICES*	MED. PRICES*	LOW PRICES*
Cl:		$/A	S/A	S/A	$/A	$/A	S/A
WHEAT**	0.50	195	173	156	55	33	16
PEAS	0.50	34	34	34	-77	-77	-77
C2:							
WHEAT**	0.33	202	180	163	61	39	22
BARLEY**	0.33	61	42	36	-46	-65	-70
PEAS	0.33	34	34	34	-80	-80	-80
Al:							
WHEAT***	0.31	230	208	191	72	50	33
BARLEY***	0.31	45	28	23	-57	-74	-79
CLOVER	0.37	-37	-37	-37	-73	-73	-73
A2:							
WHEAT***	0.17	202	180	163	66	44	27
FALLOW	0.17	-66	-66	-66	-102	-102	-102
RAPESEED	0.17	144	144	144	60	60	60
WHEAT***	0.17	202	180	164	67	46	29
BARLEY***	0.17	61	42	36	-37	-56	-61
PEAS	0.17	34	34	34	-73	-73	-73
A3:							
BLUEGRASS EST.	0.04	-131	-131	-131	-218	-218	-218
BLUEGRASS PROD.	0.21	260	260	260	124	124	124
NT LENTILS	0.04	64	64	64	-22	-22	-22
NT WHEAT***	0.04	163	141	124	48	27	10
NT LENTILS	0.04	57	57	57	-30	-30	-30
WHEAT***	0.25	192	171	154	53	31	14
BARLEY***	0.13	58	39	33	-49	-68	-74
PEAS	0.25	32	32	32	-79	-79	-79
A4:							
NT WHEAT**	0.33	130	110	95	19	-1	-16
WHEAT**	0.33	105	88	76	-9	-25	-37
SPRING WHEAT**	0.33	42	30	20	-57	-69	-79

*Effective price at the farm-Level, including government payments and net of transportation charges are $4.05/bu for wheat and $87.00/ton for barley under the HIGH price level scenario; $3.78/bu for wheat and $77.00/ton for barley under the MEDIUM price level scenario; and $3.57/bu for wheat and $74.11/ton for barley under LOW price level scenario. Prices remain constant for the remaining crops at $9/cwt for peas, $15/cut for lentils, $10/cwt for rapeseed, and $75/cwt for bluegrass seed.

**Includes summer fallow for set-aside requirements.

***Set-aside requirements are met by other crops in the rotation (clover, fallow, or bluegrass establishment)

Table 4. Average Annual Net Returns Per Acre Over Variable Costs and Total Costs by Rotation and Price Level.

ROTATION	RETURNS OVER VAR. COSTS			RETURNS OVER TOTAL COSTS		
	HIGH PRICES*	MED. PRICES*	LOW PRICES*	HIGH PRICES*	MED. PRICES*	LOW PRICES*
CONVENTIONAL:	S/A	S/A	S/A	S/A	S/A	S/A
Cl: WHEAT/PEAS	109	99	91	-13	-23	-31
C2: WHEAT/BARLEY/PEAS	99	85	78	-22	-35	-42
ALTERNATIVE:						
Al: WHEAT/BARLEY/CLOVER	73	61	54	-22	-34	-41
A2: WHEAT/FALLOW/RAPESEED/ WHEAT/BARLEY/PEAS	96	86	79	-3	-14	-20
A3: BLUEGRASS X 6/NT LENTILS/ NT WHEAT/NT LENTILS/ 3 X (WHEAT/PEAS/ WHEAT/BARLEY/PEAS)	124	115	109	4	-5	-11
A4: NT WHEAT/WHEAT/ SPRING WHEAT	92	76	64	-16	-32	-44

Soil Erosion Potential

Estimates of average annual soil erosion in eastern Whitman County range from 5 to 12 tons per acre, depending on crop residue and management factors. These are typically measured using the Universal Soil Loss Equation's cover management or "C" factor, which incorporates data on crop rotation, tillage practices, and yields to produce the C-factor ratio. This number is the ratio of erosion from the chosen crops and management practices to the erosion from a tilled fallow field.

Table 5 lists estimates of soil loss and nitrogen leaching for the conventional and alternative rotations. The two conventional-tillage conventional rotations are the most erosive.

Table 5. Predicted Soil Loss and Leaching of Nitrate-Nitrogen by Rotation.

Rotation/Tillage	Soil Loss	Nitrogen Leached
	(t/A/yr)	(lbs/A/yr)
Conventional:		
C1: WW/SP	6.53	12.54
C2: WW/SB/SP	6.26	9.75
Alternative:		
A1: WW/SB/CL	4.22	3.79
A2: WW/F/WR/WW/SB/SP	5.74	12.46
A3: 6xBG + NTSL/NTWW/NTSL + 3x (WW/DP/WW/SB/SP)	4.90	16.92
A4: NTWW/WW/SW	2.61	20.71

Legend: WW = Winter Wheat, SW = Spring Wheat, SB = Spring Barley, CL = Sweetclover, F = Summer Fallow, WR = Winter Rapeseed, BG = Bluegrass, NTSL = No-Till Spring Lentils, NTWW = No-Till Winter Wheat, SL = Spring Lentils, CT = Conventional Tillage, NT = No-Till

Note: Nitrogen leaching estimates the amount of nitrate-nitrogen from applied nitrogen fertilizer that moves below 0.25 meters soil depth using an attenuation factor approach. Painter (1992) provides detail on sources and methods for estimates in this table.

REFERENCES

Painter, Kathleen Marie. "Projecting Farm Level Economic and Environmental Impacts of Farm Policy Proposals: An Interregional Comparison." Ph.D. dissertation, Dept. of Agr. Econ., Wash. State University, 1992.

APPENDIX

DISCUSSION OF BUDGET INFORMATION

Detailed production cost and profitability data are presented in two tables for each crop in the alternative rotations. These tables include:

Table MA, A2A, ...: Schedule of Operations and Costs Per Acre

The "A" tables outline the schedule of field operations by calendar month, the type of machinery used, and the machinery and labor hours used per acre for each of the given enterprises. The costs of field operations are divided into two categories. The first is the fixed cost of owning equipment and land. Variable costs, the second category, include costs associated with operating machinery, labor use, and purchasing services and materials. Total production cost is the sum of fixed costs and variable costs.

Table MB, A2B, ...: Itemized Cost Per Acre

The "B" tables itemize the costs appearing in the "A" tables, "Schedule of Operations and Costs Per Acre." Most of the items are self-explanatory or have been previously explained. Two entries, "Machinery Interest" and "Tractor Interest," warrant additional explanation.

Machinery and tractor interest is calculated on the average annual investment in the equipment. The formula used to calculate the average annual machinery investment is:

$$\frac{\text{Purchase Cost} + \text{Salvage Value}}{2}$$

The 12% annual interest charge made against this average investment value represents an opportunity cost or interest paid on money borrowed to finance machine purchases, or both. Machinery interest cost for one acre of winter wheat, spring barley, spring peas, or set-aside is determined by multiplying the respective machine hours per acre times per hour interest costs (Table A15).

The last two tables in this Appendix contain cost data used to calculate the previous tables.

Table A28: Machinery Cost Per Hour of Use

Table A28 presents a sample machine complement used to derive the budgets. These complements vary by rotation, as different crops will have different machinery use requirements. This table presents the type of machines used on the representative farm and current replacement prices plus annual hours of use and estimated per-hour fixed and variable costs for a sample rotation (C2, wheat/barley/peas). Machinery fixed costs include depreciation, interest on investment, property taxes, housing, and insurance. Machinery variable costs include machinery repair, fuel, and lubrication costs.

Machinery prices are representative of what growers would pay to replace their machinery complement with new equipment. While this assumption may result in an overstatement of production costs currently experienced by producers, it provides an indication of the enterprise's ability to generate the earnings needed to replace depreciable assets. Continuing increases in the prices paid for replacement machinery due to inflation and improved technology mean that depreciation claimed on assets purchased prior to price advances understates the amount of capital currently required for asset replacement.

When an enterprise is evaluated to determine its long run viability, it is important to consider its ability to replace depreciable assets on a replaceable cost basis. It should also be noted that interest on investment represents a 12% opportunity cost to the enterprise. These are earnings foregone by investing in the machinery complement rather than in the next best alternative investment.

Table A29: Prices for Selected Inputs

Table A29 lists the prices for fuel, chemicals, and other inputs used to generate these budgets.

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