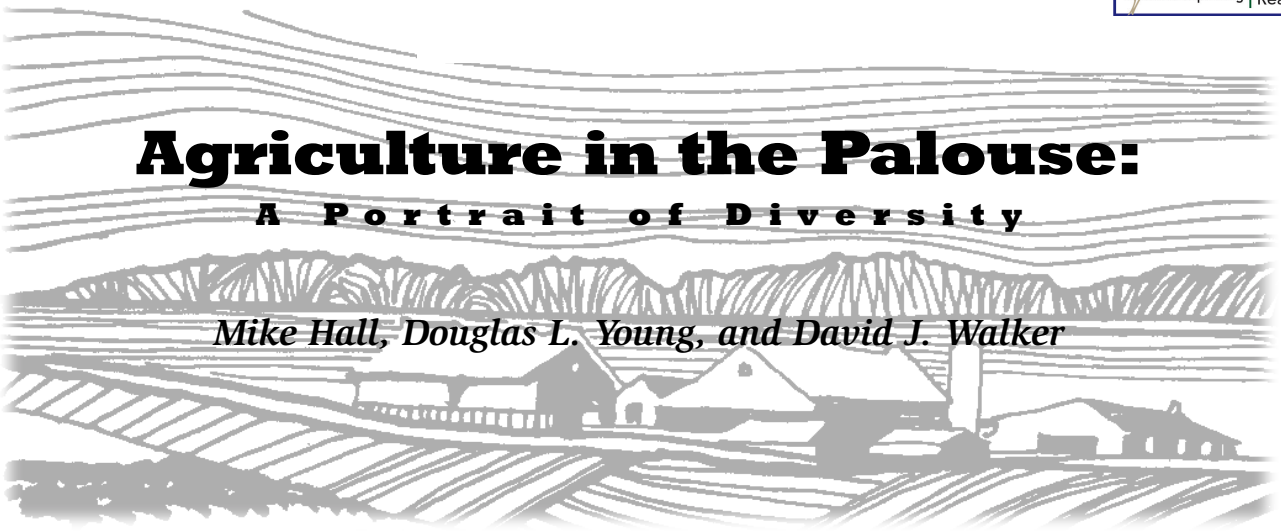

Agriculture in the Palouse:

A Portrait of Diversity

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Introduction

The objective of this bulletin is to report previously unpublished survey information on farm and farmer characteristics in the Idaho-Washington Palouse River Basin by precipitation zone. The general public regards the Palouse as a relatively homogeneous region of rolling hills and generous wheat yields. In fact, agriculture in the Palouse is more diverse than that in some larger wheat-producing regions in the United States such as Kansas. This diversity stems from wide variations in annual average precipitation, which ranges from an average of 11 inches per year along the western edge of the Palouse to a high of 26 inches per year at the eastern boundary. Soil diversity caused by climatic differences in the Palouse subregions leads to wide variations in crop yields, crop rotations, fertility management, pest management practices, and tillage.

Unfortunately, the standard statistics provided by Washington and Idaho Agricultural Statistics Services provide average yields, harvested acreage, and other annual data only at the county level. Similarly, the periodic U.S. Agricultural Census reports data at no lower level of aggregation than the county. Due to the climatic differences, average values for Whitman County, Washington, and Latah County, Idaho, the two counties that contain most of the Palouse River Basin cropland, are too imprecise for many uses. Individuals who need precise subregion agricultural information include farmers, agribusiness managers, investors, land appraisers, bank loan officers, attorneys, government agency personnel, agricultural scientists, and economists. Individuals who attempt to analyze problems based upon the "average" farm in Latah or Whitman counties will nearly always miss the mark in describing the situation of farms within a particular subregion. Lacking a statistically reliable source of agricultural information by precipitation zone, individuals have often been forced to rely upon incomplete information from non-random and casual sources for particular geographic subregions. This report may partially fill this long-standing need for more precise information by providing data for four subregions; Western, Central and Eastern Whitman County and West Latah County.

This bulletin summarizes previously unpublished information from part of a large multi-purpose survey which was conducted in the winter of 1989-90 (Carlson, Schnabel, Beus, and Dillman 1994; Halvorson 1991). While Palouse agriculture has changed slightly since 1989-90, there are good reasons for making this information available now. First, similar information on Palouse agriculture by precipitation zone from a scientifically random sample is not available elsewhere and there is a strong need for such information. Secondly, many of the results in this study on agricultural cultural practices, farm size, and other characteristics change only gradually. Thirdly, publication of these survey results provides a useful benchmark against which future surveys can be compared in order to determine trends. Given current budget constraints, it is likely that

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the interval between major surveys will lengthen so the "shelf-life" of a single survey must increase.

Diversity in the Palouse: Comparison to Kansas

The Palouse River Basin borders the rain shadow of the Cascades in the west and the western slopes of the Clearwater and Bitterroot Mountains in the east (Fig. 1.01). The Palouse covers roughly two million acres, including most of Washington's Whitman County and Idaho's western Latah County. Sixty percent of the Palouse is cropland (1.2 million acres) with winter wheat as the main crop. Of this cropland, nearly one million acres have slopes ranging from 8 to 30 percent (Beus 1990). Average annual precipitation increases from 11 inches in the west to 26 inches in the east. Precipitation falls mainly in the winter, when the ground is partially frozen and sometimes unable to absorb moisture and prevent runoff. Due to the severe slopes, the seasonal concentration of precipitation, and intensive tillage for winter wheat production, soil erosion is a serious problem in the Palouse. Multiple tillage passes to prepare winter wheat seedbeds leaves the ground vulnerable to water erosion in the winter months. Erosion claims an estimated 10 t/ac of topsoil annually, but it can exceed 100 t/ac on particularly severe slopes (U.S.D.A 1978).

FIGURE 1.01. The Palouse River Basin, Whitman County, Washington, and Latah County, Idaho.

The Palouse region comprises 1,221,000 acres of fertile wheatland. About 81 percent of the annual precipitation occurs during the months of October through May. Winters are relatively mild, allowing a 150-day growing season throughout much of the region. The extreme eastern region of the Palouse lies at a higher elevation with a shorter 100-day growing season on forest soils. The climate and deep fertile soils of the Palouse permit the record-setting dryland wheat yields for which the region is known. The highly productive soils were formed in deep loess under native prairie vegetation.

Soil formations vary across precipitation zones. This is partially a function of annual precipitation which influences native vegetation. Lower precipitation in the western Palouse produces less crop foliage, which produces less organic matter. Reduced foliage, coupled with the common practice of summer fallowing land every other year results in light soils with less humus and less water holding capacity. Generally, soil organic matter content rises from west to east. In central and eastern Whitman County higher average precipitation allows lusher vegetation, returning greater amounts of organic matter to the soil. Soils with more organic matter are better able to absorb and retain moisture. In the high rainfall western Latah County the soils are less productive due to leaching of soil nutrients. In addition, the higher elevation results in a shortened growing season.

Crop choice is limited in the Palouse due to soil, topographic, and climatic factors which vary across subregions. Soft white winter wheat is the major cash crop across the Palouse. In the moister eastern Palouse, wheat is rotated with a pulse crop - pea or lentils - and sometimes with spring barley or occasionally with canola for oilseed. Wheat in a wheat-barley-fallow rotation is most common in the central Palouse, and in the drier western region, wheat-fallow is the common cropping sequence.

While wheat is the major crop throughout the region, the Palouse is not nearly as homogeneous agronomically as some other major wheat producing regions like Kansas. Kansas was chosen to provide a perspective on Palouse wheat production because Kansas is the largest wheat producing state in the nation. During 130 years of state history, Kansas has become synonymous with wheat. Like the Palouse, Kansas produces winter wheat, although it specializes in a different market class, hard red winter wheat. Winter wheat, being a cool season crop, does well in temperate zones like Kansas and the Palouse. Winter wheat survives Kansas winters well and it is harvested before the hot summer temperatures of later June and July. Kansas wheat yields are much lower than in the Palouse, with a recent 10-year average of 34.1 bu/ac (Ham and Highan 1987). Yields are constrained by the short grain growing period from blooming to physiologic maturity, about 30 days in Kansas compared to 45 days in more favorable areas, and high day and night summer temperatures in Kansas that drain the plant's energy.

The leading wheat producing counties in Kansas are in the south-central region; Reno, Kingman, Sedgwick, Harper, and Sumner (Fig. 1.02). This premier wheat region comprises about 3,270,000 acres, about 50 percent greater than the Palouse. Over three-quarters of the harvested acres were planted into wheat in 1992 and these

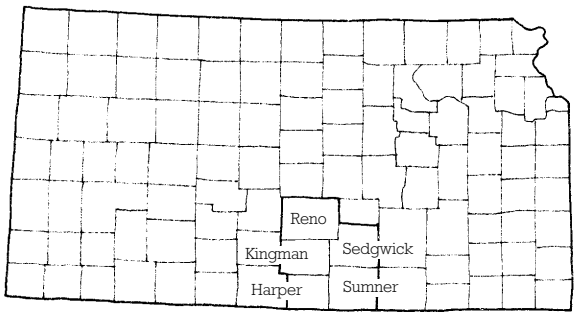

FIGURE 1.02. Kansas area map.

counties produced 13 percent of the wheat produced in Kansas that year. (U.S. Dept. of Commerce 1992). Soils, precipitation, yields, and management practices are fairly homogeneous. Even though this region is larger than the Palouse, it displays less climatological and agronomic diversity (Table 1.01).

Throughout most of the Kansas region, the growing season is 190 to 200 days, longer than the 100 to 150-day Palouse growing season. Average annual precipitation ranges from 32 inches in the east to 25 inches in the west over a 70-mile width. From east to west across the relatively short 62-mile width of the Palouse there is significant meteorological and agronomic diversity. Precipitation declines by 15 inches or 57 percent. The rainfall variation across the Palouse is more than twice the seven inch variation in the Kansas region and occurs over a smaller area. Although there is some in-

TABLE 1.01.
Comparison of the diversity in the Palouse and in the 5-county wheat-producing region of Kansas

	Region			
	Palouse		Kansas Region	
Item	Westernmost Subregion	Easternmost Subregion	Western	Eastern
Cropland (ac)	1,221,000		2,341,000	
Precipitation (in/yr)	11-14	18-26	25	32
Growing Season (days/yr)	150	100	190	200
Wheat yield (bu/ac)	54	73	32	32
Farm Size (ac)	1770	965	597	430
Crop Rotation (with wheat)	wheat-fallow	wheat-pea, wheat-barley-pea	continuous wheat	

tercropping of sorghum in the northwest, the relatively uniform soils and climate result in a single cropping pattern of continuous wheat throughout most of the Kansas region.

With this background from the well-known and fairly homogeneous wheat state of Kansas, the remainder of this bulletin is focused upon the diversity present in Palouse agriculture.

Survey description

The survey, "Palouse Agriculture; A study on Production Practices, Policies, and Problems," was conducted in the winter of 1989-90 as a joint project between Washington State University and the University of Idaho (Carlson, Schnabel, Beus, Dillman 1994; Halvorson 1991). The farm population was provided by the Agricultural Stabilization and Conservation

Service offices of Whitman County, Washington and Latah County, Idaho. To be eligible for the survey, farms had to be at least 38 acres in size and have a majority of their acreage located in one of the subregions. A random number generator was then used to select a systematic simple random sample of the 1464 farms in the population. About three-fourths of the farm population was in Whitman County and one-fourth was in Latah County.

A total of 322 farms were in the sample. Of these, 239 agreed to participate and produced useable responses, for a response rate of 75 percent. The sample consisted of 47 respondents from the western subregion of Whitman County, Washington, 68 each from the central and eastern subregions of Whitman County, and 56 from the west Latah County, Idaho subregion. The survey consisted of 132 questions and was administered in personal interviews that ranged from 30 to 180 minutes in duration. Some respondents did not answer all the questions, so sample sizes vary slightly on some questions. Questions with low response rates are less reliable, so sample size is provided for all results. Many questions referred to more than just the previous crop year. The time reference for various questions will be specified in reporting the results.

Table 1.02 provides perspective on how well the 1989 crop year approximates an "average" crop year in the Palouse. Average precipitation for the crop year beginning in September and ending in August are reported for western and eastern Whitman County subregions and the West Latah County subregion for the years 1985-92. Average yields for winter wheat and barley for Whitman and Latah

TABLE 1.02. Annual Precipitation and County Wheat and Barley Yields from Whitman County, Washington and West Latah County, Idaho, 1985-92 Crop Years.

	Annual Precipitation (in/yr)[2]			Yield (bu/ac)[3]			
	Whitman County Sites		West Latah				
	Western	Eastern	County	Winter Wheat		Barley	
Crop Year[1]	(Lacrosse)	(Pullman)	(Moscow)	Whitman	Latah	Whitman	Latah
1985-86	11.42	18.70	27.86	58.0	52.8	58.9	55.0
1986-87	15.80	19.50	25.18	67.1	66.9	61.7	60.8
1987-88	—	18.80	20.63	73.0	86.2	59.0	60.0
1988-89	14.61	16.00	27.30	70.0	73.9	70.0	65.0
1989-90	12.64	23.00	26.35	67.0	73.7	64.0	66.2
1990-91	9.70	20.40	26.55	80.5	80.0	67.5	56.6
1991-92	13.52	20.80	22.90	71.0	65.5	84.0	55.6
1992-93	11.98	16.70	—	61.0	61.1	46.0	60.3
8-yr. avg.	12.81	19.24	25.25	68.5	70.0	63.9	60.0

[1]Crop year starts in the previous September and continues through August of the year listed.

[2] USDA Ag. Research Service Pullman Weather Station, Washington, Moscow Weather Station, Idaho.

[3] Washington State Ag. Statistics, Idaho State Ag. Statistics.

counties have also been provided for the 8-year period. Averages indicate that the 1989 crop year was generally close to normal in both yields and precipitation, except for higher than normal precipitation in eastern Whitman County.

Farm characteristics

The average farm in the survey ranged from 1,768 acres in the western subregion to 965 acres in the west Latah subregion (Fig. 2.01). Farm size generally decreased from west to east in the Palouse, as precipitation increased, accommodating annual cropping. Lower yields and fallowing land every other year requires growers in the western subregion to farm more acres to generate sufficient income. Surveyed farmers in the western subregion had the highest percentage (25 percent) of land owned free of debt (Fig. 2.01). The percentage of land owned without debt was 3 to 8 points lower across the remaining Palouse subregions. Western subregion farmers also had the smallest percentage of rented land, 60 percent. Central subregion farmers had the largest percentage of rented land, 66 percent. The percentage of farms with at least some land rented was slightly over 80 percent of farms in all four subregions (Table 2.01).

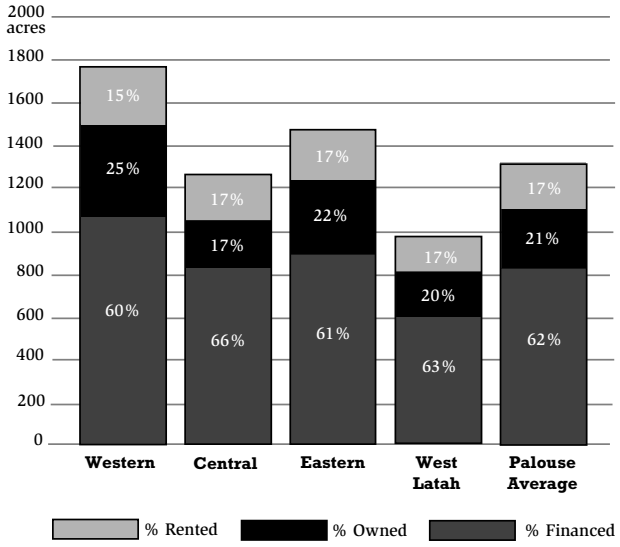

FIGURE 2.01. Average Farm Size in Acres and Percent of Farm Acreage Rented, Owned and Financed, by Precipitation Subregion.

TABLE 2.01. Percent of Farms or Farm Area with Selected Land Tenure and Commodity Program Bases by Precipitation Subregion, the Palouse River Basin, Southeast Washington, and Northwest Idaho, Winter of 1989-90.

	Whitman County				Palouse
Item	Western 11”-15”	Central 15”-18”	Eastern 18”-22”	West Latah 18”-26”	Average 11”-26”
Farms in Sample (No.)	47	68	68	56	239
			%		
Farms which are					
Renting land	83	84	81	82	82
Owning land	55	50	53	61	54
Financing land	32	35	43	52	41
Farms with					
Wheat base	96	97	93	96	95
Barley base	91	93	86	93	91
CRP	28	13	13	21	18
Greater than 100 ac in CRP	13	12	10	14	12
Farm area in					
Wheat base	53	44	46	42	46
Barley base	25	27	21	19	23
CRP	4	1	1	3	2
Range of CRP (acres)	15-900	2-672	3-280	5-306	2-900

TABLE 2.02. Percent of Farms by Gross Farm Receipts From Agricultural Sales and by Precipitation Subregion, the Palouse River Basin, Southeast Washington, and Northwest Idaho, 1988-89 Crop Year.

	Whitman County				Palouse
Gross Farm Receipts	Western 11"-15"	Central 15"-18"	Eastern 18"-22"	West Latah 18"-26"	Average 11"-26"
Farms in Sample (No.)	47	68	68	56	239
<$100,000	42	37	25	57	40
$100,000-$249,999	45	44	47	23	40

The percentage of farmland in the survey that was in wheat base for the government farm programs was highest in the western subregion, at 53 percent of available acreage (Table 2.01). This was seven percentage points greater than the Palouse average and 11 points greater than the west Latah subregion. Farmers in the western and west Latah subregions had a greater percentage of farms with land enrolled in the Conservation Reserve Program (CRP) than the rest of the Palouse, but acreage enrollment was relatively low throughout by state-wide standards. In the central and the eastern subregions annual cropping and favorable yields made the opportunity cost of enrolling land in the 10-year conservation grass-planting program prohibitively high. Profits in the western and west Latah subregions were limited by the less favorable growing conditions which made the CRP rent relatively more attractive.

The western subregion had the lowest income distribution with 87 percent of farms reporting gross farm receipts of less than $250,000 and only13 percent earning more. The eastern subregion had the highest income distribution with 28 percent of farms reporting gross receipts greater than $250,000 and 72 percent earning less. Even though farm size was the largest in the western subregion, lower rainfall and biannual cropping explain the lower incomes. While in the eastern subregion, annual cropping, the largest farm size in the annual cropping area, and high wheat yields account for the higher incomes.

Farm activities
Cropping activities

Crop rotations in the Palouse are a function of climate. West Latah had the greatest percentage of farmers with rotations that fall outside the four main rotations in the Palouse (Table 3.01). This partially reflects the greater rotation flexibility which higher precipitation permits. Higher rainfall also contributed to the greater number of farms raising peas or lentils in the eastern half of the Palouse. Farmers in the western subregion lacked the cropping options available to producers in the other subregions. With 11 to 15 inches of rain per year in the western subregion, most of the farms reported rotations including a year of summer fallow. The percentage of farms including the listed summer fallow rotations shrank to 2 percent in the west Latah subregion (Table 3.01). The central subregion was transitional with a little more than one-third reporting summer fallow and a substantial number also reporting peas and lentils. Readers should note that while a fair percentage of farms in the western and central regions reported growing some peas or lentils (Table 3.01), relatively few acres were devoted to these crops in these low rainfall subregions (Table 3.02). It is likely that limited areas with higher soil moisture within individual farms or within the subregions were selected for pea or lentil production.

Similar trends can be observed in the number of acres in each subregion devoted to specific crops (Table 3.02). Summer fallow, winter wheat following summer fallow, and barley accounted for 87 percent of the acreage in the western subregion. Farm-

TABLE 3.01. Percentage of Farms by Crop Rotation and by Precipitation Subregion, the Palouse River Basin, Southeast Washington and Northwest Idaho, 1989-90.

	Whitman County				Palouse
Rotation	Western 11"-15"	Central 15"-18"	Eastern 18"-22"	West Latah 18"-26"	Average 11"-26"
Farms in Sample (No.)	47	68	68	56	239
Other	19	22	26	41	27
WW/PL[1]	20	21	31	38	24
WW/SB/SF	32	34	6	2	18
WW/SB/PL	4	15	31	13	17
WW/SF	36	4	3	0	9
None	6	4	3	7	5

[1] WW = winter wheat, PL = peas or lentils, SB = spring barley, SF = summer fallow.

TABLE 3.02. Crops Present in the Palouse River Basin by Percentage of Acreage and Percentage of Farms, by Precipitation Subregion, Southeast Washington and Northwest Idaho, 1988-89 Crop Year.

	Western 11"-15"		Central 15"-18"		Eastern 18"-22"		West Latah 18"-26"		Palouse Average 11"-26"	
Item	Acreage	Farms	Acreage	Farms	Acreage	Farms	Acreage	Farms	Acreage	Farms
WW[1] following SF	37	87	24	85	12	66	5	50	20	72
WW following P/L	1	9	13	51	28	84	35	79	19	59
Summer Fallow	38	91	19	91	9	78	4	66	17	81
Barley	12	77	18	84	13	76	11	77	14	79
Spring Peas	1	6	13	53	17	60	17	63	12	48
Lentils	1	4	1	3	11	41	14	39	6	22
ACR Fallow	5	60	4	56	4	56	4	57	4	57
Spring Wheat	1	13	35	35	3	32	1	23	11	27
WW following WW	4	19	2	12	2	9	2	13	2	13
Alfalfa/Hay	<1	26	1	26	1	24	3	50	1	31
WW following Barley	<1	4	1	1	1	6	1	14	1	6
Green Manure	—	—	1	7	1	9	2	23	1	10
ACR Green Manure	—	—	1	7	1	9	1	23	1	10
Total in sample (ac and no.):	66,500	47	82,532	68	101,612	68	47,663	56	298,307	239

[1] WW = winter wheat, P/L = peas or lentils, SB = spring barley, SF = summer fallow.

ers in the remaining subregions spread their acreage among a wider assortment of crops, including peas, lentils, and winter wheat following peas or lentils. Farms in the west Latah subregion had more crop options available because of increased precipitation, while farmers in the western subregion were restricted to a limited number of proven crops and rotations adapted to lower precipitation levels. As expected, the frequency of growing peas or lentils increased from west to east (Table 3.03). Three-quarters of producers in the western subregion and nearly one-third of producers in the central subregion never grew legumes during 1985-1989. In contrast, three-quarters of the farms in the west Latah subregion and 85 percent of the producers in the eastern subregion reported growing peas or lentils in all five of the years. Fewer than 25 percent of the farms in the western subregion raised peas or lentils, while 94 percent and 87 percent of responding producers in the eastern and west Latah subregions grew them at least once during 1985-89 (Table 3.03).

Yields

The yield data gathered by this survey illustrate the diversity in Palouse agriculture, but it

TABLE 3.03. Number of Years Peas or Lentils Were Grown During 1985-89 Displayed as Percentage of Farms in Each Precipitation Subregion, the Palouse River Basin, Southeastern Washington and Northwest Idaho.

	Whitman County				Palouse
	Western 11"-15"	Central 15"-18"	Eastern 18"-22"	West Latah 18"-26"	Average 11"-26"
Zero	76	32	6	13	29
One	2	1	1	2	2
Two	6	4	3	4	4
Three	6	9	4	5	6
Four	4	4	0	2	3
Five	4	49	85	75	56
Farms in Sample (No.)	47	68	68	56	239

reflects only the 1989 harvest (Table 3.04). However, as discussed earlier, 1989 was a representative year in terms of both rainfall and crop yields in the Palouse, with the exception of greater than normal precipitation in eastern Whitman County (Table 1.02). Average yields for some crops in certain subregions may also be skewed by small samples of less than five farms (Table 3.04). These small samples might contain unrepresentative farms or fields such as wet fields in otherwise dry regions.

The eastern subregion produced the highest wheat yields and was consistently near the top for other crops. Yields generally declined as distance from the eastern subregion increased. Exceptions were lentils in the west Latah subregion,

TABLE 3.04. Crop Yields Per Acre by Precipitation Subregion, the Palouse River Basin, Southeast Washington and Northwest Idaho, 1988-89 Crop Year.

	Western 11"-15"		Central 15"-18"		Eastern 18"-22"		West Latah 18"-26"		Palouse Average 11"-26"	
Crop	**Average**	**Range**	**Average**	**Range**	**Average**	**Range**	**Average**	**Range**	**Average**	**Range**
WW[1] following P/L	78 bu (4)[2]	65 to 90	69 bu (35)	18 to 91	76 bu (57)	40 to 107	75 bu (44)	35 to 96	74 bu (140)	18 to 96
WW following SF	51 bu (41)	35 to 91	67 bu (58)	38 to 100	83 bu (45)	47 to 120	76 bu (28)	35 to 100	69 bu (172)	35 to 120
WW following Barley	59 bu (2)	48 to 70	50 bu (1)	—	69 bu (4)	60 to 75	66 bu (8)	50 to 90	64 bu (15)	48 to 90
WW following WW	55 bu (9)	40 to 81	54 bu (8)	30 to 100	60 bu (6)	50 to 75	60 bu (7)	40 to 78	57 bu (30)	30 to 100
Spring Wheat	52 bu (6)	32 to 65	58 bu (24)	26 to 83	65 bu (22)	45 to 84	51 bu (13)	35 to 76	58 bu (65)	26 to 84
Spring Peas	25 cwt (3)	22 to 27	24 cwt (36)	15 to 40	22 cwt (44)	8 to 38	21 cwt (35)	10 to 33	23 cwt (115)	8 to 40
Lentils	10 cwt (2)	8 to 12	10 cwt (2)	9 to 10	12 cwt (28)	5 to 18	14 cwt (22)	9 to 25	13 cwt (54)	5 to 25
Barley	1.5 tons (36)	.5 to 2.5	1.8 tons (57)	1 to 3	1.7 tons (52)	1 to 3	1.7 tons (7)	1 to 3	1.7 tons (152)	0.5 to 8
Alfalfa/Hay	2.9 tons (12)	1.3 to 5	3.8 tons (18)	1 to 8	2.8 tons (16)	1 to 6	2 tons (28)	1 to 4	2.8 tons (74)	1 to 8

[1] WW = winter wheat, P/L = peas or lentils, SF = summer fallow.
[2] Sample size is in parenthesis.

pea and hay in the central subregion, and pea in the western subregion. Although reported pea yields in the western subregion sample were higher than those in the rest of the Palouse, the sample contained only three farmers and likely consisted of fields bordering the central subregion and/or situated in valleys where moisture was available for the crop. Similarly, the high yield for winter wheat following peas/lentils produced by four farms in the western subregion may have come from unrepresentative moist valley fields. Most land in the western subregion is too arid to grow peas or lentils.

Yield for winter wheat following summer fallow declined by a consistent 16 bu/ac per subregion moving west from the eastern subregion. Yield for winter wheat following peas/lentils declined by seven bu/ac from the eastern to the central subregion. Barley yields in the Western subregion were 20 percent lower than the average for the Palouse. In the west Latah subregion yields fell slightly relative to the neighboring eastern Whitman County subregion. This decline was probably attributable to less fertile soils and cooler temperatures. Lentils were the only crop that responded positively to the cooler, more moist climate in west Latah.

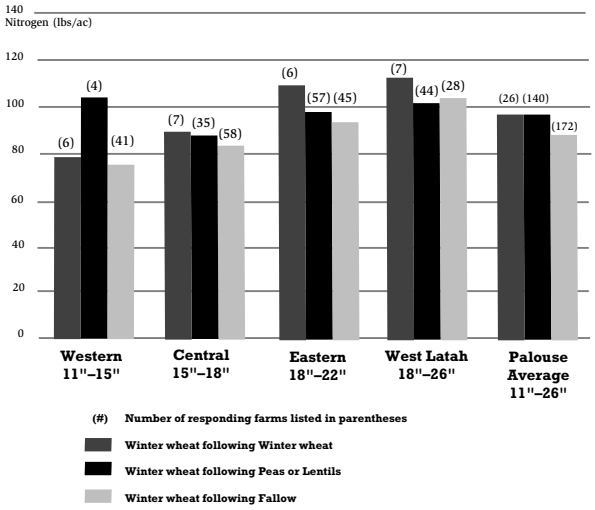

FIGURE 3.01. Average Nitrogen Application (lbs/ac) to Winter Wheat by Preceding Crop and by Precipitation Subregion.

Fertility management
Fertilizer application

Generally, nitrogen applications for winter wheat were heaviest where yields and precipitation were highest, namely the eastern Whitman and west Latah subregions (Fig. 3.01). Producers may maximize profit by adding nitrogen until the additional revenue generated by an additional unit of nitrogen is equal to the

TABLE 3.05. Average Phosphate and Sulfur Application to Winter Wheat by Preceding Crop and Precipitation Subregion, the Palouse River Basin, Southeast Washington and Northwest Idaho, 1989 Crop Year.

	Whitman County				Palouse
Fertilizer Preceding Crop	Western 11"-15"	Central 15"-18"	Eastern 18"-22"	West Latah 18"-26"	Average 11"-26"
	lbs/ac				
Phosphate:					
Peas/Lentils	21	16	19	37	24
	(4)[1]	(25)	(45)	(36)	(110)
Fallow	4	12	16	21	14
	(9)	(27)	(33)	(17)	(86)
Sulfur:					
Peas/Lentils	20	15	16	16	16
	(4)	(29)	(51)	(40)	(124)
Fallow	7	12	16	16	13
	(23)	(35)	(39)	(22)	(119)

[1] Number of farms in sample listed in parentheses.

TABLE 3.06. Percentage of Farms That Administer Soil Tests by Precipitation Subregion, the Palouse River Basin, Southeast Washington and Northwest Idaho, 1989 Crop Year.

	Whitman County			Palouse	
Extent of Soil Testing	Western 11"-15"	Central 15"-18"	Eastern 18"-22"	West Latah 18"-26"	Average 11"-26"
Farms in Sample (No.)	47	68	68	56	239
Very extensive	0	1	3	0	2
Extensive	11	22	13	5	13
Moderate	28	32	40	27	32
Minimal	32	15	25	25	23
Other	2	0	1	0	1
No test	27	30	18	43	29

cost. Because of precipitation, wheat has a higher potential yield in the eastern regions of the Palouse, which may justify greater application rates of nitrogen. In the western and central subregions, precipitation limits yields, and additional nitrogen without higher precipitation would be unprofitable. Also, lower levels of decomposing organic matter in the western soils tie up less nitrogen.

In general, the use of phosphorous was heavi-

TABLE 3.07. Soil Testing Information as Percentage of Farms that Test, by Precipitation Subregion, the Palouse River Basin, Southeast Washington and Northwest Idaho, 1989 Crop Year.

	Whitman County				Palouse
Item	Western 11"-15"	Central 15"-18"	Eastern 18"-22"	West Latah 18"-26"	Average 11"-26"
Farms in Sample (No.)	47	68	68	56	239
Farms that test (No.)	34	48	56	32	170
			% of farms that test		
Sample collection made by					
Farmer	6	13	11	19	12
Fertilizer company fieldman	79	79	77	72	77
Other	15	8	13	9	11
Testing location					
Private lab	62	68	66	47	61
Other	26	22	21	40	27
Fertilizer company	12	11	13	13	12
Use for fertilizer rate	47	71	53	36	53
Source of recommendation					
Fertilizer company	38	54	59	9	42
Consultant	20	19	11	57	26
Farmer	24	15	21	28	22
Other	18	12	9	6	11
Level of trust in recommendation					
Little	6	6	14	6	9
Medium	81	65	70	80	73
High	12	29	16	13	18
Perform residual nitrogen test	88	85	96	91	90
Average depth of test (feet)	5.2	4.7	4.4	3.9	4.5
Average pH	6.6	6.2	6.0	5.8	6.1

est and most widespread in the west Latah subregion and the use was lightest in the western subregion (Table 3.05). Sulfur applications showed no appreciable trends across rainfall subregions or by preceding crop. The percentage of farms applying phosphorous or sulfur was lowest in the western subregion, while a majority of surveyed farms used them in the other subregions. A small number of respondents in the eastern and west Latah subregions were also applying potassium or calcium at (mostly) low rates (Halvorson 1991).

Soil testing

The percentage of farmers using soil tests varied by subregion (Table 3.06). The six listed testing practices were not defined in detail in the survey, although very extensive testing was defined as consisting of several samples per acre farm-wide. Fifty-three percent of surveyed Palouse farmers used soil tests for determining fertilizer application rates (Table 3.07). The highest rate was in the central subregion at 71 percent, the lowest (36 percent) was in the West Latah subregion. Soil testing is more reliable in lower rainfall areas where the more stable weather conditions limit nitrogen loss in the soil. Therefore, it is not surprising that the percentage of farmers basing fertilizer recommendations upon soil tests generally increased from east to west. The exception was the western subregion where cost might have reduced the use of soil tests in this low-yielding subregion.

Soil samples were reported collected on 170 of the 239 farms surveyed. In all but the west Latah subregion, roughly two-thirds of the farmers had the tests performed at a private lab (Table 3.07). Under 50 percent of farmers in the west Latah subregion used a private lab, possibly due to the availability of a university lab in this region. The source of the recommendations stemming from the soil tests varied across subregions (Table 3.07). In west Latah County, consultants were the primary source of recommendations. Fertilizer company fieldmen were the main source of recommendations in the eastern and central subregions. More farmers in the central sub-region had a high level of trust in the recommendations. Central farmers also based fertilizer application rates upon soil tests most often.

Residual nitrogen tests were conducted by 90 percent of the producers who reported having their soil tested (Table 3.07). A slightly larger percentage of the producers in the two eastern subregions tested for residual nitrogen than those in the western subregions. The average depth of the residual nitrogen test decreased from 5.2 ft in the western subregion to 3.9 ft in the west Latah subregion possibly due to greater precipitation and nitrogen loss in west Latah. On average, farmers in the western subregions tested to deeper levels. Average soil pH declined from west to east as rainfall increased and more nitrogen was applied.

Pest management
Weed management

Winter wheat herbicide applications differed between the western subregion and the rest of the Palouse (Table 3.08). Producers in the central, eastern, and west Latah subregions consistently applied a wider spectrum of herbicides to a higher percentage of their acres than the producers in the more arid western subregion. Farmers in the semiarid western subregion relied on mechanical fallow for weed control. The economic threshold for treating weeds may be higher in this region due to lower average yields.

Harmony is a contact herbicide which does not carryover to the following crop and was used on only 23 percent of the wheat acres in the western subregion, compared to the 85 percent in the west Latah subregion. Hoelon, commonly used to control wild oats, is used on more farms and acres in the higher rainfall zones where wild oats are more prevalent. However, herbicides restricted to strictly grain rotations due to carryover, like Finesse and Glean, were more popular in the western subregion. These chemicals tend to be more effective on broadleaf plants but cannot be used

TABLE 3.08. Herbicides Used in Winter Wheat in the Palouse River Basin Measured as Percentage of Acreage and Percentage of Farms, by Precipitation Subregion, Southeast Washington and Northwest Idaho, 1988-89 Crop Year.

	Western 11"-15"		Central 15"-18"		Eastern 18"-22"		West Latah 18"-26"		Palouse Average 11"-26"	
Herbicide	**Acreage**	**Farms**	**Acreage**	**Farms**	**Acreage**	**Farms**	**Acreage**	**Farms**	**Acreage**	**Farms**
No rotation restrictions										
Harmony (B)[1]	23	40	56	62	67	68	85	71	57	61
Buctril (B)	24	38	45	56	39	44	35	41	37	46
Bronate (B)	11	21	20	21	32	40	26	27	23	28
Chiptox (B)	14	19	15	24	25	44	27	38	20	32
Fargo (G)	4	11	19	21	15	16	22	14	15	16
2,4-D (B)	26	34	12	26	11	26	9	21	14	26
Hoelon (G)	2	15	12	34	13	35	17	52	11	35
Other	7	13	10	4	0	0	6	7	4	3
Igran (B)	1	1	3	6	6	12	1	44	3	16
Lexone (B)	0	0	2	7	1	3	8	11	2	5
Avenge (G)	1	2	2	12	2	6	1	7	1	7
Assert (G)	0	0	0	0	1	1	1	5	1	1
Carbyne (G)	0	0	0	0	1	3	1	2	1	1
Grain rotations only										
Curtail (B)	4	4	2	18	3	16	23	41	5	20
Banvel (B)	10	23	5	18	6	18	2	20	4	19
Direx (B)	1	4	2	6	7	10	3	7	3	7
Finesse (B)	25	30	5	6	1	1	0	0	2	8
Glean (B)	20	15	3	1	3	1	1	5	2	5
Non-selective										
Roundup (NS)	3	19	5	21	7	26	4	25	4	23
Landmaster (NS)	6	19	2	15	6	16	8	14	4	16
Treflan (NS)	0	0	1	1	1	1	0	0	1	1
Cheat Stop (NS)	0	0	0	0	1	1	0	0	0	0
Total in sample (No.):	27,755	47	32,769	68	42,423	68	20,389	56	123,336	239

[1] B = broadleaf herbicide, G = grass herbicide, NS = non-selective.

on ground that will be planted into peas or lentils the following year, which makes them unsuitable in the eastern subregions. Fargo tends to lose is effectiveness in dry spring conditions. It was used on 15 to 22 percent of the winter wheat acreage in all but the western subregion, where it was applied to only 4 percent.

Winter wheat disease control

Foot rot (*Cercosporella*) was the most common disease, identified by 51 percent of surveyed farmers in the Palouse (Table 3.09). *Pythium* was the next most common, reported by 23 percent of Palouse farmers. In the west Latah subregion, foot rot was still the most common disease but it was less prevalent than the Palouse average and *Cephalosporium Stripe* and rust were more prevalent than the Palouse average. Higher precipitation and cooler temperatures favor the development of the latter diseases in this subregion. *Pythium* had the same frequency in west Latah as in the Palouse but in the western and central subregions *Pythium* was less prevalent than the Palouse average. More than half of the producers surveyed in the two eastern subregions reported disease problems in winter wheat, as compared to fewer than 30 percent of those in the western

TABLE 3.09. Diseases in Winter Wheat as Percentage of Farms Reporting Disease Problems, by Precipitation Subregion, the Palouse River Basin, Southeast Washington and Northwest Idaho, 1988-89 Crop Year.

	Whitman County				Palouse
Disease Type	Western 11"-15"	Central 15"-18"	Eastern 18"-22"	West Latah 18"-26"	Average 11"-26"
Farms in Sample (No.)	47	68	68	56	239
Farms reporting diseases (No.)	14	28	35	29	106
	% of farms reporting disease problem				
Foot Rot	57	61	57	31	51
Pythium	14	14	34	24	23
Cephalosporium Stripe	7	4	3	14	7
Rust	0	7	3	17	7
Strawbreaker Foot Rot	7	7	0	3	4
Rhizoctonia	0	0	3	7	3
Leaf Rot	7	0	0	0	1
Root Rot	0	4	0	0	1
Smut	0	4	0	0	1
Dwarf Bunt	0	0	0	3	1

TABLE 3.10. Winter Wheat Disease Control Agents Used in the Palouse River Basin as Percentage of Treated Acreage and Percentage of Farms, by Precipitation Subregion, Southeast Washington and Northwest Idaho, 1988-89 Crop Year.

	Western 11"-15"		Central 15"-18"		Eastern 18"-22"		West Latah 18"-26"		Palouse Average 11"-26"	
Product	Acreage	Farms	Acreage	Farms	Acreage	Farms	Acreage	Farms	Acreage	Farms
Vitavax	92	68	79	57	66	59	73	66	76	62
Benlate	2	13	8	13	17	24	12	16	10	17
Mertect	4	4	6	9	7	7	1	4	5	6
Topsin-M	0	0	3	4	5	10	1	4	3	5
Other	1	2	2	3	3	3	5	4	3	3
Apron	0	0	0	0	0	0	4	7	1	2
Bayleton	1	2	2	1	1	1	0	0	1	1
Tilt	0	0	0	0	1	4	5	7	1	3
Total in Sample(No.)	23,952	47	25,625	68	35,658	68	20,211	56	105,446	239

subregion. The seed treatment Vitavax was the only disease control agent used by many wheat producers in the western subregion at the time of the survey (Table 3.10). Due to the cost of treatment and the arid conditions, costly fungicides were probably not economical. A larger percentage of the treated acres in the eastern and west Latah subregions were treated with a fungicide, since conditions there are more favorable for disease development.

Insect control in spring peas

Nearly half (48 percent) of pea and lentil producers in the Palouse used insecticides every year between 1985 and 1989 (Table 3.11). The percentage who applied insecticides every year during 1985-1989 rose from 18 percent in the Western subregion, to 62 percent in the west Latah subregion. In contrast, the percentage of producers that did not use an insecticide fell from over 36 percent in the western subregion to 5

TABLE 3.11. Number of Years Insecticide Was Used on Peas/Lentils Displayed as Percent of Growers During 1985-89 by Precipitation Subregion, the Palouse River Basin, Southeast Washington and Northwest Idaho.

	Whitman County				Palouse
Years of Insecticide Use	Western 11"-15"	Central 15"-18"	Eastern 18"-22"	West Latah 18"-26"	Average 11"-26"
Zero	36	3	3	4	5
One	9	7	6	2	5
Two	28	30	22	4	20
Three	9	13	16	14	14
Four	0	4	8	14	8
Five	18	43	45	62	48
Farms in Sample (No.)	11	46	64	49	170

TABLE 3.12. Insecticides Used to Treat Peas and Lentils in the 1988-89 Crop Year by Percentage of Pea/Lentil Acreage and by Percentage of Farms that Raised Peas/Lentils During 1985-89, by Precipitation Subregion, the Palouse River Basin, Southeast Washington and Northwest Idaho.

	Western 11"-15"		Central 15"-18"		Eastern 18"-22"		West Latah 18"-26"		Palouse Average 11"-26"	
Product	Acreage	Farms	Acreage	Farms	Acreage	Farms	Acreage	Farms	Acreage	Farms
Dimethoate	75	27	28	26	45	36	37	43	40	35
Parathion	0	0	35	24	24	20	33	29	28	22
Imidan	7	9	14	11	3	8	20	31	10	16
Lindane	0	0	0	0	5	3	14	10	6	4
Malathion	0	0	7	9	4	5	3	8	4	7
Asana	18	9	0	0	3	13	9	10	4	8
Other	0	0	5	13	0	0	12	14	4	8
Di-Syston	0	0	1	2	4	9	3	4	3	5
Diazinon	0	0	6	4	1	2	3	4	3	3
Penncap	0	0	2	9	3	6	2	4	2	6
Pydrin	0	0	0	0	0	0	3	8	1	2
Mehoxychlor	0	0	2	2	1	2	0	0	1	1
Phosdrin	0	0	0	0	0	0	1	2	0	1
Treated acres, 1988-89 crop year (No.)	724		10,667		28,417		14,513		54,321	
Farms that raised peas/lentils in the five-year period, 1985-89 (No.)	11		46		64		49		170	

percent for the entire Palouse. Dimethoate, an aphid treatment, was the most popular insecticide among the farmers surveyed (Table 3.12). The insecticides Parathion, a restricted use pesticide, Imidan, and Lindane were also popular. Parathion, which controls a wide range of insects in legumes, was widely used in the central, eastern, and west Latah subregions.

Livestock

Livestock populations, while small, were reported to have increased substantially on the surveyed Palouse farms from 1980 to 1990 (Table 3.13); however, trends varied by subregion. The largest increases were in beef cow-calf pairs and

TABLE 3.13. Livestock numbers, percentage of subregion farms with livestock present, and number of livestock per farm for farms with livestock present in three time periods, the Palouse River Basin, southeast Washington, and northwest Idaho, as reported in the winter of 1989-90.

	Western 11"-15"			Central 15"-18"			Eastern 18"-22"			West Latah 18"-26"			Palouse Average 11"-26"		
Livestock Type	No. of Livestock	% of Farms	No./ Farm	No. of Livestock	% of Farms	No./ Farm	No. of Livestock	% of Farms	No./ Farm	No. of Livestock	% of Farms	No./ Farm	No. of Livestock	% of Farms	No./ Farm
Beef Cow-Calf															
1980	1,802	31	120	245	22	16	543	36	23	37	43	1	3,238	35	39
1985	2,020	31	135	490	21	35	485	20	35	33	29	2	3,671	26	58
1989-90	2,642	31	176	624	22	42	538	8	108	20	31	1	4,440	23	79
Feeder Cattle															
1980	74	6	25	113	9	19	125	7	25	173	16	16	485	10	19
1985	426	15	61	140	9	23	130	1	130	194	16	18	890	10	36
1989-90	795	17	99	256	9	43	173	7	35	90	16	8	1,314	13	44
Dairy Cattle															
1980	0	0	0	0	0	0	1	3	1	0	0	0	3	1	2
1985	4	6	1	0	0	0	0	0	0	0	0	0	4	1	1
1989-90	8	6	3	0	0	0	0	0	0	0	0	0	8	1	3
Swine															
1980	525	4	263	620	4	207	805	4	268	6	1	6	1,958	4	218
1985	530	4	265	420	4	140	911	4	304	6	1	6	1,867	4	207
1989-90	160	6	53	600	4	200	1,911	4	637	0	0	0	2,671	4	297
Sheep															
1980	30	2	30	57	4	19	225	9	38	13	5	4	325	5	25
1985	55	4	28	92	4	31	285	9	48	15	5	5	445	6	32
1989-90	30	2	30	189	4	63	302	9	50	12	5	4	623	5	48
Other Livestock															
1980	37	9	9	19	3	9	24	4	8	7	7	1	87	6	6
1985	33	11	7	20	3	10	36	4	12	7	7	1	96	6	6
1989-90	31	11	6	20	3	10	50	4	17	11	7	2	112	6	7

feeder cattle in the western subregion. In 1980, the western subregion had fewer feeder cattle than the other subregions. Ten years later, the percentage of farms raising feeder cattle had more than doubled in the western subregion, and feeder cattle and beef cow-calf pairs in this subregion numbered more than the remaining subregions combined. The number of beef cow-calf units and feeder cattle per farm with cattle was also highest in the western subregion.

Swine numbers were highest in the eastern subregion, where the overall number of swine and the number of swine per farm had increased substantially from 1985. The number of hogs in the western subregion sample declined from 1980 to 1990. Also, the size of the operations decreased substantially in the western subregion. Most of the small number of sheep reported in the Palouse were found in the central and eastern subregions. Feeder cattle were the only livestock present in large numbers in the West Latah subregion. Livestock generated 19 percent of the gross receipts on farms where livestock were raised for market in the western subregion, and 13 percent elsewhere (Table 3.14). The percentage of farms raising livestock was highest in the western subregion and west Latah subregion. Six of the 239 farms surveyed reported livestock sales accounting for greater than 60 percent of gross farm receipts. Half of those farms were in the Western subregion.

No-till

No-till accounted for 14,563 ac, or roughly five percent, of total surveyed acreage in the Palouse in 1989, up from the previous five-year average (1984-88) of 3 percent (Table 3.15). The eastern and west Latah subregions accounted for nearly 95 percent of the reported no-till acreage in the Palouse. The western subregion respondents reported a pronounced decline in no-till acres over the last four years of this time period. Surveyed farmers in the western subregion re-

TABLE 3.14. Livestock Contribution to Gross Farm Receipts, by Precipitation Subregion, the Palouse River Basin, Southeast Washington and Northwest Idaho, 1989-90 Survey.

Item	Whitman County			West Latah	Palouse
	Western 11"-15"	Central 15"-18"	Eastern 18"-22"	18"-26"	Average 11"-26"
Farms in Sample (No.)	47	68	68	56	239
Farms reporting livestock	23	20	22	25	90
Average contribution to gross receipts for farms with livestock (%)	19	13	13	13	14
Number of farms with livestock providing more than 60% total receipts	3	1	1	1	6

TABLE 3.15. Number of acres of no-till and percentage of farms with no-till as reported by surveyed farmers in the winter of 1989-90 by precipitation subregion, the Palouse River Basin, southeast Washington, and northwest Idaho, 1970-89.

Year	Western 11"-15"		Central 15"-18"		Eastern 18"-22"		West Latah 18"-26"		Palouse Average 11"-26"	
	Number of Acres	% of Farms	Number of Acres	% of Farms	Number of Acres	% of Farms	Number of Acres	% of Farms	Number of Acres	% of Farms
1970	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	100	1	0	0	100	0
1972	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0
1974	100	2	100	1	1,000	1	64	2	1,264	1
1975	100	2	600	1	1,000	1	70	2	1,770	1
1976	100	2	750	1	1,350	4	710	2	2,910	2
1977	80	2	1,964	4	1,661	7	30	2	3,735	4
1978	0	0	1,271	6	1,630	6	330	4	3,231	4
1979	0	0	1,550	6	1,538	7	410	7	3,498	5
1980	0	0	2,049	7	1,255	9	971	7	4,275	6
1981	190	4	2,117	10	1,055	4	1,784	14	5,146	8
1982	290	4	1,724	10	970	6	1,887	14	4,871	9
1983	820	13	1,556	9	4,318	13	1,940	16	8,634	13
1984	770	15	1,780	12	4,345	13	2,110	14	9,005	13
1985	1,315	19	430	7	4,444	12	2,372	18	8,561	13
1986	1,100	19	592	13	5,788	13	2,025	20	9,505	16
1987	825	11	987	10	6,813	16	1,200	14	9,825	13
1988	680	4	549	10	6,710	15	1,331	13	9,270	11
1989	290	2	508	9	9,104	24	4,661	13	14,563	13
Tried no-till (%)		38		46		49		43		45

TABLE 4.01. Farmer characteristics by precipitation subregion, the Palouse River Basin, southeast Washington, and northwest Idaho. Winter of 1989-90.

Subregion	Age (yrs.)		Married	Children Expected to Farm		
	Average	Range		Yes	No	Unsure
			%			
Western	47	29-76	96	42	14	44
Central	49	21-78	85	26	19	55
Eastern	48	21-91	88	32	16	52
West Latah	50	22-83	75	24	26	50
Palouse Average	49	21-91	86	35	18	47

TABLE 4.02. Percentage of farmers and their spouses who have completed high school and college by precipitation subregion, the Palouse River Basin, southeast Washington, and northwest Idaho. Winter of 1989-90.

Subregion	Farmers Percent Completing		Spouses Percent Completing	
	High School	College	High School	College
Western	98	32	98	31
Central	94	29	95	22
Eastern	93	28	100	35
West Latah	86	32	98	41
Palouse Average	93	30	98	32

ported that no-till peaked at 19 percent of the farmers using it in 1985-1986, and declined to 2 percent in 1989. Forty-five percent of the surveyed producers had tried no-till according to this 1990 survey.

Farmer characteristics

Ninety-six percent of the surveyed western subregion farmers were married, compared to 75 percent in the west Latah subregion (Table 4.01). This difference may be attributable in part to the fact that none of the producers surveyed in the western subregion were less than 29 years old, whereas farmers in their early 20's were part of the random sample in other subregions.

The west Latah subregion had a greater percentage of farmers whose children were declared unlikely to farm (Table 4.01). In the western and eastern subregions, among farmers who were sure of their children's intentions, three times as many believed their children would farm as those who thought they would not.

The level of education of Palouse farmers and their spouses varied slightly across precipitation subregions (Table 4.02). Ninety-eight percent of the farmers in the western subregion had completed high school compared to 86 percent in the west Latah subregion. The percentage of farmers having completed college was consistent across subregions. However, the percentage was higher in the eastern half of the Palouse for spouses. This might be attributable to two large universities in the eastern half of the Palouse.

Fewer than a quarter of the farmers surveyed were employed off the farm (Table 4.03). The lowest percentage of farmers with off-farm employment occurred in the western and central subregions. These two subregions are more distant from the university cities of Moscow, Idaho and Pullman, Washington which might provide off-farm employment.

Conclusions

The Palouse encompasses substantial agricultural diversity. Due to variations in precipitation and soils, the crop rotations, crop yields, and

TABLE 4.03. Employment of farmers and their spouses by precipitation subregion, the Palouse River Basin, southeast Washington, and northwest Idaho. Winter of 1989-90.

	Farmers				Spouses			
	Farm	Off-farm			Farm	Off-farm		
Subregion	Only	Part	Full	Hrs/week	Only	Part	Full	Hrs/week
	— — — —	% — — — —			— — — —	% — — — —		
Western	85	6	9	29	60	31	9	23
Central	82	12	6	23	62	24	14	28
Eastern	75	13	12	30	52	28	20	31
West Latah	75	18	7	26	59	19	22	31
Palouse Av.	79	13	9	27	57	25	17	29

cultural practices differ markedly across subregions. These differences are more pronounced than those found across much larger wheat-producing areas such as south-central Kansas. Farms in the western subregion of the Palouse are larger, and less diverse in their crop rotations. Producers in this subregion rely upon mechanical summer fallow to conserve moisture and control weeds. Moving eastward across the Palouse, rotations become more diverse, with less dependence upon summer fallow and greater use of fertilizer and pesticides. Yields generally peak in the Eastern Whitman County subregion, and then decline slightly in the West Latah County subregion.

Users are cautioned not to treat the Palouse as a homogeneous region given the agricultural diversity shown in the survey results. Agricultural lenders, for example, must be aware that the expected yields of crops grown in the western subregion are lower than those for the rest of the Palouse. The ability of an acre of land to generate revenue from which to repay loans will be less in the more arid western subregion where land is often idled every other year than in the other subregions.

When designing policy for the Palouse, agricultural policymakers should take into consideration the widely divergent conditions under which Palouse farmers operate. For example, government programs such as the Conservation Reserve Program (CRP), designed to target erodible land for retirement, should calibrate annual payments to the profitability and productivity of lands in different subregions. This was not entirely accomplished in the 1985 Farm Bill CRP. Uniform county-wide CRP bid caps in Whitman County lead to relatively few acres enrolled in the erodible but high yielding eastern parts of the county.

Similarly, extension crop nutrient recommendations should reflect the average yield potential of different crops in different regions. Pest control problems also vary by climate and soil type. Some information on these variations can be obtained by talking to a small sample of growers, but it is useful to have a statistically random sample of growers in the subregion to validate the representativeness of small sample information.

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University of Idaho

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