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Land Use and Production Costs on Dry-land Wheat Farms

Columbia Basin, Oregon

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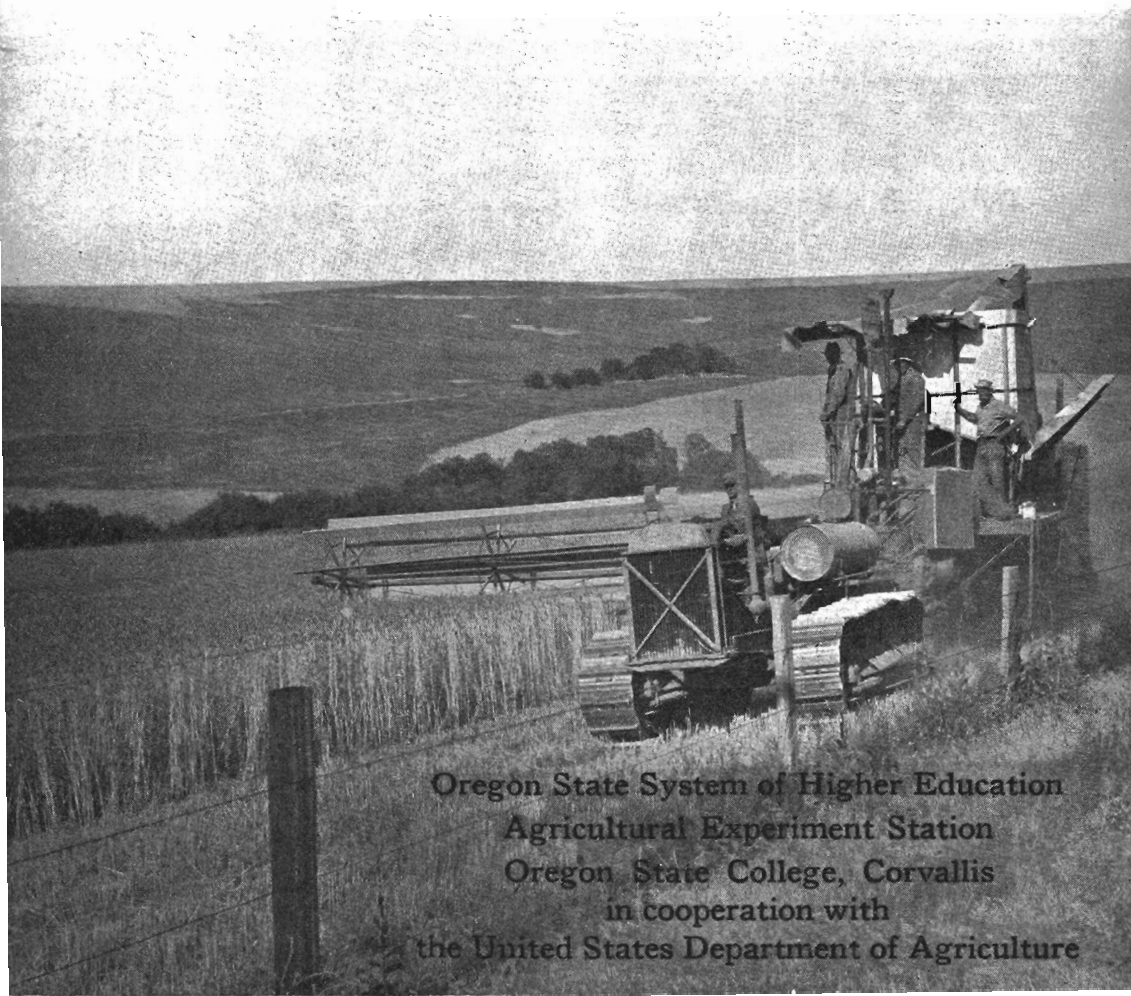

Oregon State System of Higher Education
Agricultural Experiment Station
Oregon State College, Corvallis
in cooperation with
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APPRECIATION AND ACKNOWLEDGMENT

This posthumous bulletin is the last of a series of publications bearing the name of Arnold S. Burrier, late head of the Department of Farm Management, whose death at the age of only 36 cut short a most promising career. Professor Burrier directed the field work of this study while serving as land-planning specialist for the Resettlement Administration. This bulletin was first prepared as a report to the various cooperating agencies and was in that form at the time of Professor Burrier's death. During the years of his service to the people of Oregon, Professor Burrier was author or co-author of 17 printed bulletins as well as of a large number of special reports. Staff members with whom he worked pay him the highest tribute as a research worker, administrative leader, and friend.

Acknowledgment is due the numerous agencies and individuals participating in the study reported on in this bulletin for assistance rendered. Particular appreciation is expressed: (1) to the following agencies that furnished funds or personnel, or both: Resettlement Administration, Agricultural Adjustment Administration, Soil Conservation Service, and the Bureau of Agricultural Economics, all of the United States Department of Agriculture; (2) to the 99 farmers who contributed the information that made this study possible; (3) to Clarence T. Waldo and Howard N. Magness, representatives of the Soil Conservation Service, U. S. Department of Agriculture, for their work on soils and erosion; (4) to Arnold N. Bodtker and Chester A. Loe, cooperative employees of the Bureau of Agricultural Economics, U. S. Department of Agriculture, and the Oregon Agricultural Experiment Station, for their assistance in securing field schedules; (5) to County Agents W. A. Holt of Umatilla County, Russell McKennon, formerly of Gilliam County, and LeRoy C. Wright of Sherman County for assistance in selecting study areas; and (6) to D. Curtis Mumford, Head, Department of Farm Management, for aid given in the final preparation of this bulletin for publication.

SUMMARY

Introduction

1. Wheat is the most important field crop grown in Oregon, and during the past ten years has accounted for 15.3 per cent of the total cash farm income of the State. The Columbia Basin Region normally produces approximately 60 per cent of the wheat grown in Oregon. The importance of the wheat production of this region to the agricultural income of Oregon is enhanced by the fact that in practically all of this area there is no substitute crop now known that will normally produce as much income as wheat.
2. The study reported herein presents factual information representative of the five Columia Basin counties of Umatilla, Morrow, Gilliam, Sherman, and Wasco. For this purpose complete farm-enterprize records were obtained from 99 representative wheat farmers in Umatilla, Gilliam, and Sherman Counties during the summer of 1936. These records cover a year's operation on 151,649 acres, of which 106,017 acres were in wheat or summer fallow. The wheat acreage covered accounts for approximately 8.3 per cent of the total wheat acreage of the Columbia Basin Region of Oregon.

Farm Organization

3. A typical wheat farm in the Columbia Basin consists of several tracts of rolling crop land separated from each other by canyons and steep slopes that are generally used for pasture. On the farms studied 77 per cent of the total farm area was cropped. There is need, in many cases, for a reorganization of the farm layout that will smooth out the boundaries of cultivated fields.
4. Wheat and summer fallow occupied 92 per cent of the crop land on the dry-land wheat farms studied. Of the wheat raised 86 per cent was sold or paid as rent to the landlord and only 3 per cent was fed to livestock. Of the remainder, 7 per cent was seeded and 4 per cent carried over.

Wheat Yields

5. The average yield of wheat for the region during the period 1929-1932 was 19.3 bushels per acre. During this period .3 per cent of the land in wheat averaged less than 5 bushels per acre, 10.0 per cent yielded less than 10 bushels, and 3.6 per cent yielded more than 40 bushels.
6. For the 1935 crop, which was harvested during the period covered by this survey, wheat yields in Gilliam County and in the lower producing areas of Sherman and Umatilla Counties were markedly below average. For the 99 farms included in this study yields averaged 15.5 bushels per acre or only 81 per cent of the 8-year (1929-1936) average of 19.1 bushels.

Tenure

7. The entire acreage operated was owned by the operator on only 19 per cent of the farms studied. Farmers who owned some land and rented additional acreage (part-owners), operated 58 per cent of the farms in the study, and the remaining 23 per cent were operated by

tenants who owned no land. The average owner-operated farm contained 998 acres, compared with 1,802 acres for part-owners and 1,252 acres for tenants. Eighty-eight per cent of the rented land was owned by private individuals.

8. Approximately 90 per cent of all the rented land was leased on a share-rental basis. Share-rental terms ranged from one-fourth to one-half the crop, and were governed largely by the yielding capacity of the land. Approximately 53 per cent of the rented land was leased for one-third crop rent. Cash rent was common only in the highest yielding sections of Umatilla County.

Livestock

9. Grass seedings for pasture purposes are of increasingly more importance in this area for they can be used to relieve overgrazed native pastures, and to supplement other pastures to the end that wheat by-products (chaff, straw, and stubble) may be more fully utilized. Seedings may also enable operators to avoid the overuse of straw and stubble that, from the standpoint of permanent wheat culture, might better be incorporated into the soil.
10. Beef cattle, horses, sheep, and dairy cattle, in the order named, were the leading classes of livestock on wheat farms. In the three counties studied, Umatilla, Sherman, and Gilliam, the total numbers of animal units per farm of these four types of livestock combined were 17, 33, and 72, respectively.
11. Income from livestock is of particular importance to wheat farmers in the lower-yielding parts of the region. In Gilliam County in 1935, for example, income from livestock accounted for more than one-fourth of all receipts. Especially in those areas subject to frequent low-yield years, the diversified wheat and livestock farmer would appear to be in a sounder position than the specialized wheat farmer.

Soil Depletion

12. Despite the deleterious effects of the one-crop system of farming practiced in this area, yields in general are being maintained. This has been made possible by improved tillage methods, by superior yielding varieties of wheat, and by the inability of the soil to produce maximum crops because of lack of moisture. These factors undoubtedly have masked the seriousness and extent of soil depletion in this area, but the ravages of erosion and the exploitative production methods commonly employed must ultimately result in a decline in yield unless corrective measures are adopted.
13. The wheat and fallow system of farming followed in this area is conducive to the development of wind and water erosion. According to a field survey covering 71 farms in the study area, 58 per cent of the 87,232 acres of crop land on these farms had lost more than 25 per cent of the surface soil by wind or water erosion.

Farm Investment and Farm Returns

14. The average farm investment for all of the operators included in this study was $30,905. For owner-operators it was $50,485, of which 89 per cent was for real property and 11 per cent for equipment and livestock. Part-owners had an investment of $34,608 and

tenants $6,010. These high capital requirements for wheat farming in the Columbia Basin Region tend to encourage tenancy. In this specialized wheat-growing area, however, even tenants must possess a relatively large amount of capital.

15. Data on farm income and outgo for the period July 1, 1935, to June 30, 1936, show that sales of wheat and the receipt of Agricultural Adjustment Administration payments accounted for 78 per cent of the farm receipts. By counties, this percentage was: Umatilla 82 per cent, Gilliam 66 per cent, and Sherman 76 per cent. The average farm income amounted to $3,057, and the average rate of return on the investment was 6.8 per cent. This was with wheat selling at 69 cents per bushel at the local elevator.
16. For the period covered by the study, 1935-36, the incomes of the farmers included were greatly influenced by two major factors that must be reckoned with in applying the data presented to other years: (1) The wheat yields of the lower-producing farms were far below average and the average yield for all of the farms included in this study was only 81 per cent of the usual yield. (2) All of the farms cooperating in this study received payments from the Agricultural Adjustment Administration. These payments averaged $1,717 per farm. In the absence of the Agricultural Adjustment Administration program the average farm income would have been about $1,729 and the return on the investment approximately 2.5 per cent. It is probable that without these payments and with usual yields the average farm income would have been about $2,300 per farm instead of the $3,057 per farm that is shown in this study, and that the return on the investment would have been 5 per cent instead of 6.8 per cent.
17. In Gilliam and Sherman Counties the income derived from livestock averaged $1,757 and $875 per farm, respectively. This livestock was fed chiefly on wheat by-products (chaff, stubble, and straw). In low-yielding areas in particular there is need to evaluate the insurance features of income from a livestock sideline and to balance against such income the need for straw and stubble for erosion control.
18. Gross and net farm incomes normally vary with the number of acres farmed and the productivity of the soil. With low-yielding land, large and efficiently operated units are required if a favorable net income is to be expected.

Cost of Production

19. Cost of production data for the 1936 crop year were obtained on 60 of the 99 farms included in this study. The average yield on these farms was 17.3 bushels per acre, and wheat was produced at a net cost of $11.36 per acre, or 66 cents per bushel. Of this total cost approximately 36 per cent was chargeable to the fallow year and 64 per cent to the wheat-growing year.
20. The major items of cost in producing wheat, in the order of their magnitude, are: interest on the capital investment, cost of materials and repairs, man labor including contracted work, general expense such as taxes, insurance, and depreciation. Owing to the fact that land values are based almost entirely on the use of land for growing wheat, costs tend to become adjusted to the value of the product by variations in land values. The cost of production exclusive of all interest charges averaged 43 cents per bushel.

Land Use and Production Costs on Dry-land Wheat Farms, Columbia Basin, Oregon

By

A. S. BURRIER* and W. W. GORTON

INTRODUCTION

WHEAT is the most important cultivated crop grown in Oregon and during the 10-year period 1926-1935 was the second largest income producer among the farm enterprises, being exceeded only by dairy products. Over this period wheat has produced 15.3 per cent of the total cash farm income. In 1935 the Oregon cash farm income from wheat, including benefit payments from the Agricultural Adjustment Administration, was estimated by the Bureau of Agricultural Economics to be $11,325,000.

The five Columbia Basin counties, Umatilla, Morrow, Gilliam, Sherman, and Wasco,† produced on the average about 13,000,000 bushels of wheat annually during the 1929-1932 Agricultural Adjustment Administration base period. This production represents about 60 per cent of all wheat produced in Oregon during these years. Thus it is quite evident that anything that may adversely affect the prosperity of wheat farmers in these five Columbia Basin counties will also adversely affect the total agricultural income of Oregon and in turn the business people who depend on this income for their livelihood. It can be truly said that the problems of the Columbia Basin wheat farmers are the problems of Oregon.

Cash grain (wheat) farms in the five Columbia Basin counties produced 61 per cent of the total farm income of the region during 1929. By counties the percentage was: Umatilla 62, Gilliam 72, Morrow 48, Sherman 92, and Wasco 42. In practically all of this area there is no substitute crop now known that will normally produce as much income as wheat. The economic welfare of Columbia Basin wheat farmers and of Columbia Basin communities is thus dependent, to a very large degree, upon the perpetuation of wheat growing in this area. It is believed to be imperative, therefore, to seek out and establish systems of farm organization and management that will meet this need.

THE SITUATION

Wheat production in the Columbia Basin is threatened with decadence unless adjustments can be effected in the present system of farming. Danger at present appears to be approaching chiefly from two directions. The first and

* Late Head of the Department of Farm Management and Former State Land Planning Specialist, Resettlement Administration.

† Jefferson County is sometimes considered as a Columbia Basin county, but was not so considered in this report. A large block of land in Jefferson County, at the time of this survey, was in the process of being purchased under the Sub-marginal Land Purchase Program of the United States Department of Agriculture.

most apparent danger is the wind and water erosion that is occurring to some extent in practically all sections. Soil cannot be subjected indefinitely to erosion losses, even though this erosion be moderate, without seriously impairing its productive capacity. A second danger, and one that is not now generally apparent, is the exhaustion of fertility resulting from a one-crop system of farming. Most wheat growers in this region are cognizant of these general problems.

Farmers pressed by creditors, tax collectors, and the necessity to provide for their families naturally desire a better price for their product. It does not appear, however, that price boosting measures alone, even if effective, will serve to perpetuate wheat growing in this very important agricultural area. It is basic that soil and soil fertility must be conserved if wheat farming in this area is to continue.

OBJECTIVES OF STUDY

The objectives of this survey were to study farm organization, farm operation, and the extent of erosion in typical wheat-producing areas to determine:

(a) Types of farming and sizes of farm units best adapted to various conditions.
(b) The effect of cropping systems and farm practices on soil erosion, soil depletion, and economical farm operation.
(c) The relation between prevailing farm practices and needed agricultural adjustments in this region.
(d) Costs of producing wheat.

METHOD AND SCOPE OF STUDY

This study was made by use of the survey method. A total of 99 schedules, each representing an individual farm, was obtained by personal interview. Of these, 50 schedules were obtained in Umatilla County, 28 in Gilliam County, and 21 in Sherman County.

In Umatilla and Sherman Counties a strip method of sampling was used in selecting study areas, while in Gilliam County it was necessary to spot sample to include the various production conditions. Within the study areas, farms were selected by random sampling. The location of the farms included in the study is shown in Figure 7.*

The number of schedules obtained were distributed roughly proportional to the volume of wheat production (Table 1). As about half the wheat produced in this area comes from Umatilla County, this county was allowed half of the schedules. As production conditions in Morrow and Gilliam Counties are similar, the Gilliam schedules also represent Morrow County conditions. Sherman County is an intermediate yield area somewhat below Umatilla County and somewhat above Morrow and Gilliam. The Sherman County records and part of the Umatilla County records represent fairly well the production conditions existing in Wasco County.

* The wheat farms studied have been located in place on a map showing average wheat yields for the 1929-1932 Agricultural Adjustment Administration base period. This yield map was prepared by E. B. Hurd, Bureau of Agricultural Economics, United States Department of Agriculture, and H. D. Scudder, Oregon Agricultural Experiment Station, from data obtained from Agricultural Adjustment Administration wheat contracts.

The acreage of wheat covered by the survey was 48,592 acres, which accounts for about 8 per cent of the total wheat acreage in the Columbia Basin in 1935. In the three counties, Umatilla, Gilliam, and Sherman, the percentage of the total wheat acreage covered by the study was 10 per cent, 19 per cent, and 6 per cent, respectively. The large sample obtained in Gilliam County represents Morrow County also, and when the wheat acreages of both counties are considered, this sample covers only 9 per cent of the combined wheat acreage of the two counties.

Table 1. DISTRIBUTION AND SIZE OF SAMPLE
(Columbia Basin Dry-Land Wheat Study, Oregon, 1936)

County	Total acreage of wheat (1935 crop)*	Acres of wheat in study (1935 crop)	Per cent acreage studied was of 1935 crop	Number of records obtained
Umatilla	225,277	22,676	10	50
Morrow	106,778	....	....	....
Gilliam	98,887	18,509	19	28
Sherman	117,158	7,407	6	21
Wasco	57,931	....	....	....
AVERAGE OR TOTAL	606,031	48,592	8	99

* Total acreage figures from the Agricultural Adjustment Administration. All acreage figures are for seeded acres.

GENERAL DESCRIPTION OF THE REGION

The Columbia Basin of Oregon is a distinct physiographic region lying in a basin that slopes from the south toward the Columbia River. Elevations of the greater portion of the agricultural lands vary from 2,000 feet to less than 500 feet.

The growing season in most of the wheat-producing region is between 150 and 200 days. The average annual rainfall for the region as a whole is about 15 inches but in eastern Umatilla and western Wasco Counties it reaches 20 or more inches and in parts of all five Columbia Basin counties is less than 10 inches (Figure 1). There is, of course, considerable annual variation in the amount of precipitation received. At Moro over a 29-year period (1910-1938) the minimum annual precipitation was 6.69 inches and the maximum 14.89 inches. The precipitation during the growing season, March 1 to July 31, shows an even greater relative variation. The minimum seasonal rainfall over a 28-year period was .92 inch and the maximum was 7.07 inches (Table 2).

Soils of the wheat-producing parts of the region are brown or gray-brown prairie or semidesert types and are of loessial or alluvial origin. They have developed under grass cover, and under virgin conditions are generally high in organic matter and essential plant nutrients.

Moisture is the limiting factor in controlling production on most of these soils. If more moisture were available much larger crops could be produced. In general the available plant food in the soil is far in excess of the amount that can be utilized by plants under existing moisture conditions. Experimental data from plots show that there is a high correlation between yield and the moisture content of the subsoil (Figure 2).

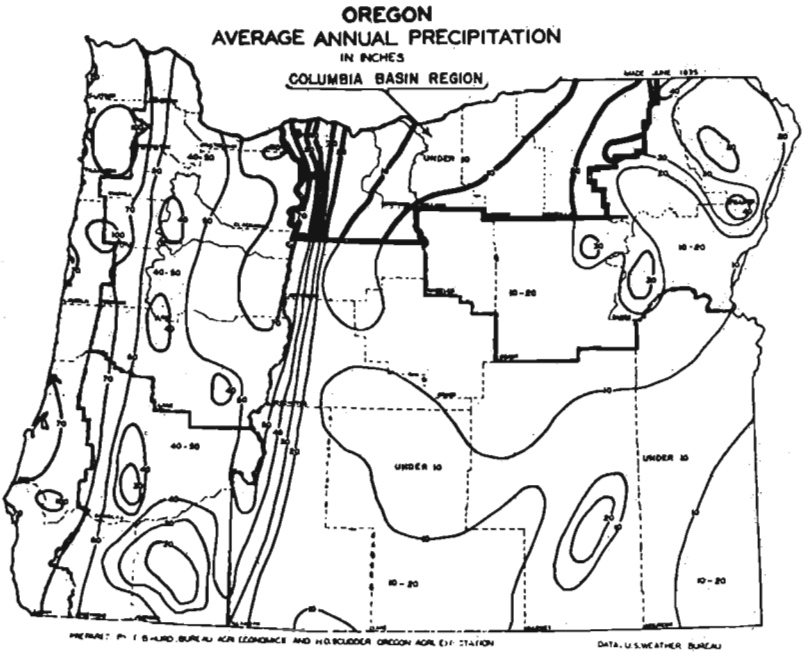

Figure 1.

Table 2. Annual and Seasonal Precipitation at Moro, Oregon
Data from Records of the Sherman Branch Experiment Station

Annual precipitation		Seasonal precipitation (March 1 to July 31)	
Year	*Inches*	*Year*	*Inches*
1910	10.39		
1911	9.20	1911	2.29
1912	13.33	1912	3.24
1913	12.17	1913	5.06
1914	11.32	1914	3.67
1915	14.89	1915	4.91
1916	14.49	1916	7.07
1917	11.39	1917	2.84
1918	10.45	1918	1.75
1919	12.74	1919	2.11
1920	10.50	1920	3.28
1921	12.65	1921	2.92
1922	9.27	1922	2.03
1923	12.58	1923	4.39
1924	8.18	1924	.92
1925	10.61	1925	3.56
1926	12.74	1926	1.96
1927	13.84	1927	2.60
1928	9.89	1928	3.21
1929	8.46	1929	1.88
1930	6.69	1930	1.32
1931	11.79	1931	4.45
1932	11.17	1932	4.60
1933	10.74	1933	3.23
1934	10.24	1934	2.12
1935	6.72	1935	2.19
1936	9.58	1936	3.16
1937	11.17	1937	6.35
1938	11.60	1938	4.27
Average	10.99	Average	3.26

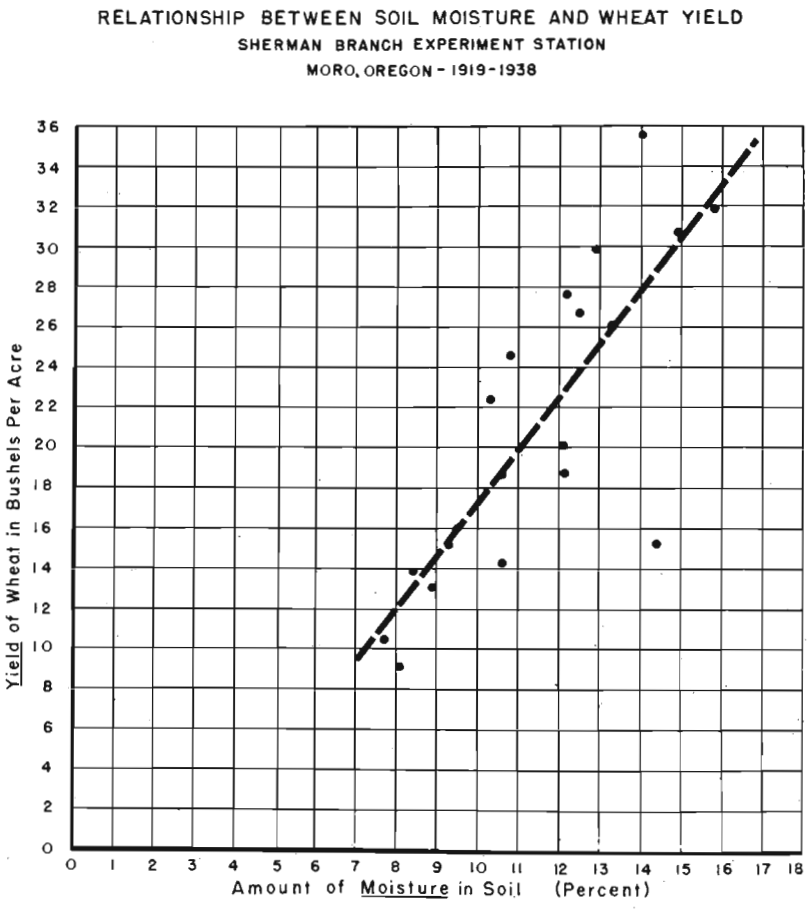

Figure 2.

AGRICULTURAL DEVELOPMENT OF THE COLUMBIA BASIN

Statistics regarding the agricultural development of this area are available from the United States Census as far back as 1860. It is difficult, however, to trace accurately the development of the Columbia Basin Region because of the frequent changes made in the boundaries of the counties on which the census data are based.

The County of Wasco, for example, as created by the Oregon Territorial Legislature in 1854, was bounded on the north by the Columbia River and latitude 46° North, on the east by the Rocky Mountains, on the south by the northern boundary of California, and on the west by the summit of the Cas-

cade Range. These boundaries stood until 1859 when Oregon was admitted to the Union and the northern and eastern boundaries of the State were established as they are today. As Oregon shrank so shrank Wasco County. It still, however, included all of Oregon east of the Cascades. From this time until 1908 county boundaries in Eastern Oregon were subject to periodic changes that must be noted in using county statistics. These changes as they affect Columbia Basin counties are indicated in footnotes to Table 3.

Table 3. DISTRIBUTION OF FARMS BY SIZE GROUPS IN THE COLUMBIA BASIN, OREGON By Census Periods, 1860 to 1935*

Census of	Total number of farms	Farms in each size group			
		1 to 100 acres	100 to 500 acres	500 to 1,000 acres	1,000 acres and over
		Per cent	*Per cent*	*Per cent*	*Per cent*
1860†	174	93.7	6.3	....	....
1870‡	775	81.2	17.8	....	1.0
1880‡	1,926	8.2	87.6	3.2	1.0
1890§	3,991	5.8	77.8	11.8	4.6
1900	4,516	15.2	58.8	14.7	11.3
1910	4,848	21.0	45.4	17.9	15.7
1920	5,298	29.2	33.8	19.6	17.4
1925	5,243	36.4	26.1	17.8	19.7
1930	4,691	35.0	24.2	16.3	24.5
1935	5,141	41.4	23.0	13.9	21.5

* From United States Census.
† Wasco County only. Includes all of Eastern Oregon.
‡ Wasco and Umatilla Counties. Includes considerable area not in Columbia Basin.
§ Wasco, Sherman, Gilliam, Morrow, and Umatilla Counties. Data for this and later census periods on approximately the same area. Hood River County taken out of Wasco County in 1908 and part of Gilliam County taken to form Wheeler County in 1899.

The number of farms in this region increased by leaps and bounds from the time the territory was opened to settlement until about 1900. From this time until the present the number of farms has increased but little, the high point being reached in 1920 after which the number of farms decreased. An important change in farming in this region has been the shift from farms of less than 100 acres in size, which predominated until the 1870's, to farms of from 100 to 500 acres, which in turn gave way to larger units, as may be observed in Table 3. The increase in the number of small farms during the latter part of the period is largely explained by the growth of irrigation farming in certain sections of the region.

The agricultural development in the five Columbia Basin counties was varied. Improved land in farms in Gilliam, Morrow, and Umatilla Counties reached a peak in 1930, while in Sherman County this peak occurred in 1925 and in Wasco in 1920.

The trend in wheat production by census periods since 1860 is presented in Table 4 which reveals that the wheat acreage in the Columbia Basin steadily increased up to 1919. The census of 1920 shows a wheat acreage for 1919 of 602,307 acres. The post-war decline in wheat prices resulted in a reduced acreage. Some wheat farmers moved away to accept more lucrative employment, but even so the 1925 census shows 554,963 acres of wheat, which was about 30,000 acres more than was farmed to wheat in 1909. This decline proved to be temporary for in 1928 a new high was reached with 716,550 acres in wheat. This was exceeded in 1930 by some 4,000 acres, and again in 1932 by about

9,000 acres to reach a high point of 725,333 acres. After 1932 the acreage in wheat dropped precipitously to 587,738 acres in 1934. This drop was also of temporary duration for the acreage in wheat increased steadily for the next four years to an all-time high in 1938 and then again declined sharply. It would appear that much of this area is at or near the peak of its agricultural development and that the often repeated statement that war prices for wheat were primarily responsible for overdeveloping the enterprise in this area is in error.

TREND AND VARIATION OF WHEAT YIELDS IN THE COLUMBIA BASIN

Trend. A one-crop exploitative system of farming has been practiced in this region. Under such a system a decline in yields might be expected, but a careful analysis of available statistical data fails to indicate any such downward trend. In 1879 an average yield of 28 bushels was reported for the Columbia Basin Region (Table 4). This, however, was from only about 36,000 acres which were largely located in Umatilla and Wasco Counties where lies the best wheat land of the region. The yield of 10.0 bushels in 1889 is the lowest reported and that for 1928, 22.7 bushels, the highest except for that of 1879 already mentioned. Wheat yields for each county in the region by census periods from 1889 to 1924 and annually from 1928 to 1939 are presented in Table 5. These county data also show no trend in yield.

There are several reasons that may help to explain the apparent inconsistency between the statement that yields might be expected to decline in this region, and the lack of proof that this has taken place.

One reason for this is that only a limited amount of wheat growing occurred in the Columbia Basin prior to the late 1880's. Hence most of the wheat

Table 4. TREND OF WHEAT PRODUCTION IN THE COLUMBIA BASIN, OREGON, 1859 TO 1939

Crop year	Acres of wheat	Wheat production	Average yield per acre
	Acres	*Bushels*	*Bushels*
1859 (C)	.....	64,627	.....
1869 (C)	.....	38,808	.....
1879 (C)	35,785	1,001,465	28.0
1889 (C)	209,408	2,082,477	10.0
1899 (C)	402,185	5,555,030	13.8
1909 (C)	523,786	7,389,662	14.1
1919 (C)	602,307	10,638,592	17.7
1924 (C)	554,963	8,643,367	15.6
1928 (A)	716,550	16,250,226	22.7
1929 (A)	706,334	12,467,038	17.6
1930 (A)	720,390	15,108,530	21.0
1931 (A)	681,181	10,016,449	14.7
1932 (A)	725,333	14,467,562	19.9
1933 (A)	688,925	10,138,702	14.7
1934 (A)	587,738	9,206,285	15.7
1935 (A)	606,031	9,120,548	15.1
1936 (A)	689,000	12,274,700	17.8
1937 (A)	709,400	13,296,500	18.7
1938 (A)	751,800	16,273,000	21.6
1939 (A)	556,660	10,608,000	19.1
10-YEAR AVERAGE 1928-1937 (A)	683,088	12,234,654	17.9

(C) Data from United States Census, based on harvested acres.
(A) Estimates furnished by the Division of Agricultural Statistics of the Agricultural Marketing Service, United States Department of Agriculture, based on seeded acres.

land in this area has been farmed less than 50 years, which under the summer-fallow system would mean only about 25 crops of wheat. Good soil such as is generally used for wheat production in this region would not ordinarily be expected to show serious signs of fertility depletion after growing so few crops.

Table 5. TREND OF WHEAT YIELDS BY COUNTIES IN THE COLUMBIA BASIN, OREGON 1889-1939

Crop year	Average yield per acre				
	Umatilla	Morrow	Gilliam	Sherman	Wasco
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*
1889 (C)	12.7	6.6	5.7	4.6	4.7
1899 (C)	17.6	8.8	8.8	11.5	12.8
1909 (C)	21.3	4.2	8.6	12.5	16.2
1919 (C)	23.1	9.5	11.0	18.4	19.9
1924 (C)	22.5	7.3	7.9	13.6	16.9
1928 (A)	26.1	17.5	20.8	22.1	23.5
1929 (A)	27.8	12.8	11.9	14.1	17.4
1930 (A)	30.1	16.4	14.9	17.9	20.2
1931 (A)	27.9	11.2	9.2	13.2	16.5
1932 (A)	25.8	16.2	14.6	16.9	20.6
1933 (A)	27.3	10.7	11.1	17.3	17.1
1934 (A)	20.6	7.6	8.7	13.7	14.2
1935 (A)	23.0	4.9	4.9	14.0	18.4
1936 (A)	25.2	10.7	10.7	18.3	20.4
1937 (A)	25.5	13.5	13.5	17.0	19.0
1938 (A)	28.2	15.3	16.9	19.9	22.4
1939 (A)	28.6	10.0	11.9	17.6	16.9
10-YEAR AVERAGE 1928-1937 (A)...	25.9	12.2	12.0	16.4	18.7

(C) Data from United States Census, based on harvested acres.
(A) Estimates furnished by the Division of Agricultural Statistics of the Agricultural Marketing Service, United States Department of Agriculture, based on seeded acres.

Another reason is that during the period many improvements have been made in wheat-growing methods. The more important of these are: (1) development of higher-yielding varieties, (2) the control of wheat diseases such as smut and bunt through resistant varieties and strains of wheat and through more efficient methods of chemical control, (3) the use of more efficient tillage methods and implements, and (4) the use of tractors, which has made it possible to perform necessary operations at the proper time even when large acreages are operated by a single individual.

A third, and perhaps the most important reason is that, as was previously pointed out, moisture rather than fertility is the limiting factor in crop production in this area. The soils generally were well supplied with plant nutrients under virgin conditions and the limited crops removed to date have not yet reduced the supply to a critical point. It is quite likely, however, that yields have been reduced on certain fields or portions of fields but that these losses have been obscured by yield data that are based on entire farms or large fields. In these cases the losses on small low-yielding tracts would be averaged out when the production of a large acreage was combined. The Soil Conservation Service is now making tests on small areas for the purpose of determining the effect of erosion and fertility loss on crop yields.

The opinions of cooperative farmers were obtained to supplement available statistical data with reference to whether or not wheat yields were declining in the area (Table 6). More than half of them believed that yields were declining. The soil and erosion conditions found by the technical staff of the Soil Con-

servation Service who cooperated in this study are presented in the next section of this report.

The situation with regard to wheat yields in this area, to recapitulate, seems to be that while erosion, fertility depletion, and exhaustion of active organic matter are taking place other factors, such as higher-yielding and disease-resistant varieties of wheat, are compensating for them and thus maintaining yields. It is believed that despite technological advancements the ravages of erosion and the exploitative production methods commonly employed must ultimately result in a decline in yield unless corrective measures are adopted.

Table 6. ARE WHEAT YIELDS DECLINING, INCREASING, OR STATIONARY

(A summary of opinions expressed by 99 Columbia Basin dry-land wheat farmers, Oregon, 1936)

Status of wheat yields	Opinions of farmers regarding wheat yield trends			
	Umatilla	Gilliam	Sherman	For entire study
	Number	*Number*	*Number*	*Number*
"Declining"	27	21	10	58
"Increasing"	3	....	2	5
"Stationary"	20	7	9	36
TOTAL	50	28	21	99

Variation. The wheat lands in each county vary widely in their productive capacity as is shown on the map (Figure 7), and in Table 7. The widest yield spread is found in Umatilla County, which has some wheat land in production that yields less than 5 bushels per acre, and other land that yields about

Table 7. VARIATION IN WHEAT YIELDS--COLUMBIA BASIN COUNTIES, OREGON

Based on 4-year average yield, 1929-1932*

Range in yield per acre	Proportion of wheat land in each county having indicated yield					
	Umatilla	Morrow	Gilliam	Sherman	Wasco	Weighted average
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
0- 5 bushels	.1	.3	.8	.5	.....	.3
5-10 bushels	2.2	11.8	22.0	13.6	5.9	10.0
10-15 bushels	8.6	49.1	60.4	41.5	16.1	32.1
15-20 bushels	13.3	34.1	15.5	26.5	32.8	22.0
20-25 bushels	16.7	4.4	1.1	15.8	30.6	13.0
25-30 bushels	16.9	.3	.2	2.1	13.8	7.8
30-35 bushels	18.8	.....	.....	.....	.5	6.6
35-40 bushels	13.0	.....	.....	.....	.3	4.6
40-45 bushels	6.9	.....	.....	.....	.....	2.4
45-50 bushels	2.8	.....	.....	.....	.....	1.0
50-55 bushels	.7	.....	.....	.....	.....	.2
55-60 bushels	.....	.....	.....	.....	.....	.....
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
Average wheat plantings—*acres*	240,400	124,300	120,900	132,300	68,300	686,200
Average wheat production—*bushels*	6,624,000	1,751,000	1,495,000	2,010,000	1,340,000	13,220,000
Average yield-*bushels*	27.6	14.1	12.4	15.2	19.6	19.3

* Data compiled from original producer contracts of the Agricultural Adjustment Administration by E. B. Hurd, Bureau of Agricultural Economics, and H. D. Scudder, Oregon Agricultural Experiment Station.

55 bushels per acre. Most of this variation is attributable to differences in rainfall and depth of soil, rather than to the supply of essential plant nutrients in the soil.

The area of low-yielding wheat land is of particular significance to those interested in land-use adjustment programs. It is often contended that such lands contribute scantily, if at all, to the economic well-being of the owners and operators thereof, but in the aggregate frequently produce enough wheat to affect seriously the market price.

The area of wheat land in the Columbia Basin producing less than 5 bushels per acre amounts to approximately 2,115 acres, while the area producing less than 10 bushels per acre amounts to 70,892 acres according to available statistics that are based on farm yields. Both figures are based on the 1929-1932 base-period yields. It is believed that these figures are conservative. In many cases low-yielding lands do not lie in large, contiguous blocks, but occupy only part of what may otherwise be a fair-yielding field. Since the figures reported on the Agricultural Adjustment Administration contracts are for entire tracts, many low-yielding areas were obscured by the yields obtained on the better parts of the tract.

It does not appear that the relatively low yields obtained in certain parts of the Columbia Basin today are, to any great extent at least, a result of soil depletion. It is believed that yields in these particular areas have consistently been low ever since such lands were first plowed but, of course, have been better some years than others because of variations in growing conditions. Nevertheless, the same relative decline in productivity will be quite as critical, if not more so, in these low-yielding areas as in the higher producing areas.

Just how low yields can go before land becomes submarginal for wheat production is a much discussed question. Obviously both the price of wheat and the cost of farming will enter into the answer. Likewise, the location of the low-yielding land in relation to the good wheat land is also a factor. This factor of submarginality is discussed more in detail in the section of this report dealing with the cost of producing wheat.

SOIL AND EROSION CONDITIONS

The type of wheat farming that has been practiced in the Columbia Basin has been conducive to the development of erosion. When strong winds blow over fine dust mulches on fallowed land it is inevitable that soil blowing will occur. The extent and seriousness of the movement of soil will, of course, depend on many factors. Likewise, when heavy rains fall on sloping land unprotected by cover, or when sudden thaws quickly remove a snow covering from bare land, soil will be washed. It appears that this erosion is aggravated by the exhaustion of humus that results when land is long cropped and when this cropping is not accompanied by the return of crop residues, or compensating organic matter.

A study of erosion conditions on dry-farmed crop land was included as part of the investigation of wheat-farm organization. This phase of the study was carried on by Mr. Clarence Waldo and Mr. Howard Magness, representatives of the Soil Conservation Service of the United States Department of Agriculture. These investigators inspected 71 farms located within the study area and on most of these places farm organization records were also obtained. These farms contained 104,516 acres, of which 87,232 acres, or 83 per cent, were in crop or fallow.

A summary of their findings shows that:

(1) On 37,076 acres, or 42.5 per cent of the crop land, less than 25 per cent of the surface soil has been removed by wind or water (or both), and evidences of erosion are not usually apparent.

(2) On 45,061 acres, or 51.7 per cent of the crop land, 25 to 75 per cent of the surface soil has been removed or relocated by wind or water (or both), and evidences of erosion are quite apparent.

(3) On 4,792 acres, or 5.5 per cent, of the crop land, over 75 per cent of the surface soil has been removed or relocated by wind or water (or both), and the land is now marginal to submarginal for further cropping.

(4) On 303 acres, or .3 per cent of the crop land, erosion has destroyed the crop producing ability of the land.

These data indicate clearly that erosion is becoming a serious factor in this area. Owing to the fact that only a small percentage of the crop land has been eroded to the point of submarginality, many operators are inclined to discount the seriousness of this problem. According to the Soil Conservation Survey, however, better than half of the crop land is well on the way toward becoming marginal or submarginal for wheat production unless some effective action is taken to check this erosion.

Except in the heavier rainfall areas where rills and gullies were plainly visible and where these tended to interfere with harvesting, most farmers did not appear to be greatly concerned about water erosion. In the blow areas, more farmers appeared to be erosion conscious, and for the most part were adopting tillage practices designed to lessen blowing. Perhaps part of this indifference to the future of these lands on the part of resident farmers can be attributed to lack of observation as to the cumulative effects of erosion. Absentee ownership, however, and the pressure for the highest immediate economic return to pay living expenses, taxes, and mortgage payments also influence individual reaction to the problem.

Considerable variation exists in the type and extent of erosion in the various Columbia Basin counties. In the lighter-rainfall and light-soil areas such as western Umatilla and northern Morrow, Gilliam, Sherman, and Wasco Counties, wind erosion is most prevalent. In the heavier-rainfall sections in eastern Umatilla, western Wasco, and in parts of the other counties, water

Table 8. EXTENT OF EROSION ON WHEAT LANDS OF UMATILLA, GILLIAM, AND SHERMAN COUNTIES, 1936

(Based on a study of 71 farms made by Clarence Waldo and Howard Magness of the Soil Conservation Service, U. S. Department of Agriculture)

County	Crop land where less than 25 per cent of surface soil removed	Crop land where 25 to 75 per cent of surface soil removed	Crop land where over 75 per cent of surface soil removed	Crop land where all of surface soil removed and subsoil now being eroded
	Per cent	*Per cent*	*Per cent*	*Per cent*
Umatilla	44.8	50.4	4.0	0.8
Gilliam	30.9	58.7	10.4	.....
Sherman	57.8	42.2	.....	.....
TOTAL FOR STUDY AREA	42.5	51.7	5.5	0.3

erosion assumes the lead. Within such areas the extent to which the lands are eroded depends on the prevalence of conditions conducive to erosion, and the care that the farmer has used in controlling these conditions.

The data presented in Table 8 reveal that at present Sherman County wheat lands show the least amount of erosion with Umatilla ranking second and Gilliam showing the greatest amount. The bulk of the erosion noted in Gilliam County was wind rather than water erosion, and was most prevalent on the light soils in the north end of the county.

Methods used in controlling erosion varied with the type present. Sheet erosion, which occurs mainly on the heavier soils, was controlled by cultural practices such as contour cultivation, trashy summer fallow, and by seeding out steep slopes. Strip cropping was used only to a very limited extent. Small straw, rock, or sack check dams in gullies and seeded waterways were also used (Figure 3).

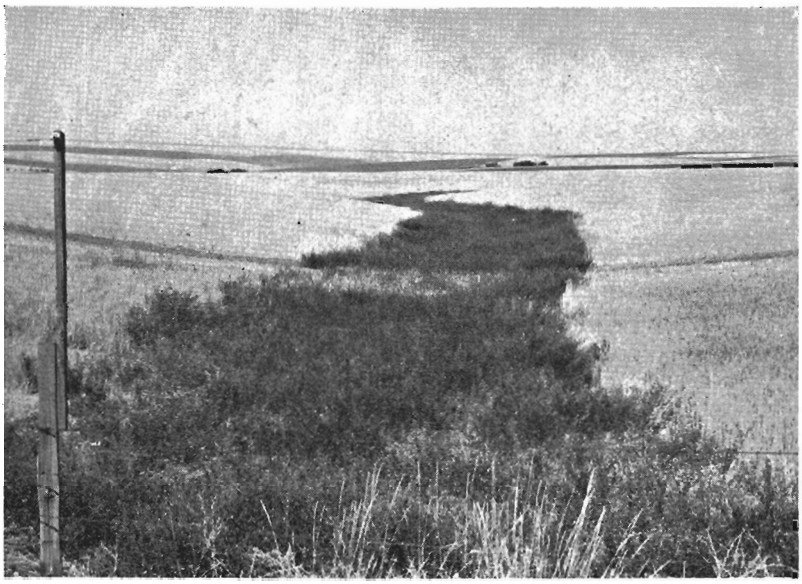

Figure 3. Seeded drainage ways prevent gullies and provide feed for livestock.

Wind erosion, the most spectacular form of soil loss, is being coped with principally by two methods: trashy fallow and grass seedings. Trashy fallow, which may be defined as that method of soil preparation and cultivation that leaves on or near the surface of the soil most of the stubble and straw remaining on the field after harvest, appears to be an efficient and practical method of control. Where the soil is extremely unstable grass cover is considered to be the best preventive.

The effects of wind erosion on one Columbia Basin wheat farm are illustrated in Figure 4, which shows the only piece of machinery in sight after a 1936 dust storm. Plows, drills, harrows were completely buried, but since the

wheat crop was a total loss the operator did not find it necessary to dig out the equipment. This sight is not as yet common in this region but the portent is clear and unmistakable: *it can happen in Oregon.*

Figure 4. It happened in Oregon.

Section I

PRESENT FARM ORGANIZATION

THE farms covered by the survey have been analyzed for five factors which it is believed point out the present organization and status of these farms as operating business units and indicate future adjustments that might occur. These factors are: (1) Land and Crop Utilization, (2) Livestock, (3) Tenure, (4) Farm Investment, and (5) Farm Income and Outgo.

LAND AND CROP UTILIZATION

A typical wheat farm in the Columbia Basin consists of dry-farmed crop land more or less interspersed with pasture or range land. In a few instances these two types of land may be supplemented by small irrigated areas, but this is the exception rather than the rule. The land in the wheat farm may be owned, share rented or cash rented, and in some instances a farmer will sublet part of his owned or rented land.

Dry-land wheat farming in the Columbia Basin Region is of an extensive type due mainly to three factors: low yields, the use of summer fallow, and power-machine methods. The average yield of the region as a whole for the four-year base period of the Agricultural Adjustment Administration, 1929-1932, was 19.3 bushels per acre with 77 per cent of the land yielding less than 25 bushels. With the summer-fallow system, under which nearly all dry-land wheat in this area is grown, wheat alternates with fallow; hence only one crop of wheat is grown on any particular acre every two years. For this reason, farmers must operate twice the acreage necessary under continuous cropping, on land of equal productivity, to realize the same output.

The average size of the wheat farms included in this study was 1,167, 2,442, and 1,187 acres, for Umatilla, Gilliam, and Sherman Counties respectively. Size of farm was related to yield per acre, the larger farms being in the lower-yielding areas (Table 21).

Topography plays a leading part in the use of land in the Columbia Basin. The outstanding topographic features are: (1) the deep canyons that in some areas completely separate fields within the farm, (2) rocky outcrops which occur in many fields and which must be "farmed around", and (3) steeply sloping fields. Canyons and steep slopes constitute the bulk of the pasture or range land on wheat farms.

The ratio of pasture land to crop land on wheat farms varied considerably in the different counties (Table 9). In Umatilla County, where there are relatively few canyons or excessively steep slopes, 89 per cent of the land in farms was cropped. In Gilliam County, where the wheat land consists chiefly of ridge tops, only two-thirds of the land in farms was cropped. With the exception of a few very shallow or droughty areas, practically all of the farm land that it was physically possible to till was being used for wheat production at the time of this study.

Farm layout. The relative locations of the different tracts of land making up the farming unit have an important bearing on the farming operations. Owing to extensive renting there is a tendency toward scattered farm holdings throughout the Columbia Basin. The operation of such holdings often requires the movement of heavy machinery for considerable distances, and in some instances this results in adding materially to the cost of farming.

Table 9. UTILIZATION OF OPERATED LAND

(For 99 Columbia Basin Dry-Land Wheat Farms, Oregon, 1935-1937 crop year)

Land utilization	Umatilla County (50 farms)			Gilliam County (28 farms)			Sherman County (21 farms)			Total for area (99 farms)		
	Land operated	Average per farm	Proportion of total acres	Land operated	Average per farm	Proportion of total acres	Land operated	Average per farm	Proportion of total acres	Land operated	Average per farm	Proportion of total acres
	Acres	*Acres*	*Per cent*	*Acres*	*Acres*	*Per cent*	*Acres*	*Acres*	*Per cent*	*Acres*	*Acres*	*Per cent*
Plow land	51,927	1,038	89	45,106	1,611	66	19,358	922	78	116,391	1,176	77
Pasture and range land	5,635	113	10	22,562	806	33	4,108	243	20	33,305	336	22
Waste	783	16	1	713	25	1	457	22	2	1,953	20	1
TOTAL OPERATED	58,345	1,167	100	68,381	2,442	100	24,923	1,187	100	151,649	1,532	100

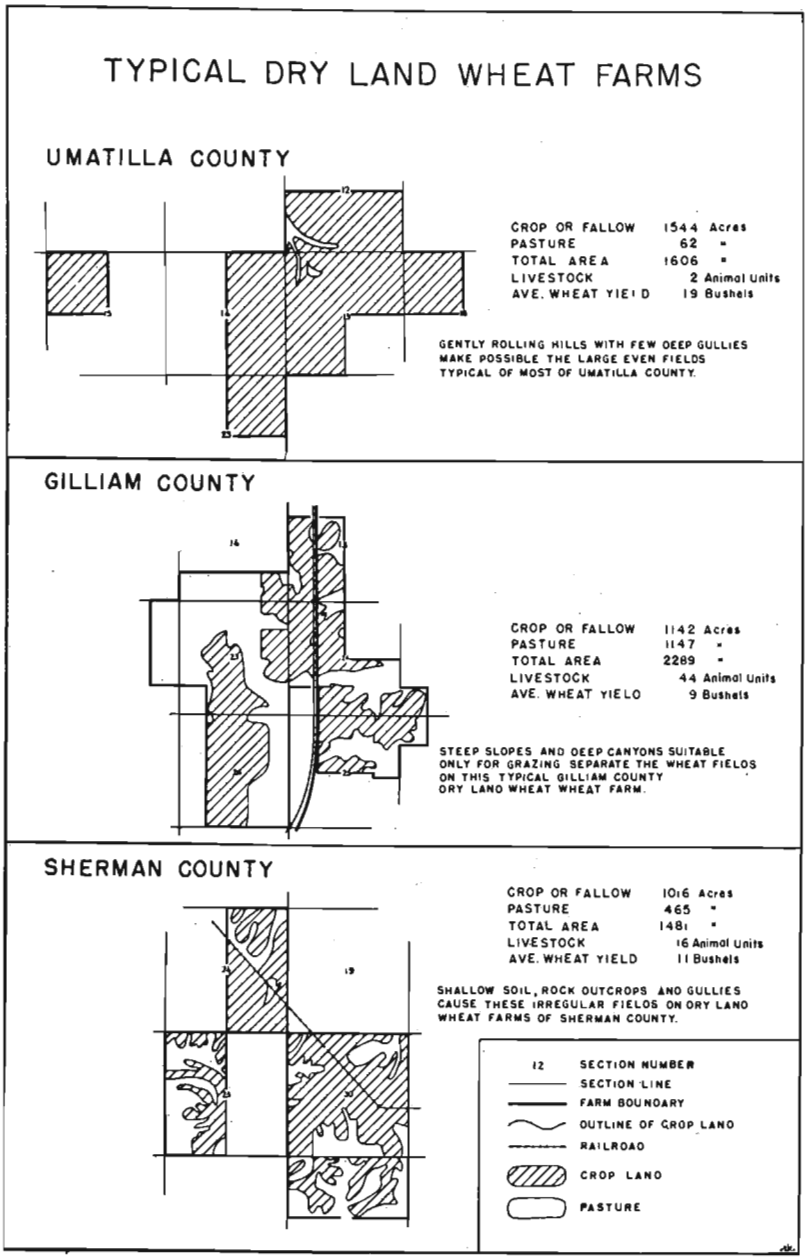
TYPICAL DRY LAND WHEAT FARMS
UMATILLA COUNTY
CROP OR FALLOW 1544 Acres
PASTURE 62 "
TOTAL AREA 1606 "
LIVESTOCK 2 Animal Units
AVE. WHEAT YIELD 19 Bushels
GENTLY ROLLING HILLS WITH FEW DEEP GULLIES MAKE POSSIBLE THE LARGE EVEN FIELDS TYPICAL OF MOST OF UMATILLA COUNTY.
GILLIAM COUNTY
CROP OR FALLOW 1142 Acres
PASTURE 1147 "
TOTAL AREA 2289 "
LIVESTOCK 44 Animal Units
AVE. WHEAT YIELD 9 Bushels
STEEP SLOPES AND DEEP CANYONS SUITABLE ONLY FOR GRAZING SEPARATE THE WHEAT FIELDS ON THIS TYPICAL GILLIAM COUNTY ORY LAND WHEAT WHEAT FARM.
SHERMAN COUNTY
CROP OR FALLOW 1016 Acres
PASTURE 465 "
TOTAL AREA 1481 "
LIVESTOCK 16 Animal Units
AVE. WHEAT YIELD 11 Bushels
SHALLOW SOIL, ROCK OUTCROPS AND GULLIES CAUSE THESE IRREGULAR FIELDS ON ORY LAND WHEAT FARMS OF SHERMAN COUNTY.
12 SECTION NUMBER
SECTION LINE
FARM BOUNDARY
OUTLINE OF CROP LAND
RAILROAD
CROP LAND
PASTURE

Figure 5.

The location of crop and pasture land within the farm unit is often of even more importance to economical and efficient operation than the location of the different parts of the farm. It is not uncommon to find the wheat land on a given farm divided into several irregularly shaped fields separated from each other by canyons or rocky washes that are difficult to cross with machinery. This condition is more prevalent in Gilliam and Sherman Counties than in Umatilla County.

Figure 5, which shows the location of crop and pasture land on typical wheat farms in each of the counties studied, presents graphically this problem of scattered fields. Umatilla County wheat farms contain only a small amount of pasture land and large contiguous bodies of crop land. In contrast to this condition, Gilliam and Sherman County wheat farms are frequently cut up by canyons, rocky outcrops, and slopes too steep to till, with the result that the crop land is divided into many small or irregularly shaped fields that are difficult to get to and even more difficult to farm.

There is need in many areas for a reorganization of the farm layout that will throw out of cultivation small, isolated, low-yielding, or irregular-shaped fields, and will smooth out the boundaries of larger fields. It is believed that the encouragement of grass seedings through the Agricultural Conservation Programs will assist in correcting this situation. Especially will this be true where such areas can be fenced in with the regular pasture land, or where such areas are of low productive value.

Crop land and crops. For the study as a whole approximately 99 per cent of the crop land was devoted to soil-depleting uses in 1935. Wheat for grain and summer fallow occupied 92 per cent of the land devoted to soil-depleting uses (Table 10).

The average yield of the 1935 wheat crop on the 99 farms studied was 15.5 bushels per acre. The average yield per acre for the farms studied in Umatilla, Gilliam, and Sherman Counties was 23.2 bushels, 6.0 bushels, and 16.0 bushels, respectively. These yields are considerably below the average yields for the eight-year period 1929-1936. During this period the average yield of wheat per acre on these identical farms was: Umatilla 26.2 bushels, Gilliam 12.0 bushels, and Sherman 16.8 bushels.

A limited amount of barley was grown in all three counties, averaging less than 10 acres per farm. A shift toward growing barley for livestock feed might be a desirable farm adjustment in this area.

In the heavier-rainfall sections of Umatilla County peas for canning were grown by some farmers in place of summer fallow. As the amount of such land available for peas without a major displacement of wheat exceeds any probable acreage of peas that will be grown, a material reduction of wheat acreage by pea growing is unlikely. The average yield of shelled green peas obtained in 1935 on the farms studied was 1,150 pounds per acre.

The production of grain hay chiefly represents wheat cut from strips around the edge of the field preparatory to entering the field with the combine. For the area as a whole a yield of about nine-tenths of a ton of grain hay per acre was obtained. This phase of wheat farming is discussed more fully in Appendix B.

The utilization of the major crops produced on the wheat farms studied is shown in Table 11. Of the wheat raised 70 per cent was sold and 16 per cent paid to the landlord as rent. As most of the wheat received as rent was sold by the landlord, in effect about 86 per cent of the wheat crop reached the market. Very little wheat was fed when measured in percentage of the total crop, but

Table 10. Utilization of Crop Land

(For 99 Columbia Basin Dry-Land Wheat Farms, Oregon, 1935-36 crop year)

Utilization of crop land	Umatilla County		Gilliam County		Sherman County		Total for study	
	Total	Average per farm	Total	Average per farm	Total	Average per farm	Total	Average per farm
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Soil Depleting Uses								
Winter wheat	18,700	374	13,363	477	7,025	335	39,088	396
Spring wheat	3,976	79	5,146	184	382	18	9,504	96
Barley	359	7	240	8	151	7	750	8
Rye	.....	.....	40	1	.....	.....	40	.....
Oats	75	2	.....	.....	38	2	113	1
Grain hay	1,562	31	2,348	84	1,265	60	5,175	52
Grain pastured	189	4	1,582	57	158	8	1,929	19
Canning peas	696	14	.....	.....	.....	.....	696	7
Miscellaneous crops*	145	3	.....	.....	28	1	173	2
Summer fallow	25,818	516	21,378	764	10,229	487	57,425	580
TOTAL SOIL DEPLETING USES	51,520	1,030	44,097	1,575	19,276	918	114,893	1,161
Soil Conserving Uses								
Seeded grasses	53	1	68	2	.....	.....	121	1
Green manure crops	108	2	.....	.....	.....	.....	108	1
Sweet clover	18	.....	.....	.....	.....	.....	18	.....
Alfalfa	149	3	20	1	.....	.....	169	2
TOTAL SOIL CONSERVING USES	328	6	88	3	.....	.....	416	4
Neutral								
Idle crop land	79	2	921	33	82	4	1,082	11
TOTAL ACRES CROP LAND	51,927	1,038	45,106	1,611	19,358	922	116,391	1,176
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Crop land in wheat and summer fallow	93	93	88	88	91	91	92	92

* Includes 9 acres asparagus, 30 acres potatoes, 87 acres beans, 21 acres garden, and 26 acres of mixed grains.

Table 11. UTILIZATION OF MAJOR FIELD CROPS

(For 99 Columbia Basin Dry-Land Wheat Farms, Oregon, July 1, 1935 to July 1, 1936)

Crop	Units on hand at beginning of year	Units purchased during year	Units produced crop of 1935	Total units available	Method of disposal expressed in percentage of units available				
					Sold	Rent paid to landlord	Fed	Used for seed	On hand end of year
					Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Wheat—*Bushels*	26,172	10,716	754,987	791,875	70	16	3	7	4
Barley—*Bushels*	582	634	17,310	18,526	43	4	34	6	13
Oats—*Bushels*	124	179	5,173	5,476	38	9	28	10	15
Rye—*Bushels*	.....	440	200	640	33	....	67	....	....
Canning peas*—*Cwt.*	8,010	1,050	13,265	22,325	35	1	....	5	59
Wheat hay—*Tons*	50	60	2,254	2,364	7	2	88	....	3
Barley hay—*Tons*	.....	3	445	448	16	1	81	....	2
Oat hay—*Tons*	.....	10	384	394	11	2	78	....	9
Rye hay—*Tons*	.....	20	473	493	4	2	94	....	....
Alfalfa hay—*Tons*	.....	38	281	319	20	....	79	....	1
Pea vines—*Tons*	110	.....	276	386	....	....	28	....	72
Chaff and straw—*Tons*	86	160	2,965	3,211	4	....	92	....	4

* The large inventories of peas and pea vines on hand at beginning and end of the period is explained by the fact that the crop year (July to July) used in this study coincided with harvest time for peas. This large stock is not held for long as these items are not ordinarily carried over from one year to the next.

when measured in bushels there was more wheat fed than all of the other feed grains combined. Of the barley and oats raised about half was sold or paid as rent, and the remainder was fed, seeded, or carried over. A large part of the hay raised was fed on the farm, but some farmers raised surplus hay and sold it. The carry-over of peas into the inventory is a result of the closing inventory for this study almost coinciding with pea harvest, and does not represent a practice of holding over peas. Pea sales represent the 1935 crop, while peas on hand at the end of the year represent the 1936 crop.

The effect of weeds on crop land utilization. The control of weeds is a major problem on many wheat farms. Practically every farmer cooperating in this study reported annual or perennial weeds that were seriously interfering with his wheat production program. The annual weeds most often reported were: Russian thistle (*Salsola pestifer*), Jim Hill mustard (*Norta altissima*), peppergrass (*Lepidium perfoliatum*), and tarweed (*Amsinckia intermedia*). Morning-glory (*Convolvulus arvensis*) was the most common perennial weed.

Russian thistle is usually controlled by fall seeding of wheat on properly weeded summer fallow. To control this thistle in spring wheat some farmers plow immediately after harvest in order to destroy the weed before its seed is ripe. As a matter of fact, however, this weed seldom gets out of control unless spring wheat is grown year after year on the same land.

Tarweed, peppergrass, and Jim Hill mustard are held in check by spring sowing of wheat as it is then possible to weed before drilling. As the Columbia Basin, however, is predominantly adapted to fall rather than spring seeding, control of these three and similar weeds in actual practice is usually attempted by increasing the seeding rate to obtain a thick stand of wheat that will smother out the weeds, and by seeding early to get the wheat up and growing ahead of the weeds. Occasional freeze-outs of winter-seeded grain or dry fall weather compel spring seedings on a large scale, and in such years many infestations of annual weeds are brought under control. Some farmers are inclined to allow thin stands to mature to avoid reseeding costs, and such stands are usually very weedy. From the weed-control standpoint these stands are to be avoided if at all possible. A shift to one of the newly developed higher-yielding varieties of spring wheat is a method that offers possibilities to operators with a serious weed-control problem.

The control of morning-glory, the chief perennial noxious weed now present on wheat farms, is extremely difficult. For the area as a whole, it is doubtful whether the wheat rancher is holding his own against the encroachments of this weed. On some ranches badly infested areas have been completely abandoned; on others cropping is continued despite markedly reduced yields. Weed-control programs launched by local, state, and Federal authorities are becoming increasingly effective as greater knowledge of the problem is obtained. These programs should proceed as rapidly as funds can be obtained for the reason that large economic losses are suffered annually from the growth of weeds on crop and pasture lands.

Cultivation and the use of chemicals, chiefly sodium chlorate, are the weapons most frequently used in fighting morning-glory.* In general, chemicals are used where only small patches of the weed are present. If the infestation covers large areas, the land is temporarily retired from wheat production and control is effected by frequent cultivation over a period of two or occasionally three years. In using this method of control delayed fallow has been shown by

* For detailed methods of controlling morning-glory and other perennial weeds see Jackman, E. R., Jenkins, L. C., et al., "Control of Perennial Weeds in Oregon", Extension Bulletin 510, Oregon State College, 1938.

the Oregon Experiment Station to be fully as effective, and in many cases more so, than clean fallow. Delayed fallow, which consists of delaying the first spring plowing until bud stage and thereafter allowing the weeds to grow from 6 to 8 days after emergence, decreases the number of cultivations necessary by 25 to 35 per cent.

The high cost of chemical weed killers is a serious handicap to an effective fight against morning-glory. Farmers estimated that it required $35 to $75 worth of sodium chlorate per acre of morning-glory, depending on degree of infestation, to effect a complete kill. A pressing need is either a new and cheaper proved chemical weed killer or a cheaper source of supply of the chemicals now used. A word of warning should be given regarding allegedly new and improved treatments, for farm operators occasionally sustain substantial losses from purchasing chemicals that are not effective in their areas and under their farming conditions. The county agricultural agent is always informed on the merits of the different methods of control in his area and his advice may be obtained on the local effectiveness of suggested treatments.

Range and native pastures. Wheat lands in the Columbia Basin were originally covered with bunch grass. Those pasture lands that have never been plowed still retain this type of cover, although in many cases heavy grazing has almost obliterated the stand. On pasture lands that have been plowed at some time in the past the native bunch grass is of course destroyed. Weeds or low-value annual grasses are the usual cover on such lands unless seeding to more desirable grasses has taken place.

Permanent pasture is generally used to carry stock from the time stubble land is plowed in the spring until new stubble pasture is available in the fall (Figure 6). Many wheat farmers stated that the shortage of grass pasture was a hinderance to the keeping of enough stock to utilize properly the chaff, straw, and stubble available. Frequently permanent pastures are supplemented by plantings of wheat or rye for pasture. The amount of supplemental grain pasture used by farmers included in this study is shown in Table 12.

Figure 6. Beef cattle on native bunch-grass pasture. Cattle such as these offer a profitable side line to wheat farming.

The number of cattle, sheep, and horses on wheat farms tended to vary directly with the area of pasture land available. For example, in Umatilla County, where only 10 per cent of the farm area was pasture land, there was an average of 17 animal units* per farm of these three classes of stock. In Sherman County, with 20 per cent in pasture, there were 33 animal units per farm, and in Gilliam County, where the farms averaged about one-third grass land, there was an average of 72 animals units per farm.

For the study as a whole there was an average of 9 acres of native pasture per animal unit. For the three counties, Umatilla, Gilliam, and Sherman, the acres of native pasture per animal unit were 7, 11, and 7 respectively (Table 12).

Table 12. AMOUNT OF PASTURE AND SUPPLEMENTAL FORAGE USED PER ANIMAL UNIT OF LIVESTOCK

(For 99 Columbia Basin Dry-Land Wheat Farms, Oregon, 1935-36 crop year)

County	Native pasture per animal unit	Crop pasture per animal unit	Stubble pasture per animal unit	Supplemental feed (Chiefly used for winter feed)	
				Chaff and straw per animal unit	Hay per animal unit
	Acres	*Acres*	*Acres*	*Tons*	*Tons*
Umatilla	7	.3	29	.7	1.8
Gilliam	11	.8	10	.8	.7
Sherman	7	1.2	13	1.2	.8
TOTAL FOR AREA	9	.8	15	.9	1.0

Seeded grass pastures. Seeding of pastures in the dry-land wheat area of the Columbia Basin was not a common practice prior to 1935 or 1936. This was not due to a lack of need for pasture but rather because few grasses of value for grazing were available that would grow successfully in this area. With the introduction of crested wheat grass (*Agropyron cristatum*), a grass imported from Siberia, however, active interest in grass seeding manifested itself. Limited acreages of this grass were planted in this area prior to 1935, but it was not until the advent of soil-conservation-practice payments by the Agricultural Adjustment Administration in 1936 that large acreages were seeded.†

Crested wheat grass is not only a valuable pasture grass, it is also well adapted to erosion control. Since it serves the dual purpose of furnishing forage and preventing erosion, farmers in this area have become increasingly more interested in it. Certain perennial grasses including crested wheat grass may be seeded by wheat farmers to secure agricultural conservation payments under the Agricultural and Domestic Allotment Act passed by Congress in 1936. Most grass seedings in this area have been made under the terms of this act.

At the time this survey was made, the summer of 1936, few seeded permanent pastures were sufficiently well established to be used for grazing. For this reason no data were available on their carrying capacity, nor was it possible

* An animal unit consists of one mature horse, cow, or steer, 2 colts or 2 calves, 5 ewes or 10 lambs, 5 sows or boars or 10 pigs, or 100 head of poultry. Hogs and poultry were not considered to be grass- or hay-consuming animals.

† The total acreage of crested wheat grass at year's end in the five Columbia Basin counties has been estimated by E. R. Jackman, Extension Specialist in Farm Crops, Oregon State College, at approximately 750 acres in 1935, 24,500 in 1936, 43,700 in 1937, 83,400 in 1938, and 139,000 acres in 1939.

to accurately appraise their future place in the internal economy of wheat farms. It is certain, however, that definite need for such seedings exists on many wheat farms. Such seedings can be used for erosion control; for seeding out of cultivation isolated, irregular, or excessively steep areas; for furnishing pasturage; or for a combination of these uses. A limited acreage of grass may also be utilized for seed production.*

On many wheat farms in this region additional pasture from new grass seedings will not result in an increase in the number of head of livestock kept. A number of the farmers reported in this study that additional grass would not allow them to increase the number of livestock because they were already stocked to the limit of their stubble pastures. Additional grass pasture from new seedings would, in these cases, serve to relieve badly overgrazed native pastures and stubble fields and thus provide better feed for the present number of livestock rather than permit expansion. The improvement of native pastures as a result of such decreased grazing is greatly to be desired. Reduced grazing of stubble and use of straw is also desirable because, from the standpoint of permanent wheat culture, it is probable that a large portion of such by-products might better be incorporated in the soil.

Utilization of by-products. The utilization of chaff, straw, and stubble presents to the wheat farmer the problem of how heavily these products may be used by livestock without depleting the soil through the removal of needed organic matter. Livestock farmers usually considered chaff a valuable livestock feed and dropped it in piles to be picked up later. Straw, in the absence of straw spreaders, either was strung out in rows and left in the field or if needed for winter feed was dumped in piles and picked up by hand. Straw burning, once so prevalent in the higher-yielding areas of the Columbia Basin, was never practiced much in the lower-yielding areas. In the higher-yield areas, however, some farmers still burned straw dumps because they hampered plowing and other field operations, and in some instances also burned the stubble. All burning is decreasing as the need for organic matter in the soil is becoming more thoroughly understood.

The extent to which these by-products are used for feed should be governed by conditions existing on the individual farm. The stubble of low-yielding wheat land should be grazed sparingly, if at all, and the straw should be returned to the soil. It so happens that the stubble and straw on low-yielding land is very palatable. This is because the lower-yielding land usually lacks in moisture and produces a straw somewhat higher in protein and lower in fiber than does land with a more favorable moisture content. As this straw is so palatable livestock, if grazing is not controlled, will eat a very large percentage of it. Grazing on any stubble land is probably unsafe when it exceeds one animal unit month per 10 acres of wheat stubble.

It must be recognized that the utilization of grass on wheat farms is controlled to a large extent by the utilization of stubble and straw. If, for example, it is proved that on some farms straw and stubble are of more value in the long run when used for trashy summer fallow than when used for livestock feed, it is entirely conceivable that in these instances it may be desirable to stop all pasturing on stubble and to substitute other types of feed for the straw. There is a definite need for more information on the relative value of stubble

* For information on crested wheat grass practices in this region see Extension Bulletin 494, Oregon State College, "Crested Wheat Grass in Eastern Oregon," published in 1936, and Circular of Information 203, Oregon Agricultural Experiment Station, "Crested Wheat Grass Practices on Wheat Farms in Four Eastern Oregon Counties", published in 1939.

and straw when used for feed and when used for erosion control and fertility building.

Livestock. The leading classes of livestock on the farms studied were beef cattle, horses, sheep, and dairy cattle in the order named. The predominance of each class of stock varied between counties, but in all instances there were more beef cattle than sheep (Table 13). Horses and cattle appeared better suited to utilize the different kinds of feed available than were sheep. In the

Table 13. DISTRIBUTION OF LIVESTOCK ON WHEAT FARMS
(For 99 Columbia Basin Dry-Land Wheat Farms, Oregon, 1935-36 crop year)

Item	Kind of livestock						
	Horses	Dairy cattle	Beef cattle	Sheep	Hogs	Poultry	Total
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Umatilla County—50 farms							
Number of farms reporting	42	45	13	11	33	46	....
Animal units per farm reporting	7.3	4.5	19.3	8.6	1.6	1.1	....
Animal units per farm—all farms	6.1	4.1	5.0	1.9	1.4	1.0	19.5
Gilliam County—28 farms							
Number of farms reporting	26	25	21	9	20	24	....
Animal units per farm reporting	18.3	5.7	39.5	62.7	2.2	1.4	....
Animal units per farm—all farms	17.0	5.1	29.3	20.1	1.6	1.2	74.3
Sherman County—21 farms							
Number of farms reporting	19	20	8	7	18	21	....
Animal units per farm reporting	14.2	10.7	19.8	7.9	1.4	1.1	....
Animal units per farm—all farms	12.9	10.2	7.5	2.6	1.2	1.1	35.5
Total for study area—99 farms							
Number of farms reporting	87	90	42	27	71	91	....
Animal units per farm reporting	12.1	6.2	29.5	26.6	1.7	1.2	....
Animal units per farm—all farms	10.6	5.7	12.5	9.2	1.2	1.1	40.3

NOTE: One animal unit is equivalent to: one mature cow or horse, five mature sheep, five mature hogs, or one hundred poultry. Two head of young stock are considered equivalent to one mature animal of like kind.

lighter soil areas some farmers objected to sheep because they cut up the soil and thus might induce soil blowing. Dairying was not generally an important enterprise because of the lack of succulent pasture during the summer and because only grain hay, which is a poor dairy feed, was available on most of the wheat farms studied. Hence, when a farmer buys a tractor and cuts down the number of work stock he is more likely to replace them with beef cattle than with other kinds of stock.

The size of the beef cattle and sheep enterprises on the wheat farms in this area is definitely limited by the amount of roughage available. If the size of the beef cattle or sheep enterprise is expanded beyond the point where wheat by-products (chaff, straw, and stubble) become limiting factors in production, these enterprises will be in direct competition with wheat, because wheat land will then be needed to produce additional roughage for livestock. In most cases where expansion in livestock enterprises is desired beyond the point where they

can be fed from wheat by-products, the logical enterprises to select for this expansion would seem to be hogs, poultry, or feeder stock which serve to utilize grain and require little if any roughage.

TENURE

A large portion of the land in wheat farms in the Columbia Basin is operated by renters. Sherman County wheat farmers included in this study were renting about 69 per cent of the land they operated, while in Umatilla and Gilliam Counties the percentages were 58 and 40 respectively. Share renting predominated.

Fifty-eight per cent of the operators included in this study were part owners, 23 per cent tenants, and only 19 per cent full owners. Part owners rented about half of the total crop acreage on their farms and operated much larger farm units than either tenants or full owners. Part owners averaged 1,802 acres per farm, tenants 1,252 acres, and full owners 998 acres. It is probable that additional land is rented by part owners in an attempt to obtain what they believe to be an economic unit. Part owners were operating land with a much lower average yield (12.6 bushels) than were owners (22.5 bushels) or tenants (23.0 bushels).

Ownership of rented land. The bulk of the rented land was owned by individuals. For the study as a whole about 29 per cent of the rented area was owned by relatives of the operator, 59 per cent by other individuals, and 12 per cent by banks, loan companies, and other corporations. Almost 60 per cent of the rented land was owned by landlords who were residents of the same county in which the land was located. Most of the remaining rented land was owned by landlords who were residents of the state; out-of-state owners controlled only 5 per cent of the rented acreage. Many of the landowners were themselves wheat farmers or heirs of former wheat farmers of the area. Some quit farming apparently because their holdings were not large enough to constitute an efficient unit, and others because opportunities elsewhere seemed to be more favorable. While much of this rented land was for sale, it was not, as a rule, for sale at liquidation prices.

Amount of rent paid. In Gilliam County the prevailing share rent on farms surveyed was one-fourth of the crop, in Sherman County one-third crop rent was universal, and in Umatilla County one-third crop rent predominated. Most of the cash-rented crop land was found in the higher-yielding parts of Umatilla County. The average cash rental for the farms studied in 1935 was $4.59 per acre.

Yield is the chief factor responsible for determining the amount of share rent paid (Table 14). In low-yielding areas, such as Gilliam County, tenants require a large share of the crop in order to meet expenses, while on higher-yielding lands such as those of eastern Umatilla County, tenants are willing to pay as much as two-fifths or one-half the crop as rent.

Returns to the landlord. The value of the landlord's share of the wheat crop at varying prices, based on eight-year-average yield, is also shown in Table 14. The amounts indicated represent the sums available to the landlord to pay taxes, keep up fences, and have a return upon his capital investment. Taxes per acre for the two-year period needed to obtain a crop of wheat averaged about $0.60, $1.00, and $2.44, for land rented for one-fourth, one-third, and two-fifths of the crop, respectively. Fence upkeep was very small,

Table 14. VALUE PER ACRE OF LANDLORD'S SHARE OF CROP RENT USING 8-YEAR AVERAGE YIELDS AND VARYING PRICE LEVELS FOR WHEAT

(Rental data from 78 Columbia Basin Dry-Land Wheat Farmers, Oregon, 1935-36 crop year)

Share rental terms	Number of records	Average yield per acre for 8-year period 1929-1936	Average per acre return to		Value per acre of landlord's share of crop with the wheat price per bushel at*							
			Tenant	Landlord	30¢	40¢	50¢	60¢	70¢	80¢	90¢	$1.00
		Bushels	*Bushels*	*Bushels*								
Umatilla County												
¼ of crop	5	14.4	10.8	3.6	$1.08	$1.44	$1.80	$2.16	$2.52	$2.88	$3.24	$3.60
⅓ of crop	20	24.0	16.0	8.0	2.40	3.20	4.00	4.80	5.60	6.40	7.20	8.00
⅜ of crop	11	32.4	19.4	13.0	3.90	5.20	6.50	7.80	9.10	10.40	11.70	13.00
½ of crop	1	39.5	19.7	19.8	5.94	7.92	9.90	11.88	13.86	15.84	17.82	19.80
Gilliam County												
¼ of crop	10	10.8	8.1	2.7	.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70
⅓ of crop	9	12.6	8.4	4.2	1.26	1.68	2.10	2.52	2.94	3.36	3.78	4.20
⅜ of crop	---	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
½ of crop	---	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sherman County												
¼ of crop	---	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
⅓ of crop	18	16.7	11.1	5.6	1.68	2.24	2.80	3.36	3.92	4.48	5.04	5.60
⅜ of crop	---	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
½ of crop	---	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total for study												
¼ of crop	15	11.9	8.9	3.0	.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00
⅓ of crop	47	19.0	12.7	6.3	1.89	2.52	3.15	3.78	4.41	5.04	5.67	6.30
⅜ of crop	11	32.4	19.4	13.0	3.90	5.20	6.50	7.80	9.10	10.40	11.70	13.00
½ of crop	1	39.5	19.7	19.8	5.94	7.92	9.90	11.88	13.86	15.84	17.82	19.80

* The values shown are for two years' use of the land, for under the summer-fallow system the land is fallowed the year preceding each wheat crop.

and probably did not average more than 10 cents per acre for the two-year period. The land that rented for one-fourth share was valued at $16 per acre, that which rented for one-third share at $36, and land renting for two-fifths share at $82. The interest charge at 5 per cent for the two-year period required to produce a crop of wheat amounts to $1.60, $3.60, and $8.20, respectively, on these values.

The total two-year cost for taxes and fence repairs on land renting for one-fourth, one-third, and two-fifths shares amounted to $0.70, $1.10, and $2.54, respectively. If these costs are deducted from the value of the wheat paid as rent the balance represents return on the landlord's capital investment. Considering his return in bushels per acre, it appears that he will receive some return on his investment even if prices are at comparatively low levels. For example, with the farm price of wheat at $0.50 per bushel the landlord would receive approximately 2.5 per cent return on his investment after all other costs as shown above had been met. With the farm price of wheat at $0.80, however, he would receive a return of approximately 5 per cent.

Permanency of tenure. The length of time that an owner or tenant may plan to live on the same farm will usually have a bearing on his attitude toward soil-conservation practices. Farmers who are continually moving from one farm to another are likely to be interested only in the immediate future and so not inclined toward long-range planning or changes in farm practices for the purpose of soil conservation if these involve extra labor or costs not immediately compensated for.

Data from the 1935 Federal Agricultural Census on the permanency of residence of owner and tenant farmers in the Columbia Basin reveal that of the owners reporting 72 per cent had been on the same farm five or more years. In contrast, of the tenants reporting, only 37 per cent had been on the same farm five or more years. No data are available for part-owners, but it is believed that they are somewhat more permanent renters than full-time tenants, for they will ordinarily select land that is favorably located with reference to their owned land, and hence will probably attempt to retain it year after year.

In view of the extensive amount of full and part tenancy in the Columbia Basin, a program designed to encourage long-time leases or owner-operation should be an integral part of any soil conservation program. As long as the bulk of tenants change farms every four years or less, it will be difficult to extend the use of practices from which full benefits cannot be expected for several years.

THE WHEAT FARM INVESTMENT*

Owner-operators included in this study valued their land, buildings, machinery, and livestock at an average figure per farm of $50,485, of which $44,861 was for land and buildings, $3,362 for machinery, and $2,262 for livestock (Table 15). For the 661 crop acres on the average owner-operated farm this amounted to a total investment of $76.33 per crop acre. Crop land, per acre, was valued at an average of $57.16, and native pasture land at $3.60 per acre.

* The term "investment," as used in this report, represents present inventory values as estimated by the operator.

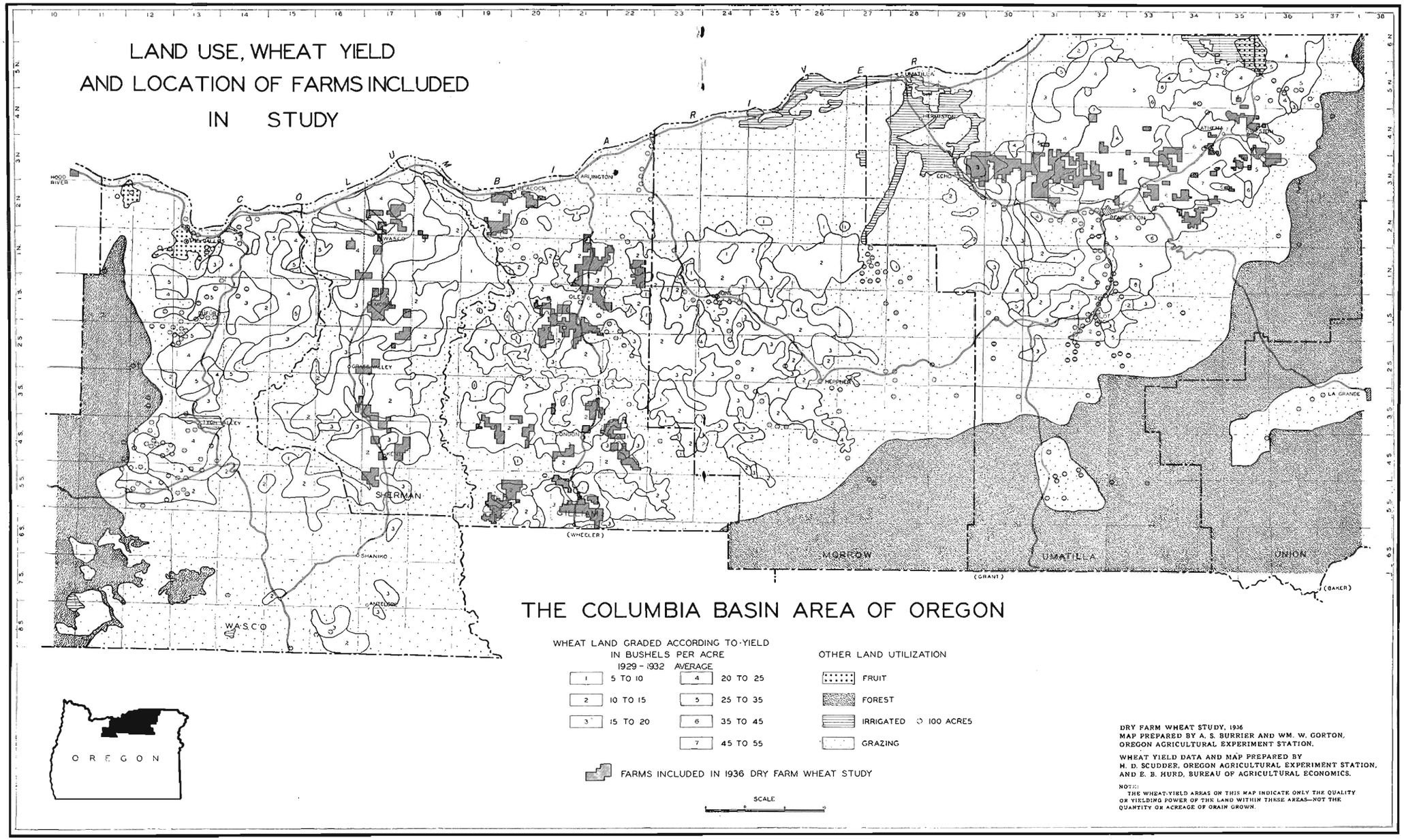
LAND USE, WHEAT YIELD
AND LOCATION OF FARMS INCLUDED
IN STUDY
COLUMBIA RIVER
HOOD RIVER
ARLINGTON
PEACOCK
WASCO
SHERMAN
(WHEELER)
MORROW
UMATILLA
UNION
(GRANT)
(BAKER)
LA GRANDE
HERMISTON
SHANIKO
ANTELOPE
WASCO
OREGON
THE COLUMBIA BASIN AREA OF OREGON
WHEAT LAND GRADED ACCORDING TO YIELD
IN BUSHELS PER ACRE
1929 - 1932 AVERAGE
1 5 TO 10
2 10 TO 15
3 15 TO 20
4 20 TO 25
5 25 TO 35
6 35 TO 45
7 45 TO 55
OTHER LAND UTILIZATION
FRUIT
FOREST
IRRIGATED ○ 100 ACRES
GRAZING
FARMS INCLUDED IN 1936 DRY FARM WHEAT STUDY
SCALE
DRY FARM WHEAT STUDY, 1936
MAP PREPARED BY A. S. BURRIER AND WM. W. GORTON,
OREGON AGRICULTURAL EXPERIMENT STATION.
WHEAT YIELD DATA AND MAP PREPARED BY
H. D. SCUDDER, OREGON AGRICULTURAL EXPERIMENT STATION,
AND E. B. HURD, BUREAU OF AGRICULTURAL ECONOMICS.
NOTE:
THE WHEAT-YIELD AREAS ON THIS MAP INDICATE ONLY THE QUALITY
OR YIELDING POWER OF THE LAND WITHIN THESE AREAS—NOT THE
QUANTITY OR ACREAGE OF GRAIN GROWN.

Table 15. THE WHEAT FARM INVESTMENT
(For 97 Columbia Basin Dry-Land Wheat Farms, Oregon, 1935-36 crop year)*

Investment item	Average for study					
	Full owners		Part owners		Tenants	
	Per farm	Per acre crop land operated	Per farm	Per acre crop land operated	Per farm	Per acre crop land operated
Land and Buildings						
Crop land	$37,809	$57.16	$23,232	$17.03	.....	.....
All other land	1,591	2.41	921	.68	.....	.....
Dwelling	2,453	3.71	1,589	1.16	.....	.....
Other buildings and improvements	3,008	4.55	2,312	1.70	.....	.....
TOTAL LAND AND BUILDINGS	$44,861	$67.83	$28,054	$20.57	.....	.....
Farm Machinery						
Tillage machinery	$ 323	$ .49	$ 651	$ .48	$ 387	$ .35
Drills	110	.17	181	.13	203	.18
Combine	632	.96	833	.65	960	.87
Auto and truck	589	.89	591	.43	730	.66
Tractor	1,166	1.75	1,538	1.12	1,945	1.74
Other machinery and equipment	542	.82	622	.46	563	.51
TOTAL FARM MACHINERY	$ 3,362	$ 5.08	$ 4,466	$ 3.27	$ 4,788	$ 4.31
Livestock						
Work stock	$ 872	$ 1.32	$ 916	$ .67	$ 759	$ .69
Cattle	484	.73	635	.47	25	.02
Sheep	527	.80	166	.12	26	.02
Other livestock	379	.57	371	.27	412	.37
TOTAL LIVESTOCK	$ 2,262	$ 3.42	$ 2,088	$ 1.53	$ 1,222	$ 1.10
TOTAL WORKING CAPITAL†	$ 5,624	$ 8.50	$ 6,554	$ 4.81	$ 6,010	$ 5.41
TOTAL CAPITAL	$50,485	$76.33	$34,608	$25.37	$ 6,010	$ 5.41
Number of farms	19		57		21	
Acres of crop land	12,567		77,736		23,295	
Acres of crop land per farm	661		1,364		1,109	
Total acres per farm	998		1,802		1,252	
Average yield per acre	22.5		12.6		23.0	

* Two farms where both the tenant and landlord owned part of the machinery were omitted from this tabulation.

† Working capital is that capital invested in livestock and machinery.

Land values. The value of dry-farm land in this region is based almost entirely on its productive capacity for raising wheat. The value of all owned crop land in the different yield classes was as follows:

Item	Eight-year average yield (1929-1936)				
	Yield less than 15 bushels	15-24 bushels	25-34 bushels	35 bushels and over	All farms
Average yield—*Bushels*	11.9	19.8	27.7	37.8	19.0
Average value crop land—*Dollars*	22.61	31.00	74.65	95.00	38.49
Land value per bushel of average production—*Dollars*	1.90	1.57	2.69	2.51	2.03

It should be remembered in comparing these land values with those prevailing in other localities that, because of the prevailing summer-fallow system of farming, two acres of this land are required to produce one acre of crops. The average dry-land wheat owner-operator in this study, for example, who

had an average yield of less than 15 bushels per acre had $45.21 invested in land to produce 11.9 bushels.

Working capital. Working capital, which includes the value of all investment other than real estate, averaged, for all farms included in the study, about $6,100 per farm or $5 per crop acre. Of this about 69 per cent or $3.60 per crop acre was for machinery. In all but two instances the tenant provided all of the stock and equipment used in the operation of the farm.

Machinery investment. Three machines—the combine, tractor, and truck—accounted for 63 per cent of the machinery investment. Umatilla County wheat farmers, on the average, reported about $1,000 more machinery investment per farm than farmers in the other two counties. Much of this added investment was due to newer and hence more valuable machinery, rather than to more machinery. The prevailing practice in Umatilla County, however, of bulking rather than sacking threshed wheat, did tend to require a greater truck investment, and there were more farms using tractors in Umatilla County than in either of the other two counties. The machinery investment per crop acre was much lower in Gilliam than in either Sherman or Umatilla Counties, principally because of the larger size of farm in Gilliam.

Of the 99 operators included in this study, 73 owned tractors. Nearly all of these were of the "crawler" or track-laying type. Farmers with about one section (640 acres) of crop land seemed to favor a tractor with approximately 30 drawbar horsepower over the smaller sizes. Larger farms, averaging two to three sections of wheat land, were partial to the 60-horsepower gas tractor or the 50-horsepower diesel (Table 16). Large tractors have a high initial cost,

Table 16. NUMBER AND KIND OF TRACTORS USED ON WHEAT FARMS

(For the 73 tractor-operated Columbia Basin Dry-Land Wheat Farms, Oregon, 1936)

Type of tractor	Fuel used	Drawbar horse-power rating*	Number of farms	Acres of crop land per farm	Original cost of tractor	Cost of tractor per crop acre
Wheel.....	Gasoline	10 to 20	8	654	$1,000	$1.53
Track laying....	Gasoline	30	23	660	2,502	3.79
Track laying....	Gasoline	50	1	1,826	3,950	2.16
Track laying....	Gasoline	60	21	1,510	4,888	3.24
Track laying....	Diesel	40	9	1,545	3,780	2.45
Track laying....	Diesel	50	11	2,089	4,440	2.12

* These figures necessarily indicate only the approximate drawbar horsepower of the tractors included in each group because of the variation in ratings as between the different makes and models of tractors included in this study.

hence they must be used over a considerable acreage of land if the operator is to avoid an unduly high interest and depreciation charge per acre. Contract work was resorted to by a number of tractor owners as a means of reducing overhead costs by distributing them over as many hours of productive work as possible.

Combines were owned by 74 of the 99 farms cooperating in the study (Figure 8). The farmers with one to one and one-half sections of wheat land seemed to favor a machine with a cut of 14 feet. When the wheat land acreage increased to approximately two sections the 16-foot-cut machine was popular. Farmers operating approximately three sections of wheat land seemed to favor combines with an 18-foot cut. The combine, like the tractor, is an expensive machine, and must be used on a large acreage to justify the overhead charges

of interest and depreciation. The original investment in a combine ranged from $1.70 to $2.85 per crop acre for the farms included in this study.

Figure 8. Outfits such as this are no longer common in this area, only 17 of the 74 combines included in this study being horse drawn.

The machinery requirements of dry-land wheat farms of comparable size were found to be similar. The following list, taken from the inventory of a Gilliam County wheat farm containing 2,021 crop acres, may be considered typical of a large outfit:

Number of machines	*Kind*	*Present value*
3	4-bottom gang plows	$ 486
1	Walking plow	22
10	8-foot sections of spike tooth harrows	123
5	8-foot sections of spring tooth harrows	188
1	Tandom disc	60
4	12-foot rotary rod weeders	216
5	10-foot drills	496
1	18-foot-cut combine	1,400
4	Wagons	180
1	Automobile	140
1	60-horsepower tractor	1,000
2	Small gas engines	228
4	Sets of harness	60
1	Grain cleaner	90
1	Seed treater	63
2	Saddles	20
1	Mower	30
1	Hay rake	50
	Shop tools	150
	Tractor and horse hitches	250
	TOTAL PRESENT VALUE	$ 5,252

For Umatilla County the average present value of the investment in machinery and equipment was $4,694; for Gilliam County, $3,778; and for Sherman County, $3,787. These average investment figures are lower than the example given above for they include many small farms, a number of horse-powered farms, and a few farms poorly equipped. For the entire study the investment for machinery and equipment varied from $16,103 to $380 and averaged $4,242 per farm. The largest investment was on an abnormally large wheat farm, the smallest on one where nearly all operations were done on contract.

Livestock investment. The livestock investment accounted for only 17 per cent of the total working capital in Umatilla County, but in Gilliam County 47 per cent of the working capital was invested in livestock. In other words, Umatilla County wheat farmers had most of their working capital tied up in wheat-farming machinery, while in Gilliam County the livestock investment was approximately equivalent to the wheat-machinery investment. Sherman County occupied an intermediate position between Umatilla and Gilliam Counties. The average investment in livestock per farm for the study as a whole was $1,901, of which work stock accounted for $856, dairy cattle $263, beef cattle $466, sheep $202, and hogs and poultry $114.

The influence of tenure on investment. For the study as a whole the capital investment of full owners was $50,485, of part-owners $34,608, and of tenants $6,010 (Table 15). Owners in Umatilla County reported the largest investment per farm, Sherman County owners the next largest, and Gilliam County owners the least. These differences are believed to be a reflection of the yields and profits ordinarily obtained from wheat production in these areas.

According to the 1930 census, cash grain farming on the average requires a larger amount of capital per farm than any other type of farming practiced in Oregon. Even the tenant who operates a wheat farm must have a sum of capital ($6,010) which in some parts of the state would buy an entirely equipped farm.

For the entire study tenants reported a larger machinery investment per farm than part-owners and a substantially larger one than full owners. When this machinery investment is reduced to a crop-acre basis, however, part-owners show the smallest, tenants a larger, and owners the largest investment. The larger acreages of crop land operated by tenants and part-owners account for much of the decreased investment per crop acre for items other than land reported by these groups.

Mortgage indebtedness. Because of the large capital investment involved and the more or less speculative nature of the enterprise, Oregon wheat farmers have always been heavy borrowers of capital. About 70 per cent of all of the farms in the Columbia Basin Region, according to Federal Census statistics, were mortgaged in 1930 compared with 52 per cent for the entire state. In normal times interest and principal payments were no serious burden. During the depression years, however, debt payments frequently became delinquent, and considerable refinancing and scaling down occurred. In some instances the entire debt plus several years of accumulated interest still hangs over the head of the wheat farmer.

Complete data on indebtedness were not obtained from the farms covered in the 1936 dry-farm wheat study. In a number of instances where such data were obtained, the payments on principal and interest were found to equal or exceed all other farm operating expenses. Several good crops sold at fairly

high prices will in many cases be required before the annual debt load can be reduced substantially.

In Sherman County, where a special investigation of this problem was made, data from 39 owned wheat farms show that 69 per cent were mortgaged for an average of $11,264 each. This debt represented 39 per cent of the full value of the farm. In addition to the mortgage debt on land, many farmers were in debt for machinery or owed money borrowed to finance general farm operations.

FARM INCOME AND OUTGO

Data on farm income and outgo were obtained for the period July 1, 1935, to June 30, 1936. During this period Columbia Basin wheat farmers harvested and sold their 1935 wheat crop, completed the fallowing and seeding of land on which the 1936 crop was grown, and plowed and commenced the fallow operations on land intended for the 1937 wheat crop. While the farm record for this period really involved work incidental to the production of three crops of wheat, this fact is of little consequence, because in this area it is the prevailing practice to fallow approximately half the crop land each year; hence any record that covers a complete year of fallow and harvest is adequate to portray the normal farm operations.

Farm receipts. During the year covered by this part of the study (July 1, 1935, to June 30, 1936) the farm price of wheat in Oregon averaged 72 cents per bushel, which was 10 cents below the 1910-1914 average, 37 cents below the 1926-1930 average, but 16 cents higher than the 1931-1935 average (Table 17). The farmers included in this study received an average price of 69 cents per bushel during the period studied.

Table 17. OREGON FARM PRICE OF WHEAT BY MONTHS 1935, 1936, AND AVERAGES FOR THE PERIODS 1910-1914, 1926-1930, 1931-1935*

Month	Average Oregon farm price of wheat per bushel				
	1910-1914	1926-1930	1931-1935	1935	1936
January	83¢	$1.18	53¢	74¢	76¢
February	83	1.16	53	73	75
March	84	1.12	54	72	75
April	84	1.15	57	78	73
May	84	1.16	58	75	70
June	84	1.13	54	66	68
July	82	1.10	57	69	76
August	80	1.06	57	67	86
September	79	1.02	57	69	84
October	80	1.00	57	79	85
November	80	1.00	60	73	86
December	83	1.00	58	75	94
AVERAGE	82¢	$1.09	56¢	72¢	79¢

* Data compiled by the Oregon State College Extension Service, from data of the United States Department of Agriculture.

In addition to a generally unfavorable wheat-price situation which was preceded by five years of even lower prices, wheat yields in Gilliam County

and in parts of Sherman and Umatilla Counties were far below average. The yield situation by counties was:

	Average yield obtained in 1935 Bushels	*8-year (1929-1936) average yield Bushels*	*Per cent 1935 yield is of 8-year average yield Per cent*
Umatilla	23.2	26.2	88
Gilliam	6.0	12.0	50
Sherman	16.0	16.8	95
All 99 farms	15.5	19.1	81

Because of these handicaps of price and yield, the payments from the Agricultural Adjustment Administration were virtually a haven of financial refuge on many individual farms. For the farms studied these payments amounted to $1,717 per farm, or 24 per cent of the total gross receipts.

For the entire study the income from wheat and Agricultural Adjustment Administration payments accounted for 78 per cent of the total farm receipts. The percentage of receipts from these two sources in the respective counties was: Umatilla 82, Gilliam 66, and Sherman 76. Farm receipts other than from wheat and Agricultural Adjustment Administration conservation payments were chiefly from livestock in Gilliam and Sherman Counties, and from peas in Umatilla County. The major sources of income, by per cent of the total income received, were as follows:

	Umatilla County Per cent	*Gilliam County Per cent*	*Sherman County Per cent*	*Entire study Per cent*
Wheat	60	35	56	54
A.A.A. Payments	22	31	20	24
Other crops	9	1	—	6
Livestock	5	29	18	12
All other	4	4	6	4
TOTAL	100	100	100	100

On a farm basis the average income from all classes of livestock by counties amounted to $441 in Umatilla, $1,757 in Gilliam, and $875 in Sherman Counties (Table 18). The average income from livestock for all of the farms included in this study was $905 per farm. The average income per animal unit of beef cattle, sheep, and dairy stock was $17, $26, and $31, respectively.*

In both Umatilla and Sherman Counties about half the livestock income was from beef or dairy animals and products and about one-fourth was from hogs. In Gilliam County sheep were an important enterprise and accounted for about 30 per cent of the livestock income, which served to reduce the proportion of the livestock income from cattle and hogs. Income from the sale of horses and colts, which was an important source of revenue in this area twenty years ago, was rather small in 1935, and in several instances represented liquidation of work stock incidental to the purchase of a tractor rather than the sale of surplus stock. The raising of colts as a by-product from work stock is definitely a thing of the past in this area unless unforeseen changes occur that will materially increase the cost of tractor farming.

* This measure of income was derived for each class of livestock by subtracting the sum of the value of the livestock at the beginning of the year and the cost of the livestock purchased from the sum of the value of the livestock at the end of the year and the receipts from livestock and livestock products sold during the year and dividing the remainder by the average number of animal units on hand during the year.

Aside from the income received for crops, crop adjustment, and livestock, there was some income from work for pay that was chiefly machine work on neighboring farms, and for such items as breeding fees, rent of pasture, and rent of equipment. This miscellaneous income normally amounts to but a

Table 18. FARM FINANCIAL SUMMARY FOR PERIOD JULY 1, 1935, TO JUNE 30, 1936
(For 99 Columbia Basin Dry-Land Wheat Farms, Oregon)

Item	Average per farm			
	Umatilla County	Gilliam County	Sherman County	Entire study
*Receipts**				
Wheat	$ 5,363	$ 2,078	$ 2,777	$ 3,887
AAA payment	1,952	1,838	996	1,717
Other crops	776	89	.....	416
TOTAL CROPS†	$ 8,091	$ 4,005	$ 3,773	$ 6,020
Sheep	$ 51	$ 527	$ 47	$ 185
Beef cattle	62	524	143	210
Dairy cattle	140	204	286	188
Hogs	97	244	207	162
Horses	33	162	150	94
Poultry	58	96	42	66
TOTAL LIVESTOCK‡	$ 441	$ 1,757	$ 875	$ 905
Work for pay	$ 208	$ 87	$ 269	$ 187
Miscellaneous	110	160	16	104
TOTAL OTHER FARM INCOME	$ 318	$ 247	$ 285	$ 291
TOTAL RECEIPTS	$ 8,850	$ 6,009	$ 4,933	$ 7,216
Expenses				
Labor including board	$ 905	$ 840	$ 618	$ 826
Contracted work	128	387	206	218
Feed and seed purchased	274	293	149	252
Gas and oil	636	499	395	546
Sacks and twine	147	142	229	163
Repairs	439	430	355	390
Taxes	400	398	180	347
Other cash expense	785	213	199	534
TOTAL CASH OPERATING EXPENSE	$ 3,714	$ 3,202	$ 2,331	$ 3,276
Depreciation	$ 882	$ 779	$ 658	$ 805
Unpaid family labor	54	131	61	78
TOTAL NON-CASH EXPENSE	$ 936	$ 910	$ 719	$ 883
TOTAL EXPENSE	$ 4,650	$ 4,112	$ 3,050	$ 4,159
FARM INCOME§	$ 4,200	$ 1,897	$ 1,883	$ 3,057
Interest on investment at 5 per cent	1,743	1,680	894	1,545
OPERATOR'S LABOR INCOME‖	2,457	216	989	1,512
Estimated value of operator's labor	$ 984	$ 947	$ 943	$ 964
TOTAL FARM INVESTMENT	$34,869	$33,605	$17,871	$30,905
PERCENTAGE RETURN ON INVESTMENT¶	9.2%	2.8%	5.3%	6.8%

* On share-rented lands only the operator's share is included in the receipts. Includes all changes in inventory.
† Includes all changes in inventory.
‡ Includes sales and purchase of livestock and livestock products and all changes in inventory.
§ Total receipts less total expense.
‖ Farm income minus interest on investment.
¶ Farm income less value of operator's labor divided by total farm investment.

small fraction of the total farm receipts and is of no particular significance in the farm organization of most wheat farms.

A substantial income from livestock is of particular importance to farmers in the lower-yielding parts of the Columbia Basin. For example, in 1935 the value of wheat produced on the average Gilliam County farm was not sufficient to meet the cash farm-operating expense. When the value of livestock income was added to the wheat income, however, there was enough to cover the cash operating expense with some funds left over with which to replace worn-out machinery, pay the operator's living expense, or pay interest and principal on farm debts. In areas subject to frequent low-yield years the diversified wheat and livestock farmers may be in a sounder position than the specialized wheat farmer.

Farm expense. In this study farm expense includes the cash farm expenses actually incurred, depreciation of equipment, and the value of unpaid family labor. Cash expense accounted for 79 per cent of the total, depreciation for 19 per cent, and unpaid family labor for the remaining 2 per cent (Table 18).

The major items of cash expense were for hired labor, contract work, gasoline and oil, repairs, taxes, and feed and seed purchased. Depreciation was charged on all machinery and equipment used and on farm buildings. Depreciation was computed by the straight-line method based on original value depreciated out over the total expected life of the item. Unpaid family labor was charged at the going rate of pay for such services.

Expenses have thus been classified as to whether they are non-cash or cash in character. Non-cash expenses, particularly depreciation, can usually be partly or wholly deferred in any given year, but eventually must be met if the farm and the family are to continue to function on a satisfactory basis. The opportunity thus to defer a substantial portion of the farm operating expense enables wheat farmers to exist through short periods of unfavorable yields or prices. To a considerable degree this fact explains how wheat growers can continue to farm for several years land on which yields have dropped to very low levels. Usually such land returns a fairly good yield in some years and, if these years occur frequently enough, will provide funds for the upkeep of machinery and equipment. Under these circumstances wheat farming, even though not particularly profitable, can continue.

Interest payments on real estate and chattel mortgages were not recorded as a farm operating expense, but interest at the rate of 5 per cent on the total investment at the beginning of the year was computed and charged against the farm income in arriving at the operator's labor income.

It is recognized that interest on mortgage debt is an important factor in determining the status of any individual operator. It is not, however, a factor that concerns the permanency of wheat production in the area, for wheat production will continue as long as the farm income will meet operating expenses, pay a living wage to the farmer for his labor, and return a larger sum on the land investment than any other alternative method of land use. Farm mortgage debt, in other words, is a most potent factor in determining the permanence of any particular wheat farmer, but probably does not affect the permanency of wheat farming.

Farm and labor income. The farm income, or the amount of money left for the payment of the operator's farm labor and for the use of the farm capital after all the other expenses had been paid, amounted to $3,057 per farm for the 99 farms included in this study. The amount left for the operator's

labor and management after deducting the $1,545 interest charge (at 5 per cent) on the investment of $30,905 was $1,512. By counties, this labor income varied greatly, averaging $2,457 for Umatilla, $216 for Gilliam, and $989 for Sherman; hence the rather favorable showing for the area as a whole was due in large part to the influence of Umatilla County farms. It must also be noted that, on the average, about one-fourth of the total receipts on all farms was from payments made by the Agricultural Adjustment Administration.

For the entire study, the ratio of farm income to total gross receipts was 42.3 per cent or, stated in another way, for each dollar of sales there remained 42.3 cents with which to pay interest and wages to the operator. This ratio was 47.4 per cent in Umatilla County, 31.7 per cent in Gilliam County, and 38.2 per cent in Sherman County.

Effect of Agricultural Adjustment Administration benefit payments on income. The benefit payments received by the farmers cooperating in this study averaged $1,717 per farm or almost half (44 per cent) as much as did receipts from wheat sold. Without these payments, the labor income would have been about $184 per farm instead of $1,512 (Table 19).

To compute the probable income from wheat in the absence of the Agricultural Adjustment Administration program and payments, the income from wheat has been arbitrarily increased by 10 per cent, which is about the amount by which wheat acreages were reduced in order to qualify for payment. It is recognized that this method of calculation is only approximate, but the results at least indicate what might have happened had no such program existed. It will be noted from Table 19 that the operator's labor income in Gilliam County was $216 with Agricultural Adjustment Administration payments and without them it would have been a *minus* $1,413. Gilliam County, as has been mentioned, had only a 50 per cent wheat crop in 1935 and this poor showing

Table 19. PROBABLE EFFECT OF AGRICULTURAL ADJUSTMENT ADMINISTRATION PAYMENTS ON INCOME

(For 99 Columbia Basin Dry-Land Wheat Farms, Oregon, 1935-36 crop)

Item	Umatilla		Gilliam		Sherman		All farms	
	With AAA	Without AAA	With AAA	Without AAA	With AAA	Without AAA	With AAA	Without AAA
Receipts								
Wheat	$5,363	$5,363	$2,078	$2,078	$2,777	$2,777	$3,887	$3,887
AAA	1,952	.....	1,838	.....	996	.....	1,717	.....
Wheat from AAA diverted acres*	.....	536	.....	208	.....	278	.....	389
TOTAL	$7,315	$5,899	$3,916	$2,286	$3,773	$3,055	$5,604	$4,276
All other income	1,535	1,535	2,093	2,093	1,160	1,160	1,612	1,612
TOTAL RECEIPTS	$8,850	$7,434	$6,009	$4,379	$4,933	$4,215	$7,216	$5,888
Difference	.....	-1,416	.....	-1,630	.....	-718	.....	-1,328
Farm income	$4,200	$2,784	$1,897	$ 267	$1,883	$1,165	$3,057	$1,729
Labor income	2,457	1,041	216	-1,413	989	271	1,512	184
Interest rate earned on investment—*per cent.*	9.2	5.2	2.8	-2.0	5.3	1.2	6.8	2.5

* Income from wheat land diverted out of production to comply with the AAA Program estimated at 10 per cent of the income from the acreage remaining in wheat. Balance of table based on Table 18, "Farm Financial Summary."

would not have occurred nor would the average income for the 99 farms have been so low had yields been normal.

Effect of yield on income. The relationship between yield per acre and income for the year of the study is shown in Table 20. Yields in the two lowest-yielding classes, it should be noted, were far below average during this year, averaging only 56 and 81 per cent, respectively, of the 8-year average. With this handicap, these farms made a particularly poor showing in 1935, even though, as has been previously pointed out, benefit payments paid by the Agricultural Adjustment Administration increased the total gross receipts by about 25 per cent.

With average yields the farms in these two lower-yielding classes would have had, respectively, about 3,400 and 2,600 more bushels of wheat to sell which could have been harvested at little additional cost. Estimating the net value of this additional production at 60 cents a bushel, the gain in income from an average yield would have been $2,040 and $1,560 and the farm income $3,899 and $5,078 instead of $1,859 and $3,518, respectively, which they actually did have.

Effect of size of farm on income. The acreage of crop land needed to provide the farmer sufficient volume of sales so that a reasonable farm income will remain after paying operating costs is, of course, dependent upon the productivity of the land. Table 21, which shows variation in number of crop acres per farm and the total receipts per farm and per crop acre demonstrates conclusively the need for large units when land of low productivity is farmed.

Return on the wheat-farm investment. One of the measures of the success of a business is return on the capital invested after all charges, including the operator's wage, are paid. For the crop year 1935-36 the average rate of return on the investment of the 99 farmers included in this study was 6.8 per

Table 20. EFFECT OF YIELD ON INCOME

(For 96 Columbia Basin Dry-Land Wheat Farms, Oregon, 1935-36 crop year*)

Item	Farms with yields of—			
	Less than 15 bushels	15-24 bushels	25-34 bushels	35 or more bushels
Number of farms	46	15	17	18
Crop acres per farm	1,465	1,333	1,024	487
Acres in wheat (1935 crop)	608	568	432	217
Total bushels of wheat produced per farm	4,448	11,281	13,275	8,400
YIELD PER ACRE—*bushels*	7.3	19.9	30.6	38.7
Total receipts per farm	$ 6,295.00	$ 8,657.00	$12,108.00	$ 7,909.00
Total expense per farm†	4,436.00	5,139.00	6,425.00	4,179.00
Farm income per farm	1,859.00	3,518.00	5,683.00	3,730.00
Farm income per crop acre	1.27	2.64	5.55	7.66
Labor income per farm‡	385.00	2,182.00	3,902.00	2,269.00
Labor income per crop acre	0.26	1.64	3.81	4.66
8-year (1929-1936) average wheat yield per acre—*bushels*	13.0	24.5	28.4	37.4
Per cent 1935 yield is of 8-year average yield—*per cent*	56	81	108	103

* Three farms were omitted from this tabulation because they were not representative, two of these were operated under an unusual lease agreement and one had no wheat acreage for this crop year.

† Does not include charge for interest on the investment or for operator's wage.

‡ Farm income less 5 per cent interest on the investment.

cent (Table 18). This rather favorable return on the average investment of $30,905 was made possible largely through the receipt of sizable Agricultural Adjustment Administration payments for without them the return on the investment would have been only about 2.5 per cent (Table 19). This rate of return is less than would usually be expected because the yield was only 81 per cent of average for all of the farms in the study. Without Agricultural Adjustment Administration payments, but with average yields and with prices as they were during the crop year 1935-36, the average farm income probably would have been about $2,300 and the return on the investment in the neighborhood of 5 per cent for the farms as a group. Individual farms, of course, would have earned both more and less than this average return.

Table 21. RELATIONSHIP BETWEEN NUMBER OF CROP ACRES PER FARM, YIELD OF WHEAT PER ACRE, AND TOTAL FARM RECEIPTS

(For 99 Columbia Basin Dry-Land Wheat Farms, Oregon, 1935-36 crop year)

Variation in number of crop acres per farm	Number of farms	Crop acres per farm	8-year average yield per acre	1935 crop yield per acre	Total receipts per crop acre	Total receipts per farm	Farm income per farm
		Acres	*Bushels*	*Bushels*			
1 to 99	1	57	35.7	*	$28.82	$1,643	$ 267
100 to 259	5	184	35.5	38	24.71	4,547	2,294
260 to 499	13	401	28.0	32	10.46	5,358	2,852
500 to 999	28	719	24.7	25	9.98	7,178	2,687
1,000 to 1,499	22	1,236	13.9	9	5.08	6,281	1,821
1,500 to 1,999	19	1,689	21.5	18	5.32	10,652	4,535
2,000 to 2,499	6	2,196	19.1	14	5.47	12,324	4,828
2,500 to 3,999	4	3,024	12.5	7	3.93	9,808	3,894
4,000 and over	1	5,492	11.5	6	4.42	24,261	7,836

* This farmer raised no wheat and had no summer fallow for the 1935-36 crop year.

Section II

THE COST OF PRODUCING WHEAT*

A SCHEDULE separate from that used in obtaining the farm organization data presented in the preceding section of this bulletin was used in obtaining cost data, and only 60 of the 99 cooperators were able to furnish detailed cost information. The difference in time covered should be carefully noted: *The farm organization schedules cover the crop year July 1, 1935, to June 30, 1936, during which time the 1935 crop was harvested, whereas the cost schedules cover the 1936 wheat crop and the 1936 fallow operations.* The more recent crop was covered by the cost schedules because of the difficulty of going back two years to cover any one crop of wheat through both fallow and wheat years, and because the details of the 1936 operations were fresh in the minds of the operators. To determine the cost of producing a bushel of wheat the cost of fallowing one acre and of producing wheat on one acre were combined and the same divided by the yield obtained in 1936.

The data cover both horse- and tractor-operated farms, and farms operated under all of the systems of tenure prevailing in this section. It was not possible with the time and funds available to obtain a large enough number of field schedules to permit detailed comparisons of cost for different methods of wheat farm operations, types of tenure, soil types, and other factors that doubtless influence production costs. Most of the cost data, therefore, are presented only as general averages.

In obtaining the cost data all rented lands were treated as owned lands by giving full credit for all production therefrom and by charging the operator of these rented lands with interest and taxes prevailing on adjacent lands. Further details as to the methodology used in computing the cost of producing wheat are presented in Appendix B.

The net cost of producing wheat for the entire study area as determined from data for the 1936 crop averaged $11.36 per acre, or 66 cents per bushel for the 17.3-bushel average yield, as shown in Table 22. These costs apply to the wheat in sack or bin at the local warehouse or elevator. Approximately 36 per cent of this cost is chargeable to the fallow year and 64 per cent to the wheat-growing year. Included in these costs are two years' use of the land and all operation cost incident to fallowing the ground, seeding, and harvesting the wheat crop. Storage, insurance on stored grain, and other marketing costs are not included in the cost as reported.

Representativeness of the data. From the standpoint of production on farms included in this study, 1936 was probably very near the long-time average. A comparison of the 1936 yields per acre with the average yields obtained over the 8-year period 1929 to 1936 inclusive shows the 1936 yields to be about 3 bushels per acre below average in Umatilla County, approximately average in Gilliam County, and about 3½ bushels above average in Sherman County. In 1936 the average yield of the farms included in this cost study was 21.2 bushels in Umatilla County, 11.1 bushels in Gilliam County, and 19.1 in Sherman County.

* See Appendix A for methods used in obtaining, analyzing, and computing wheat-cost data and for explanation of terms used.

Table 22. COST OF PRODUCING WHEAT IN THE COLUMBIA BASIN, OREGON, 1936 CROP
(Data for 60 dry-land wheat farms, 35,855 acres of wheat, producing 619,934 bushels of grain, averaging 17.3 bushels per acre, and 37,758 acres of fallow)

Cost item	Cost per acre			Cost per bushel
	Fallowing	Growing wheat	Total	
Labor				
Hired labor and board	$0.14	$0.56	$0.70	
Operator's labor (direct)	.10	.25	.35	
Operator's labor (overhead)	.21	.67	.88	
Unpaid family labor (direct)	.....	.01	.01	
Contracted labor	.13	.36	.49	
Total man labor	$0.58	$1.85	$2.43	$0.14
Horse work	$0.22	$0.26	$0.48	$0.03
Materials and repairs				
Seed and seed treatment	.....	$0.86	$0.86	
Weed control chemical	*	.....	*	
Sacks and twine	.....	$0.35	.35	
Fuel and oil	.29	.51	.80	
Tractor repairs	.06	.05	.11	
Auto and truck repairs	.03	.09	.12	
Other machinery repairs	.06	.24	.30	
Building repairs	.01	.01	.02	
Total materials	$0.45	$2.11	$2.56	$0.15
General expense				
Truck and automobile license	$0.01	$0.04	$0.05	
Crop insurance (fire only)	.....	.09	.09	
Telephone	*	.01	.01	
Taxes	.51	.53	1.04	
Total general expense	$0.52	$0.67	$1.19	$0.07
Depreciation				
Automobile and truck	$0.07	$0.23	$0.30	
Tractor	.14	.13	.27	
Other farm machinery	.11	.35	.46	
Buildings	.04	.11	.15	
Total depreciation	$0.36	$0.82	$1.18	$0.07
Interest at 5 per cent				
Automobile and truck	$0.01	$0.04	$0.05	
Tractor	.06	.05	.11	
Other farm machinery	.04	.12	.16	
Buildings	.03	.08	.11	
Land	1.80	1.82	3.62	
Total interest	$1.94	$2.11	$4.05	$0.23
Total gross cost	$4.08	$7.81	$11.89	$0.69
Credits for by-products	.....	.53	.53	.03
TOTAL NET COST	$4.08	$7.28	$11.36	$0.66

* Less than 0.5¢ per acre.

MAJOR ITEMS OF COST

For convenience of discussion, the costs of producing wheat have been segregated into six major classes. These classes and the percentage of the total cost accounted for by each are: man labor, including contracted work, 20 per cent; horse work, 4 per cent; materials and repairs, 21 per cent; general

expense, 10 per cent; depreciation, 10 per cent; and interest, 35 per cent. Detailed cost data are presented in Table 22.

ESTIMATED DISTRIBUTION OF MAN LABOR ON A DRY LAND WHEAT FARM WITH 600 ACRES OF WHEAT AND 600 ACRES OF SUMMER FALLOW

(Wheat & Fallow Operations Only)

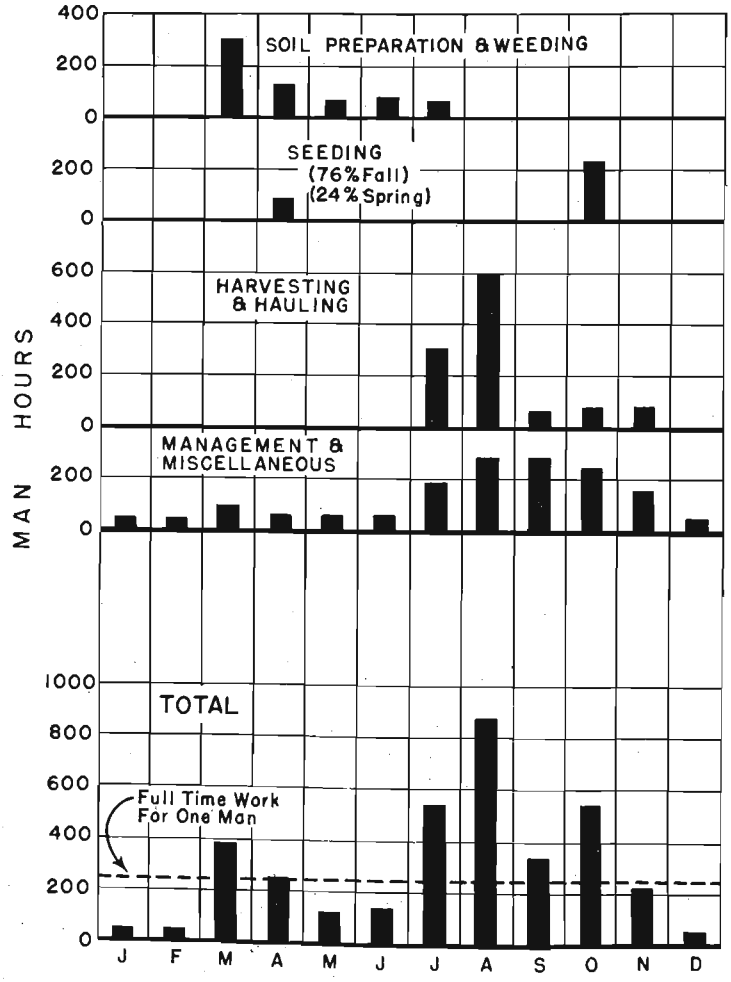

Figure 9.

Labor. Of the total cost for man labor about 50 per cent consisted of charges for time put in by the operator either as direct labor or in work incident to directing the operations of wheat growing, 30 per cent was for hired labor, and 20 per cent for contracted work. Of the $964 average annual wage of the operator (Table 18) 77 per cent was chargeable to the wheat enterprise and 23 per cent to other enterprises or outside work. Out of the amount chargeable to wheat ($742) 28 per cent was for direct labor and 72 per cent for overhead and management.

One of the major problems in wheat-farm operation is the utilization of the farm operator's time in productive work. High overhead labor costs occur when the operator is unable fully to utilize his time in direct labor. The seasonal variation in labor requirements is illustrated in Figure 9 which brings out the uneven labor schedule existing on highly specialized dry-land wheat farms. This unevenness and the low labor requirements of wheat production from November to March further bring out the need for an enterprise that will furnish the operator employment during otherwise slack periods. Livestock offers an excellent choice, for beef cattle or sheep need but little care during the months when wheat requires the most labor, and feeding during the winter offers an opportunity for profitable employment. In connection with a full labor schedule it might be well to point out that most farm management studies have shown that in general returns to the operator are directly proportional to the amount of *productive* man labor that the operator expends on the farm.

Owing to the limited season during which many operations must be performed because of existing moisture conditions, and because many operations require more than one man to perform, certain operations must be hired and others done partly by hired labor. Hired labor, including contracted work, is most frequently required for plowing, seeding, and at harvest. Some operators attempted to reduce hired and contracted work to the minimum by acquiring larger and more powerful machinery. Others contracted considerable of the heavy work, such as plowing, because they considered the contract rates below their own actual cost of operation when depreciation was considered. Hired labor accounted for 63 per cent of the total hours of direct man labor performed on summer fallow and 69 per cent of those expended on wheat production.

Labor requirements tended to increase as yield increased, as is shown in Table 23. On land averaging less than 15 bushels per acre it required about 5 hours total labor per acre to raise a crop of wheat, whereas on land yielding more than 25 bushels it required more than 9 hours. Greater efficiency and better utilization of the operator's labor, as reflected in a lower overhead labor rate, occurs on the lower-yielding farms. The operators in the lower-yielding bracket hired 65 per cent of the direct labor used, compared to 75 per cent and 83 per cent hired by those in the two highest-yielding classes; this in spite of the fact that the former group operated an average of 1,502 acres of wheat and fallow land compared to 762 and 848 acres for the latter groups. If overhead labor is included, all groups hired about one-third of all labor used.

Weeding is the only major operation, except reseeding, that is ordinarily repeated on any one field during the crop or fallow year. The only significant difference in the amount of weeding done was that in the 2 higher-yielding brackets 5 operators out of the 14 who reported on this question weeded more than twice. For the group as a whole 48 per cent weeded only once, 11 per cent weeded part of their acreage twice, 30 per cent weeded their entire acreage twice, and 11 per cent weeded oftener.

The operator's labor was valued at an average of 33 cents an hour, family labor at 28 cents an hour, and hired labor at 31 cents an hour. The rates paid for contracted work averaged 65 cents an acre for plowing, 23 cents an acre for weeding, and $1.63 an acre for combine harvesting. The contractor furnished all tools and labor, and paid all operating expenses on the equipment used.

Table 23. LABOR UTILIZATION BY YIELD CLASSES
(For 50 Columbia Basin Dry-Land Wheat Farms, Oregon, 1936 Crop)

Item	Man hours per acre				
	Under 15 bushels	15-24 bushels	25-34 bushels	35-45 bushels	All farms
	Hours	*Hours*	*Hours*	*Hours*	*Hours*
Fallow					
Soil preparation	.51	.86	.56	.68	.64
Weeding	.28	.33	.35	.56	.32
Miscellaneous	....	....	....	....	....
Total direct labor	.79	1.19	.91	1.24	.96
Total overhead labor	.53	.50	1.38	1.28	.66
TOTAL FALLOW	1.32	1.69	2.29	2.52	1.62
Wheat					
Seeding	.41	.51	.79	.39	.49
Harvesting wheat and hay	1.52	2.30	2.70	1.83	1.92
Miscellaneous	.04	.06	.05	....	.04
Total direct labor	1.97	2.87	3.54	2.22	2.45
Total overhead labor	1.67	1.67	3.56	4.50	2.09
TOTAL WHEAT	3.64	4.54	7.10	6.72	4.54
TOTAL LABOR—FALLOW AND WHEAT	4.96	6.23	9.39	9.24	6.16
Per cent of direct labor hired	65%	69%	75%	83%	69%
Per cent of all labor hired (Includes overhead)	36%	45%	36%	31%	38%
Number of farms reporting	20	15	9	6	50

Horse work. The use of horses was charged at a uniform rate of 10 cents per horse hour.* Only 19 per cent of the farms were primarily horse operated, but almost every wheat farm required one or more teams to do minor hauling jobs. Hauling in chaff and straw is one of the more important jobs for which horses are ordinarily used even on tractor-operated farms.

Materials and repairs. The principal items in this group of costs are seed, fuel and oil, and repairs.

Practically all farmers used seed from the preceding crop which was treated for smut before sowing, usually by the copper carbonate method. Before treating it was valued at 76 cents per bushel. The rate of seeding varied with the yielding power of the land, being lowest on light-yielding soil and increasing as the yield increased. On land producing less than 15 bushels per acre the average seeding rate was 57 pounds per acre; on 15- to 24-bushel land 64 pounds; on 25- to 34-bushel land 86 pounds; and on 35- to 44-bushel land 88 pounds.

Fuel and oil expense was chiefly for tractor fuel. Many farmers were becoming interested in Diesel tractors because of the cheapness of Diesel fuel

* Selby, H. E., Rodenwold, B. W., and Scudder, H. D., *The Cost of Horse Labor on Oregon Farms*, pp. 10-11, Bulletin 250, Oregon Agricultural Experiment Station, 1929.

and the greater efficiency of that type of motor. The average cost of Diesel fuel was 6½ cents per gallon, while gasoline cost 13 cents per gallon.

Sacks and twine were a major expense item on all farms where wheat was sacked. On the average sacks cost 8.6 cents each. In the heavier-yielding part of Umatilla County bulk handling of wheat was rapidly displacing sack handling, but in other areas sacks were used almost universally. On many farms wheat is not sold in sacks but merely transported and perhaps stored in them. On these farms sacks are used over and over again.

Repairs on machinery are an important item of expense on all wheat farms. The bulk of the repair expense goes on combines, tractors, automobiles, and trucks. Some mechanically inclined farmers have reduced their repair expenses materially by installing their own shop equipment.

General expense. Under the heading of general expense are included truck and automobile licenses, crop insurance, telephone charges, and general property tax. Of these, taxes are the chief item, accounting for about 9 per cent of the total cost of wheat production. The tax contribution of the wheat grower represents a very substantial portion of the total taxes collected in the region. If wheat growing, as a result of soil erosion and fertility depletion, deteriorates, the tax contribution will also deteriorate, and communities may no longer be able to support themselves. Furthermore, any considerable shift out of wheat in this area, beyond the point dictated by conservation of the soil and without being accompanied by a higher price of wheat or a compensating adjustment payment, would likely have a far-reaching effect on the tax base.

Depreciation. Depreciation, both from wear and obsolescense, is an expense that is forever present on the wheat farm. As a group, wheat farmers have generally been quick to adopt more efficient machinery whenever offered, even though such adoption resulted in scrapping tools with several years of remaining life. Such a procedure appears to be sound, for depreciation is a minor cost compared to fuel and oil, repairs, and labor, which may be made more costly unless the most efficient machinery available is used. The rates of depreciation as computed from the operator's estimate of the total life of the machine were approximately 5 per cent for plows; 7 per cent for drills, combines, and tillage tools; 8 per cent for tractors; and 12 per cent for automobiles and trucks.

Interest. Interest on the present value of the investment in the wheat enterprise was charged at a uniform rate of 5 per cent. Operators who were in debt for land, buildings, or machinery were in many instances paying higher interest rates than 5 per cent, but others owned their land, buildings, and machinery, and so were not paying interest.

The total interest cost amounted to $4.05 per acre for the 2 years' use of the land, or 23 cents per bushel of wheat produced. Exclusive of all interest charges, wheat was being produced for 43 cents per bushel for the study as a whole.

COST OF PRODUCING WHEAT BY OPERATIONS

The cost of producing wheat, by operations, for the fallow and wheat-growing years separately is shown in Table 24 by yield groups and for the study as a whole. Of the total net cost of $11.36 per acre for the entire study, approximately 36 per cent was chargeable to the fallow year, and the remainder to the wheat-growing year.

Table 24. Cost of Wheat Production by Yield Classes

(Data for 60 Columbia Basin Dry-Land Wheat Farms, Oregon, 1936 Crop)

Cost items	5-14 bushels		15-24 bushels		25-34 bushels		35-45 bushels		All farms	
	Per acre	Per bushel	Per acre	Per bushel	Per acre	Per bushel	Per acre	Per bushel	Per acre	Per bushel
Fallow Operations										
Soil preparation	$0.71	.....	$1.06	.....	$0.91	.....	$1.00	.....	$0.86	.....
Weeding	.32	.....	.35	.....	.55	.....	.65	.....	.38	.....
Use of buildings	.07	.....	.06	.....	.07	.....	.05	.....	.08	.....
Operator's overhead labor	.17	.....	.16	.....	.44	.....	.41	.....	.21	.....
Truck and automobile	.16	.....	.18	.....	.29	.....	.42	.....	.19	.....
Miscellaneous	.03	.....	.06	.....	.12	.....	.07	.....	.05	.....
Taxes	.36	.....	.44	.....	1.09	.....	1.09	.....	.51	.....
Interest on land	1.12	.....	1.48	.....	3.73	.....	5.14	.....	1.80	.....
Total cost of fallow	$2.94	$0.23	$3.79	$0.25	$7.20	$0.24	$8.83	$0.25	$4.08	$0.24
Acres fallow per farm	771		664		354		457		629	
Wheat Operations										
Seeding	$1.25	.....	$1.38	.....	$2.01	.....	$1.76	.....	$1.42	.....
Harvesting	2.08	.....	2.71	.....	2.83	.....	1.96	.....	2.37	.....
Use of buildings	.24	.....	.20	.....	.19	.....	.15	.....	.20	.....
Operator's overhead labor	.54	.....	.54	.....	1.14	.....	1.44	.....	.67	.....
Truck and automobile	.50	.....	.53	.....	.87	.....	1.28	.....	.61	.....
Miscellaneous	.14	.....	.15	.....	.33	.....	.39	.....	.19	.....
Taxes	.36	.....	.43	.....	1.13	.....	1.08	.....	.53	.....
Interest on land	1.09	.....	1.52	.....	3.78	.....	5.07	.....	1.82	.....
Total cost of wheat operations	$6.20	$0.49	$7.46	$0.49	$12.28	$0.42	$13.13	$0.37	$7.81	$0.45
Total gross cost	$9.14	$0.72	$11.25	$0.74	$19.48	$0.66	$21.96	$0.62	$11.89	$0.69
Less credits	.48	.04	.68	.04	.53	.02	.16	.01	.53	.03
Total net cost	8.66	.68	10.57	.70	18.95	.64	21.80	.61	11.36	.66
Interest on land	$2.21	$0.17	$3.00	$0.20	$7.51	$0.25	$10.21	$0.29	$3.62	$0.21
Net operating cost*	6.45	.51	7.57	.50	11.44	.39	11.59	.32	7.74	.45
Acres wheat per farm	731		604		408		391		598	
Number of farms	24		19		11		6		60	
Average yield per acre	12.7		15.2		29.5		35.6		17.3	

* For convenience, total net production cost less interest on land has been designated as operating cost. This term is not strictly correct, because interest on working capital is included in the operating cost.

The fallow year. Approximately 69 per cent of the costs for the fallow year are for overhead items, the most important of which are interest and taxes on land. Of the two direct operations, soil preparation and weeding, the former is about twice as costly as the latter. Plowing with moldboard plows has been the conventional method of preparing land for summer fallow in this area. This method, however, is changing as the use of trashy summer fallow becomes more general.

The effect of this change in method of preparing summer fallow does not appear likely to cause any major increases in cost except as it necessitates the purchase of different and more expensive machinery. Many farmers are planning the use of modified shares on the frames of their present plows since this change does not require a large outlay of cash and avoids the loss from obsolescence that would result if plows were abandoned for another implement. Cultivation or weeding is almost universally performed by use of revolving rod weeders (Figure 10).

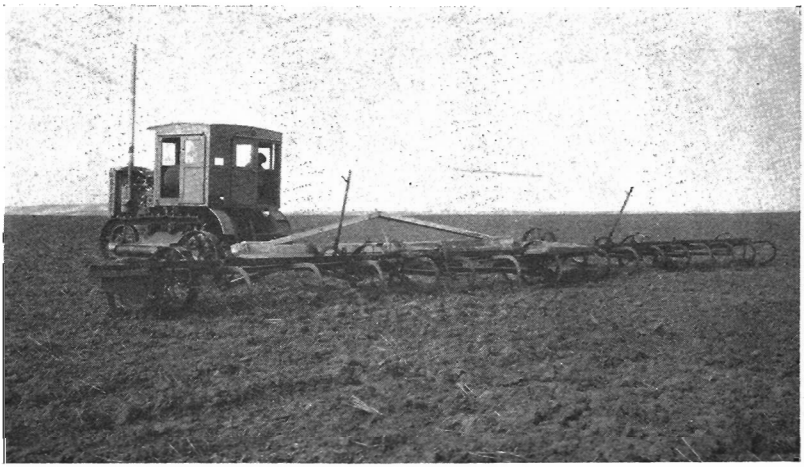

Figure 10. Rotary rod weeders at work on a summer-fallow field.

The wheat-growing year. During the growing year direct operations accounted for about half of the wheat production costs. Of the two direct operations, seeding and harvesting, the latter was the more costly even though seeding included the cost of the seed. Seeding was done with both the hoe and the disk drill. Where any considerable amount of trash was left on the surface a single disk drill was generally considered to be essential.

Harvesting was universally done by combines, practically all of which were tractor drawn. The practice of "bulking", which eliminates sack and twine cost, was more popular in Umatilla County than in the other two counties studied. It is believed that this accounts for the fact that Umatilla County growers were able to harvest at a lower cost per acre and per bushel than were the growers in either of the other two counties.

CASH COSTS OF PRODUCING WHEAT

Costs may be broken down as to whether they are cash or out-of-pocket costs that must be met each year, or non-cash or deferrable costs that are not necessarily paid out during any particular year or period of time (Table 25). In the cash classification are hired and contract labor; materials such as sacks,

Table 25. CASH AND NON-CASH COSTS OF WHEAT PRODUCTION

(Data for 60 Dry-Land Wheat Farms with an average yield of 17.3 bushels per acre, Columbia Basin Region, Oregon, 1936 Crop)

Cost item	Cost per acre			Total cost per bushel
	Cash	Non-cash	Total	
Labor				
Hired	$0.70	.....	$0.70	
Contracted	.49	.....	.49	
Operator's (direct)	.....	$0.35	.35	
Operator's (overhead)	.....	.88	.88	
Unpaid family	.....	.01	.01	
Total man labor	$1.19	$1.24	$2.43	$0.14
Horse work	.....	$0.48	$0.48	$0.03
Materials				
Fuel and oil	.80	.....	.80	
Sacks and twine	.35	.....	.35	
Seed	.....	.86	.86	
Total materials	$1.15	$0.86	$2.01	$0.12
Repairs				
Buildings	.02	.....	.02	
Tractor	.11	.....	.11	
Machinery	.30	.....	.30	
Automobile and truck	.12	.....	.12	
Total repairs	$0.55	.....	$0.55	$0.03
Depreciation				
Buildings	.....	.15	.15	
Tractor	.....	.27	.27	
Machinery	.....	.46	.46	
Automobile and truck	.....	.30	.30	
Total depreciation	.....	$1.18	$1.18	$0.07
Interest				
Land charge at 5 per cent	.....	$3.62	$3.62	
Buildings	.....	.11	.11	
Tractor	.....	.11	.11	
Machinery	.....	.16	.16	
Automobile and truck	.....	.05	.05	
Total interest	.....	$4.05	$4.05	$0.23
Miscellaneous				
Taxes	$1.04	.....	$1.04	
Crop insurance (fire only)	.09	.....	.09	
License (truck and automobile)	.05	.....	.05	
Telephone	.01	.....	.01	
Total miscellaneous	$1.19	.....	$1.19	$0.07
Total gross cost	$4.08	$7.81	$11.89	$0.69
Credits for by-products	.....	.53	.53	.03
TOTAL NET COST	$4.08	$7.28	$11.36	$0.66

twine, fuel, oil, and repairs; and general expenses such as taxes, license fees for cars and trucks, fire insurance, etc. Non-cash items include interest on the investment, depreciation, wages for operator or family labor, and the value of farm-raised seed used. Actual interest paid on farm mortgage debt is not

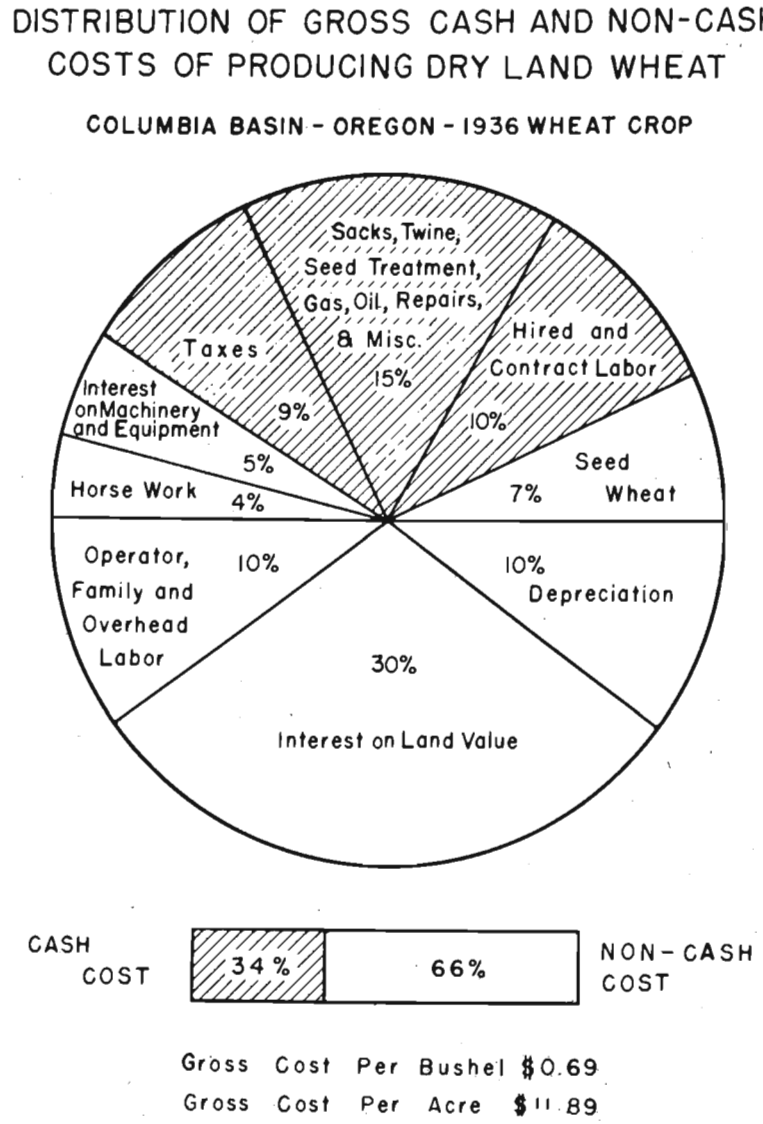

Figure 11.

here included as a cost but instead a flat 5 per cent is charged on the total farm investment utilized in wheat production.

It must be remembered that even though the operator does not necessarily draw full wages from the wheat enterprise he must have some funds with which to pay living expenses, and that likewise most wheat farmers must pay interest on borrowed money. Hence, any allocation of costs into cash or non-cash groups is at best an arbitrary classification. Such a classification does show, however, the maximum amount of "cushion" a wheat farmer has during years of low price if he is not in debt, and if he can depend on other farm enterprises or outside work to pay his living expenses.

For the entire study only 34 per cent of the gross cost of producing wheat was cash, or out-of-pocket cost (Figure 11). In other words, assuming no indebtedness, and assuming normal crops and costs as of 1936, any price over 24 cents per bushel would have enabled the average farmer in the area studied to pay his direct out-of-pocket costs and begin paying on the deferrable items. When it is considered, however, that, according to the 1930 Federal Census of Agriculture, more than half of the farms in this area are mortgaged; that the ratio of mortgage debt to total value of land and buildings is about 40 per cent; and that the charges on this debt were a little more than 6 per cent, it seems fair to estimate that another 10 cents per bushel was paid out in actual interest charges. This additional cash outlay would bring the cash or out-of-pocket cost of producing wheat in this region to perhaps, at least, 34 cents per bushel.

It is believed that the low cash costs of production were chiefly responsible for the expansion in wheat production in the Columbia Basin during the period 1925 to 1930. The incentive behind this increase was chiefly the need for more income to pay interest and debts, and expansion was made possible by the development of machinery that enabled the individual operator to farm more acres.

A serious problem facing many wheat farmers is indebtedness, for farmers who are heavily in debt have a much higher actual cash cost of production than debt-free farmers. In view of the unstable export demand for wheat and the generally unfavorable world price outlook, it appears desirable for wheat farmers to liquidate indebtedness as fast as possible so that they may operate with a minimum amount of cash outlay. This situation is realized by most farmers and wherever possible debts are being paid off. If, however, additional land is purchased in order to obtain an economic sized unit, additional debt is an almost inevitable concomitant. This undoubtedly deters many farmers from expanding through purchase of land, and results in the widespread practice of renting rather than buying land to augment that already owned.

THE EFFECT OF WHEAT YIELDS ON PRODUCTION COSTS

Yield in the Columbia Basin Region of Oregon is largely conditioned by moisture, soil, and other physical and climatic factors that are not subject to control by man. For this reason, and because standard methods of management have been generally adopted, yield does not vary much between farms because of management. Wheat land, therefore, can be classed rather accurately as to its productivity. Owing to the fact that for most of this land there is no alternative use that will sustain values anywhere near the level set by wheat production, land values are based almost solely on this use. This makes it possible to adjust wheat costs to prospective wheat prices—generally predicted from prices obtained in the immediate past—by simply raising or lowering land values. Naturally, as there are diverse ideas as to what prospective wheat

prices will be, and there are lags in the adjustment, costs are not held at a constant figure, but they are held in a much narrower range than is usually found for other agricultural products.

The effect of yield on the cost of performing different operations as well as its effect on total cost is presented in Table 24. To produce wheat on land yielding less than 15 bushels it cost an average of $8.66 per acre or $0.68 per bushel; on land yielding from 35 to 45 bushels the average cost was $21.80 per acre or $0.61 per bushel. The operating cost per bushel declined as yield increased, but the charge for use of land (interest) increased at nearly the same rate, making the average total cost per bushel about the same for lands lying within the different yield classes.

RELATIONSHIP BETWEEN YIELD AND COST PER BUSHEL.

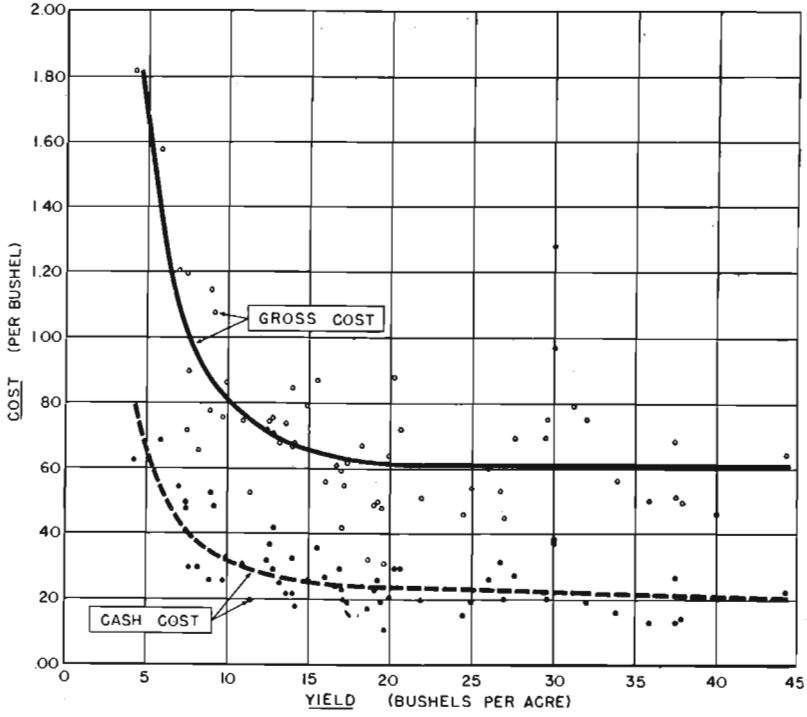

Figure 12.

That wide variations in cost occur on land of the same yielding power is evident from the data shown in Figure 12. The two highest cost operators on land yielding 30 bushels or more per acre had high costs throughout their entire range of operations. It is probable that this high-cost condition is not normal for these particular growers, for examination reveals that they had a less-than-average acreage in wheat in 1936. For this reason allocation of costs as

between enterprises on the farm resulted in an abnormally high charge to wheat production for the year of the study.

Of the 14 operators producing less than 12 bushels per acre 6 had costs in excess of $1 per bushel. The principal cause appears to be unusually low yield, for the highest cost per acre was but $7.66. The unweighted average yield for these 6 operators in the year of the study (1936) was 7.1 bushels per acre compared to their 8-year (1929-1936) average of 10.9 bushels.

Another 6 of the 14 operators of these low-yielding lands, on the other hand, had costs of $0.80 or less per bushel. The average yield of this group for 1936 was 9.4 bushels per acre compared to an 8-year average yield of 13.5 bushels.

Operators of this low-yielding land have been able to work out low-cost methods of production through operating large acreages with efficient machinery that will enable them, in years of average yield, to produce wheat at costs comparable to those of producers on better-yielding lands. The unweighted average yield of all 14 operators in this low-yield group was but 8.4 bushels in 1936 compared to 13.2 bushels for an 8-year average. Their average cost in 1936 was $7.38 per acre or $0.88 per bushel. If average yields had been obtained the cost would have been approximately $0.56 per bushel.

Conclusion

On the basis of the facts presented in this bulletin it would appear that with reasonably efficient operation, normal yields, and costs and prices as of 1936, there is but little land now in wheat in the Columbia Basin that will not pay operating costs and yield a fair return on present land values. When land lies well and can be efficiently and cheaply farmed, little is likely to be abandoned because of normal low yields. On the other hand, steep, isolated, or irregular tracts that are costly to farm may not pay operating costs, and hence will be classed as submarginal. Submarginality is therefore largely determined by individual conditions rather than by rule.

Potential submarginality through erosion and fertility depletion is another factor that may cause producers to divert land from wheat to grass. In other words, some land that will now pay a fair return on the investment may be best removed from wheat production to prevent its eventual deterioration to the point where it is not only nonproductive but is also an active menace to adjacent lands. To forestall such depletion, long-time rotations of grass with wheat may prove to be useful. Under this plan wheat land would be seeded to grass for a period of 5 to 6 years and then plowed up and used for wheat production for a few years. When one field of grass was plowed up another would be seeded so that all cultivated land on the farm could eventually be covered by the rotation. The effects of such a rotation are not as yet fully known, but experimental work on the problem is now (1939) under way at the Sherman Branch Station of the Oregon Agricultural Experiment Station.

Appendix A

COST OF PRODUCING WHEAT HAY AND OF HARVESTING WHEAT BY-PRODUCTS

WHEAT HAY

Most of the wheat hay used on dry-land wheat farms is a semi-by-product of wheat production, for prior to the time when combines are put in the field to harvest wheat grain it is the usual practice to cut what is called a right-of-way around the outside of each field. This is done because the tractor and combine would crush the wheat stalks and shatter out the grain when making the first round or two of the harvesting operations if the grain on the outside of the field were allowed to stand. To prevent this waste the outside 10 to 18 feet are cut with a mowing machine or header set to cut most of the wheat stalk and the material so cut is used for hay. This operation is usually performed while the wheat stalk is green as it then makes a better-quality hay and the grain does not shatter out. Most of the grain hay used on wheat farms is obtained in this way.

Not all operators cut border strips for hay. Some of them use grass borders and others, not needing hay, cut the back-swath with a combine or header for grain. Some operators, on the other hand, cut parts of regular wheat fields, usually the lower-yielding portions, for hay because they do not have sufficient tonnage available from border strips.

The cost of producing this hay is similar to the cost of producing wheat up to the time of harvesting; that is, the land is fallowed and seeded in the same way whether it is to be harvested for wheat grain or for hay. Since hay costs are similar to wheat costs up to harvesting time, only hay-harvesting

Table 26. Cost of Producing Wheat Hay*
(Columbia Basin Dry-Land Wheat Region, Oregon, 1936 Crop)

Item	Cost per acre	Cost per ton
Fallow Operations		
Soil preparation and weeding	$1.03	$1.12
Use of buildings	.07	.08
Operator's overhead labor	.17	.18
Truck and auto	.16	.17
Miscellaneous	.03	.04
Taxes	.36	.38
Interest on land	1.12	1.22
Total Fallow Operations	$2.94	$3.19
Haying Operations†		
Seeding	$1.25	$1.36
Cutting and hauling	4.10	4.46
Operator's overhead labor	.50	.55
Miscellaneous	.10	.11
Taxes	.36	.38
Interest on land	1.09	1.19
Total Haying Operations	$ 7.40	$ 8.05
Total Cost	$10.34	$11.24

* All cost items are from Table 24, except harvesting costs which are from Table 27. The average wheat yield of this land was 15.5 bushels per acre.
† Hay yield per acre, .92 ton.

costs need be computed and substituted for cost of harvesting and hauling wheat grain to determine the cost of producing hay. The hay costs presented in this appendix are based on the data obtained from the 5- to 15-bushel yield class presented in Table 24, which appears in the section of this bulletin devoted to the cost of producing wheat.

The average wheat yield on the 17 farms included in the hay-cost tabulation was 15.5 bushels and the average yield of hay was .92 ton per acre. The cost of fallowing the land, seeding the wheat, taxes, overhead, etc., exclusive of the cost of harvesting, was $6.24, and the cost of harvesting was $4.10, or a total of $10.34 per acre. The cost per ton for the .92 ton produced per acre was, therefore, $11.24 as is shown in Table 26.

The labor requirement per acre for harvesting wheat hay is higher than for other wheat-farm operations because hay is ordinarily gathered from around the outside of large acreages of wheat, and also because picking up and hauling it is largely a man labor rather than a machine operation. Seven and a half hours of man labor per acre were required to cut and haul the hay on the farms included (Table 27). Of this amount about half was hired labor.

Horses were used almost exclusively for hauling hay and on some of the farms were also used to power the mowing machine. Horse work amounted to 12.6 hours per acre.

As low annual precipitation makes it unnecessary to store hay under cover in most of the Columbia Basin Region, hay is stacked out of doors near the barn or feed rack. Most hay was hand stacked because only a limited amount was harvested per farm and because grain hay is difficult to handle with mechanical stackers.

Table 27. COST OF MOWING AND HAULING WHEAT HAY CUT LARGELY FROM RIGHT-OF-WAYS AROUND WHEAT FIELDS

(417 acres of hay, 17 operators, 377 tons harvested, average yield .92 ton. Columbia Basin Dry-Land Wheat Region, Oregon, 1936 Crop)

Item	Hours per acre	Cost per acre	Cost per ton
Labor			
Operator	3.7	$1.23	$1.33
Hired	3.8	1.17	1.27
Overhead	.....	.....	.....
TOTAL LABOR	7.5	$2.40	$2.60
HORSE WORK	12.6	$1.26	$1.36
Equipment			
Repairs	.....	.27	.29
Interest and depreciation	.....	.17	.18
Automobile	.....	.....	.....
TOTAL EQUIPMENT	.....	$ .44	$ .47
TOTAL COST	.....	$4.10	$4.46

One acre wheat hay from hay strips around fields to every 30 acres of wheat for grain.

CHAFF AND STRAW

Chaff and straw, as has been pointed out in previous sections of this report, are by-products of wheat production that are used on many farms for winter feeding. The combines used are so constructed that the operator can either drop the straw in piles, string it out in rows, or, if a straw spreader is

attached, distribute the straw evenly over the field. Chaff can either be intermingled with the straw or dumped in separate piles.

On farms where a need for livestock feed exists or where the material is to be sold, the chaff or straw or both are dropped in piles and picked up later by hand. Many operators gather chaff and straw only from fields near feed lots, although the need for feed on some farms makes it necessary to pick up all that is available.

On the 21 farms from which these data were taken, 5.4 acres were covered to obtain one ton of chaff and straw, and it required .43 hour man labor per acre or 2.3 hours per ton to pick up, haul, and stack a ton of this material (Table 28). The cost for man labor, two-thirds of which was hired, was $0.75 per ton. Horse work cost an estimated 38 cents per ton for the 3.84 hours worked per ton. The combined cost for man labor and horse work was 21 cents per acre or $1.13 per ton. These two expenses are virtually the only ones involved, for the only equipment used was wagons and since they are operated at little or no cost the outlay for their use was disregarded.

Operators interviewed on the question believed that chaff and straw in the stack was worth about $2.50 per ton. Some chaff and straw was sold in the stack at this figure and some was sold in the field at $1.00 a load. A few operators gave it away to anyone who would come and haul it out of the field. The advisability of removing these materials from the wheat field is discussed in the section on by-products on page 31 of this bulletin.

Table 28. COST AND VALUE OF WHEAT PRODUCTION BY-PRODUCTS (Chaff and straw)

(Data from 21 operators harvesting 12,073 acres of wheat from which 2,239 tons of chaff and straw were removed for feed, Columbia Basin Dry-Land Wheat Region, Oregon, 1936 crop.)

Man Labor	
Hours per acre	.43
Hours per ton	2.30
Cost per acre	$ .14
Cost per ton	.75
(66 per cent hired labor)	
Horse work	
Hours per acre	.71
Hours per ton	3.84
Cost per acre	$ .07
Cost per ton	.38
Total cost	
Cost per acre	$ .21
Cost per ton	1.13
Estimated value per ton (Operator's estimate)	2.58

5.4 acres required to furnish 1 ton chaff and straw.

Appendix B

METHODS USED IN OBTAINING AND ANALYZING WHEAT COST DATA

The cost data were collected at the same time that the farm-organization data were obtained. The cost portion of the field schedule, however, was considered separately, for the cost data cover the 1936 wheat crop and the 1936 summer-fallow operation, while the farm-organization data cover the period July 1, 1935, to July 1, 1936. Analysis was by the method of grouping and cross-tabulation. All averages presented are weighted arithmetic means.

Dry-land wheat in the Columbia Basin area is produced under a two-year rotation plan. In restricted areas of higher rainfall in Umatilla and Wasco Counties, peas, beans, potatoes, and other specialty crops are sometimes grown in alternate years with wheat. The predominant system, however, is a wheat-fallow rotation.

In this study the two years' operations (fallow and wheat growing) have been studied separately and the costs are presented separately. To do this the total cost of plowing, weeding, and other operations performed on fallow were computed and reduced to a cost-per-acre basis. The cost-per-acre for operations such as seeding and harvesting that were performed during the year that the land was in wheat were similarly computed and the two years' costs combined to arrive at a total cost per acre for the two years required to produce a crop of wheat. The acreage of summer fallow usually exceeds the acreage of wheat for grain by 5 or 10 per cent, for land must be fallowed for hay, crop pasture, and other small grain crops as well as for wheat.

DIRECT MAN LABOR

Each operator estimated the hours of labor required for each fallow or wheat-growing operation. The total direct man-labor costs, including hired operator, or family labor, is obtained by adding up the labor put in on the various individual operations.

Hired labor was charged at the actual wage paid plus an allowance for board and lodging where furnished. Rates at harvest time were considerably higher than at other times during the season, averaging 38 cents per hour at harvest time compared with 27 cents at other times of the year.

The operator's direct labor was charged at the going wage for such work at the particular season performed. Family labor was charged in like manner, allowance being made for age and ability.

OPERATOR'S OVERHEAD LABOR

Each operator estimated a yearly wage, exclusive of board or lodging, at which he could hire the services he performed on the farm. From this total was deducted the charge at going day wages for direct labor done by the operator on wheat, fallow or other enterprise, and the balance was charged to overhead labor. This overhead was allocated between wheat and other enterprises according to the ratio that gross wheat income bore to the total gross income of the farm. The division of overhead cost between summer fallow and wheat growing was made in proportion to the direct labor charges of the two

operations. On the average about 25 per cent of the overhead labor was charged to summer fallow.

HORSE WORK

Horse work was charged at a uniform rate of 10 cents an hour. This rate is based on data presented in Bulletin 250, Oregon Agricultural Experiment Station, *Cost of Horse Labor on Oregon Farms.*

CONTRACT LABOR

Contract labor on wheat farms is usually found on farms where tractors are not owned. Plowing and the combine harvesting of wheat are particularly adaptable to power-machine methods, and many horse farmers contract part or all of these two operations rather than do them with horse labor. The contractor is usually a neighboring farmer who wishes to reduce the fixed costs on his tractor by utilizing the machine more fully than is possible on his own farm. Contract labor was charged at cost. The rates paid averaged 65 cents an acre for plowing, 23 cents an acre for weeding, and $1.63 an acre for combine harvesting.

MATERIALS EXPENSE

All materials except seed were purchased, and were charged at cost at point of purchase plus freight, if any. Usually the farmer hauled these supplies in his own truck or trailer. Farm-raised seed was charged at market value at the farm at sowing time. Tax rebates were deducted from the cost of tractor fuel.

TAXES

Taxes were computed from information given by farm operators. Taxes on rented lands were charged as if owned at rates similar to those paid on similar lands in the immediate vicinity.

USE OF MACHINERY

Depreciation was charged on the straight-line basis and was based on the original cost of the machine. In the case of automobiles, trucks, and tractors, trade-in or salvage value was deducted from the original cost in arriving at a yearly depreciation figure.

Repair charges are actual cash costs for repair parts and mechanics' labor. Time put in on machinery repair by the operator is covered by the operator's overhead labor.

The amount of machinery costs to be borne by each operation is based on the percentage of its total use chargeable to the operation as estimated by the operator.

USE OF BUILDINGS

Interest on present value, depreciation, and repairs for all farm buildings except the farm dwelling were charged to the wheat enterprise according to the ratio that gross wheat income bore to the total gross income of the farm. The operator's wage was estimated exclusive of board or housing; hence each operator is presumed to provide himself a dwelling from his allowed wages.

INVESTMENT

In order to simplify analysis, and also because of an insufficient number of records to justify a breakdown as to tenancy, all cost records were converted to an ownership basis. The value of land represents the operator's estimate of the asking price for land of similar productivity in his locality. Value of machinery and equipment used jointly for wheat and other enterprises was prorated to each enterprise according to the operator's estimate. Interest on the wheat-enterprise investment was charged at a uniform rate of 5 per cent.

CREDITS FOR BY-PRODUCTS

Credit was allowed the wheat enterprise for straw and chaff to be utilized as feed, for stubble or uncut wheat to be used as pasture, and for wheat hay harvested from opening strips around the fields or from small patches within the main fields. Rates allowed for these items were the going farm prices for similar feed in the vicinity. Possible income for compliance with the Agricultural Conservation Act was ignored, for the amount of by-products from the 1936 crop which might be used for soil building could not be determined.

COST PER ACRE AND PER BUSHEL

The costs for 1936 cover the operations performed on practically all of the wheat land in the farm. Wheat was harvested, however, from only part of the land. The principle has been followed of adding the cost of fallowing an acre to the per-acre cost of actually growing the wheat. This cost, which actually represents two seasons' work on the land in wheat, was divided by the average yield of wheat per seeded acre to obtain the cost per bushel of wheat.

Where peas or other crops were grown instead of summer fallowing the land the cost of wheat should be less than reported on herein for no fallow was used in preparation for the wheat crop. Owing to the small acreage affected by such practices, however, the costs of producing wheat under this type of management were not computed.

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