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An Analysis of Agriculture on the Valier Irrigation Project

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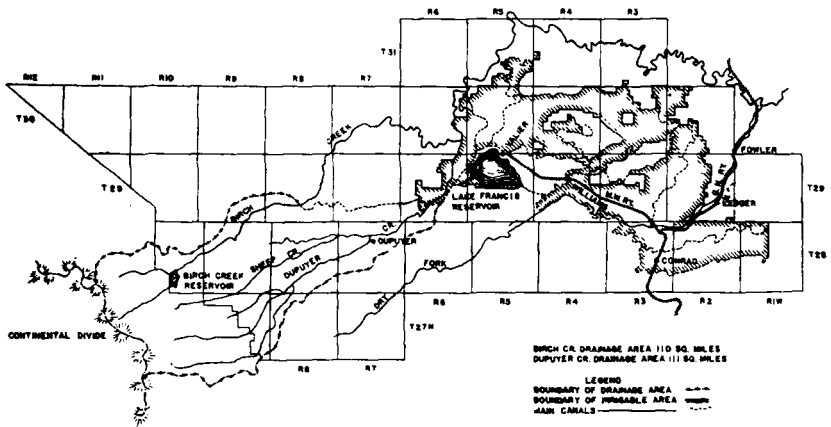
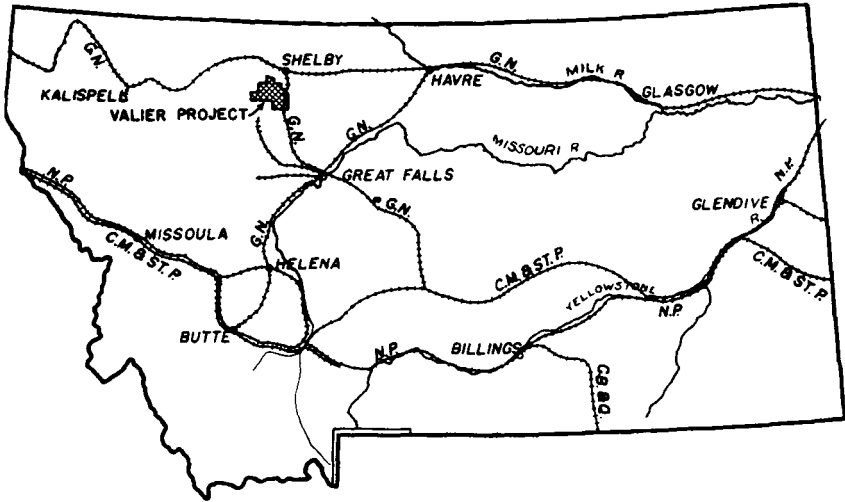
Farm Management data was obtained from 100 farms.

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An Analysis of Agriculture on the Valier Irrigation Project

I. INTRODUCTION

Many irrigation projects in Montana, whether private or governmental, have not shown the results anticipated. The net income from irrigated farms has been low, both as compared with income from irrigated farms in other areas and in some cases even as compared with that from dry farms in Montana. On some projects there has been a wholesale abandonment of farms, with resultant tenancy problems. Wheat has been and still is in many cases the principal crop, often produced by dry-land methods. In many instances the farmers have made little use of available irrigation water, with the result that yields often have been very poor. To cope with the weed problem, summer fallowing has been resorted to, which means a crop only every other year. Considering the fact that irrigated land usually is costly and that charges for water must be paid every year, it is obvious that a crop produced only every other year must bring an exceedingly high return in order to pay costs. Moreover, such practices have caused considerable soil blowing and loss of fertility.

A study of yields obtained on some northern Montana irrigation projects shows clearly that in many areas good returns are not being obtained. Further evidence of the results of poor farming is shown by the number of failures among farmers on these projects. High-priced irrigated land cannot compete with cheap dry land in producing wheat. The problem on irrigated land is to obtain the greatest net return per acre, since land is the expensive factor. Dry land is relatively cheaper than labor and machinery, so that the aim is to obtain the greatest return per unit of *equipment* and *labor*.

In order to pay out on an irrigated farm, not only must crops produced every year, but they must be crops that will yield maximum income per acre. This usually means cultivated crops, such as sugar beets, alfalfa, and other legumes which may be fed to stock. In any case emphasis must be placed upon high chemical productivity per acre. Net income depends not only upon prices received but upon cost and quantity. In general, the lower the yield the lower the cost per unit of product. It is more expensive to produce 15 tons of sugar beets per acre than 12 tons. Even when prices are relatively low, a profit can be made if the quantity produced per acre exceeds the *low* costs.

One of the main problems confronting farmers on irrigation projects is to determine the possibilities of their land and to plan so

as to derive maximum returns per acre. This problem involves not only a knowledge of the physical characteristics of the area, such as soil and climate, but also economic considerations of markets, costs, and so on. The northern Montana projects, being located far from consuming centers, need to adopt a farming program which takes account of all these factors.

PURPOSE OF THE STUDY

The purpose of this study is twofold: (1) to obtain an inventory of the physical and economic resources of the Valier irrigation project, and (2) to suggest a method of farm organization analysis which may be helpful in working out a more stable agriculture on the project.

SOURCES OF DATA

The material contained in this bulletin was obtained from various sources. Data on climate were secured from the United States Weather Bureau office at Helena; soil conditions, from a detailed survey of the Valier irrigation project;¹ and the remainder principally from the Valier-Montana Land and Water Company and from farmers on the project. A large part of the material was obtained during the summer of 1927, when complete farm management records were secured from over one hundred farmers. Annual crop census data have been analyzed for the past several years. The crop census cards were sorted first according to the size of the farm operated; in some cases, several cards had to be combined, since some farmers worked more than their own farm units. Next, the cards in each group were sorted according to type of farm, that is, dairy, beet, sheep, beef, and so on. This latter classification indicated the prevailing systems of farm organization on the project.

HISTORY OF VALIER IRRIGATION PROJECT

The Valier project is located in northern Montana, about 100 miles northwest of Great Falls, 50 miles south of the Canadian boundary, and about 50 miles east of the main range of the Rocky Mountains. The entire project is located in Pondera County.

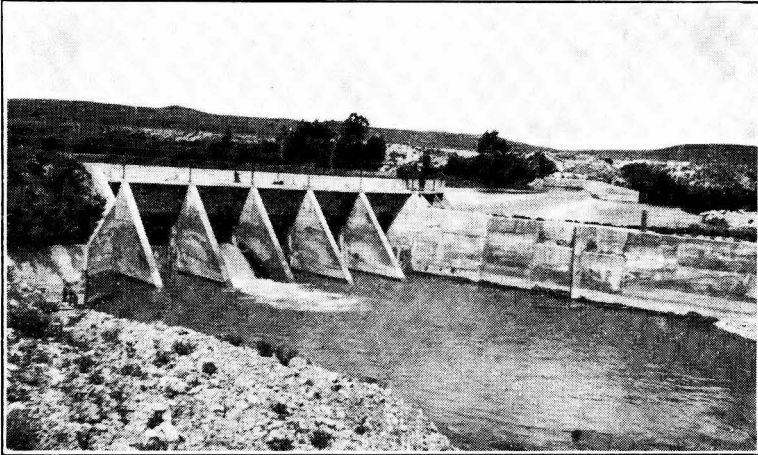
The present system is the outgrowth of a smaller system which was owned by the Conrad Brothers. They appropriated water from Birch and Dupuyer creeks and conveyed it through a system of canals to several thousand acres now included in the project. The land irrigated was used to grow feed for the head of livestock.

In 1908 the original irrigation development and lands embraced were sold by Conrad Brothers. Other lands were purchased by the buyers under the Carey Act and storage canals were built to accommodate about 80,000 acres. 85,000 acres of Carey Act land were segregated.

¹DeYoung, William, Soil Survey of the Valier Irrigation Project, Agr. Expt. Sta. Bul. 217.

60,000 acres were irrigable. This land was homesteaded by settlers and rights to a certain quantity of water per year were sold by the development company.

The Valier project is not a bonded district. There are no future construction charges to be assessed against the land.



The irrigation structures on the Valier project are built of concrete to insure permanency

II. PHYSICAL AND ECONOMIC CHARACTERISTICS OF THE VALIER PROJECT

CLIMATIC FACTORS

Rainfall.—Weather data for the project are available for a period of about twenty years.² Records show that the average annual precipitation is about 12.36 inches. The average precipitation during the spring and summer months is indicated in table 1.

TABLE 1.—AVERAGE MONTHLY PRECIPITATION AT VALIER, 1912-1935

| Month | Average Precipitation Inches |
|--------------|---------------------------------|
| April | 0.91 |
| May | 1.36 |
| June | 2.78 |
| July | 1.56 |
| August | 1.41 |
| Total | 8.02 |

²See "Climatological Data, Montana Section," U. S. Dept. of Agr. Weather Bureau.

The rainfall in April generally is not more than 1 inch, in May not more than 2 inches; in June, 1 to 4 inches; in July, 2 inches or less; and in August, 3 inches or less. It should be pointed out, however, that the precipitation indicated above is not all effective. A good deal of the rainfall during the summer months comes as short dashing showers which are of little benefit to growing crops. If rains of less than 0.02 inch are considered ineffective, probably 30 per cent should be deducted from the figures in table 1, leaving a total of 5.6 inches for April to August, inclusive. For the year, the average would be about 8 inches. This amount of effective precipitation may be expected in three out of every four years. It is clear that a much greater amount of moisture is required in order to produce good crops of grain; alfalfa and cultivated crops could be produced only in the most favorable years with such scanty average moisture. The necessity for irrigation is obvious if maximum results are to be obtained.



Low maintenance costs are possible where irrigation structures are well made

The exact amount of irrigation necessary to supplement rainfall depends upon the kind and amount of crop, the condition of the soil, and upon other weather factors. It is conceded that irrigation generally should be carried out irrespective of rainfall. Experienced irrigators turn water on the fields at specified times, even though it may be raining at the time and some rain has fallen since the last irrigation.

Figure 1 shows the relationship of irrigation practices to rainfall on the Valier project. It is evident that there is a close inverse relationship between the two. The acreage irrigated has decreased materially when precipitation has increased, although the latter may have been relatively low.

Experiments which have been carried out in Montana, in neighboring states with a climate similar to that of Montana, and in Canada, show the following water requirements for maximum yield: alfalfa, 28 inches; potatoes and barley, 20 inches; oats, 19 inches; and flax, 16 inches.³ On that basis, the average amount of irrigation necessary to supplement the summer rainfall ranges from 9 inches for flax to 18 inches for alfalfa.

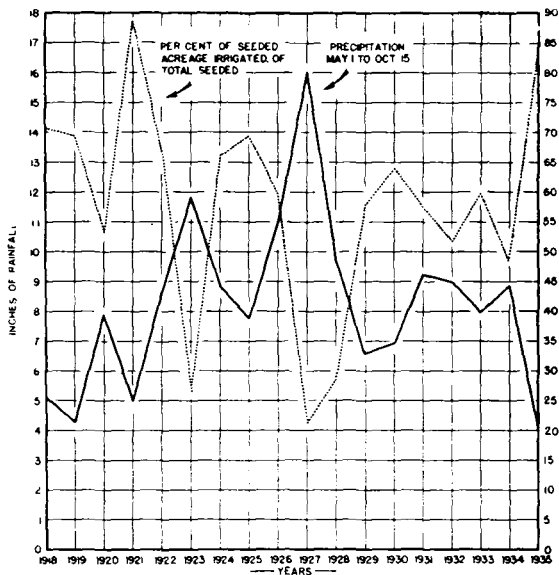


Figure 1.—Relation of irrigation to precipitation

The following quotations are taken from the published results of experiments at Lethbridge, Alberta, Canada:

The results of these tests and a study of field irrigation in south Alberta for the past twenty-five years lead to the conclusion that, on medium and heavy soils, one irrigation, applied in the previous fall or in the spring or early summer, before the crop is seriously in need of water, will produce a good crop in the years of average rainfall.⁴ If May and June are dry

³See "The Weather Influence on Crop Production in Regions of Scanty Rainfall," U. S. Dept. of Agr., Monthly Weather Review, Aug., 1926, pp. 336-341; "Irrigation of Alfalfa," U. S. Dept. of Agr. Farmers' Bul. 373; "Irrigation of Grain," U. S. Dept. of Agr. Farmers' Bul. 399; "Irrigation of Wheat," Utah Agr. Sta. Bul. 146; "Irrigation Experiments with Sugar Beets," Utah Agr. Expt. Sta. Bul. 186; Palmer, A. E., "Use of Irrigation Water on Farm Crops," Dom. of Canada, Dept. of Agr. Bul. 125 (n. s.), 1929.

⁴The average rainfall at Lethbridge for 26 years is nearly 10 inches for the crop season.

months, a second application of water, at the heading to flowering stage, may be required. On soil that is light or low in fertility, three irrigations may be necessary in drier years.

Undoubtedly the most important item for the irrigation farmer to bear in mind in considering his irrigation practice for wheat is to apply the first irrigation before the crop shows signs of needing water. It seems advisable to irrigate as much of the grain land as possible in the previous fall, and as soon as seeding is finished in the spring to ditch the fields that were not fall-irrigated and start irrigating early enough so that the first irrigation will be completed before any of the grain is injured from lack of water. . . .

Four irrigations gave the highest five-year average of alfalfa, followed closely, even in dry years, by three irrigations, one applied in early May, another when the plants were 12 inches high, and the third immediately after the first crop was harvested. In the drier years, two irrigations were not enough to produce heavy yields, but in the seasons of medium rainfall, two were sufficient.

All of the alfalfa should be irrigated in the fall or early May of the following spring, unless an unusually wet fall or wet spring is experienced. If May is dry, another application of water when the crop is about 12 inches high is desirable. If the season continues dry, a third application of water before or just after cutting may be required. . . .

These experiments would indicate that a good crop of potatoes can usually be raised on fertile, medium-textured soils without irrigation during the growing season, if the land has been irrigated the previous fall. The yields were increased in the drier years, however, by irrigating again soon after the plants started to bloom and by giving two more irrigations at intervals of twenty days.

It does not appear to be a good practice to irrigate before the plants start to bloom unless the soil is so dry as to retard growth.⁶

Irrigation is essential for satisfactory crop results and should be planned for regardless of rainfall. It costs less to prepare for irrigation at the proper time than to attempt to irrigate after the crops are burned.

Growing Season.—The date of the last frost in the spring—32° F. or lower—during the past 20 years has ranged from April 22 to June 1. In three years out of four it comes before May 17, and usually between May 7 and May 17. The first frost in the fall usually comes in September, and most often later than September 12. September 11 to 20 seems to be the usual period for a fall frost. The growing season averages about 115 days.

The mean temperature at Conrad is about 41.6° F. and at Valier, 41.4° F. The mean maximum temperature at Conrad is 53.7° F. while at Valier it is 54.0° F. The mean minimum temperature is slightly higher at Valier than at Conrad. It appears that Conrad gets slightly more heat than does Valier, probably because of being 300 feet lower.

⁶"Use of Irrigation Water on Farm Crops," Dom. of Canada, Dept. of Agr. Bul. 125 (n. s.) 1929.

Table 2 shows a comparison of heat units at Valier and other selected points.* In about 65 per cent of the years studied, the number of heat units at Valier ranged from 2000 to 2500. At Billings the number of heat units has been over 2500 in 26 of the past 35 years.

TABLE 2.—AVERAGE NUMBER OF HEAT UNITS AT SELECTED POINTS

| Station | April | May | June | July | August | September | October | Total |
|-----------------|-------|-----|------|------|--------|-----------|---------|-------|
| Valier | 4 | 143 | 462 | 707 | 650 | 253 | 21 | 2239 |
| Fairfield | 0 | 84 | 450 | 706 | 642 | 239 | 6 | 2127 |
| Billings | 4 | 215 | 622 | 865 | 794 | 317 | 32 | 2849 |
| Bozeman | 1 | 94 | 392 | 662 | 599 | 190 | 7 | 1945 |

*Data based on records from the United States Weather Bureau for the number of years listed: Valier, 22 years; Fairfield, 8 years; Billings, 36 years; and Bozeman, 41 years.

A certain amount of heat is necessary to mature crops. Relatively heavy soils are likely to warm up slowly in the spring unless the number of heat units during this period is high. Where April and May are somewhat cool, therefore, some crops will not yield heavily in spite of an apparently adequate growing season, as measured by the number of days between killing frosts.

While the exact number of heat units necessary to produce a given crop is not known, Valier is probably on the margin so far as crops requiring a long and warm growing season are concerned. Up to the present time, sugar beet yields on parts of the Valier project have been smaller and less certain than where the growing season is longer and the number of heat units greater. Relatively good yields of sugar beets can be obtained in some areas however, and the beet acreage may expand some in the future.

On the whole, the climate on the Valier project is favorable to feed crops such as alfalfa and sweet clover and to small grains. At least a part of the project will produce good yields of sugar beets. Adequate irrigation is necessary for all crops, however, and farmers should plan on it without regard to rainfall.

SOIL AND TOPOGRAPHY ON THE VALIER PROJECT

Soil.—A soil survey of the project was made by the Montana Agricultural Experiment Station in 1927. The following account is taken from the report of that survey:

The soils of the Valier Project may be classified into three broad groups based on the color of the surface material, namely, (1) Dark-Colored Soils, (2) Brown Soils, and (3) Light-Brown Soils. All of these soils have been developed under prairie conditions, having a short grass cover, a comparatively cool climate as influenced by the nearness of the mountains and the elevation of the project, and a rainfall varying from

*The base used is 43° F. If the mean temperature for a given month is 53°, the number of heat units is 53 minus 43 or 10, multiplied by the number of days in the month. The base, 43° F., is not accurate for all crops, but is commonly considered the vegetative temperature.

10 to 15 inches annually. Under these climatic conditions the accumulation of organic matter in the medium-textured, well-drained soils has been rather shallow as compared with the more humid prairie region of the Dakotas and Minnesota. The development of the lime layer has taken place from 3 to 4 inches below the surface in the heavy soils and 10 to 12 inches in the medium-textured soils and is more concentrated in the latter

A large part of the project has been influenced by the glacial debris that was carried into this area by ice. This glacial material varied greatly in composition, being made up of silt, clay, sand, gravel, and boulders. A part of this material weathered in the position in which it was left, while some of it was transported and redeposited by water or glacial lakes. In places the glacial material was very thin or has since been eroded, leaving the underlying strata of sandstones or shales exposed.

As the glacier melted and receded and the ice in the mountains was melted, a large amount of water must have accumulated and very likely played an important part in forming the heavy soils of the Valier district. Streams from the mountains probably influenced a considerable territory as evidenced by the gravel deposits west of Valier.

A considerable area of transported sandy deposits is found in the Bullhead Valley and Pondera Valley and indicates wide-spread stream deposits.

Dark-Colored Soils.—In this group are included the Valier, Winginaw, and Manson soils. These soils are heavy and their accumulation has been influenced by water, either as a stream deposit or as a glacial lake. While these soils have a somewhat higher nitrogen content than the brown soils of this region, it is thought that the color is not entirely due to organic matter that they contain, but is probably in part the effect of original material. . . .

Beneath the fine-grained silty mulch of the virgin areas the surface soil is a dark brown to dark gray heavy silty clay and varies from 3 to 7 inches in depth to the accumulation of free lime. . . . The lower subsoils of the Winginaw Valley and Manson soils are slightly lighter colored and more mottled than the Valier soils and in some cases a distinct flaky or platy structure was noted. Because of the heavy character of these soils their development has been slower than that of the more porous brown soils of the glaciated area. . . .

Brown Soils.—In this group are included the Scobey soils of glacial origin and the Cheyenne series, which is probably an ancient stream deposit. The Scobey soils have been developed from the glacial drift that has largely weathered in the position in which it was deposited by the ice sheet. These soils vary from a loam to a silty clay at the surface, becoming reddish brown and somewhat heavier in texture at 5 to 7 inches beneath the surface. . . . At 24 to 30 inches the brown color again becomes apparent. This soil is considered mature for this region. Glacial pebbles and boulders may be found throughout the soil section.

In the Cheyenne group are included the gravelly terrace or bench soils which were probably laid down as a stream deposit and are brown in color. In some cases the lime layer, which varies in depth, has developed as a binding agent to form a semi-consolidated mass with the gravels. In extreme cases a cemented gravelly hardpan has formed

Light-Brown Soils.—The light-brown soils include the lighter-textured soils of residual origin as well as the stream deposits, such as are formed in the Pondera Valley. The Bainville loam and fine sandy loam have been weathered rather recently from the sandstone formations. These soils are young in their development as the lime has not been leached, even from the surface soil. . . .

Miscellaneous Types.—The miscellaneous types are overflow bottoms and coulee material, rough non-agricultural land, and areas of seeped land. The overflow bottoms are found principally along Dupuyer and Birch creeks and the Dry Fork of the Marias River.⁷

In general, the Valier project has a fertile soil, capable of high yields under good farming practices. Small grains, peas, alfalfa, and sweet clover are well adapted to nearly all the land on the project. Sugar beets are grown near Conrad, Manson, and Williams at the present time. The soil in this area is lighter than that north of Valier and is more readily made suitable for sugar beets. The heavier soils will not produce good yields of sugar beets until proper rotations and soil management have been practiced for a few years. Sugar beets require a relatively long growing season and a fairly high average temperature during the summer months. Well-drained, loamy soils warm up much earlier in the spring than do the heavy soils; this lengthens the growing season and permits a fair yield of beets even at high altitudes.

Topography.—The topography of the area included within the limits of the project varies from nearly level or gently undulating to rolling and broken land bordering the larger creeks. The most distinct topographic feature of this area is Trunk Butte, located about 10 miles east of Valier. Its eastern cliff, bordering the Bullhead Valley and Schultz Coulee, rises abruptly for about 200 feet, being somewhat higher than Valier. Comparatively narrow strips of land too rough for cultivation border Dupuyer and Birch creeks, Marias River, the Dry Fork of the Marias, Schultz and Big Flat coulees, and Trunk Butte.

The project is divided into seven more or less distinct irrigable districts which are determined largely by the stream courses and topography, thus limiting the territory that the various main canals are actually able to serve with irrigation water. A continuous depression, now occupied by Schultz Coulee, which drains north to the Marias River, and Big Flat Coulee, which drains south into the Dry Fork of the Marias, indicates a former stream course and divides the eastern part of the project from the western. In like manner, Dupuyer Creek, Dry Fork of Marias, and Bullhead Coulee naturally separate other areas or divisions of the project.

⁷Soil Survey of the Valier Irrigation Project, Mont. Agr. Expt. Sta. Bul. 217, pp. 9-12.

District No. 1 comprises the irrigable area bordering Dupuyer Creek and west of Lake Francis. The area west of Lake Francis is essentially a rather level bench that is underlain in part by gravel. The land bordering Dupuyer Creek consists of a series of narrow level terraces, indicating former levels of the stream channel. The entire area contains varying amounts of rounded gravel.

District No. 2 includes the territory north of Valier and the Bullhead Valley north of Bullhead Coulee. This area varies from nearly level to gently rolling land. With the exception of the land bordering Bullhead Coulee, which is hummocky and uneven, practically all this territory is irrigable.

District No. 3 takes in the territory east of Valier and north of the ridge extending from Valier to Trunk Butte. This area is largely gently rolling with the exception of the Winginaw Valley, which is level to gently sloping. This area drains into Bullhead Coulee.

District No. 4 comprises the territory east of Williams and north of Manson, extending north around Trunk Butte, all lying west of Big Flat Coulee, and Schultz Coulee. This area varies from the rather level land in the vicinity of Manson to gently rolling.

District No. 5 is made up of the land . . . east of Schultz Coulee. This area is in general nearly level but contains many small knolls and hummocks that are difficult to irrigate without a general leveling of the land.

District No. 6 is located east of Big Flat Coulee . . . and the Dry Fork of the Marias River. This area has a general slope to the south and east.

District No. 7 is known as the "Conrad District" and comprises the area irrigated by the P Canal which divides north of Conrad. This area is an ancient valley drained by Pondera Coulee which is, on the whole, level to gently sloping towards the east. Sandy hills bordering the breaks of the Dry Fork of the Marias are too high for irrigation.

Of the irrigated area the lands to the north of Valier and the Manson district are probably more nearly level and more easily prepared for irrigation than other portions of the project. The benchlands north of the Dry Fork of the Marias River and east of Schultz and Big Flat coulees in general are gently sloping but contain many small knolls and hummocks that are either difficult to irrigate or too high to reach. There is undoubtedly a need for a large amount of land preparation for the best methods of irrigation.

The largest area of non-irrigated land, too high to be reached by the gravity system of water supply, is located south and east of Valier. The ridge rises gradually and extends east of Valier to Williams and Trunk Butte. This area, comprising about 15 square miles, is a gently rolling to rolling glaciated section. Another area about half the size of the former, too high for irrigation, is located about 8 miles north of Conrad and just east of Trunk Butte and is known as "Hi-Land Ridge." A much smaller non-irrigated area is found 2 miles east of Williams. These areas of non-irrigated land have a more or less rolling and hummocky topography similar to other glaciated areas of the state.⁸

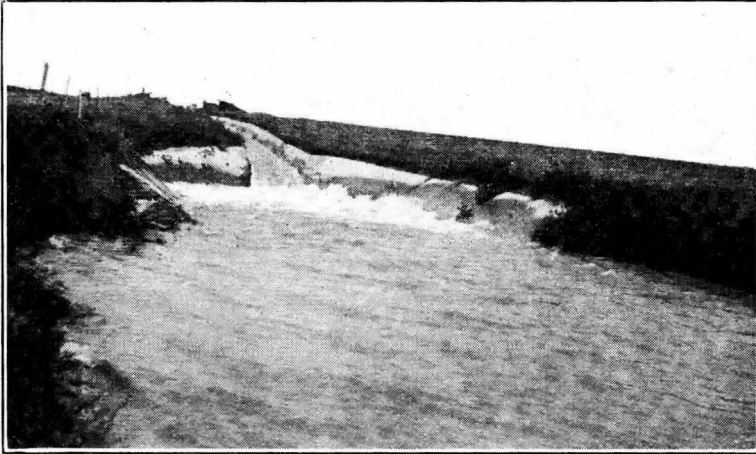
⁸Soil Survey of the Valier Irrigation Project, Mont. Agr. Expt. Sta. Bul. 217, pp. 3-5

IRRIGATION AND DRAINAGE

There are two large storage reservoirs on the project, Lake Francis at Valier and Birch Creek in the mountains west of Valier. The former holds 112,000 acre-feet of water and the latter 30,000, a total of 142,000 acre-feet, giving an ample water supply even for dry years. In 1930, a dry year with heavy irrigation, over 80,000 acre-feet of stored water was available at the end of the season.

The total length of the canals is about 480 miles, all in good operating condition. So far as structures and water supply are concerned, therefore, the project is in good condition to take care of all ordinary demands on the 80,000 acres to which the Carey Act has limited the project.*

It was originally planned to irrigate over 120,000 acres, but the Department of the Interior has ruled that for the present not more



Concrete drop on Valier project

than 80,000 acres may be furnished under the company's water right. Many of the irrigation structures are oversize as a result.

No serious seepage or drainage problem has been encountered to date, the seeped area being less than 1½ per cent of the total irrigable acreage. In case a farmer has purchased land which later becomes seeped, thus making it unfit for agricultural purposes, the general practice is for the development company to cancel the water stock on the land and allow the farmer credit for his outlay, provided he is indebted to the company. If the land is already fully paid for, his water right may be transferred to other land.

*At present the irrigable area comprises about 69,000 acres.

MARKETS AND TRANSPORTATION

The nearest city of any size, Great Falls, is about 100 miles away. Conrad, the county seat of Pondera County, with a population of 1,500, Valier with a population of 600, Williams with a population of 65, and Fowler and Ledger, with about 10 people each, constitute the local markets. Shelby, with 1,500 population, is 35 miles from Valier. None of the local markets, therefore, are of any especial significance for the project, except as receiving points for surplus products to be shipped out. Creameries are located at Conrad, Valier, and Williams, and cream-buying stations are found in all the local centers.

The project is traversed by the Montana Western Railway, a line of 20 miles operating between Conrad and Valier. At Conrad this line connects with a line of the Great Northern Railway running from Billings to Shelby and the Canadian border. The rail distance to outside markets is indicated in table 3.

TABLE 3.—RAIL MILES FROM VALIER TO OUTSIDE MARKETS

| Market | Distance in miles |
|-------------------|-------------------|
| Chicago | 1,490 |
| Kansas City | 1,375 |
| St. Paul | 1,060 |
| Seattle | 810 |
| Spokane | 480 |

These distances become important considerations in determining the most profitable farm enterprises on the project. Unless freight rates are quite low, only products having a relatively high unit value can stand a long shipment. Since freight costs are deducted from the central market price in determining the local price in surplus areas, some products can pay for only a relatively short haul. If wheat in Minneapolis were 75 cents per buhsel, the price at Valier would be only about 48 cents for corresponding grades. Livestock and livestock products usually can stand a long haul; since the price per pound is relatively high for these products, the freight charge takes a relatively small proportion of the central market price.

Another consideration is the freight cost from the Valier project relative to the cost from competing areas. Potatoes, for example, can be grown successfully without irrigation in Minnesota and Michigan. From these areas to large consuming markets the distance is short. While good yields of potatoes may be produced on the Valier project, no large special market has yet been developed, so that direct competition from short-haul areas has to be met. Crops which can be sold for local or near-by utilization or high-value crops, therefore, appear at present to be the most economic for this area. Special crops, of course, may be developed in limited quantities for local markets.

COST OF LAND AND WATER

The Valier-Montana Land and Water Company constructed its irrigation works under the Carey Act and has expended about \$5,000,000 to complete the project. The Carey land was sold to the settlers by the state for the filing fees of \$1.50 per acre with the provision that water rights of 1½ acre-feet per annum should be purchased from the development company for \$40 to \$60 per share, one share for each acre of irrigable land. The down payment to the water company was \$3 to \$5 per acre, the balance to be paid in 14 annual installments with 6 per cent interest. In addition to the Carey Act land, the development company owned several thousand acres of deeded land which were sold to the settlers on terms similar to those for the Carey Act land. The irrigable land was sold for \$50 to \$60 per acre and the dry land for \$10 to \$15 per acre.

The company has had to repossess a good deal of the first land sold. When reverted, much of this land was in a poor state of cultivation, in some cases foul with weeds and in other cases in a semi-cultivated condition. In some instances the buildings were removed before the company could repossess the farm.

The land owned by the company at present is being farmed by tenants. The price currently asked for this land, including a fully paid water right, varies from \$50 to \$90 per acre, depending upon the improvements and the distance from town. The terms are 10 to 15 per cent of the purchase price as a down payment, with the balance funded into an amortized payment mortgage extending over a period of 20 years, with interest at 6 per cent.

The maintenance and operation charges on the project average \$1 per acre for 1½ acre-feet of water per year. Each acre of irrigable land is assessed regardless of whether water is used or not. From 1912 to 1920 the charges were only 50 cents per acre because of a limitation in the construction agreement with the State of Montana. It is anticipated that water charges will be about \$1 per acre in the future.

TAXES

For taxation purposes the land is classified in accordance with tillability and distance from local market. The bulk of the tillable land on the project is assessed on a valuation of \$40 to \$55 per acre for irrigable and \$12 to \$25 per acre for dry land. The taxable value is 30 per cent of the assessed value according to state law, which means \$12 to \$16.50 for irrigable and \$3.60 to \$7.50 for dry land. The tax rate varies in the different school districts. Generally the combined state, county, and school district tax is from 5 to 6½ per cent of the taxable value, making the actual tax 60 cents to \$1.07 per acre for irrigable and 18 cents to 49 cents per acre for dry land. Taxes on the best land on the project average \$1 per acre. With the operation and maintenance costs, the fixed charges per acre

amount to approximately \$2 per year on the better grades of land. Table 4 summarizes the taxable value, taxes, and levies in Pondera County for 1935 and 1936.

TABLE 4.—TAXABLE VALUATIONS—TAXES AND LEVIES IN PONDERA COUNTY

| | 1936 | 1935 |
|--|---------|---------|
| Irrigated land—valuation | \$30.21 | \$29.37 |
| Grazing land—valuation | 3.37 | 3.34 |
| Average tax per acre—irrigated land | .55 | .57 |
| Average tax per acre—grazing land | .06 | .07 |
| Horses—valuation | 34.22 | 28.90 |
| Dairy cattle—valuation | 40.17 | 34.75 |
| All cattle—valuation | 28.74 | 21.81 |
| Sheep—valuation | 4.22 | 3.01 |
| Total average school tax levy—mills | 24.72 | 24.51 |
| Total average levy, all purposes—mills | 60.943 | 65.143 |

III. LAND UTILIZATION AND FARMING PRACTICES

Irrigation farming usually connotes intensive farming. Irrigated land generally has a high value per acre, and, in addition, a relatively high annual production cost, since taxes ordinarily are higher than on dry land and since water charges must be met annually. An intensive type of farming should be developed, therefore, the aim being to get maximum production *per acre*. If land is cheap, on the other hand, farmers will make the most money by growing such crops as wheat by extensive methods and by combining land and labor in such proportions as to get the highest possible returns *per man* and *unit of capital* rather than *per acre*.

ACREAGES OF LEADING CROPS

A study of the trend in acreages of leading crops shows that extensive rather than intensive farming has been practiced on the Valier project. Table 5 and figures 2 and 3 indicate the situation since 1918.

Wheat and summer fallow have taken up the larger proportion of the available crop area. Since 1924 the wheat acreage has remained at about the same level, though fluctuating widely, but the acreage devoted to summer fallow has increased materially. Together, wheat and summer fallow annually account for about 60 per cent of the cropped acreage. Summer tillage has been resorted to as a means of weed eradication. The failure of some farmers has made it possible for the remainder to rent more land and to go into large scale farming, with wheat and fallow as the main enterprise. Many farmers have purchased tractors and combines, and have felt that the logical way of paying out with such equipment is to acquire more land.

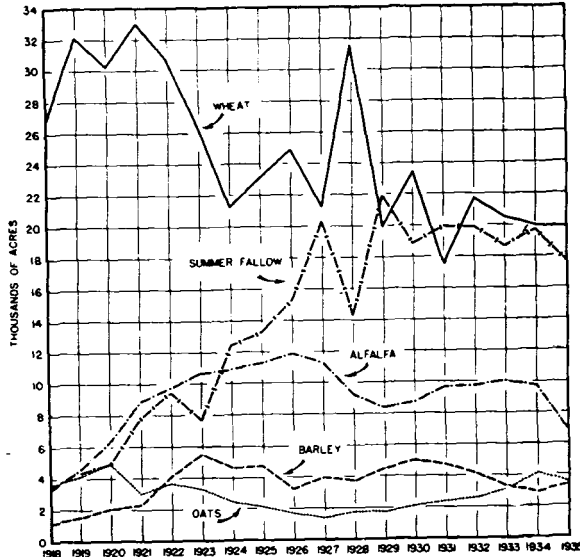


Figure 2.—Trend in land use, 1918-1935

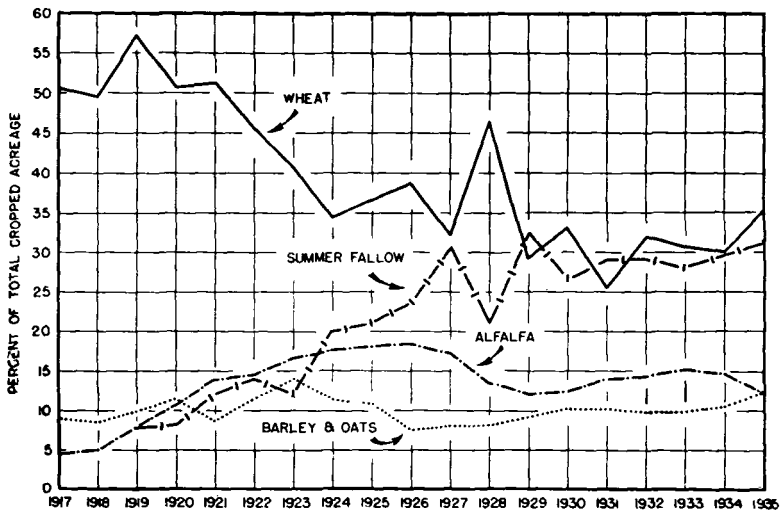


Figure 3.—Trend in proportion of acreage used for various crops

One problem to be faced when such a large proportion of the land is devoted to wheat and summer fallow is that of maintaining soil fertility and preventing erosion. On most irrigation projects, farmers plan to devote a majority of their available acreage to hay and cultivated crops.

TABLE 5.—ACREAGES OF LEADING CROPS ON THE VALIER PROJECT, 1918-1935

| Year | Wheat | Summer fallow | Alfalfa | Barley | Oats | Sugar beets | Per cent of total acres in wheat & fallow | Per cent of total acres in feed crops |
|-----------|--------|---------------|---------|--------|-------|-------------|---|---------------------------------------|
| 1935..... | 19,915 | 17,704 | 6,898 | 3,361 | 3,518 | 689 | 55.5 | 22.4 |
| 1934..... | 19,980 | 19,633 | 9,757 | 2,942 | 4,109 | 700 | 59.7 | 25.3 |
| 1933..... | 20,536 | 18,661 | 10,027 | 3,353 | 3,128 | 846 | 58.8 | 24.8 |
| 1932..... | 21,671 | 19,849 | 9,709 | 4,152 | 2,586 | 758 | 61.4 | 24.3 |
| 1931..... | 17,488 | 19,906 | 9,613 | 4,718 | 2,379 | 607 | 54.6 | 24.6 |
| 1930..... | 23,397 | 18,804 | 8,719 | 5,050 | 2,090 | 152 | 60.0 | 23.0 |
| 1929..... | 19,960 | 21,909 | 8,197 | 4,492 | 1,752 | 201 | 61.6 | 21.2 |
| 1928..... | 31,590 | 14,271 | 9,203 | 3,772 | 1,776 | 223 | 67.4 | 21.6 |
| 1927..... | 21,212 | 20,259 | 11,355 | 3,986 | 1,393 | 38 | 63.0 | 25.4 |
| 1926..... | 24,870 | 15,326 | 11,883 | 3,208 | 1,628 | 101 | 62.5 | 26.0 |
| 1925..... | 23,180 | 13,364 | 11,369 | 4,700 | 2,103 | — | 57.6 | 28.6 |
| 1924..... | 21,310 | 12,479 | 10,950 | 4,626 | 2,426 | — | 54.5 | 29.1 |
| 1923..... | 26,281 | 7,744 | 10,700 | 5,786 | 3,315 | — | 52.8 | 30.7 |
| 1922..... | 30,691 | 9,427 | 9,750 | 4,146 | 3,607 | — | 59.7 | 26.4 |
| 1921..... | 33,099 | 7,811 | 8,868 | 2,354 | 3,085 | — | 64.0 | 22.4 |
| 1920..... | 30,320 | 4,891 | 6,374 | 2,026 | 4,863 | — | 59.0 | 22.3 |
| 1919..... | 32,128 | 4,381 | 4,470 | 1,449 | 4,079 | — | 65.3 | 17.9 |
| 1918..... | 26,996 | — | 3,346 | 1,157 | 3,593 | — | — | 13.8 |

Another problem concerns the possibility of competing with good dry land in wheat production. Costs on irrigated land are higher than on dry land because of higher taxes, water costs, irrigating expenses, and smaller fields. To overcome this handicap in costs, yields on irrigated land must be correspondingly higher.

The acreages of oats, barley, and alfalfa have fluctuated considerably, but the trend has not changed much in recent years. Table 6 shows the distribution of soil depleting and soil conserving crops on the project for the past four years.

TABLE 6.—PERCENTAGE OF SOIL DEPLETING AND SOIL CONSERVING ACREAGE, 1932-1935, VALIER PROJECT

| Item | 1932 | 1933 | 1934 | 1935 | Average |
|---|------|------|------|------|---------|
| Soil conserving, pasture included | 25.3 | 26.2 | 22.9 | 18.8 | 23.3 |
| Soil depleting, pasture included | 74.7 | 73.8 | 77.1 | 81.2 | 76.7 |
| Soil conserving, pasture excluded | 18.1 | 19.1 | 16.5 | 14.2 | 16.9 |
| Soil depleting, pasture excluded | 81.9 | 80.9 | 83.5 | 85.8 | 83.0 |

CROP YIELDS

Not only has the type of farming on the Valier project been uneconomical in some respects, but methods of farming apparently have been poor in many cases, judging by the average yields obtained. Table 7 and figure 4 show the average yields of the leading crops since 1917.

TABLE 7.—AVERAGE YIELDS OF LEADING CROPS ON THE VALIER PROJECT, 1917-1935

| Year | Wheat | Oats | Barley | Alfalfa | Sugar beets |
|-----------|---------|---------|---------|---------|-------------|
| | Bushels | Bushels | Bushels | Tons | Tons |
| 1935..... | 20.2 | 31.9 | 28.5 | 1.78 | 8.34 |
| 1934..... | 23.1 | 40.0 | 27.8 | 1.52 | 15.69 |
| 1933..... | 15.3 | 27.8 | 21.0 | 1.44 | 10.00 |
| 1932..... | 18.6 | 33.8 | 23.8 | 1.47 | 10.71 |
| 1931..... | 17.2 | 33.8 | 28.6 | 1.75 | 9.90 |
| 1930..... | 23.2 | 33.9 | 29.2 | 1.80 | 14.00 |
| 1929..... | 17.7 | 25.3 | 22.3 | 1.70 | 6.47 |
| 1928..... | 25.2 | 37.4 | 31.4 | 1.50 | 6.91 |
| 1927..... | 25.3 | 34.2 | 31.3 | 1.70 | 9.53 |
| 1926..... | 20.5 | 26.7 | 24.0 | 1.90 | 3.50 |
| 1925..... | 20.0 | 24.3 | 20.7 | 1.70 | — |
| 1924..... | 16.6 | 25.9 | 20.1 | 1.70 | — |
| 1923..... | 16.8 | 22.4 | 18.5 | 1.40 | — |
| 1922..... | 20.0 | 30.4 | 22.8 | 1.60 | — |
| 1921..... | 13.1 | 21.5 | 17.0 | 1.60 | — |
| 1920..... | 17.8 | 31.1 | 26.9 | 1.70 | — |
| 1919..... | 9.5 | 19.2 | 15.9 | 1.40 | — |
| 1918..... | 13.9 | 24.6 | 18.7 | 1.60 | — |
| 1917..... | 11.1 | 21.0 | 15.7 | 1.60 | — |

The average yield of wheat from 1917 to 1930 has been only 17.2 bushels per acre, the result of continuous cropping and the fact that much of the acreage was stubbled in. In many cases, also, the acreage per farm has been too large for adequate irrigation. A yield of even 30 bushels of wheat per acre, however, when summer fallowing is practiced, obviously cannot pay out on irrigated land with average prices; nor can the irrigation farmer with higher land cost, water charges, and higher taxes meet the competition of dry-land farmers in wheat production.

It is evident from figure 4 that the average yield of alfalfa has been much more stable than has the yield of grain crops. The reason is that alfalfa must be irrigated in order to produce satisfactory returns, whereas grains are assumed to give fair yields without irrigation. Even alfalfa yields probably would be much higher if better practices were followed. In the past many farmers have regarded alfalfa production as a side issue and have been satisfied with low yields. Some of the dairy farmers on the project have obtained yields of 3 tons per acre or more.

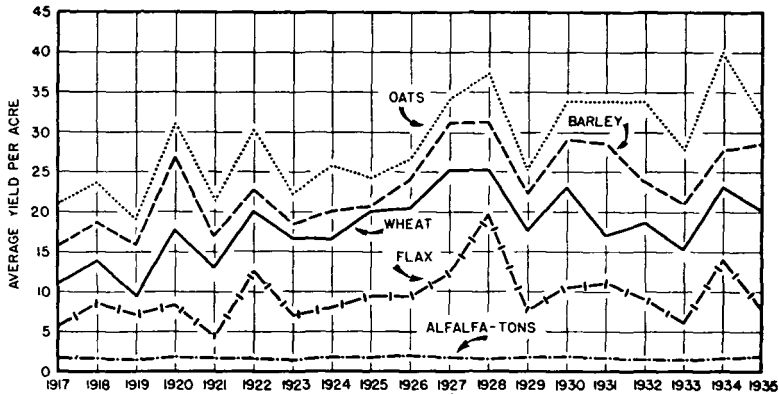


Figure 4.—Trend in yields of leading crops

Figure 5 shows that grain yields vary directly with rainfall, being high when there is plenty of rain and low when there is a drought. In 1927, a year of heavy rainfall, over 30 per cent of the alfalfa was not irrigated at all and only a few acres were irrigated twice. In no year prior to 1929 has as much as one-half of the wheat acreage been irrigated. Many farmers irrigate if it does not rain, often waiting until the crop is partially or wholly burned

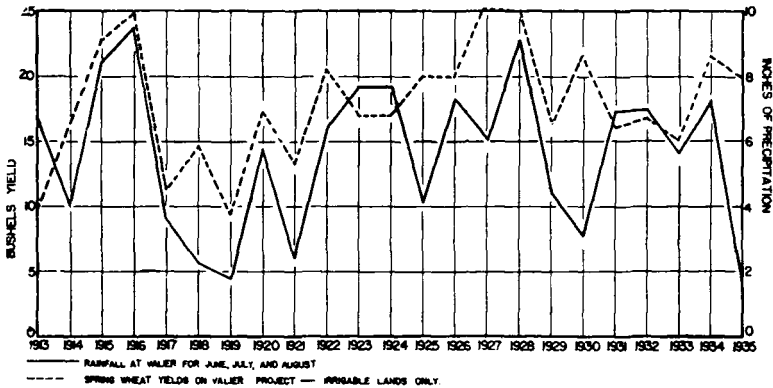


Figure 5.—Comparisons between spring wheat yields and summer rainfall

before calling for water. Low yields obviously follow. Crops generally should be irrigated irrespective of rainfall, if maximum returns are to be expected. Precipitation during the growing season is not sufficient to produce maximum yields of all crops.

LIVESTOCK

Feed crops and livestock should form the foundation for successful farming on the Valier project. Livestock is necessary in order to maintain the fertility of the soil. Equally important is the fact that returns from other enterprises in this area probably will be less over a period of years than returns from livestock. Since the project is located far from consuming centers, the products shipped out should have a high value relative to transportation cost. If the price of wheat in Minneapolis were \$1 per bushel, freight charges from Valier would absorb about 30 per cent which, added to the farm costs of production, means a very small net return per bushel to the farmer.¹⁰ With a corresponding price level for livestock and livestock products, on the other hand, the freight charges from Valier generally would absorb less than 10 per cent of the central market price.

Livestock production has not developed so far as seems desirable on the project. Table 8, showing the trend since 1918, reveals some changes in numbers. The number of horses and mules has decreased by over 40 per cent, undoubtedly a result of the increasing number of tractors on the project.¹¹ This decrease in horses largely accounts for the decrease in the acreage of oats.

TABLE 8.—LIVESTOCK ON THE VALIER PROJECT, 1918-1935

| Year | Horses and mules | Dairy cattle | Beef cattle | Hogs | Sheep | Fowls |
|------------|------------------|--------------|--------------------|-------|--------|--------|
| 1935 | 1,188 | 1,587 | 3,450 | 2,097 | 6,067 | 25,982 |
| 1934 | 1,340 | 2,030 | 4,300 | 1,950 | 8,740 | 29,700 |
| 1933 | 1,410 | 2,150 | 3,920 | 3,050 | 12,100 | 29,900 |
| 1932 | 1,556 | 2,178 | 3,187 | 3,637 | 9,600 | 28,750 |
| 1931 | 1,869 | 2,319 | 3,703 | 3,814 | 15,900 | 27,080 |
| 1930 | 1,832 | 2,010 | 2,860 | 2,882 | 15,270 | 28,380 |
| 1929 | 2,020 | 1,970 | 2,360 | 3,000 | 8,950 | 29,920 |
| 1928 | 2,250 | 1,915 | 1,684 | 3,350 | 11,200 | 24,892 |
| 1927 | 2,110 | 1,875 | 1,830 | 1,850 | 8,710 | 26,860 |
| 1926 | 2,510 | 1,990 | 1,790 | 1,670 | 8,680 | 31,300 |
| 1925 | 3,190 | 2,110 | 2,450 | 2,100 | 8,650 | 31,300 |
| 1924 | 2,960 | 1,850 | 2,150 | 3,500 | 7,420 | 32,600 |
| 1923 | 3,240 | 1,477 | 2,693 | 4,237 | 1,335 | 34,689 |
| 1922 | 3,311 | — | 4,084 ^a | 2,773 | 1,075 | 30,486 |
| 1921 | 2,990 | — | 3,051 | 1,265 | 1,000 | — |
| 1920 | 3,480 | — | 4,021 | 1,940 | 1,040 | 29,324 |
| 1919 | 3,554 | — | 3,465 | 1,768 | 1,281 | 24,132 |
| 1918 | 3,523 | — | 1,193 | 1,813 | 1,054 | 28,052 |

^aIncludes dairy cattle

The number of milk cows changed little between 1924 and 1934, but showed a material drop in 1935. The number of beef cattle

¹⁰No account has been taken of protein premiums which in occasional years may be substantial.

¹¹There were 212 tractors on 205 farms in 1934.

tended upward until 1934, but, like dairy cattle, showed a marked decrease in 1935. These fluctuations in cattle numbers generally reflect changes in the price and feed situation. The number of sheep has increased many fold since 1918 but has shown wide fluctuations in recent years. The hog population has run in wide swings, being over 8,000 in 1914 and 1915, less than 1,300 in 1922, over 4,000 in 1923, and less than 1,700 in 1926.

Figured in terms of animal units,²² there has been some increase in the past few years, but not to the extent that would be expected. Livestock and livestock feeding should prove much more profitable than straight wheat farming.



Plowing under sweet clover loosens the soil, increases the productivity of the land, and prepares it for a greater variety of uses

Dairying has not developed so far as might seem desirable, in view of the conditions for such development. Good yields of alfalfa hay may be obtained and the climate is not adverse for dairy enterprises. Three creameries are now operating on the project, and cream-buying stations are found in all of the local markets. With a greater development of dairying, there are possi-

²²An animal unit has been commonly counted as 1 horse, 1 head of mature cattle, 2 young cattle, 5 hogs, 10 pigs, 7 sheep, 14 lambs, or 100 chickens. From the standpoint of animal feed requirements, however, the following classification is often used: 1 beef cow is the equivalent of 1 animal unit; 1 dairy cow, 1.3 animal units; 1 horse, 1.2 animal units; other cattle 0.7 animal unit; 1 sheep 0.25 animal unit; and 1 hog, 0.25 animal unit.

bilities for the establishment of a market for high-quality dairy products. A cow-testing association has been operating on the project for some time and has no doubt been influential in improving existing dairy herds. The distance to large consuming centers is not the handicap in dairy production that it is in grain production. Table 9 shows the relationship between number of animal units and acreage in feed crops since 1932.

TABLE 9.—ANIMAL UNITS PER FEED-CROP ACRE, VALIER IRRIGATION PROJECT

| Year | Number of animal units | Total feed crop acres | Number of animal units per feed crop acre |
|-----------|------------------------|-----------------------|---|
| 1935..... | 10,576 | 15,224 | 1.44 |
| 1934..... | 11,093 | 16,071 | 1.45 |
| 1933..... | 12,881 | 16,083 | 1.25 |
| 1932..... | 10,337 | 14,906 | 1.44 |

FARM OWNERSHIP AND TENANCY

As already indicated, a large portion of the land sold to new settlers has reverted to the development company. The result has been twofold—first, an increase in tenancy and, second, an increase in the size of farms. When new families could not be brought in from outside, the land had to be leased to farmers on the project. A study of the 1935 situation showed that over 33.5 per cent of the farms were over 240 acres. The average size of irrigated farms that were tilled increased from 125 acres in 1919 to 223 acres in 1935. The average size of farms owned increased from 82 acres in 1919 to 157 acres in 1934.

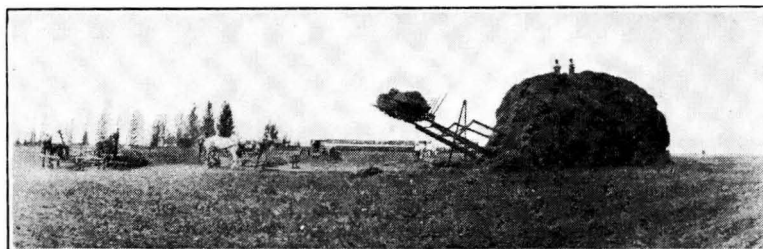
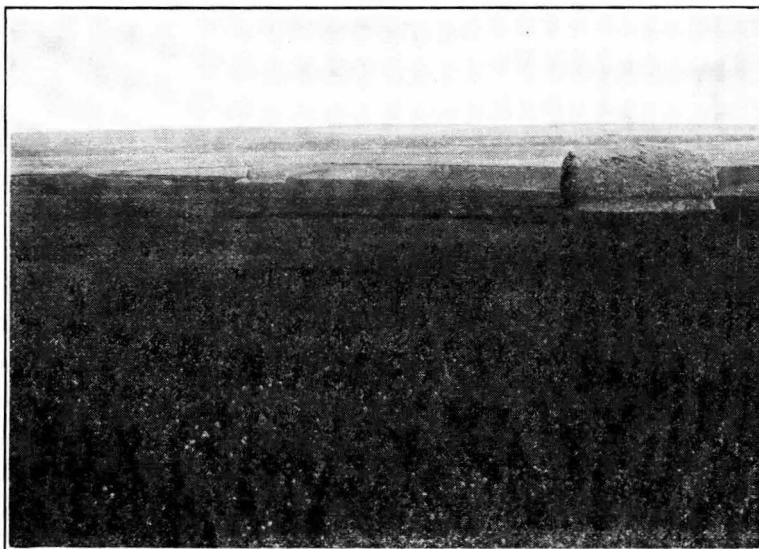
The irrigable land farmed by tenants has increased from 37 to over 70 per cent of the total area on the project. The difficulty of getting tenants with some capital and with proper irrigation experience and attitude has intensified the problems on the project. Landowners are not inclined to spend much money for improvements and farm betterment so long as tenants insist on extensive wheat farming. On the other hand, tenants often have large-scale farming machinery and feel that it is difficult to pay expenses without extensive farming. Exclusive wheat farming, however, apparently encourages some summer fallowing every other year, and this, in turn, means low returns for the landowner, who has to pay taxes and water charges on the land.

Table 10 shows the distribution of owners and tenants on the project since 1926. Tenancy has increased considerably. This increase, no doubt, is an outgrowth of low agricultural prices, low farm income because of low yields, and land prices out of line with the buyer's ability to pay with the type of farming practiced.

TABLE 10.—TENURE ON THE VALIER PROJECT

| Year | Owners | Tenants | Per cent tenants ^a |
|-----------|--------|---------|-------------------------------|
| 1935..... | 100 | 154 | 59.9 |
| 1934..... | 96 | 158 | 61.0 |
| 1933..... | 109 | 148 | 57.6 |
| 1932..... | 122 | 127 | 51.0 |
| 1926..... | 37 | 68 | 45.0 |

^aPercentage of tenants in the group of farms analyzed



Good crops and low cost methods of haying make cheap feed for livestock

CROP AND LIVESTOCK COMBINATIONS ON THE VALIER PROJECT

Crop census data were analyzed in 1926, 1930, and annually since 1932.¹³ The same group of farms was not necessarily studied each year, since the attempt was made to include all farm units for which complete records were available.¹⁴

The analysis covered 249 farms in 1932, 257 farms in 1933, 229 farms in 1934, and 257 farms in 1935. Table 11 shows the distribution of size by years, and indicates relatively few changes since 1932. Small variations in percentage distribution are indicated, but these probably are due to variation in the sample from year to year. There is a concentration in farms of 160 and over 320 acres. About one-sixth of the farms are 80 acres and less. It is significant from the standpoint of type of farming that over 40 per cent of all farms studied averaged over 200 acres, and nearly 20 per cent were over 320 acres.

TABLE 11.—PERCENTAGE DISTRIBUTION OF SIZE OF FARMS,
VALIER PROJECT

| Size of farm acres | 1935 | 1934 | 1933 | 1932 | 1930* | 1926* |
|-----------------------|------|------|------|------|-------|-------|
| 1-40 | 4.7 | 7.3 | 4.7 | 5.6 | — | — |
| 41-80 | 10.0 | 11.5 | 16.3 | 10.4 | 5.6 | 6.6 |
| 81-120 | 10.1 | 12.4 | 11.3 | 9.6 | 1.4 | 7.5 |
| 121-160 | 20.2 | 14.3 | 17.1 | 16.5 | 19.7 | 22.7 |
| 161-200 | 11.7 | 9.7 | 10.5 | 14.5 | 9.9 | 7.8 |
| 201-240 | 8.9 | 10.0 | 6.2 | 6.8 | 12.7 | 11.9 |
| 241-280 | 7.0 | 9.3 | 10.1 | 13.7 | 8.5 | 6.8 |
| 281-320 | 6.6 | 7.7 | 6.6 | 7.2 | 7.0 | 12.8 |
| Over 320 | 19.9 | 17.8 | 17.2 | 15.7 | 35.2 | 23.9 |

*The smallest size analyzed in 1926 and 1930 was 80 acres

The proportion of irrigable land in farms averaged from 71.5 to 79.5 per cent. The dry land in most cases was nontillable and was used for pasture.

Tables 12 to 16, inclusive, show the trend in crops and livestock on farms for the years studied. Table 12 indicates that the proportion of cropped acreage in wheat tends to increase with the size of farm. Summer fallow increased some since 1926 on all sizes of farms studied.

Tables 13 and 14 show the distribution of oats and barley on the farms studied. The proportion of the crop acreage devoted to feed grains varies considerably from year to year. The smaller farms have relatively more of their acreage devoted to feed grains

¹³The divisions according to size of farm in 1926 and 1930 did not include the 1 to 40-acre classification used since 1932. In the first two years, therefore, the first class includes all farms from 0 to 80 acres.

¹⁴There is always some question as to accuracy of crop census data even with careful editing of the original records. In a few cases some dry land, not listed, may be farmed. This means that an apparently unbalanced farm organization actually is in balance considering the resources available.

TABLE 12.—PERCENTAGE OF THE CROPPED ACREAGE IN WHEAT AND SUMMER FALLOW BY SIZE OF FARM, VALIER PROJECT

| Acres | 1935 | | 1934 | | 1933 | | 1932 | | 1930 | | 1926 | |
|----------------|-------|-------------|-------|-------------|-------|-------------|-------|-------------|-------|-------------|-------|-------------|
| | Wheat | Fal- low | Wheat | Fal- low | Wheat | Fal- low | Wheat | Fal- low | Wheat | Fal- low | Wheat | Fal- low |
| 1-40 | 23.5 | 23.6 | 17.7 | 4.4 | 20.6 | 6.8 | 38.8 | 0.2 | — | — | — | — |
| 41-80 | 37.2 | 27.3 | 37.4 | 38.1 | 33.8 | 31.2 | 29.0 | 17.7 | 9.6 | — | 45.0 | 18.3 |
| 81-120..... | 43.2 | 50.4 | 53.8 | 48.0 | 35.4 | 30.4 | 37.8 | 20.9 | 4.0 | 34.0 | 45.6 | 15.0 |
| 121-160..... | 46.4 | 38.3 | 32.1 | 55.5 | 46.5 | 37.6 | 41.3 | 47.9 | 33.8 | 11.9 | 50.5 | 22.2 |
| 161-200..... | 55.6 | 38.8 | 49.5 | 40.0 | 44.7 | 35.8 | 52.4 | 28.2 | 40.3 | 28.8 | 36.5 | 21.9 |
| 201-240..... | 44.2 | 27.0 | 45.8 | 45.1 | 48.7 | 47.2 | 6.0 | 36.7 | 35.0 | 30.4 | 42.6 | 16.7 |
| 241-280..... | 46.5 | 30.1 | 38.8 | 42.8 | 44.5 | 35.7 | 54.5 | 46.7 | 40.5 | 30.0 | 48.8 | 22.6 |
| 281-320..... | 49.8 | 61.3 | 49.7 | 60.2 | 59.6 | 53.0 | 47.2 | 51.2 | 59.2 | 21.6 | 49.4 | 20.6 |
| Over 320 | 55.1 | 53.8 | 35.7 | 53.0 | 37.0 | 21.4 | 63.8 | 44.4 | 46.6 | 29.7 | 43.0 | 25.0 |

than the larger farms, because of a greater emphasis upon livestock production. The percentage of all acreage devoted to oats has increased materially since 1932 on all sizes of farms, while the proportion devoted to barley shows a decrease on all but a few farms.

TABLE 13.—PERCENTAGE OF TOTAL CROPPED ACREAGE IN OATS, BY SIZE OF FARM, VALIER PROJECT

| Acres | 1935 | 1934 | 1933 | 1932 | 1927 | 1926 |
|----------------|------|------|------|------|------|------|
| 1-40 | 14.4 | 18.5 | 8.5 | 2.6 | — | — |
| 41-80 | 16.6 | 22.3 | 10.9 | 4.7 | 4.3 | — |
| 81-120..... | 12.4 | 6.5 | 7.0 | 5.6 | 4.0 | 7.0 |
| 121-160..... | 8.0 | 4.2 | 6.0 | 6.3 | 5.4 | 3.8 |
| 161-200..... | 9.0 | 9.4 | 7.8 | 8.3 | 5.0 | 6.2 |
| 201-240..... | 11.8 | 9.9 | 5.7 | 5.6 | 4.9 | 4.2 |
| 241-280..... | 10.6 | 13.1 | 9.4 | 5.9 | 8.5 | 2.5 |
| 281-320..... | 6.0 | 13.1 | 6.0 | 10.6 | 0.4 | 2.2 |
| Over 320 | 7.5 | 9.5 | 8.6 | 6.3 | 3.44 | 2.8 |

TABLE 14.—PERCENTAGE OF TOTAL CROPPED ACRES IN BARLEY BY SIZE OF FARM, VALIER PROJECT

| Acres | 1935 | 1934 | 1933 | 1932 | 1927 | 1926 |
|----------------|------|------|------|------|------|------|
| 1-40 | 15.7 | 2.6 | 9.9 | 1.18 | — | — |
| 41-80 | 3.4 | 10.5 | 6.5 | 14.1 | 20.8 | 4.2 |
| 81-120..... | 6.9 | 7.7 | 11.3 | 6.3 | 10.0 | 15.7 |
| 121-160..... | 10.6 | 24.0 | 11.1 | 14.2 | 8.5 | 4.4 |
| 161-200..... | 7.5 | 6.2 | 13.3 | 11.2 | 12.8 | 6.1 |
| 201-240..... | 12.4 | 7.6 | 11.9 | 7.0 | 7.9 | 4.4 |
| 241-280..... | 9.3 | 9.3 | 8.2 | 12.8 | 7.7 | 8.7 |
| 281-320..... | 12.3 | 5.3 | 4.9 | 13.5 | 9.3 | 6.3 |
| Over 320 | 6.9 | 6.5 | 7.8 | 7.9 | 8.7 | 6.1 |

Table 15 shows that smaller farms have relatively more of the available crop land devoted to alfalfa than have larger farms. There has been some variation in the percentages from year to year, but no significant changes are apparent.

TABLE 15.—PERCENTAGE OF TOTAL CROPPED ACRES IN ALFALFA BY SIZE OF FARM, VALIER PROJECT

| Acres | 1935 | 1934 | 1933 | 1932 | 1930* | 1926* |
|----------------|------|------|------|------|-------|-------|
| 1-40 | 35.2 | 33.0 | 43.3 | 28.7 | — | — |
| 41-80 | 29.5 | 31.0 | 41.3 | 44.6 | 61.0 | 32.8 |
| 81-120 | 29.6 | 29.4 | 37.0 | 31.7 | 27.0 | 16.7 |
| 121-160 | 25.6 | 34.0 | 31.6 | 32.0 | 29.6 | 19.2 |
| 161-200 | 17.5 | 29.4 | 30.0 | 24.9 | 14.1 | 29.0 |
| 201-240 | 21.8 | 26.0 | 26.3 | 18.9 | 21.0 | 32.0 |
| 241-280 | 22.8 | 28.7 | 31.7 | 24.0 | 13.3 | 17.5 |
| 281-320 | 17.8 | 22.2 | 22.4 | 25.4 | 9.5 | 24.2 |
| Over 320 | 16.1 | 16.5 | 21.4 | 20.0 | 15.6 | 23.2 |

*For 1926 and 1930 the figures show alfalf and clover combined.

Table 16 shows that the proportion of cropped acreage devoted to sugar beets has remained practically constant; only on the smaller farms is any appreciable percentage of the acreage used for this crop.

TABLE 16.—PERCENTAGE OF TOTAL CROPPED ACRES IN SUGAR BEETS BY SIZE OF FARM, VALIER PROJECT

| Acres | 1935 | 1934 | 1933 | 1932 | 1930 |
|----------------|------|------|------|------|------|
| 1-40 | 10.0 | 10.4 | 7.1 | 7.3 | — |
| 41-80 | 2.1 | 0.8 | 2.6 | 3.7 | 4.3 |
| 81-120 | 2.4 | 2.5 | 3.2 | 5.3 | 21.0 |
| 121-160 | 1.3 | 4.2 | 1.4 | 2.0 | — |
| 161-200 | 2.0 | 0.6 | 0.5 | 5.3 | — |
| 201-240 | 0.9 | — | — | — | — |
| 241-280 | 0.5 | 2.5 | — | — | — |
| 281-320 | 3.4 | 2.2 | 1.2 | 2.1 | — |
| Over 320 | 1.7 | 0.1 | 1.0 | 0.5 | 0.8 |

The proportion of the acreage which has been devoted to peas is not shown. This crop has been grown only a short time and on many farms has been substituted for wheat. Generally the largest farms have been growing peas and the smallest farms sugar beets.¹⁵

On the average, about 20 per cent of the crop land has been devoted to hay, as against about 60 per cent for wheat and summer fallow. It is doubtful whether soil fertility can be maintained and soil blowing prevented with such a large proportion of the land in wheat and fallow. The deterioration of the soil from these causes is rapid once the soil becomes pulverized from repeated fallowing.

Tables 17 to 21, inclusive, show the distribution of livestock on the farms studied. The largest farms were the best stocked. There is no definite relationship, however, between size of unit and number of livestock, except in the case of beef cattle. The medium-sized farms appear to be better stocked than the others, indicating

¹⁵Practically no peas were grown in 1936 since it was found that losses in some years, due to high winds, made the crop uneconomical.

that the largest farms specialized in wheat.¹⁰ About 10 per cent of the farms had sheep and about 60 per cent had beef cattle. The number of farms having beef cattle decreased considerably in 1935. The number of farms having sheep decreased sharply in 1933 but has remained constant since that time.

Approximately 90 per cent of all farms had dairy cattle. The average number was about the same for all sizes of farms in the years studied, but shows some increase since 1930 on nearly all farms, probably because of the relatively better returns than from beef cattle. Dairying is not developed as a specialized industry to any extent, hence shifts from dairying to beef production are readily made.

Most of the farms studied had horses, according to table 20. The average number per farm has decreased some in recent years. Generally the smallest farms have the fewest horses per farm, but there is no definite relationship between the number of horses and the acreage on farms of 120 acres and over.

Summarizing the discussion on crop and livestock combinations, it may be concluded that few if any significant changes have taken place in recent years except for the introduction of peas on a major scale in 1934. The most important crop enterprise is wheat, which generally has been grown on summer fallow. Feed grains occupy only a relatively small proportion of the available crop land, which is true also of alfalfa. The livestock intensity is low for irrigated land, probably because of the emphasis on grain farming. Wheat, alfalfa, and summer fallow are representative uses of crop land on most sizes of farms, with feed grains, sugar beets, and other minor crops furnishing variations. The typical farm has some livestock, including horses, some chickens, and one or more hogs. A majority of the farms studied had tractors.

TABLE 17.—DISTRIBUTION OF BEEF CATTLE BY SIZE OF FARM,
VALIER PROJECT

| Acres in farms | 1935 | | 1934 | | 1933 | | 1932 | | 1930 | | 1926 | |
|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm |
| 1-40 | 5 | 12 | 11 | 14 | 8 | 18 | 3 | 35 | — | — | — | — |
| 41-80 | 14 | 20 | 15 | 25 | 11 | 27 | 7 | 27 | 1 | 35 | 2 | 9 |
| 81-120 | 13 | 17 | 12 | 24 | 13 | 44 | 7 | 35 | 0 | 0 | 5 | 5 |
| 121-160 | 19 | 17 | 23 | 18 | 23 | 37 | 17 | 19 | 7 | 9 | 13 | 7 |
| 161-200 | 21 | 24 | 14 | 30 | 15 | 50 | 16 | 30 | 5 | 7 | 7 | 17 |
| 201-240 | 15 | 38 | 17 | 34 | 6 | 38 | 10 | 39 | 6 | 13 | 12 | 12 |
| 241-280 | 13 | 34 | 22 | 42 | 15 | 39 | 25 | 32 | 5 | 12 | 5 | 14 |
| 281-320 | 13 | 30 | 8 | 18 | 9 | 31 | 10 | 35 | 4 | 6 | 6 | 23 |
| Over 320 | 32 | 56 | 36 | 52 | 32 | 43 | 23 | 44 | 16 | 26 | 23 | 30 |

¹⁰About 10 per cent of the farms specialized in wheat.

VALIER IRRIGATION PROJECT

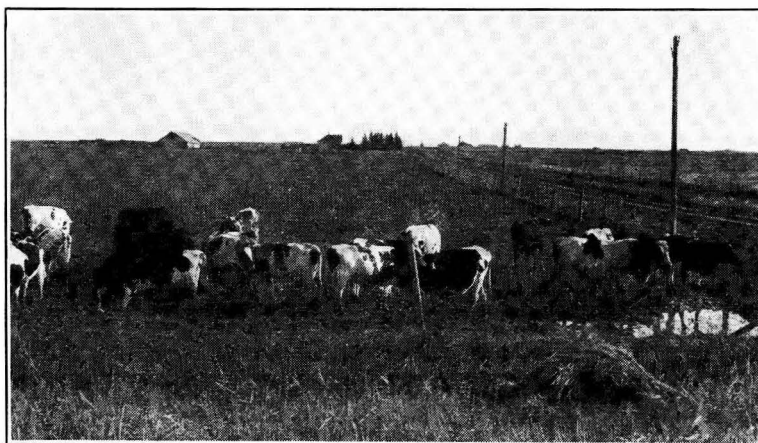
31

**TABLE 18.—DISTRIBUTION OF DAIRY CATTLE BY SIZE OF FARM,
VALIER PROJECT**

| Acres in farms | 1935 | | 1934 | | 1933 | | 1932 | | 1930 | | 1926 | |
|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm |
| 1-40 | 11 | 5.7 | 15 | 7.8 | 11 | 8.3 | 13 | 7.5 | — | — | — | — |
| 41-80 | 25 | 9.8 | 24 | 13.5 | 35 | 14.2 | 25 | 11.7 | 4 | 6 | 9 | 6.0 |
| 81-120 | 26 | 9.6 | 25 | 15.5 | 27 | 12.0 | 21 | 12.6 | 1 | 7 | 11 | 6.0 |
| 121-160 | 37 | 10.3 | 34 | 9.1 | 39 | 12.4 | 41 | 12.6 | 13 | 10 | 30 | 5.0 |
| 161-200 | 29 | 10.6 | 21 | 11.1 | 25 | 13.3 | 33 | 11.8 | 6 | 6 | 11 | 6.0 |
| 201-240 | 22 | 10.3 | 26 | 11.9 | 14 | 14.0 | 16 | 14.0 | 9 | 8 | 19 | 5.0 |
| 241-280 | 17 | 11.5 | 24 | 13.2 | 23 | 14.0 | 32 | 14.5 | 5 | 9 | 10 | 5.0 |
| 281-320 | 15 | 13.8 | 16 | 14.3 | 15 | 14.6 | 18 | 13.4 | 5 | 5 | 19 | 7.0 |
| Over 320 | 45 | 11.1 | 40 | 11.4 | 39 | 16.8 | 37 | 14.5 | 25 | 7.8 | 35 | 7.6 |

TABLE 19.—DISTRIBUTION OF SHEEP BY SIZE OF FARM, VALIER PROJECT

| Acres in farms | 1935 | | 1934 | | 1933 | | 1932 | | 1930 | | 1926 | |
|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm |
| 1-40 | 3 | 27 | 1 | 500 | — | — | 2 | 1.5 | — | — | — | — |
| 41-80 | 1 | 5 | 3 | 194 | 5 | 300 | 3 | 183 | — | — | 2 | 95 |
| 81-120 | 4 | 790 | 5 | 203 | 4 | 545 | 5 | 219 | — | — | 1 | 100 |
| 121-160 | 6 | 186 | 3 | 348 | 6 | 314 | 2 | 550 | 2 | 700 | 0 | — |
| 161-200 | 2 | 415 | 3 | 137 | 0 | — | 3 | 126 | 2 | 265 | 1 | 234 |
| 201-240 | 1 | 100 | 1 | 500 | 1 | 1 | 3 | 16 | 1 | 127 | 7 | 295 |
| 241-280 | 2 | 67 | 3 | 254 | 3 | 398 | 1 | 15 | 1 | 25 | 2 | 85 |
| 281-320 | 2 | 23 | 3 | 273 | 2 | 100 | 20 | 25 | 1 | 30 | 3 | 228 |
| Over 320 | 5 | 120 | 5 | 207 | 6 | 637 | 7 | 368 | 4 | 473 | 6 | 298 |



Good dairy cows make a market for feed crops and produce a steady income. Dairy products can stand a longer haul than most agricultural commodities

TABLE 20.—DISTRIBUTION OF HORSES BY SIZE OF FARM, VALIER PROJECT

| Acres in farms | 1935 | | 1934 | | 1933 | | 1932 | | 1930 | | 1926 | |
|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm |
| 1-40 | 11 | 3.1 | 18 | 2.8 | 10 | 4.6 | 10 | 3.8 | — | — | — | — |
| 41-80 | 26 | 3.8 | 24 | 4.3 | 37 | 4.8 | 24 | 4.4 | 4 | 5 | 10 | 7 |
| 81-120 | 23 | 5.3 | 27 | 5.0 | 26 | 5.8 | 24 | 5.0 | 1 | 4 | 11 | 8 |
| 121-160 | 47 | 4.4 | 37 | 4.3 | 38 | 5.4 | 39 | 5.7 | 13 | 5 | 36 | 8 |
| 161-200 | 27 | 5.4 | 22 | 5.2 | 25 | 5.9 | 34 | 6.4 | 6 | 6 | 11 | 8 |
| 201-240 | 21 | 4.7 | 24 | 5.0 | 13 | 4.8 | 17 | 4.5 | 9 | 6 | 19 | 8 |
| 241-280 | 17 | 4.8 | 23 | 5.8 | 23 | 6.1 | 30 | 6.0 | 6 | 6 | 10 | 9 |
| 281-320 | 15 | 5.7 | 16 | 5.4 | 15 | 6.2 | 18 | 6.3 | 5 | 6 | 18 | 11 |
| Over 320 | 48 | 6.5 | 41 | 6.9 | 40 | 6.9 | 37 | 8.3 | 26 | 7 | 36 | 12 |

TABLE 21.—DISTRIBUTION OF HOGS BY SIZE OF FARM, VALIER PROJECT

| Acres in farms | 1935 | | 1934 | | 1933 | | 1932 | | 1930 | | 1926 | |
|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm | No. of farms | Av. per farm |
| 1-40 | 5 | 5.2 | 7 | 4.6 | 7 | 9.4 | 8 | 7.1 | — | — | — | — |
| 41-80 | 12 | 9.2 | 14 | 9.4 | 24 | 13.3 | 21 | 10.2 | 3 | 9 | 4 | 4.0 |
| 81-120 | 16 | 6.1 | 13 | 4.8 | 18 | 16.7 | 14 | 12.7 | 1 | 10 | 7 | 9.0 |
| 121-160 | 28 | 8.0 | 24 | 13.2 | 32 | 15.1 | 35 | 10.6 | 10 | 15 | 17 | 6.0 |
| 161-200 | 19 | 5.9 | 12 | 7.2 | 22 | 14.0 | 22 | 17.2 | 4 | 23 | 6 | 7.0 |
| 201-240 | 17 | 9.2 | 19 | 10.5 | 12 | 18.3 | 14 | 15.6 | 7 | 12 | 5 | 11.0 |
| 241-280 | 15 | 7.4 | 15 | 12.7 | 16 | 24.0 | 29 | 25.4 | 5 | 16 | 5 | 6.0 |
| 281-320 | 14 | 12.6 | 9 | 6.9 | 13 | 10.2 | 16 | 12.3 | 1 | 4 | 11 | 17.0 |
| Over 320 | 38 | 6.9 | 33 | 16.2 | 35 | 19.8 | 33 | 18.1 | 16 | 37 | 19 | 13.5 |



Sugar beets bring a high return under average conditions and have a definite place in farm organization wherever the soil is adapted

SUMMARY OF AGRICULTURAL DEVELOPMENT ON THE VALIER PROJECT

In analyzing the agricultural development—and lack of development—on the Valier project, many factors must be taken into consideration. The project was developed during a period of agricultural expansion and no doubt was somewhat overcapitalized. The period from about 1905 to 1920 was characterized by an overemphasis on land scarcity. The public domain was being homesteaded rapidly, farm prices were rising as were land values, causing some speculative activity in farm real estate. One result was that many people without farming experience or desire to farm obtained land for speculative purposes. With high prices for farm products and high loan values for land, some success could be attained even from indifferent agricultural practices.

With the fall in farm prices after the World War, the unsoundness of the organization of many farms became evident. Moreover, many farmers tried but failed to keep up with the rapid advances which were being made in the technique of agriculture. When prices were high, almost any system of farming enabled the owner to meet his payments. With low prices, however, those who failed to adjust their farming system and practices were gradually forced out.

The immediate causes of failure of many farmers on the Valier, as well as on some other northern irrigation projects are:

Reliance Entirely on Wheat for Cash Income.—Consistent wheat growing apparently encourages summer fallow every other year to cope with the weed problem. A crop every other year rarely will pay out on expensive irrigated land. In addition, this system of farming invites soil blowing and depletion of fertility. Some wind erosion already is evident in most parts of the Valier project.¹⁷

Failure to Use Available Irrigation Water.—As pointed out earlier, many farmers have failed to irrigate at all and very few irrigate more than once a season. With a low and not entirely consistent rainfall during the growing season, good yields are based upon sound irrigation practices. Moreover, the water is being charged for in any case and hence should be used to best advantage.

Farming Too Much Land.—The average farmer can manage profitably only a relatively small acreage of irrigated land when intensive cultivation is practiced. Since maximum returns must be obtained from each acre, it is necessary that careful practices be followed with respect to each farm operation and to irrigation.

When extensive wheat farming is resorted to, the crop is usually only partially irrigated, which ordinarily means poor

¹⁷Some erosion also has occurred because of crops being "irrigated up" in the spring. Irrigating in loose soil when the crop has not become a stabilizing factor encourages sheet erosion.



Timely operations and irrigation mean good yields

yields. Moreover, with low prices even good yields of wheat rarely are profitable on irrigated land. The average farmer can make a good income on a relatively small irrigated farm if careful attention is paid to crop rotation and irrigation practices and to livestock management. With the maximum number of animal units per acre, the average family cannot care for a large acreage without hired help the year around.

Lack of Planning.—Too often it is found that no definite plans are made for the season's operations. Success on irrigated land comes through careful planning of rotations and use of available man and machine power. The successful irrigation farmer is busy the year around and plans his crop and livestock enterprises so as to get optimum use out of available resources. Expenditures for capital and labor must be the least possible per dollar of returns obtained. Moreover, each available acre must be made to produce. If only 75 per cent of the acreage subject to charges for irrigation is used, each acre must pay the charges for an additional one-third acre.

Too often there is failure to profit by past experiences. Years which produced a fair crop without irrigation often are remembered and years of drought and poor crops are forgotten. While a previous year may have produced a crop without irrigation, it is not necessarily true that another year will do likewise. Plans for irrigating all crops should be made at the beginning of the season.

Lack of Experience.—Irrigation farming is fundamentally different from dry land farming. While good dry land farmers can make a success on irrigated land, it is probable that the farmer with an irrigation background will do better since he is in a position to get maximum results from the beginning. Without such a background, it is necessary to develop the proper attitude toward irrigation. The successful irrigation farmer prepares the land for irrigation both before and after the crops are seeded.

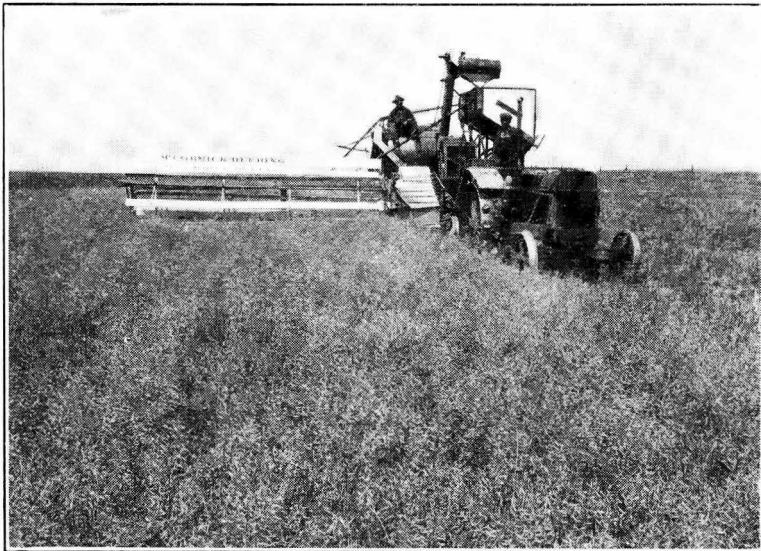
Many of the settlers on Montana irrigation projects had inadequate experience. With the high acre costs typical of irrigation, a farmer is often bankrupt before he has mastered the technique. The unsettled condition on some northern irrigation projects is at least partly a result of the failure to recognize that financial backing is not the main and only prerequisite to success on irrigated land; the settler must have the proper background, or the foresight, to adopt crop and livestock practices that are known to be remunerative.

Table 22 shows the average gross value of crops per acre on the Valier project since 1917. It is obvious that a gross income of \$15 per acre or less cannot pay all operating expenses on the average irrigated land. Better practices are needed to place farming on a sounder basis.

TABLE 22.—AVERAGE GROSS VALUE OF CROPS PER ACRE, VALIER PROJECT, 1917-1935*

| Year | Average value of crops per acre | Year | Average value of crops per acre |
|-----------|------------------------------------|-----------|------------------------------------|
| 1935..... | \$13.04 | 1925..... | \$15.97 |
| 1934..... | 16.67 | 1924..... | 14.06 |
| 1933..... | 10.47 | 1923..... | 9.72 |
| 1932..... | 7.53 | 1922..... | 12.81 |
| 1931..... | 11.11 | 1921..... | 9.75 |
| 1930..... | 15.05 | 1920..... | 19.32 |
| 1929..... | 11.14 | 1919..... | 28.68 |
| 1928..... | 14.52 | 1918..... | 25.19 |
| 1927..... | 12.53 | 1917..... | 20.06 |
| 1926..... | 14.27 | | |

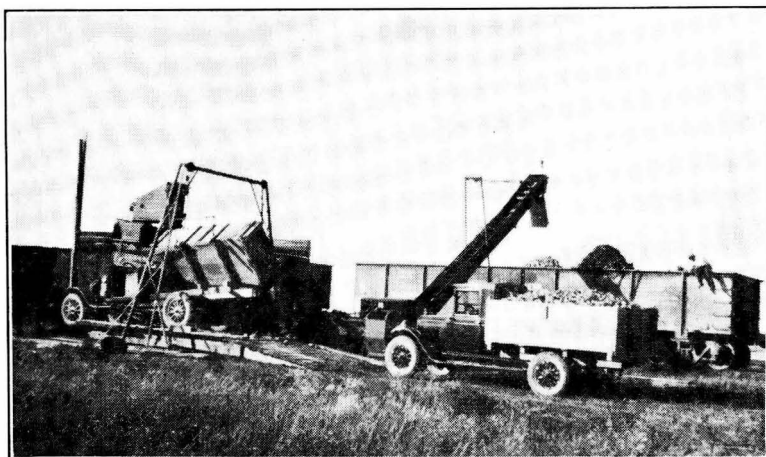
*Includes only the acreage actually cropped. If the gross income were divided by the total acreage, the figures would be much smaller.



Some mustard has been grown on the Valier project

IV. BASIS FOR RECOMMENDED AGRICULTURE ON THE VALIER PROJECT

Soil and Climatic Conditions.—These factors definitely limit the crops which may be produced successfully in a given area. While sugar beets form one of the best foundation crops for irrigated land, it is probable that both soil and climatic conditions at present prevent successful beet production on part of the Valier project. Sugar beets are being produced near Conrad, Williams, and Manson, where the soil is fairly loose and hence warms up quite early in the spring. Some of the other light soils on the project are lacking in organic matter and will not at present produce good yields of sugar beets. However, this deficiency can be remedied by manuring.



Loading sugar beets, which are harvested and marketed after the summer's rush is over. The beet sugar factory at Chinook has paid the freight on beets shipped from the Valier project

On the heavier soils, alfalfa and sweet clover at present must form the foundation crops. With feed crops as the main enterprise, livestock is the best means of maintaining soil fertility. Barnyard manure also adds humus to the soil, which is not supplied by other fertilizers.

Competition with Other Areas.—It is not enough to know that large yields of a crop can be produced on the Valier project, but it is essential to know whether that crop can compete successfully with those produced elsewhere. If freight rates take the major portion of the selling price, even high yields will not suffice. Net income to the farm is the significant figure to aim for in planning operations.

Labor and Power Utilization.—The farmer is interested in a large net income from the farm as a whole. Since net income is the difference between gross income and expenses, the problem is not only to produce high yields but to do so at the lowest possible cost. The best way to keep costs low is to plan operations in such a way that maximum use can be made of available time and equipment. An investment in a machine means an annual cost for depreciation, interest, and obsolescence. The latter two items depend not upon use but upon time. It is better to plan operations so as to keep labor and equipment busy throughout the year than to have short periods of rush work when either more labor must be hired or part of the work must be left undone.



Beets not only produce high yields per acre when properly cultivated but also control weeds and improve soil tilth

Self-Sufficient versus Commercial Farming.—In developing the resources of an irrigation project, one plan would be to work out such farm units as would enable a large number of operators to eke out a bare existence on the land and be self-sufficing in so far as possible. An alternative is to look upon the farm as a commercial enterprise which is to be made into a money-making plant. The present tendency is toward the latter view, which means that the welfare of the individual farmer and not the total number of farmers is to form the criterion for the success of an

irrigation project. This, in turn, means that the number and size of units on the project must be adjusted in accordance with the type of farming possible, and that the most economical combination of land, labor, and capital, must be developed.

Rotations.—Rotation is very important in irrigated agriculture. A recent bulletin states: "Crop rotation is so important a farm practice, especially in maintaining and increasing the yields of cereal crops, that its effectiveness may often equal or even exceed the effectiveness of the use of complete chemical fertilizer or farm manure."¹⁸

Generally a rotation on an irrigated farm should provide for a cash crop, a legume, and a feed crop. It should provide for definite acreages each year and should be followed in order to build up a balanced farm and in order to eliminate speculation in so far as possible.

Much of the soil on the Valier project is heavy and in many cases now quite weedy. The first aim of a rotation, therefore, must be to prepare the soil so as to fit it for a greater variety of crops and permit better yields. When the soil is well prepared, a greater elasticity in rotations is possible.

Soil Conservation.—Every farm must adopt a cropping program which will maintain fertility and prevent erosion if yields are to be kept up. Large open fields without cover are subject to wind erosion. Continuous use of soil-depleting crops lowers soil fertility and yields. Every irrigated area generally should have a certain proportion of its tillable area in cover crops. The exact proportion of soil-conserving crops necessary will depend upon type and condition of soil, type of farming, and so on.

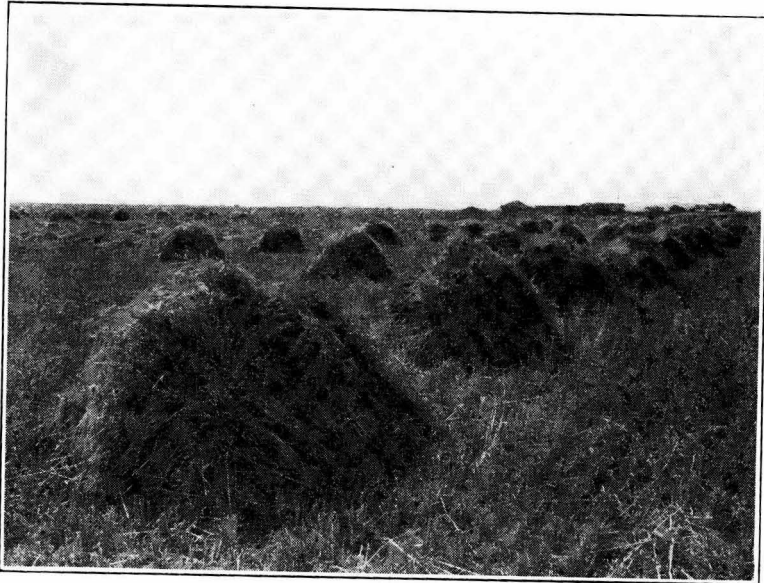
Irrigation.—In preparing land for irrigation, it is necessary to eliminate dead furrows, back furrows, and minor irregularities on the surface. This must be done before the crops are seeded. As soon as the crop is seeded, the irrigation ditches should be made so that the banks will have time to settle and become water tight. Care should be taken to place the ditches where it will take the least amount of labor to spread the water over the field. The ditches should be run on a grade of about two-tenths foot per hundred feet. All supply laterals should be cleaned out and enlarged in winter or early spring.

The irrigation method primarily used on the Valier project is the "wild flooding" method, with grade contour ditches. The "border diking" system is recommended for all land which is smooth enough. This system consists of dikes about 6 to 8 inches high and about 30 feet apart, run down the steepest slope. This is the simplest and most efficient method where it can be used.

¹⁸Weir, Wilbert W., A Study of the Value of Crop Rotation in Relation to Soil Productivity. U. S. Dept. of Agr. Dept. Bul. 1377, p. 67.

V. BUDGETING METHOD OF PLANNING FARM OPERATIONS

A single type of farming generally cannot be recommended for a given irrigated area. There are usually opportunities for success along many different lines. The resources, such as soil, equipment, available labor, and so on, must be the basis upon which planned farming operations proceed. Each farmer should evaluate his own facilities and plan his enterprises so as to obtain the maximum net income.



Barley yields well on the Valier project

In order to illustrate a method of analyzing a farm business on the Valier project, a few type setups have been worked out. While these organizations are based upon project records and, hence, could serve as a model, the primary purpose is to demonstrate a means of planning operations. The rates and production requirements used are *averages*, and may not apply to any particular situation. A farmer who is interested in analyzing and budgeting his operations can determine the rates of production and feeding which apply to *his* farm. Knowing the land, capital, and labor he has to work with, he can readily determine the best combination of crop and livestock enterprises for that particular farm. While many conditions and factors in agriculture are un-

certain and not subject to control, a budget of enterprises and operations will be valuable as a standard and as a means of analysis. The following pages give the essentials of the budgeting method.

FEED REQUIREMENTS¹⁹

Methods of livestock production will depend upon whether livestock is a major or a supplementary enterprise. Moreover, the amount of feed required for maintenance or for fattening will depend somewhat upon size and class of livestock, upon climatic factors, which influence the kind of crops and pastures feasible, and upon the relative prices of feeds and the salable products. Feeding rates need to be adjusted, therefore, to particular conditions on each farm.

The figures used here, however, are based upon actual field demonstrations and feeding experiments and may be taken as indicative of the best known feeding practices under average conditions of livestock production in Montana.

Barley and oats have been used in all the calculations because they are the feed grains with which farmers are most familiar. Other grains may be better, however, depending upon the type of livestock, relative yields, feeding experience of the farmer, and so on. A high-yielding variety of wheat, for example, may be a more economical feed.

Table 23 shows the yield and production data assumed in the budget analyses.

TABLE 23.—YIELDS AND PRODUCTION DATA FOR CROPS AND LIVESTOCK, VALIER PROJECT

| Enterprise | Production |
|-----------------|-----------------------------|
| Alfalfa | 2 tons per acre |
| Barley | 30 bushels per acre |
| Oats | 35 bushels per acre |
| Wheat | 20 bushels per acre |
| Pasture | 1-2 animal units per acre |
| Milk cows | 250 lbs. butterfat per year |
| Sows | 5 pigs per year |

The death losses and depreciation on livestock are figured as follows: Horses, 8 per cent; bulls, 25 per cent; sows and boars, 33 1/3 per cent. Where young stock is grown for replacement, only this cost and no depreciation is charged.

Table 24 shows the feed and acreage requirements for various classes of livestock, with the crop yield assumed in table 23.

Table 25 shows the price data used in the budget analyses.

¹⁹The data on livestock feeding, production, and requirements have been furnished by the Animal Husbandry Department of the Montana Agricultural Experiment Station. The feed requirements used here for the various classes of livestock are averages only.

TABLE 24.—FEED AND ACREAGE REQUIREMENTS FOR VARIOUS CLASSES OF LIVESTOCK, VALIER BUDGETS

| Animal | Pasture | Alfalfa | Alfalfa | Barley | Barley | Total |
|--------------------------|---------|---------|---------|---------|--------|-------|
| | Acres | Tons | Acres | Bushels | Acres | Acres |
| 1 dairy cow..... | 0.50 | 3.50 | 1.75 | 25.00 | 0.84 | 3.09 |
| 1 two-yr. old heifer.... | .50 | 2.00 | 1.00 | 5.00 | .17 | 1.67 |
| 1 yearling heifer..... | .35 | 1.50 | .75 | 5.00 | .17 | 1.27 |
| 1 dairy calf..... | .13 | .75 | .38 | 7.00 | .24 | .75 |
| 1 bull..... | .50 | 4.00 | 2.00 | — | — | 2.50 |
| 1 horse..... | .50 | 3.00 | 1.50 | 20.00 | .67 | 2.67 |
| 1 sow and 5 pigs..... | .50 | .50 | .25 | 100.00 | 3.33 | 4.08 |
| 1 boar..... | .20 | .25 | .12 | 20.00 | .67 | .99 |
| 100 ewes..... | 20.00 | 32.00 | 16.00 | 30.00 | 1.00 | 37.00 |
| 1 ram..... | .13 | .40 | .20 | 4.00 | .14 | .47 |
| 100 lambs, fattening ... | — | 10.00 | 5.00 | 208.00 | 6.95 | 11.95 |

TABLE 25.—PRICES FOR PRODUCTS SOLD*

| Product | Price |
|-------------------------|---------------------|
| Wheat..... | \$0.80 per bushel |
| Peas..... | 1.90 per bushel |
| Potatoes..... | .80 per bushel, net |
| Sugar beets..... | 6.00 per ton |
| Pork (200 lb. hog)..... | .07 per pound, net |
| Butterfat..... | .30 per pound |
| Lambs (90 lbs)..... | .07 per pound, net |
| Wool..... | .25 per pound |
| Eggs..... | .25 per dozen |

*Actual average farm prices for Montana, as reported by the Division of Crop and Livestock Estimates of the U. S. Dept. of Agr., Helena, are shown in the following table:

| Product | Period covered | Average price including 1917-1920 | Average price excluding 1917-1920 |
|--------------------------|----------------|-----------------------------------|-----------------------------------|
| Wheat..... | 1908-1935 | \$1.07 per bushel | \$0.92 per bushel |
| Potatoes..... | 1908-1932 | 1.02 per bushel | .95 per bushel |
| Pork (200 lb. hogs)..... | 1910-1935 | .09 per pound | .08 per pound |
| Butterfat..... | 1921-1935 | .34 per pound | .33 per pound |
| Lambs (90 lbs.)..... | 1911-1935 | .08 per pound | .08 per pound |
| Wool..... | 1911-1935 | .30 per pound | .26 per pound |
| Eggs..... | 1908-1935 | .31 per dozen | .28 per dozen |

FARM BUDGETS

The following budgets will illustrate one method of analyzing returns from various farm organizations. The cropping plans are based upon one major cash crop and one major livestock enterprise.

No attempt has been made to show every item of income and expense in detail, since emphasis is placed upon method rather than accuracy. For example, no income has been figured from poultry, although in actual practice considerable cash income for family living generally is derived from this source.

BUDGET NO. 1.—80 ACRES, 76 ACRES IRRIGABLE AND CROPPED

Table A. Livestock Inventory and Feed Requirements

| Livestock | Pasture | Alfalfa | Oats | Barley |
|-----------------------------|---------|---------|---------|---------|
| | Acres | Tons | Bushels | Bushels |
| 4 horses | 2.00 | 12.0 | 90 | — |
| 8 dairy cows | 4.00 | 26.0 | — | 200 |
| 2 two yr. old heifers | 1.00 | 4.0 | — | 10 |
| 2 yearling heifers | 0.70 | 3.0 | 10 | — |
| 4 calves | 0.52 | 3.0 | 28 | — |
| 1 bull | 0.50 | 4.0 | — | — |
| 3 sows, 15 pigs | 1.50 | 1.5 | 60 | 240 |
| Total | 10.22 | 53.5 | 188 | 450 |
| Acres required | 10.0 | 26.0 | 5 | 15 |

Table B. Cropping Program, Yields, and Costs

| Crop | Acres | Average yield | Total yield | Amt. for feed & seed | Amt. sold | Seed costs | Thresh- | | Haul- |
|-------------------|-------|---------------|-------------|----------------------|-----------|------------|-----------|-----------|-------|
| | | | | | | | ing costs | ing costs | |
| Alfalfa | 26.0 | 2 tons | 56 tons | All | — | \$16.25 | — | — | — |
| Barley | 17.0 | 30 bu. | 510 bu. | All | — | 17.00 | \$5.10 | \$25.50 | — |
| Oats | 3.5 | 35 bu. | 128 bu. | All | — | 2.10 | 1.05 | 5.12 | — |
| Sugar beets | 15.0 | 12 tons | 180 tons | — | 180 tons | 56.00 | — | — | \$135 |
| Pasture | 10.0 | — | — | — | — | 10.00 | — | — | — |
| Wheat | 5.0 | 20 bu. | 100 bu. | — | 100 bu. | 10.00 | 1.75 | 6.00 | 5 |
| Total | 76.5 | — | — | — | — | \$111.35 | \$7.90 | \$36.62 | \$140 |

Table C Farm Income^a

| | |
|---|--------|
| 180 tons sugar beets, @ \$6 per ton | \$1080 |
| 100 bu. wheat, @ 90c per bu. | 90 |
| 7 cows, 250 lbs. butterfat each, @ 30c per lb. | 525 |
| 4 veal calves, @ \$7 each | 28 |
| 2 cows, @ \$40 each | 80 |
| 13 hogs, 200 lbs. each, @ 7c per lb. | 182 |
| Total income | \$1985 |

^aThe products from one dairy cow, garden, two hogs, and one calf are assumed to be used for family living.

Table D. Farm Expenses

| | |
|---|-----------|
| Direct crop expense | \$ 295.87 |
| Labor | 350.00 |
| Livestock depreciation and expense | 53.00 |
| Taxes | 71.50 |
| Operation and maintenance charges | 80.00 |
| Insurance | 15.00 |
| Automobile, 3000 miles at 5c per mile | 150.00 |
| Building repairs and depreciation | 70.00 |
| Fence repairs and depreciation | 15.00 |
| Machinery repairs and depreciation | 232.00 |
| Miscellaneous | 8.00 |
| Total expense | \$1340.37 |

Budget No. 1 shows the following results: total income, \$1,985; total expense, \$1,340.97; the net income available for cash family living expenses, payment on land, interest, etc., is \$644.63.

BUDGET NO. 2.—160 ACRES, 145 ACRES IRRIGABLE AND CROPPED

Table A. Livestock Inventory and Feed Requirements

| Livestock | Pasture | Alfalfa | Oats | Barley |
|---------------------------|---------|---------|---------|---------|
| | Acres | Tons | Bushels | Bushels |
| 6 horses | 3.00 | 18.0 | 120.0 | — |
| 4 dairy cows | 2.00 | 14.0 | — | 100.0 |
| 1 two yr. old heifer..... | 0.50 | 2.0 | — | 5.0 |
| 1 yearling heifer | 0.35 | 1.5 | 5.0 | — |
| 2 calves | 0.26 | 1.5 | — | 14.0 |
| 1 sow and 5 pigs | 0.50 | 0.5 | — | 100.0 |
| 100 ewes | 20.00 | 32.0 | 30.0 | — |
| 25 ewe lambs | 5.00 | 8.0 | — | 7.5 |
| 25 yearling ewes | 5.00 | 8.0 | 7.5 | — |
| 75 feeder lambs* | — | 7.0 | — | 146.0 |
| 2 rams | 0.26 | 0.8 | 8.0 | — |
| Total | 36.87 | 93.3 | 162.5 | 372.5 |
| Acres required | 37.00 | 47.0 | 5.0 | 12.0 |

*5 per cent death loss is figured on lambs

Table B. Cropping Program, Yields, and Costs

| Crop | Acres | Average yield | Total yield | Amt. for feed & seed | Amt. sold | Seed costs | Thresh- | | Haul- |
|---------------|-------|---------------|-------------|----------------------|-----------|------------|-----------|-----------|-------|
| | | | | | | | ing costs | ing costs | |
| Alfalfa | 47 | 2 tons | 94 tons | All | — | \$30 | — | — | — |
| Barley | 12 | 30 bu. | 390 bu. | All | — | — | \$3.90 | \$19.50 | — |
| Oats | 5 | 35 bu. | 163 bu. | All | — | — | 1.35 | 6.52 | — |
| Pasture | 37 | — | — | — | — | 35 | — | — | — |
| Wheat | 44 | 20 bu. | 880 bu. | 60 bu. | 820 bu. | — | 11.00 | 52.80 | \$41 |
| Total | 145 | — | — | — | — | \$65 | \$16.25 | \$78.82 | \$41 |

Table C Farm Income^a

| | |
|--|-----------|
| 820 bu. wheat, @ 90c per bu. | \$ 738.00 |
| 3 dairy cows, 250 lbs. butterfat @ 30c per lb. | 225.00 |
| 2 veal calves, @ \$7 each | 14.00 |
| 5 hogs, 200 lbs. each, @ 7c per lb. | 70.00 |
| 15 old ewes, @ \$2 each | 30.00 |
| 95 ewes, shear 10 lbs. wool each, @ 25c per lb. | 237.50 |
| 70 lambs, weight 90 lbs., @ 7c per lb. | 441.00 |
| Total income | \$1755.50 |

^aThe products from 1 dairy cow, garden, 2 hogs, and 1 calf, are set aside for family living.

Table D. Farm Expenses

| | |
|---|-----------|
| Direct crop expense | \$ 201.07 |
| Labor | 175.00 |
| Livestock depreciation and expense | 60.50 |
| Taxes | 133.32 |
| Operation and maintenance charges | 150.00 |
| Insurance | 25.00 |
| Automobile, 3000 miles at 5c per mile | 150.00 |
| Building repairs and depreciation | 90.00 |
| Fence repairs and depreciation | 30.00 |
| Machinery repairs and depreciation | 190.00 |
| Total expense | \$1204.89 |

Budget No. 2 shows the following results: total income, \$1,755.50; total expenses, \$1,204.89; the net income available for cash family living expenses, payment on land, interest, etc., is \$550.61.

BUDGET NO. 3.—160 ACRES, 145 ACRES IRRIGABLE AND CROPPED

Table A. Livestock Inventory and Feed Requirements

| Livestock | Pasture | Alfalfa | Oats | Barley |
|----------------------------|---------|---------|---------|---------|
| | Acres | Tons | Bushels | Bushels |
| 5 horses | 2.50 | 15 | 100 | — |
| 8 dairy cows | 4.00 | 28 | — | 200 |
| 2 two yr. old heifers..... | 1.00 | 4 | — | 10 |
| 3 yearling heifers | .70 | 3 | 10 | — |
| 4 calves | .52 | 3 | 28 | — |
| 1 bull | .50 | 4 | — | — |
| 2 sows, 10 pigs | 1.00 | 1 | — | 200 |
| Total | 10.22 | 58 | 138 | 410 |
| Acres required | 10.00 | 30 | 4 | 15 |

Table B. Cropping Program, Yields, and Costs

| Crop | Acres | Average yield | Total yield | Amt. for feed & seed | Amt. sold | Seed costs | Thresh- | | Haul- |
|---------------|-------|---------------|-------------|----------------------|-----------|------------|-----------|-----------|-----------|
| | | | | | | | ing costs | ing costs | ing costs |
| Alfalfa | 30 | 2 tons | 60 tons | All | — | \$18.75 | — | — | — |
| Barley | 15 | 30 bu. | 450 bu. | All | — | — | \$5.25 | \$22.50 | — |
| Oats | 5 | 35 bu. | 175 bu. | All | — | — | 1.75 | 7.00 | — |
| Pasture | 10 | — | — | — | — | 8.00 | — | — | — |
| Wheat | 65 | 20 bu. | 1300 bu. | 100 bu. | 1200 bu. | — | 22.75 | 78.00 | \$60 |
| Peas | 20 | 15 bu. | 300 bu. | 60 bu. | 240 bu. | — | — | 30.00 | 12 |
| Total | 145 | — | — | — | — | \$26.95 | \$29.25 | \$137.50 | \$72 |

Table C. Farm Income^a

| | |
|---|--------|
| 1200 bu. of wheat, @ 90c per bu. | \$1080 |
| 240 bu. of peas, @ \$1.90 per bu | 456 |
| 7 dairy cows, 250 lbs. butterfat, each, @ 30c per lb..... | 525 |
| 4 veal calves, @ \$7 each | 28 |
| 1 old cow, @ \$40 each | 40 |
| 8 hogs, 200 lbs. each, @ 7c per lb..... | 112 |
| Total income | \$2241 |

^aThe products from the garden, 1 cow, 2 hogs, and one calf are assumed to be used by the family.

Table D. Farm Expenses

| | |
|--|-----------|
| Direct crop expense | \$ 266.00 |
| Labor | 175.00 |
| Livestock depreciation and expense | 55.00 |
| Taxes | 146.18 |
| Operation and maintenance charges | 150.00 |
| Insurance | 25.00 |
| Automobile, 3000 miles at 5c per mile..... | 150.00 |
| Building repairs and depreciation | 90.00 |
| Fence repairs and depreciation | 30.00 |
| Machinery repairs and depreciation | 160.00 |
| Total expense | \$1247.18 |

Budget No. 3 shows the following results: total income, \$2,241; total expenses, \$1,247.18; the net income available for cash family living expenses, payment on land, interest, etc., is \$993.82.

The net return from Budget No. 2 is less than from Budget No. 1 by about \$95. The principal reason is that the latter budget is based upon a more intensive type of farming. With wheat yields as low as 20 bushels per acre it is difficult to set up any profitable farm organization based upon this crop as the main enterprise. If, however, wheat yields averaged even 5 bushels more per acre, the gross returns according to Budget No. 2, would be increased by \$198 and the net returns by nearly the same amount. If wheat yields on an irrigated farm which cannot grow sugar beets are not increased beyond 20 bushels per acre, it is doubtful whether all charges can be met.

The same analysis applies also to other crops. If yields are low, more acres are required to feed one unit of livestock, hence costs are higher and net returns lower. If the yield of feed crops is very low, too much of the acreage must be devoted to them and, therefore, too little is available for cash crops.

Budget No. 3 shows better returns than Budget No. 2, primarily because of greater income from cash crops. Also, there are greater returns from dairy cows, under the conditions assumed, than from sheep and ewe lambs.²⁰

Relatively high returns per unit are necessary if a farm flock of sheep is to show any material returns, since expensive land is used for pasture. Availability of outside pasture would change the entire setup and also the net returns.

Any number of such budget analyses might be made in testing the relative adequacy of any particular combination of crops and livestock. In any case, however, it is important to adopt such farming practices as will maintain fertility, prevent soil erosion, and show maximum yields over a period of time. Some crops, if grown continuously, exhaust soil resources, often leaving the land practically valueless for a long period.

If present practices are viewed from a soil and fertility conserving standpoint, the budget method of analysis outlined above will be of material aid in testing out the costs of necessary and desirable shifts in farm organization.

²⁰Does not assign any value to manure.

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