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The McKenzie and Muddy Creeks Irrigation Projects

A STUDY OF TWO
IRRIGATION PROJECTS IN THE
WILLAMETTE VALLEY

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FOREWORD

THERE is no more live question than that of irrigation development in the Willamette Valley. Interest is directed in part toward individual farm pumping plants but especially toward community ditches that bring water from river to farm by gravity. Fortunately, we have four such gravity projects already in operation. A study has been made of progress on two of these projects. These two are so located that their experience should be valuable to many other projects that might be planned for the future.

This circular reports, therefore, what two groups of farmers are actually doing when they have the opportunity to get irrigation water conveniently and at relatively low cost.

Other studies now under way are expected to give more details as to the physical and economic benefits of irrigation under these and other Willamette Valley conditions. Discussion of economic benefits from irrigation based on data assembled in connection with the present study is being prepared as a separate report.

Below is a list of other publications of the Oregon Experiment Station dealing with various phases of irrigation in western Oregon. Copies of these, or of the present publication, will be sent to residents of the State of Oregon upon request.

Station Circular 124	The Ground-Water Problem in Oregon.
Station Bulletin 277	Preliminary Report on the Effect of Irrigation on Major Berry Crops in the Willamette Valley.
Station Bulletin 302	Twenty-five Years of Supplemental Irrigation Investigations in Willamette Valley.
Station Bulletin 347	Influences of Irrigation Upon Important Small Fruits.
Station Bulletin 366	The Value of Irrigated Pastures for Dairy Cattle.
Station Bulletin 392	Costs and Grazing Values of Willamette Valley and Southern Oregon Farm Pastures.
Station Bulletin 394	Irrigation Requirement of Arable Oregon Soils.

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Dean and Director

SUMMARY

The Muddy Creeks and McKenzie projects are furnishing water for irrigation at a modest cost; even though water is being furnished to small fields scattered through large areas of nonirrigated lands.

More than half of the irrigated lands in the two projects is devoted to Ladino clover for dairy cow pasture.

These Ladino pastures carried an average of almost 2 cows per acre for a grazing period of from six to seven months.

The labor involved in irrigation and ditch work for pasture averaged 7 hours per acre. This does not include fertilization, clipping weeds, or other items of pasture maintenance.

Methods of irrigation are not yet standardized and so vary greatly from farm to farm.

Grain, vetch, and grass seed crops are grown extensively but are rarely irrigated.

The irrigation of clover and alfalfa hay for hay or silage is promising but is still experimental.

Some fruit and nut trees are being irrigated, but the acreage of trees within these two projects is too small for conclusive results.

The soils irrigated by these two projects are mostly unsuited to growing truck crops and are not being used for that purpose.

Truck growing in the vicinity of these projects is almost entirely confined to river bottom soils that are generally unsuited to gravity irrigation but which are easily irrigated by pumping from wells or streams. Truck farmers on these soils have shown little interest in obtaining water from canals or ditches.

Irrigation in the Muddy Creeks and the McKenzie projects is expanding, but this expansion is at present largely limited by the need for summer pastures for dairy cows.

Expansion outside of irrigated pastures depends primarily on whether the irrigation of alfalfa and clover for hay or silage can be made profitable under postwar conditions.

These projects are in good financial condition and have very little debt.

These projects are organized as cooperative associations and have no authority to bond the land of their owners.

The cost of water per acre in these projects is much less than the costs suggested in the "Willamette Valley Project."

In the Muddy Creeks and McKenzie projects the farmer may buy water for as many or as few acres as he may decide while in the proposed Willamette Valley projects he must pay for water rights for all of his land that is judged by the project authorities to be irrigable.

The McKenzie and Muddy Creeks Irrigation Projects*

By

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INTRODUCTION

THIS report deals with two irrigation projects in the Willamette Valley. Though the Willamette Valley is known for its heavy rainfall, there is widespread interest in irrigation and it is proposed that the major portion of the valley be irrigated. In view of these apparent contradictions, it seems wise to preface any consideration of irrigation in the Willamette Valley with an examination into the peculiarities of the climate and the type of agriculture that has been developed in that climate during the one hundred years the valley has been under cultivation.

Climate of the Willamette Valley

The climate of the Willamette Valley as compared with most other parts of the United States is characterized by: (1) mild winter, (2) mild summer, (3) heavy annual rainfall unevenly distributed so as to be excessive in winter, moderate in spring and fall, and deficient in summer. In no other part of the world do we find so dry a summer associated with so wet a winter as we find in this valley and the adjacent parts of western Oregon and Washington. The monthly rainfall and monthly temperatures for Portland, Albany, and Eugene are shown in Table 1.

The growing season is long, about 200 days, and especially long for an area with so mild a summer. The long growing season is more or less cut in two by a dry summer. There are, however, many crops suited to this climate. Fall sown annuals such as barley, oats, wheat,

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peas, and vetch make a good growth in the fall, stay green all winter, grow rapidly in April, May, and June, and so are ready for harvest by dry weather. Many fruits thrive and are apparently all the better for dry weather at harvest.

Willamette Valley irrigation

While the Willamette Valley has developed a highly diversified and very successful agriculture without irrigation, it is but natural to ask what could be done with this long, mild growing season if the

Table 1. RAINFALL, TEMPERATURE, AND LENGTH OF GROWING SEASON AT PORTLAND, ALBANY, AND EUGENE, OREGON

Month	Average precipitation*			Average temperature†		
	Portland	Albany	Eugene	Portland	Albany	Eugene
	Inches	*Inches*	*Inches*	*Degrees F.*	*Degrees F.*	*Degrees F.*
January	6.03	6.13	5.59	39.4	39.6	40.1
February	4.63	5.00	4.77	42.1	42.5	42.8
March	4.04	4.15	3.99	46.9	47.1	46.5
April	2.68	2.54	2.70	51.8	51.7	51.0
May	1.93	2.02	2.26	56.9	57.0	55.7
June	1.46	1.30	1.53	62.4	61.9	60.8
July	.50	.41	.36	66.7	66.9	66.1
August	.64	.54	.46	66.7	66.5	65.9
September	1.85	1.71	1.90	61.7	60.6	60.5
October	2.85	2.94	2.80	54.2	53.2	53.7
November	6.15	6.40	5.76	46.8	45.3	46.1
December	6.68	6.37	5.76	41.2	40.8	41.1
Annual	39.43	39.51	37.88	54.8	52.8	52.5
Length of growing season in days	263	212	205	.....	.....	.....

* Data from *Climate and Man.* Yearbook of Agriculture, 1941, U. S. Department of Agriculture, pp. 1075-1079. Average for 40 years.

† Data from *Climatological Data:* Oregon Section, U. S. Weather Bureau. Annual, 1941. Average for 71, 63, and 52 years respectively.

summer drought could be overcome by irrigation. With irrigation, the Willamette Valley offers agricultural possibilities that are different from those found elsewhere. Since these conditions are unique, it requires much experimentation, both on the experiment stations and on the farms to learn the full extent of these possibilities.

Pioneer irrigation

The pioneers played with the idea of irrigation. The irrigation of lawns and gardens became general wherever water was available. Irrigation of field crops made slower progress. The pioneers tried to irrigate the crops that had demonstrated their ability to thrive in the Willamette Valley without irrigation. While irrigation frequently increased the yields of these crops, it usually failed to produce returns commensurate with the costs. Real success began when irrigation was tried on crops that had not given satisfactory results without irrigation. Ladino clover was a failure without irrigation but with

irrigation was sensational. Garden crops had long been grown without irrigation but with uncertain yield and quality. With irrigation, yields and quality are excellent so that an extensive commercial vegetable canning industry has been made possible.

Present status of irrigation

The larger part of the land so far irrigated is devoted to vegetables for canning or to Ladino clover for dairy pasture. Most of the vegetables for canning are grown on river bottom soils, such as Chehalis or Newberg, and are irrigated. Vegetable canneries generally handle only truck crops grown with irrigation. Ladino clover is grown only with irrigation but unlike cannery vegetables is grown on a wide variety of soils.

The census of 1939 indicates that irrigation at that time was practiced by 5 per cent of the Willamette Valley farmers and that the total irrigated acreage was 27,205 acres. The farms on which irrigation was practiced were by no means completely irrigated. On the contrary, the census for 1939 shows that only 13 per cent of the total land in these farms was actually irrigated. Those who have watched the situation closely since 1939 estimate that the present acreage is nearly double that of 1939. The census that is now being taken should give us a more accurate figure soon.

Systematic studies of irrigation were begun at the Oregon Agricultural Experiment Station in 1907.

Types of irrigation

Irrigation in the Willamette Valley is of two types. First is the "pump and sprinkler" system, in which water is pumped from an adjacent stream or shallow well and distributed over the surface of the field by some form of sprinkler.

The second is the "flood" system in which water is brought to the farm by ditches and distributed by gravity. There are various combinations of these systems but in general the type of irrigation used depends on the topography and the source of water; that is, whether irrigation water can be obtained from wells or adjacent streams, or whether it must be brought from some distant source by canal or ditch.

From the standpoint of irrigability, the lands of the Willamette Valley may be divided into two broad groups: the river bottom soils and the "Old Valley Floor" soils.

The river bottom soils are along the river bottoms and include such soil types as Chehalis and Newberg. These river bottoms have three important characteristics: (1) the topography is usually un-

dulating or wavy so that irrigation by flooding is difficult; (2) adequate water for irrigation may usually, but not always, be obtained by pumping from adjacent streams or shallow wells; (3) the soil is generally loose and friable and especially well adapted to truck crops.

The term "Old Valley Floor" is applied to all of the main valley floor except the river bottoms, which are assumed to be of much more recent geological origin. This Old Valley Floor includes such soil types as Willamette, Amity, Dayton, and related soils. The Old Valley Floor likewise has three important characteristics: (1) the topography is commonly smooth enough for flood irrigation with a little leveling; (2) wells usually do not afford sufficient water for irrigation and the streams are usually at some distance; (3) the soils are adapted to grain, seeds, and legumes, and while they vary greatly in quality, they are not usually adapted to truck crops.

The river bottom soils are therefore especially adapted to irrigation by pump and sprinkler. In this case, each farmer has his own irrigation plant and pumps from a stream or well on or adjacent to his own farm.

The Old Valley Floor soils are adapted to flood irrigation, but flood irrigation in the Willamette Valley presents some significant problems. The major Willamette Valley rivers have relatively deep channels and very little fall so that the water can be diverted into ditches only at certain strategic points, usually where the river comes out of the foothills. Only rarely is it feasible for the farmer to have his own ditch. Any substantial amount of irrigation of this type, therefore, must be done by some form of cooperative or group enterprise.

Potential irrigation

While it is seldom possible for a single farmer to develop his own gravity project, the Willamette Valley does lie in such a manner that most of the valley floor can be covered by a few large projects; that is, by large canals with numerous laterals. The so-called Willamette Valley Project (State Planning Board, 1936) suggests the possibility of irrigating 650,000 acres through the construction of 23 projects or canal systems and 7 large storage reservoirs. Whether it would be profitable to irrigate so large an area at the present time is a crucial question.

The success that has been attained by irrigating cannery vegetables and Ladino clover pasture has aroused much enthusiasm, especially among civic organizations. Since the area suited to pump and sprinkler irrigation is limited, interest centers around the possibility of large public or cooperative canal systems covering the main valley

floor rather than merely the river bottoms. The present study was planned to throw some light on this type of irrigation project by analyzing the progress that has been made by some of the projects already in operation.

There are now four fairly well established irrigation projects, or canal systems, of this type: the Stayton Project west of Stayton, the Lacomb Project around the town of Lacomb, the Muddy Creeks Project in the vicinity of Harrisburg and Coburg, and the McKenzie Project north of Springfield. The McKenzie and the Muddy Creeks projects were selected for study since they are representative of the projects that are suggested as irrigable under the proposed Willamette Valley Project. The primary object of the study was to learn what the farmers in these projects were actually doing, what crops they were irrigating, what crops they were not irrigating, and what proportion of their crop land they were irrigating.

THE McKENZIE PROJECT

The McKenzie project was planned from the engineering standpoint to cover the McKenzie Delta—that is, the land lying between the McKenzie River on the north and the Willamette River, the town of Springfield, and the McKenzie Highway on the south. Water is diverted from the McKenzie River at two points, one near the Hayden Bridge approximately seven airline miles east of the junction of the McKenzie with the Willamette and the other six miles farther east near the Hendricks Bridge. The total area of the McKenzie Delta below these diversion points is 16,000 acres and the original promoters of the project planned to irrigate the entire 16,000 acres.

Water diverted from the McKenzie River at these points may be carried by gravity to all parts of the area. In only a few places would flumes or levees be necessary. The ditches have been so constructed that only a few farms in the entire area are more than a mile from some existing ditch. The existing ditches are not large enough to irrigate the entire area, but they may easily be enlarged to any extent that might seem desirable.

From the standpoint of engineering and construction, the project is simple and inexpensive. This favorable situation is largely due to the natural geographic advantage of the location.

The project was originally planned to carry the water by ditches to the highest point of each farm served so that the farmer could then take the water to all points on his farm by gravity ditch. Recently some use has been made of sloughs and other natural water channels either with or without some cleaning, straightening, or deepening.

Such natural channels usually reach the farm at a low point rather than at a high point. The water user must then pump the water from this channel regardless of whether he wishes to spread the water by flooding or by sprinkler. Since using natural channels is less expensive for the association but more expensive for the water user, these users are charged 60 per cent as much for water rights and for annual operation and maintenance as is charged to water users who receive water at the high point of the farm by gravity.

The water users under this project use the term "water right" to indicate the right to use the facilities of the project to bring water from the river to their farms. This is not the same as the legal "right" to take water from the river for irrigation purposes. Actually the water users must have two "rights": (1) the right to use the facilities of the association, and (2) the legal right to take water from the river for irrigation purposes, which right is acquired by meeting the requirements set forth by the Oregon State Engineer under authority of the Oregon statutes. The possession of facilities and the actual use of water, however, are necessary steps in the acquisition of such legal right, and the association is attending to the necessary legal procedure on behalf of its members. Members of the association, therefore, expect to acquire both "rights" through their membership in the association.

History

The history of the McKenzie Project is long and devious. Some irrigation has been done since about 1911, but progress in actual irrigation was slow. The corporation became financially insolvent and the ditches were neglected. In 1939 the system was taken over by a cooperative organization formed by a group of old users and prospective new users. Since that time old debts have been adjusted, ditches cleaned, and new ones built. Irrigation under this project is now expanding about as fast as wartime conditions of labor and material permit.

The McKenzie Project is organized as a cooperative association that the farmers in the area may join or not join as they see fit. If a farmer does join the association, he buys one share of stock in the association for each acre for which he desires irrigation water. Thereafter he must pay the annual assessments levied by the association on this number of shares. If a member fails to pay his assessments, he will lose his right to obtain water through the facilities of the association, but he will not be subject to any other penalty. There is no bonded indebtedness against the land and the association has no authority to bond the land. On the other hand, the Willamette

Valley Project as at present planned (1944), calls for placing entire communities in "irrigation districts" to be established under the Oregon Irrigation District Laws. Such districts are established only on the vote of the land owners involved, but once established the board of directors of the district has authority to levy whatever bond issue against the land in the district that the Board may consider necessary for irrigation purposes.

Cost of water

A water right under this project as now set up costs the farmer $25 an acre if the water is taken from the corporation ditches by gravity and $15 an acre if the water is pumped from the corporation ditches. The reasons for this differential have already been mentioned. This investment is for original construction. In addition to this initial investment, the owners must maintain the plant at whatever cost that may involve. So far this has cost the holders of gravity water from $2.50 to $4 per acre per year. The holders of "pump" rights have had to pay 60 per cent as much.

In contrast, the cost of irrigation for the Willamette Valley Project as reported by the State Planning Board in its report of 1938 entitled, *Land Development in Oregon Through Flood Control, Drainage and Irrigation,* is estimated at $76.50 per acre original investment, to which must be added an annual charge to cover whatever operation and maintenance costs may be necessary. In further contrast, the Willamette Valley Project proposes to assess the estimated cost of $76.50 per acre against all of the land that is physically suited for irrigation regardless of whether the owner does or does not wish to irrigate it all. The charges on the McKenzie Project, on the other hand, are based on the number of acres for which the owner has purchased water rights.

This difference in cost may in part be accounted for by the fact that the McKenzie Project is so situated by nature that the ditches are short and construction easy.

Soils

The McKenzie Delta is relatively level with little land that is not tillable. The main body of the delta is Willamette silty clay loam with spots of Salem gravelly clay loam and other soils. Next to the rivers there is a belt of river bottom soil, mostly Chehalis and Newberg. These river bottom soils form a sort of border around the western end of the delta.

The farms that have water rights in this project are on the Willamette and Salem soils, and not on the river bottom soil. There are

a number of irrigated farms on the river bottom soils but these farms get their water by pumping from wells or adjacent streams and not from this project.

The drainage is variable. Along some of the swales, the soil is sticky and highly impervious to water. On the other hand, on the Salem gravelly clay loam, seepage from the ditches is so great as to cause serious loss of water and more or less damage to the adjacent land.

On the whole, the soil, drainage, and topography of this area is above the average of the Willamette Valley. It is, however, typical of the better areas.

Present status

At the time of the study, 65 farmers had water rights under this project. These rights were for 1,449 acres, of which water for 520 acres is to be pumped from the corporation ditches and 929 acres is to be delivered by gravity. These farmers had water rights for less than half of the land they owned.

Extent of the study

The study was planned to cover all of the farms getting water from this project. Three of the 65 water rights outstanding were operated in connection with other rights owned by members of the same family. One right was for industrial use. This project, therefore, includes 61 farm units including part-time farms and rural residences. The owners of seven of these units could not be interviewed for various reasons. Records were therefore obtained for 54 units. These units in some cases included land rented from persons who did not have water rights so that the total amount of land covered by the records is somewhat larger than the land actually owned by the holders of the water rights.

While we may designate these 54 units as "farms," it must be understood that some are part-time farms, some are essentially rural residences, while others are real estate developments in various degrees of subdivision. All, however, are raising some agricultural products for sale and have water rights intended for irrigating agricultural crops.

Type of farming

The type of farming in this area is quite varied. Nearly every farm had several enterprises and no two farms were alike. On the basis of what appeared to be the major activity and source of income, these 54 units may be classified as follows: 18 dairy farms, that is, farms with more than six cows and producing a substantial amount

of feed in the form of hay, grain and pasture; 3 poultry farms; 9 horticultural enterprises, including nuts, tree fruits, truck crops, and nursery; 11 part-time farms occupied and operated by men who also had nonfarm occupations; and a miscellaneous group of 13 too varied to classify. None of the farms rated as hay or grain farms; yet all but the very smallest had some hay and grain.

Turkeys, berries, grass seeds, and vetch seeds were almost entirely absent; although one turkey enterprise was being started.

Size of units

Nineteen units were part-time farms or rural residences in the sense that the occupants had other occupations than farming and were not expecting the land to afford them either a job or a living. A few of the others seemed small for family farms, yet the owners had no other occupations. Several were in the process of subdivision. The number of the farms in various size groups is as follows:

Under 10 acres	14
10 to 49 acres	17
50 to 99 acres	6
100 to 149 acres	8
150 to 199 acres	5
200 acres or more	4

Some of the operators were expert farmers. Some were handicapped by lack of experience and lack of sufficient land. Some were handicapped by lack of finance. Others were spending money in a manner that appeared lavish.

Land tenure and tenancy

The 54 units were all operated by the owners with the possible exception of one that was rented within the family. Nine farmers, however, rented land in addition to that which they owned; the amount of land so rented was 559 acres. None of this additional land had water rights. In four cases the owners had residence elsewhere than on the farms.

The area generally is in transition from family farms to suburban homes and part-time farms. Several of the 54 units studied were small tracts that had only recently been subdivided from larger units. There were also some farms in the process of being subdivided. Other owners were giving thought to the possibility of subdivision. It was frequently remarked that the land "was getting too valuable to farm." Owners were asked what they considered a normal value of their land. The answers ranged from $125 to $350 with an average of $191; yet land was being commonly quoted at $300 and up. The entire area is within 10 minutes drive of Eugene or Springfield.

Land use and acres irrigated

Table 2 shows how the 54 farmers reporting used their land in 1944. Of the land available for crops, 61 per cent was in field crops such as grain, hay, corn, and flax; 11 per cent in intensive crops such as nuts, fruits, and vegetables; 24 per cent in pasture; 5 per cent in fallow. From the standpoint of irrigation, these farmers had 1,030 acres in irrigated crops and 1,961 in nonirrigated crops.

The table includes farms of all sizes but the data fail to show any consistent difference between small farms and large farms in either the use of land or the proportion of the land irrigated.

Table 2. LAND USE AND ACREAGE IRRIGATED FOR 54 WATER RIGHT OWNERS McKenzie Irrigation Association, Lane County, Oregon, 1944.

Land use	All farm land		Irrigated land		
	Farms reporting	Acreage reported	Farms reporting	Acreage irrigated	Per cent of this crop irrigated
	Number	*Acres*	*Number*	*Acres*	*Per cent*
Small grain	16	806	4	82	10
Hay					
Oats and vetch	24	448	2	34	8
Alfalfa	13	165	7	77	47
Red clover	13	222	3	80	36
Miscellaneous field crops					
Corn	6	48	2	22	46
Flax	7	116	2	55	47
Orchard					
Walnuts	8	68	2	33	49
Filberts	13	101	5	29	29
Fruit	8	59	4	36	61
Vegetable crops					
For cannery	9	49	9	49	100
For seed	4	53	3	20	38
Fallow	11	145	1	6	4
Pasture					
Ladino	38	507	38	507	100
Other cropland	10	138	.....	.....	.....
Permanent, plowable	7	66	.....	.....	.....
TOTAL CROPLAND	54	2,991	47	1,030	34
Permanent pasture, non-plowable	14	278	.....	.....	.....
Timber	6	106	.....	.....	.....
Farmstead, roads, and waste	54	282	.....	.....	.....
TOTAL FARM LAND	54	3,657	47	1,030	28

Small grain

Only 10 per cent of the small grain and only 8 per cent of the oats and vetch were irrigated. The farmers were almost unanimous in the opinion that the irrigation of these crops did not pay. There was no indication that any increase in the irrigation of these crops could be expected.

Alfalfa and clover

Not quite half of the farmers growing alfalfa or clover were irrigating. The irrigated fields gave higher yields than the nonirrigated, but the differences were not sufficient to justify any definite conclusions as to the economy of irrigating these two crops. The concensus of opinion among the farmers, however, was that the irrigation of alfalfa and clover would expand.

Nuts and fruits

Less than half of the growers of walnuts, filberts, and tree fruits were irrigating these crops. Opinion seems to be divided as well as the practice. Yields cannot be compared since there was too wide a variation in the ages of the trees. The indications are that the irrigation of these crops will be tried out quite extensively during the next few years.

The acreage of filberts in the delta is increasing, but it cannot yet be determined for certain what proportion of these will be irrigated.

Complaint was made in some places of excessive moisture in orchards caused by seepage from adjacent canals or laterals. The seepage occurred primarily in gravelly subsoil of the Salem series. In such soils, lining the ditches in some manner may be necessary.

Vegetables for canning

There were only 49 acres of cannery vegetables on the project, but these 49 acres were all irrigated. In view of the extensive acreage of cannery vegetables under irrigation in this general vicinity, we ask why the acreage under this project is small. A study of the delta area shows that the cannery vegetables are grown almost exclusively on Chehalis and Newberg soils along the bottom lands of the Willamette and McKenzie rivers. The soil maps show approximately 4,000 acres of these soils in the McKenzie Delta. These lands are below the level of ditches of the McKenzie Project and can be reached by these ditches without great difficulty, but the farmers on these lands can get water by pumping from adjacent streams or shallow wells. Furthermore, the topography of these soils is such that the water is more easily applied by some form of sprinkling rather than by flooding. Since a pump must be used in any case, there seems to be little advantage in pumping from a ditch instead of from a stream or well. Hence these farmers have not bought water rights from the McKenzie Project.

The relatively few acres of truck crops grown by farmers who do have rights under this project represent efforts to extend vege-

table growing to other soils than those of the river bottoms. These experiments are too small and too scattered to justify definite conclusions.

Irrigated pastures

Half of the land irrigated was devoted to irrigated pasture for dairy cows. These pastures were mostly Ladino clover with or without various grasses in addition. Some trials were being made with pasture mixtures without Ladino, but these are yet in the experimental stage. Of the farmers who had more than one dairy cow, all but one had irrigated pasture and that one was reported to be planning some irrigated pasture for 1945. About 60 per cent of this Ladino pasture was used by 18 farmers who were making dairying a major enterprise. (Table 3). It will be seen that these dairy farms are essentially a combination of grain, hay, and irrigated pasture.

The livestock of this project is largely dairy and poultry (Table 4). Beef, sheep, and hogs occupy minor positions.

These irrigated pastures carried an average of 1.9 cows (including a few horses and young stock) for each acre. The average length of the grazing season was 6 months. This meant that each acre produced an average of 11.4 animal months of grazing. The larger pastures were stocked more heavily than the smaller ones. It appeared that the small farmers with only a few acres and a few cows had not yet been able to adjust the number of cows to the number of acres very carefully. The figure of 11.4 animal unit months per acre checks closely with the results of other studies.

These pastures were irrigated an average of 5.3 times during the irrigation season. The labor expended in actual irrigation for the year averaged 6.4 hours per acre. In addition to labor expended on actual irrigation, 0.7 hour per acre was expended upon ditch work, 3.8 hours on fertilizing, and 0.6 hour on clipping and weed control. The total amount of labor expended on the maintenance of these pastures was 11.5 hours per acre. The seasonal distribution of this labor is shown in Table 5.

These data apply entirely to flood irrigation. There was so little pasture irrigated by sprinklers on this project that comparable labor costs for sprinkler irrigation could not be obtained.

An important item of flood irrigation cost is leveling. So far, however, the farmers on this project have not yet determined just what degree of leveling is profitable, or the best methods of doing the leveling, or the costs.

So far, the water has been so abundant on this project that conservation of water has not seemed necessary. It is quite possible

that when the project develops to the point where conservation of water becomes necessary either because of increased demand for water, or because of drainage difficulties, labor costs of irrigation may increase and more leveling may be found necessary.

Table 3. Land Use and Acreage Irrigated for 18 Dairy Farms McKenzie Irrigation Association, Lane County, Oregon, 1944

Land use	All farm land		Irrigated land		
	Farms reporting	Acreage reported	Farms reporting	Acreage irrigated	Per cent of this crop irrigated
	Number	*Acres*	*Number*	*Acres*	*Per cent*
Small grain	11	614	1	28	5
Hay					
Oats and vetch	14	329	1	13	4
Alfalfa	7	137	3	58	42
Red clover	11	215	3	107	50
Miscellaneous field crops					
Corn	4	26	.....	.....	.....
Flax	4	61	.....	.....	.....
Orchard					
Nut	6	18	.....	.....	.....
Fruit	2	3	.....	.....	.....
Vegetable crops					
For canning	2	8	2	8	100
For seed	2	20	.....	.....	.....
Fallow	4	51	1	6	12
Pasture					
Ladino	17	318	17	318	100
Other cropland	6	98	.....	.....	.....
Permanent pasture, plowable	2	27	.....	.....	.....
Total cropland	18	1,925	17	538	28
Permanent pasture, non-plowable	7	206	.....	.....	.....
Timber	4	97	.....	.....	.....
Farmstead, roads, and waste	18	164	.....	.....	.....
Total farm land	18	2,392	17	538	22

Table 4. Kinds and Numbers of Livestock for 54 Water Right Users McKenzie Irrigation Association, Lane County, Oregon, 1944

Kind	Farmers reporting this kind of livestock	Total livestock reported
Dairy cows	37*	558
Beef	2	51
Ewes	5	142
Sows	8	37
Market hogs	7	24
Poultry	23†	10,081

* Of this number, 19 farmers reported less than 6 dairy cows.
† Only 9 farmers reported more than 100 poultry. One turkey enterprise was just starting.

Probable expansion

Thirty-six farmers indicated their plans for future irrigation. Seventeen did not expect to expand; while 19 stated that they would expand. The proposed expansion ranged from 3 to 65 acres per

farm with a total of 382 acres. Apparently, some of these farmers intend to purchase additional water rights since their present rights will not cover this additional acreage.

The superintendent of the project advised that the Association was unable to furnish water facilities to all who asked on account of wartime difficulties in the way of new construction.

Any major expansion of the acreage in irrigated pasture must be accompanied by an increase in the number of cows. The land now in irrigated pasture together with the pasture already prepared for 1945 is sufficient to pasture all of the cows on the area.

Irrigation methods

Data as to irrigation methods were obtained from 35 farmers. Fifteen of these brought water to the field by gravity ditch and distributed it over the fields by flooding. Fourteen pumped the water from a lower ditch to a higher ditch and then distributed the water by flooding. Some of these, however, pumped the water for only certain fields. Six irrigated by pumping the water out of the ditch and distributing it over the fields with sprinklers.

The acres irrigated by these different methods were: pump and sprinkler, 104; entirely by gravity, 498; pumped to a higher ditch and distributed by gravity, 347.

THE MUDDY CREEKS PROJECT

The Muddy Creeks Project was begun in 1939. It is designed, from the engineering standpoint, to cover the area north of the McKenzie River between the Willamette River on the west and the foothills on the east and extending north almost to Corvallis. The main Muddy Creek rises a few miles from where the McKenzie emerges from behind the foothills; from there the creek meanders northward for about 30 miles, more or less paralleling the Willamette and finally flowing into the Willamette just south of Corvallis. In addition to the main Muddy Creek, there are two tributaries known as Little Muddy and Dry Muddy. These creeks meander over a large area, but they carry very little water in the summer and are often dry in places. In winter they frequently overflow.

The Muddy Creeks Project takes water out of the McKenzie River where it comes from behind the hills near the Coburg-Eugene highway bridge. From that point a canal about 4 miles in length carries the water to Muddy Creek. From there on the project used natural channels aided by some cleaning and straightening and by some additional ditches. The farms that have water rights are scat-

Table 5. Man Labor Requirements for Flood Irrigated Pasture for 24 Water Right Users
McKenzie Irrigation Association, Lane County, Oregon, 1944

Operation	Average number of times over	Man hours per acre covered	Per cent of acreage covered	Man hours per average acre	Man hours per average acre per month											
					Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Fertilizer	1.1	4.8	80	3.8	.5	.5	.8	.6	.4	.1	....	....	....	....	.4	.5
Ditch work	1.1	1.0	71	.7	....	....	....	.1	.4	.2	....	....	....	....	....	....
Irrigation	5.3	6.4	100	6.4	....	....	....	....	.7	1.7	1.6	1.5	.9	....	....	....
Clipping and weed control	1.1	2.0	29	.6	....	....	....	....	....	.1	.4	.1	....	....	....	....
Total	....	....	....	11.5	.5	.5	.8	.7	1.5	2.1	2.0	1.6	.9	....	.4	.5

tered over an area about 5 miles in width and 20 miles in length extending from the Coburg Bridge to a point 4 miles west of Halsey.

This project, like the McKenzie, is very simple in its engineering plan and involves the minimum of expensive or difficult construction. The project could be expanded to cover much valley land of southern Linn County by making the ditches longer and larger and with more laterals.

The Muddy Creeks Project, like the McKenzie, has a strategic location. The entire area has a smooth topography with a gentle slope from the southeast corner to the northwest corner. Right at the southeast, or upper corner, is the one easy place to divert water from the north side of the McKenzie River. The Muddy Creeks are shallow with the adjacent land frequently sloping away from the creeks thus making the diversion of water from these creeks relatively easy.

History

The Muddy Creeks Irrigation Project was formed on March 8, 1939 as a nonprofit cooperative association. The plan of organization is very similar to that of the McKenzie Irrigation Association. The par value of the stock was fixed at $5 per share and members may irrigate 1 acre of land for each share of stock held.

The by-laws originally provided that the annual charges should not exceed 50¢ for each acre foot of water actually delivered. These charges were not sufficient for the actual expense and by 1942 the project was heavily in debt. The project then levied an assessment of $5 per share of stock to meet this indebtedness. It also increased the regular annual assessment to $1.50 per acre. As a result of these assessments combined with the help obtained from the Agricultural Adjustment Administration, the Project is now practically out of debt.

The limitation of the annual assessment to $1.50 per acre represents the present judgment of the association as to the amount that will be necessary. Actually the association will be obliged to make whatever annual expenditures are necessary in order to keep the project in running order.

Like the McKenzie Association, this association has no power to levy bond issues and the only penalty for nonpayment of assessments is the loss of the right to obtain water through the facilities of the association.

Purposes of the project

The purposes and motives that activated the various farmers who took water rights in this project are difficult to determine with

certainty. The fact that these farmers took out water rights for less than 10 per cent of the land they owned indicates that they did not intend to irrigate more than a small part of their farmland. Some of the farmers stated definitely that their purpose was to obtain adequate stock water. In some cases, improved drainage was given as the motive but whether that was the sole motive in any case is not shown.

Some of those who apparently purchased water for irrigation purposes as yet have made no attempt to irrigate, but it is not clear to what extent this delay has been due to skepticism, to wartime difficulties, or to a desire to let others do the experimenting. Some stated that they were not ready to irrigate but expected to eventually.

The place of drainage in this project requires some explanation. The project area is drained by the Muddy Creeks and their tributaries. These creeks are sluggish, crooked, and often obstructed by brush and trees. They are therefore often inadequate to carry off the flood water during the time of heavy winter rains, even though they may be dry or nearly dry in midsummer. It is the plan of the project to use natural channels as far as possible. The slope of the area is such that a straight, smooth channel will move water freely while a crooked, brushy channel tends to silt up so that the water moves very sluggishly. It is therefore assumed that any straightening or clearing of these creeks will aid winter drainage. In the minds of some farmers this is more important than summer irrigation.

Soils

The area includes various types of valley floor soils: Willamette, Amity, and Dayton, with a sprinkling of other minor types. There is a good deal of Willamette soil along the three Muddy Creeks and many of the water-right holders are located on this Willamette soil. They also have plenty of other soils, however, especially Dayton.

There is much Chehalis and Newberg soil adjacent to the project on the south and west. A number of farmers are growing truck crops on bottomland soils and are irrigating by pumping from shallow wells or adjacent streams. While most of these are below the ditch level, only two farmers located on such soils have taken out water rights in the project. On the other hand, the farms that do get water from the project are located where ground water is not generally adequate for irrigation and in some cases is not adequate for stock water.

Extent of the study

This study was intended primarily to determine the use that the 96 holders of the water rights were making of these rights. Forty-three of the rights were being used for irrigation in 1944. Complete records for 23 of these were obtained. The data for the others are less complete.

Of the fifty-two rights not being used for irrigation, rather complete records were obtained from seven as a sample.

Type of farming

Most of the farmers in this area are primarily seed and grain producers, but in many cases have dairy herds of 10 to 40 cows in addition to seed and grain. The major crops were ryegrass seed, both English and Common, vetch seed, and small grains along with some hay, either vetch or clover. The livestock was either sheep or dairy cattle.

There were of course a few exceptions to this general pattern. The exceptions include specialized dairy farms, truck farms, and one orchard. The river bottom soil was mostly in truck crops, but there was practically no truck farming except on the river bottoms. These truck farms therefore represented a soil type that was exceptional. The orchard was also exceptional for various reasons.

For the most part, orchard, berries, garden, and poultry were for home use. Only one farm had turkeys.

A few farms were less than 200 acres in size, but the majority were more than 400 acres. Since the land is level and the major crops are grains and seeds, the area is highly mechanized so that one man can farm a much larger number of acres than would ordinarily seem practicable. The farms were therefore essentially of the "family" type. Few farmers hire more than one man.

Land ownership and tenure

There were no full tenants—that is, farmers who rent all the land they farm. On the other hand, some owners rented additional land.

Forty farmers interviewed owned 11,792 acres, or an average of 295 acres each. Sixteen of these rented land in addition to that which they owned. These sixteen farmers owned 6,001 acres and rented 5,470 acres.

These forty farmers therefore farmed, both owned and rented, a total of 17,262 acres, or an average of 432 acres each.

These forty farmers had water rights for 1,758 acres, or 10 per cent of the area farmed, or 15 per cent of the area owned. The

percentages for these forty farmers are a little higher than the average for all the farmers of the project.

While the Muddy Creeks Project is separated from the McKenzie Project by only the McKenzie River, the farms of the Muddy Creeks Project are rather large and are strictly commercial farms while the farms of the McKenzie Project are mostly small with a high percentage of part-time farm and rural residences. The McKenzie area is undergoing a process of suburbanization and subdivision. The Muddy Creeks area is not being subdivided. The farms are growing larger rather than smaller and such lands as are offered for sale are mostly bought by the neighbors.

Land use on irrigated farms

The way in which the land was used on the farms practicing irrigation is shown in Table 6. This table is for the sixteen irrigated farms for which complete land use records could be obtained. The most striking fact is the large amount of land devoted to grain, hay, and field crops. Of the total amount of crop land 73 per cent was devoted to these crops (calculated from Table 6). Thirty-four per cent of the crop land was devoted to ryegrass, including both English and Common, hence the term "ryegrass farmer." Orchard and truck crops were confined to a few farms located on soils adapted to these crops but not typical of the area as a whole. Truck crops occupied most of the river bottom soils but were not being attempted on other soils.

Seven per cent of the cropland was irrigated. Ladino clover and grass pasture occupied more than half of the land irrigated. The Ladino clover pasture was primarily used for dairy cows, but occasionally for young stock or horses. There was no record of its use for sheep. One farmer was using it for beef cattle.

Extent of irrigation

The Ladino clover was all irrigated. Included with the Ladino were various mixtures of grass with the Ladino or other clovers.

Certain crops were not being irrigated at all. These include small grains, oats and vetch hay, all grass and vetch seed crops, and Austrian peas. Farmers generally stated that they did not consider the irrigation of these crops profitable. At any rate they were not irrigating them.

The truck crops for cannery were 100 per cent irrigated. This may represent not merely the judgment of the producer but the judgment of the cannery since some canneries will not contract unirrigated truck crops.

Some crops were being irrigated by only one or two farmers. One farmer was irrigating alfalfa, one was irrigating clover hay and seed, one flax, and one an orchard. All of the sugar beet seed and all of the dill were irrigated, while none of the miscellaneous vegetable seeds were irrigated in 1944.

To summarize: The farmers under this project are irrigating Ladino pasture extensively. They are definitely not irrigating grain, vetch and grass seeds. The irrigation of flax, alfalfa, and clover is being tried in a limited way. Several farmers plan to try out the irrigation of hay crops more extensively after the war. The growing of flax either with or without irrigation will depend on the price of flax and this price is at present unsettled.

Table 6. LAND USE AND ACREAGE IRRIGATED
For 16 Water Right Holders Practicing Irrigation
Muddy Creeks Irrigation Project, Linn and Lane Counties, Oregon, 1944

Land use	All farm land		Irrigated land		
	Farms reporting	Acreage reported	Farms reporting	Acreage irrigated	Per cent of this crop irrigated
	Number	*Acres*	*Number*	*Acres*	*Per cent*
Small grain	13	1,064	.....	.....	.....
Hay					
Oats and vetch	8	185	.....	.....	.....
Alfalfa	4	98	1	30	31
Clover hay and seed	8	365	1	38	10
Miscellaneous field crops					
Common ryegrass	12	1,005	.....	.....	.....
English ryegrass	5	962	.....	.....	.....
Fescue grass seed	2	22	.....	.....	.....
Sudan grass seed	1	43	.....	.....	.....
Vetches	4	225	.....	.....	.....
Austrian peas	2	24	.....	.....	.....
Seed flax	1	20	.....	.....	.....
Fiber flax	5	238	1	35	15
Orchard and hops					
Fruit and nuts	2	48	1	30	63
Hops	1	36	.....	.....	.....
Vegetable crops					
Cannery	3	72	3	72	100
Seed	5	65	3	24	37
Fallow	5	375	.....	.....	.....
Pasture					
Ladino	12	243	12	243	100
Other crop land	9	726	.....	.....	.....
Permanent, plowable	5	590	.....	.....	.....
TOTAL CROPLAND	16	6,406	16	472	7
Permanent pasture, non-plowable	9	593	.....	.....	.....
Farmstead, roads, and waste	16	290	.....	.....	.....
TOTAL FARM LAND	16	7,289	16	472	6

Livestock

The farms that had irrigated pastures kept more livestock than their neighbors who did not have such pasture. Twelve of the 16 farms from which records were obtained had irrigated pasture. One

of these was a large retail dairy not representative of the majority of the farms. Of the 11 remaining farms, all reported dairy cows. The average number of cows per farm was 17. The irrigated pastures on the 11 farms averaged just under 14 acres per farm. Of the 4 farms without irrigated pasture, 3 reported an average of only 2 dairy cows each. Ten farms had a total of 627 sheep. Only two had brood sows. Twelve had farm flocks of poultry, but there were no commercial flocks. One operator was raising turkeys. In general, livestock was a side line carried on in connection with the production of grain and seeds.

Carrying capacity of Ladino pasture

Records were obtained from seven farms on the use of Ladino pasture. On these farms the average length of the season of use was 7.1 months. The average number of cows per acre (counting horses and young stock as cows) was 1.7. Each acre afforded 12.5 animal months of grazing. In two cases some hay was also cut from these pastures in addition to grazing.

This figure of 12.5 animal months of grazing checks rather closely with the results obtained on the McKenzie project and with the results obtained from other studies.

Ten farmers answered the question as to whether bloat was more prevalent on irrigated pasture. Six answered "no" and four answered "yes." Eight cows were reported lost during the last five years.

Methods of irrigation

On the 16 farms studied in detail, different methods of irrigation were followed. On 287 acres the water was pumped from the ditches and distributed on the fields by sprinklers. On 137 acres the water was brought to the field by gravity ditch and distributed by flooding. On 57 acres the water was pumped from a lower ditch to a higher ditch and then distributed by flooding. On 25 of these 57 acres, however, the pumping was reported as "temporary," to be replaced later by gravity ditch.

The investment in leveling, structures, pumping plant, pipe, and sprinklers averaged $48 per acre irrigated on 15 of the 16 irrigated farms (Table 7). These investment costs are in addition to the cost of shares in the Muddy Creeks Project that, although only $10 per acre of water right, averaged $18 per acre irrigated. This was due to the fact that only a few of the farms were irrigating the total acreage for which they had purchased water rights.

Labor of irrigation

An effort was made to learn the amount of labor required for irrigation but irrigation is new to most of the farmers and there is so much experimenting and "cutting and trying" that the new data obtained in 1944 probably mean little as to the amount of labor that will be necessary when more experience is gained and when methods become standardized. Seven records for irrigating Ladino pasture showed an average labor requirement for irrigation of 12.5 hours per acre for the entire season. This was for an average of 6 irrigations for the season. These figures are not far out of line with the labor required for irrigation in other irrigated areas. Nevertheless, they should be considered as subject to change as irrigation methods in this project pass beyond the experimental stage.

Table 7. INVESTMENT IN LEVELING, PUMPING PLANTS AND PIPE, FOR FIFTEEN IRRIGATED FARMS, MUDDY CREEKS IRRIGATION PROJECT, LINN AND LANE COUNTIES, OREGON, 1944

Type of irrigation	Farms	Area irrigated 1944	Leveling and structures	Pumping plant*	Pipe and sprinklers	Total exclusive of investment in project
		Acres				
Gravity	4	162	$25	....	....	$25
Pump and flood	3	30	24	$14	$ 5	43
Pump and sprinkler	9	278	5	10	47	62
All types	16	472	$13	$ 7	$28	$48

* Does not include cost of tractors used as sources of power on 4 farms.

Future expansion

Some of the farmers reported that they expected to expand their irrigation to the point where the purchase of additional water rights will be necessary. Some expect to expand but not in excess of their present rights. Some who are not irrigating now expect to do so in the near future. Some who are not irrigating now do not expect to do so. No one reported an intent to reduce the area under irrigation.

There is a definite intent on the part of many farmers to establish irrigated pastures for dairy cows. There is a great deal of interest in the future irrigation of clover and alfalfa but not many farmers feel that they know yet just how far they will go in the irrigation of these crops.

In general, the farmers who are not irrigating most extensively are the ones who are planning the greatest irrigation expansion.

CONCLUSIONS AND DISCUSSION

The farmers who own water rights under the McKenzie and the Muddy Creeks projects are irrigating Ladino clover pasture extensively. Half of the land they are irrigating is devoted to this crop. They were pasturing almost 2 cows to the acre for a period of six to seven months. These results check rather closely with the results shown in other studies of irrigated pastures in western Oregon and reported in Bulletin 392, Oregon Agricultural Experiment Station. They also check closely with results obtained at the Experiment Station at Corvallis and reported in Bulletins 366 and 394. All of these indicate that Ladino clover mixed with more or less grass should afford from 8 to 18 animal months of grazing per acre with an average of about 12 animal months.

The precise effect of this pasture on milk and butterfat yields was not obtainable in this study, but in the Corvallis tests reported in Bulletin 366 where the number of animal unit months per acre was similar to data obtained on the McKenzie and Muddy Creeks projects, 1 average acre of mixed Ladino clover and grass produced feed that was equivalent in nutritive value to 4.8 tons of alfalfa hay. It appears reasonable to assume, therefore, that the pastures on the Muddy Creeks and McKenzie projects on the average were producing feed equivalent in nutritive value to 4.8 tons of alfalfa hay. The Oregon Agricultural Experiment Station tests (Bulletin 392) indicate that one-year-old stands of Ladino produce more than this average but that as the stand grows older the yield becomes less.

The users of irrigated pasture generally do not seem to fear bloat; yet it appears that that danger is not entirely absent.

Nearly all of the cows on the McKenzie Project were getting irrigated pasture so that any large increase in the acreage of irrigated pasture would have to be accompanied by an increase in the number of cows.

Ladino was found growing successfully on various types of soils. No failures due to soil type were noted. A number of farmers were fertilizing Ladino with satisfactory results,

On the basis of present information, irrigated pasture will be an important part of any future expansion of the irrigated acreage.

The farmers with water rights have not shown any particular interest in irrigating small grains, grass seeds, or oats and vetch hay, and they continue to grow large acreages of these without irrigation.

While truck crops for cannery purposes are practically all grown with irrigation, these crops have been confined to river bottom soils. While there is a large area of river bottom soil within easy reach of

the ditches of these two projects, the owners of such land are getting their water by pumping from streams or wells and have shown little inclination to buy water rights from these projects that bring the water to the land by means of ditches.

There are a few crops that some farmers irrigate and other farmers do not irrigate. Opinion is divided and it will require more time in which to determine just the conditions under which irrigation of these crops will be profitable. These crops include alfalfa, clover, flax, tree fruits, walnuts, filberts, and vegetable seeds. There were no commercial berries on either project.

The acreage under irrigation in both projects is expanding, but this expansion is limited during the war by labor scarcity. Many farmers expressed an intention to irrigate more land than the amount covered by their present water rights. These farmers are thinking of expanding their irrigation of hay and pasture, and in the McKenzie area, tree fruits and nuts. In some cases, the expansion will be definitely experimental. They are convinced that the application of water during the dry season should be beneficial to many crops and they wish to find out just how to use this water to the best advantage.

The water-right holders in these projects are using a combination of irrigated and nonirrigated crops and only in a few cases was there any apparent intention to irrigate the entire farm.

Aside from the river bottom soils, Ladino clover pasture has been the one crop that has given general satisfaction as an irrigated crop. While the acreage of Ladino is increasing, there seems to be no tendency to put entire farms into Ladino. Dairy cows require grain, hay, and silage for winter feed, in addition to the summer pasture that is afforded by the Ladino. Also many of the dairy cows are on farms where the dairying is subordinate to other enterprises such as grain, grass seeds, and cover crop seeds. These other crops are rarely irrigated yet have been profitable at current prices. The introduction of irrigated Ladino has not so far resulted in an increase in dairying, but under existing price schedules and labor conditions farmers have had little incentive to change from grain and seed production to dairying.

The irrigation of alfalfa and clover for hay is frequently handicapped by the difficulty of getting the first crop cured and off the ground in time to irrigate for the second crop. The solution for this problem will have to wait for postwar developments in hay drying equipment or in silage-making equipment.

In the meantime, therefore, irrigation will be generally limited to the amount of land needed to produce summer pasture for the cows now on these farms.

In the Muddy Creeks project, stock water is an important item to some water-right holders, while to others drainage is important. Drainage benefits could apparently be greatly increased by some additional construction. The association, however, has not yet worked out a satisfactory method of allocating costs between drainage and irrigation.

In certain gravelly subsoils, seepage causes loss of water from the ditches. This lost water serves to "subirrigate" some adjacent lands, sometimes beneficially and sometimes to the contrary. Lining the ditches may be necessary in some soils in order to keep seepage under control.

Irrigation usually is done by flooding where flooding can be done satisfactorily. As flood irrigation increases, some leveling may be necessary but the amount of leveling necessary has not yet been determined, and when the answer is determined it may be different for each farm. Irrigation by sprinkling has its advocates even where the water is brought to the farm by gravity. The extent to which sprinkling will eventually be used will depend largely on postwar developments in sprinkling equipment and the price and availability of electric power. The relative merits of distributing water by sprinklers as compared with distributing by flooding have, therefore, not been fully determined.

Are these projects successful? We should answer "yes." The water-right holders apparently have in mind a cropping system that involves a combination of irrigation and dry farming with the irrigation largely confined to dairy pasture. They are accomplishing this object and express themselves as well satisfied.

War conditions have slowed down irrigation progress by making it difficult to do construction and difficult to find labor to do the irrigating. This is especially true of the Muddy Creeks Project where the farms are large and the farmers have a great deal of land to farm.

The McKenzie Project was begun in 1911, but made slow progress and by the end of the 1930's was in financial difficulties and the ditches were in bad repair. A new organization was then formed, partly of old users and partly of new users. Since that date irrigation has been increasing rapidly. This change has been due largely to the introduction of Ladino clover and to the improved financial organization effected in 1939.

There are yet many unanswered questions in irrigation farming under these two projects. Fortunately, both projects are set up in such a way that they can be expanded as the experience of the farmers justify such expansion. The investment so far is small but can be expanded if necessary. Only a few farmers would be seri-

ously hurt financially if their investment in these projects were abandoned. All of this means that the farmers under these projects are free to expand or contract their irrigated acreage as their judgment and experience dictates. New farmers can come in if they wish. Both projects can be expanded to several times their present size without materially changing the cost per acre.

These two projects are in on the "ground floor." They control the strategic points for diverting water from the McKenzie River. Their main ditches are located along the strategic right of ways to cover very large acreages when, and if, necessary. There are no bonded debts and the associations, as organized, have no legal power to levy bond issues.

The two most important conclusions to be drawn from this study are: (1) Farmers under these two projects and located on Old Valley Floor soils have found it profitable to provide irrigated pasture for their dairy cows but have so far not extended their irrigation much beyond this point. (2) These two associations have found it practicable to build small, expansible projects which at the start irrigate only a small acreage scattered over a large area but which may be expanded as justified by the experience of the water users.

The foregoing would suggest that the Reclamation Service might find it feasible to build a small project, sell water to the users who wished it, and later expand the project as additional demand develops.