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Costs and Grazing Values of Willamette Valley and Southern Oregon Farm Pastures

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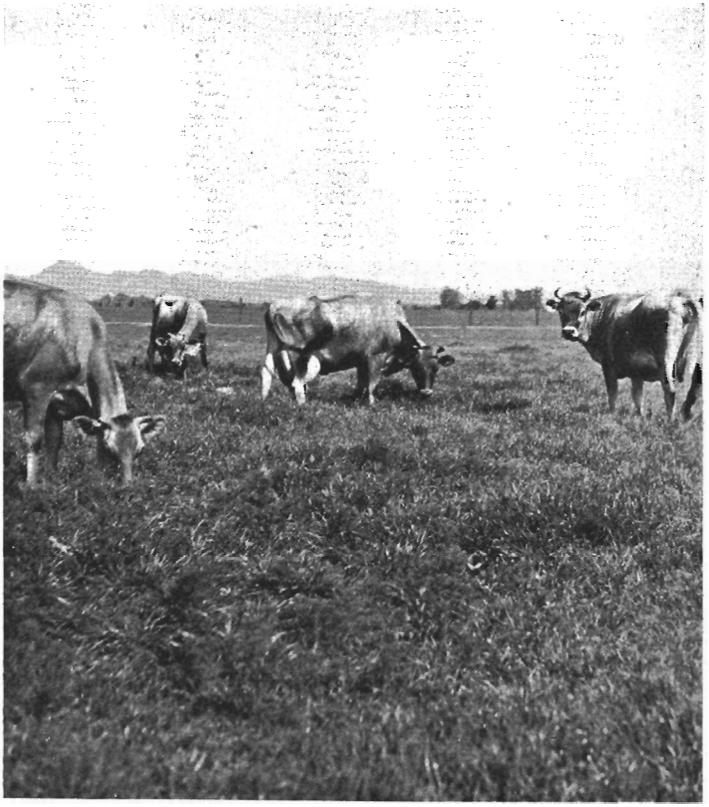

Oregon State System of Higher Education
Agricultural Experiment Station
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FOREWORD

LIVESTOCK men know that the difference between good pasture and poor pasture means the difference between profit and loss. We find increased interest, on the part of these men, in the possibilities of improving the carrying capacities of various types of pasture.

The present bulletin is the third and last in a series of three publications that report findings on the costs, efficiency, and management of pastures in three important areas of Oregon.

The first bulletin (Experiment Station Bulletin 390) covered pastures in the Coast Region; the second (Experiment Station Bulletin 391) applied to Eastern Oregon; and the present bulletin discusses pastures in the Willamette Valley.

WM. A. SCHOENFELD
Director

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SUMMARY

The Willamette Valley and southern Oregon contain a wide variety of soil and climatic conditions resulting in a diversity of pasture crops. This bulletin treats of 14 of the more important. These may be placed in four groups: (1) hill pastures, (2) valley pastures, (3) special pastures, and (4) southern Oregon pastures.

Hill Pastures

Pastures on the hill lands of the Willamette Valley were grazed principally by sheep, goats, and beef cattle. Pastures that had been seeded to mixtures of tame grasses produced more grazing than did the native pastures. Those seeded to native grasses produced 42 animal-unit (one cow or five sheep) days of grazing per acre per year and were valued at $23.60 an acre, while the native pastures produced 59 days of grazing and were valued at $19.20. The cost per day of grazing, including interest on these valuations, was the same in both cases; that is, 3.5 cents. Both types of pasture contained a substantial percentage of brush and timber, producing little or no grazing.

Valley Pastures

The pastures on the floor of the Willamette Valley were largely used by dairy cattle but are also grazed to some extent by beef cattle, sheep, horses, and hogs. The native-grass pastures on the valley floor produced an average of 50 animal-unit days of grazing per acre, tame mixed-grass pastures 96 days, rye grass 82 days, alfalfa 240 days, red and alsike clover 164 days. The value per acre of these pastures as estimated by the owners was: native grass $33.60, tame mixed grass $60.80, rye grass $53.60, alfalfa $102.20, red and alsike clover $102.80. The cost of a day's grazing on these five types of pasture, including interest on the land values quoted, was approximately 5 cents in each case, thus indicating that the differences in land values were accompanied by corresponding differences in production.

Special Pastures

Reed canary-grass pastures produced 302 animal-unit days of grazing per acre. Even with the high land value of $123.60 per acre the cost per day of grazing was only 3.1 cents. Reed canary grass, however, was generally considered as of poor quality for dairy cattle and quite unsatis-

factory for sheep; hence it may not be worth as much per day as other pastures.

Irrigated Ladino clover pastures produced 342 animal-unit days of grazing per acre. Even at this high yield the cost was 6.3 cents. Dairymen, however, considered these pastures worth the higher cost due to the higher quality of the forage and particularly to its succulence during the summer months when unirrigated pastures are dry.

Annual pastures, such as Sudan grass and rape, cost even more per day of grazing than did Ladino clover, but the Sudan grass was largely grazed during the summer months by dairy cows when other pastures are very dry and unproductive unless irrigated. Rape was used largely to fatten lambs in the summer after the grass pastures had dried up, and hence was given a high value.

Southern Oregon Pastures

The Douglas County hill pastures were similar to the Willamette Valley hill pastures except less productive. They produced only 34 animal-unit days of grazing per acre and were valued at $11.20 per acre. The cost per day of grazing was also less. The irrigated pastures of Jackson County produced an average of 210 animal-unit days of grazing and were valued at $92.20 per acre. Including interest on this valuation, the cost per day of grazing was 5.5 cents, a figure slightly higher than the cost of grazing on unirrigated grass pastures but slightly less than on irrigated Ladino pastures.

Possibilities of Pasture Improvement

The most significant fact in connection with this study was the difference in the productivity and value per acre of different kinds of pasture even on similar lands. Productivity was directly related to the clearing of brush and the seeding of tame grasses. This difference in productivity was recognized by the owners in the valuation placed on the land. The owners showed unusually good judgment in the valuation of their lands, and the valuations, on the average, reflected clearly the differences in productivity.

In the case of special pastures that produce dry-weather pasture, such as irrigated Ladino, Sudan grass, or rape, the values also reflected the higher value per day of such dry-weather grazing. The only place where the land values given by the operator did not reflect productivity was in the areas of brush and timber possessing no grazing value. Apparently the owners placed some value on these lands with the thought that eventually they might be made to produce grass at an expense not too great.

PASTURE SUMMARY TABLE
Willamette Valley and Southern Oregon Regions

Kind of pasture and region	Pastures included	Maintenance cost		A.U. days of grazing per acre	Length of pasture season	Acres required to carry one A.U. for the season	Land value per acre
		Per acre	Per A.U. day of grazing*				
	Number		*Cents*	*Number*	*Days*	*Number*	
WILLAMETTE VALLEY							
Hill pastures							
Native grass	54	$1.46	3.5	42	270	6.4	$19.20
Tame mixed grass	20	2.10	3.5	59	270	4.6	23.60
Valley pastures							
Native grass	103	2.49	5.0	50	270	5.4	33.60
Tame mixed grass	61	4.74	4.9	96	210	2.2	60.80
Rye grass	28	4.36	5.3	82	255	3.1	53.60
Alfalfa	14	12.40	5.2	240	160	.7	102.20
Red and alsike clover	32	8.14	5.0	164	141	.9	102.80
Special pastures†							
Reed canary grass	17	9.27	3.1	302	195	.6	123.60
Ladino clover (irrigated)	39	21.60	6.3	342	207	.6	153.00
Sudan grass	15	12.20	7.8	156	101	.6	52.20
Rape	29	9.44	10.5	92	106	1.2	73.60
SOUTHERN OREGON							
Douglas County							
Hill pastures	25	.83	2.7	34	360	10.6	11.20
Jackson County							
Irrigated pastures	12	11.48	5.5	210	183	.9	92.20

* An animal-unit (A.U.) day of grazing is one day's grazing for 1 mature cow or horse, 5 sheep or goats, 8 hogs, or 100 poultry. Two head of young stock were considered to be equal to 1 head of mature stock of like kind.

† Sweet clover pastures are not included in summary because only data regarding the cost of establishing a stand were obtained.

Costs and Grazing Values of Willamette Valley and Southern Oregon Farm Pastures*

By

WILLIAM W. GORTON

INTRODUCTION

HALF of the farm land of the Willamette Valley is devoted to a single purpose, pasture. On these pastures, according to the Federal Census of 1935, graze approximately 197,000 cattle, 256,000 sheep and lambs, 76,000 goats, and 44,000 horses and mules. This vast grass-consuming herd produced annually about a third of the total cash farm income of the region.

Willamette Valley pastures cover some 1,400,000 acres of farm land and provide a substantial portion of the feed for the livestock of the region. This important enterprise has developed, on the whole, by trial and error methods, for pasture is usually assigned to poorer soils and locations and is allowed, like Topsy, just to grow. There are thus pastures producing to the utmost, pastures producing only exercise for the livestock, and in between these extremes pastures of every conceivable state of productivity.

Objectives. The specific objectives of this study were:

1. To determine the yields of the principal pasture types.
2. To ascertain the cost of maintaining these pastures.
3. To determine the cost of establishing different pasture types.
4. To analyze the factors governing pasture yields and costs and to point out methods of increasing the efficiency of Oregon farm pastures.

Scope. This study was state-wide in scope, covering most of the areas where farm pastures are of major importance, but the data for eastern Oregon and the Coast regions are reported on in separate publications.† This bulletin covers the Willamette Valley and portions of southern Oregon as is shown by a map of the region (Figure 1). The Willamette Valley area will be treated separately from southern Oregon.

In the Willamette Valley 12 distinct types of pasture are covered, the basic data being obtained from individual farmers over the 2-year period 1934 and

* ACKNOWLEDGMENTS: The author expresses his sincere appreciation to those who have aided in the preparation of this bulletin. Especial credit and thanks are due: (1) the farmers from whom the basic information was obtained; (2) H. E. Selby, formerly head of the Department of Farm Management, who was instrumental in setting up this study and who directed the first year's field operations; (3) Oran M. Nelson, professor of animal husbandry, for his aid in the collection of the data and for counsel in its analysis; (4) E. R. Jackman, extension specialist in farm crops, and Harry A. Schoth, agronomist, United States Department of Agriculture, for subject-matter information freely given; (5) Howard G. Smith, G. W. Kuhlman, Arnold N. Bodtker, Leland Fryer, and Clair Wilkes for their services in collecting the field data; (6) the county agricultural agents of the counties included in this study; and (7) D. Curtis Mumford, head of the Department of Farm Management, and E. L. Potter, chief of the Division of Agricultural Economics, for aid in the preparation of the subject matter.

† Bulletin 390, Cost, Efficiency, and Management of Dairy Cattle Pastures, Coast Region, Oregon. Bulletin 391, Cost and Efficiency of Irrigated Farm Pastures in Eastern Oregon.

1935. In southern Oregon only two pasture types were covered over the period 1935 and 1936. A total of 467 usable records were obtained for the Willamette Valley and 37 for southern Oregon. These records cover 47,755 acres of pasture land and account for 2,593,341 animal-unit days of grazing.*

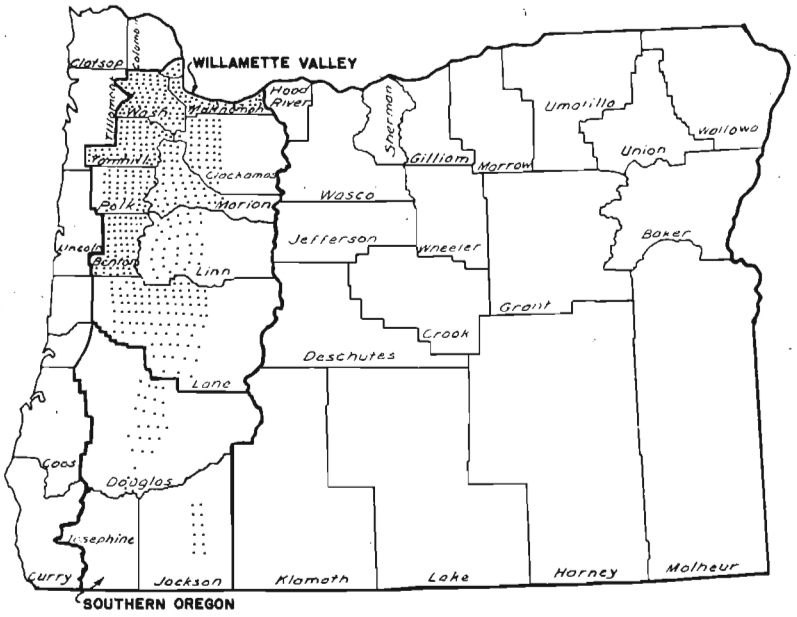

Figure 1. Number and approximate distribution of pastures included in this study.

Method used. This study was made by the survey method. In selecting the sample and obtaining the records used, operators were selected at random and records were taken on all types of pasture available. On all farms data regarding total acreage, acreage in different crops, tenure, and livestock were obtained in addition to pasture data. On farms where more than one pasture was covered, a separate schedule was used for each one. A detailed description of the methods and terms used in the research is presented in Appendix C.

GENERAL DESCRIPTION OF THE REGION

The Willamette Valley extends from the Columbia River south about 150 miles to the hills that separate it from the watershed of the Umpqua River. On the east it is bounded by the Cascade Range and on the west by the Coast Range. Lying between the main valley floor and the steep, nonagricultural portions of the mountains that surround the valley proper are rolling hills adaptable to cropping or pasture.

Soils. The main valley floor has been built largely by alluvial depositions, whereas the hill soils are composed, in the main, of residual material that has

* An animal unit was considered to be 1 mature cow or horse, 5 sheep or goats, 8 hogs, or 100 poultry. Two head of young stock were computed as being equivalent to one head of mature stock of like kind.

weathered in place. Great variation occurs in the soils due to texture, depth, drainage, parent materials, etc. To provide a convenient and easily used classification of the 157 named soil types mapped by soil surveys that cover all Willamette Valley lands outside the National Forests, the soils have been grouped into six classifications according to adaptability for agricultural purposes.* These classifications will be used in this report whenever the relation of soil to pasture is discussed.

Climatic conditions. The Willamette Valley is in a somewhat paradoxical position as regards precipitation. It has a humid climate but very low summer rainfall. The total annual average rainfall is 42 inches, but a near drouth prevails during the months of July and August (Figure 2).

Weather conditions affecting pastures in the Willamette Valley were somewhat unfavorable during both years of this study, 1934 and 1935. The normal total precipitation at Albany† for the critical pasture season, May through September, is 6.4 inches. The total amount for this period in 1934 was 3.5 inches and in 1935, 2.6 inches. Monthly temperatures were somewhat higher than average both years of the study.

The opinion of Oregon farmers generally regarding pasture conditions is reflected by data reported by crop correspondents of the United States Department of Agriculture and published in "Crops and Markets." These data reveal that, while the average condition of Oregon pastures was 80 per cent during the 11-year period 1925-1935, the average for 1934 was 73 per cent and for 1935, 69 per cent.

From this evidence it appears that the data upon which this report is based were obtained during a period when pasture yields were below normal. Yields as reported herein, therefore, are believed to be conservative and reflect what may be expected from pastures during drier-than-average periods.

Basis of classification. For simplicity of presentation and comparison, the pastures have been grouped into four major classes and subgrouped under these main classes according to the predominate type of forage on each. Twelve distinct pasture types have been covered in the Willamette Valley and two in southern Oregon. These classes and types are:

Class I. Hill pastures:
(1) Native grass, (2) tame mixed grass.

Class II. Valley pastures:
(1) Native grass, (2) tame mixed grass, (3) rye grass, (4) alfalfa, (5) red and Alsike clover.

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* Selby, H. E., and Fryer, Leland, "Willamette Valley Land Adaptability," Oregon Experiment Station Circular 120. March 1937. To quote from this circular, page 3:
"The predominating adaptability of each of the land classes, is, briefly, as follows:
"Valley soils
Land type 1. Intensive crops such as vegetables, small fruits, crops, etc.
Land type 2. General farming with limited production of intensive crops.
Land type 3. Hay, grain, and seed production.
Land type 4. Pasture, with limited production of hay, grain, and seed.
"Hill soils
Land type 1 Hill. Fruit raising and general farming.
Land type 2 Hill. Pasture and extensive cropping.
"The predominating and most characteristic soil series in the different types of valley land are Chehalis in type 1, Willamette in type 2, Amity in type 3, and Dayton in type 4 . . . "

† Data from publications of the United States Weather Bureau. Averages for the Albany Station in 1936 were based on 58 years of records.

Class III. Special pastures:

(1) Reed canary grass, (2) irrigated Ladino clover, (3) Sudan grass, (4) rape, (5) sweet clover.

Class IV. Southern Oregon:

(1) Douglas County hill pastures, (2) Jackson County tame mixed-grass irrigated pastures.

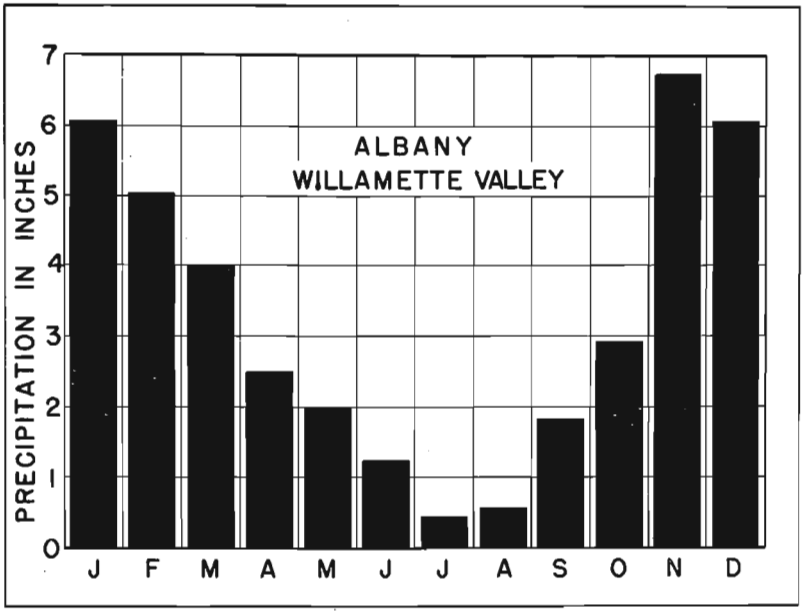

Figure 2.

The native and tame mixed-grass types listed above are generalized forage classes. "Native grass" is a term used locally to designate all grasses that come in naturally without being seeded. Some of these are indigenous to the region but the larger proportion are introduced grasses that have gone wild and have been widely diffused over the region. Tame mixed-grass pastures are those seeded to various mixtures of forage plants. No one forage plant on these pastures accounted for as much as 50 per cent of the total grass cover except in a few cases where there were too few pastures of a particular kind of grass to warrant separate analysis.

HILL PASTURES

Surrounding the main valley floor of the Willamette Valley on the east, west, and south, are more than a million and a half acres of hill lands adaptable in large part to some form of agricultural use. Much of this vast acreage is now devoted, and probably always will be, to the grazing of domestic livestock. Bordering this type of hill land are mountainous regions too steep, rocky,

infertile, or isolated to be adapted to uses other than forestry. It is improbable that the acreage of land devoted to agricultural pursuits will be expanded greatly by the inclusion of land now in forests. Agricultural expansion will rather come through the improvement of land now in farms.

A total of 74 records were obtained on hill pastures, of which 54 were native-grass pastures and 20 tame mixed-grass pastures.

DESCRIPTION

Native-grass hill pastures are those hill pastures that have had little or no improvement done on them other than varying amounts of slashing and burning to clear the land of brush and trees. The forage cover is made up of native and introduced grasses and weeds, all established without seeding. Within the boundaries of most of these pastures studied were trees, brush, and waste land that accounted, on the average, for about one-third of the total area, leaving but two-thirds of the total acreage to produce forage.

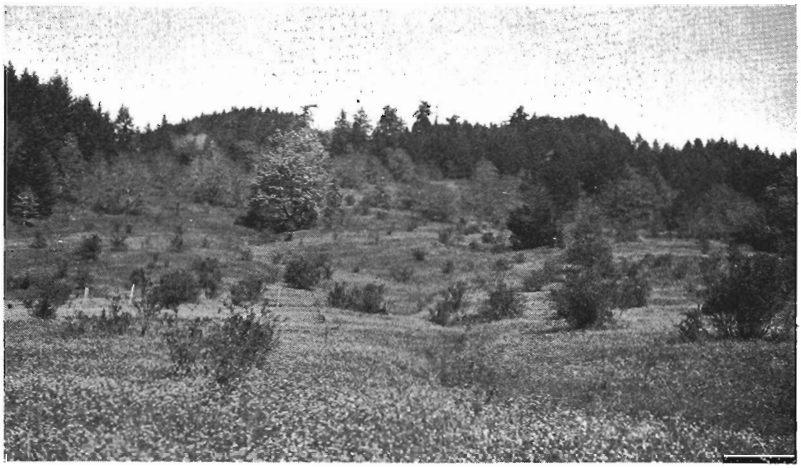

Figure 3. Weeds and brush on native-grass hill pasture.

Tame mixed-grass hill pastures differed from native-grass hill pastures in that they had been seeded to various tame-grass mixtures. The principal grasses sown were English rye grass, Italian or common rye grass, orchard grass, bent grass (Seaside, Astoria, and Highland), Chewings fescue, velvet grass (*Holcus lanatus*), red top, tall oat grass, red clover, Alsike clover, and bur clover. Little difference could be noted in soil and topography between the seeded- and native-grass pastures.

GRAZING VALUE

Native-grass hill pastures produced an average of 42 animal-unit days of grazing per acre, and the tame mixed-grass pastures 59. At this rate it would require 6.4 acres of native-grass or 4.6 acres of tame mixed-grass pasture to carry one animal unit (one cow or five sheep) for a nine-month grazing season.

Sheep and goats predominated on these pastures. Of the total number of grazing days produced, sheep accounted for 47 per cent, goats 28, milk cows 14, and all other stock 11. Goats were left on pasture the year round, sheep about three-fourths of the year, and milk cows about 6 months.

Hill pastures are used to some extent all year, for they are usually well drained and produce some forage even during the winter months. The grazing season begins in March. Production hits the peak in June or July, and then rapidly diminishes until the fall rains begin in September. The seasonal production of native-grass hill pastures is shown graphically in Figure 15, Appendix B.

In 1935 feed supplemental to pasture accounted for 38 per cent of the total feed requirements for milk cows, 8 per cent for sheep, and only 1 per cent for goats. This varied by the season of the year (Table 1). Horses were commonly fed only when working.

MAINTENANCE COST

The total annual cost of maintaining native-grass hill pastures amounted to $1.46 per acre, or 3.5 cents per day of grazing for an animal unit (1 cow or 5 sheep). These pastures produced an average of 42 days of grazing per acre per year. Tame mixed-grass pastures were maintained at a cost of $2.10 per acre or 3.5 cents per day for the 59 animal-unit days of grazing produced per acre (Table 2). Similar cost per unit produced was thus obtained on these hill pastures because higher costs per acre for improved pastures were offset by higher production.

The unit cost of 3.5 cents per day, or $1.05 per month, corresponds very closely with the amount of rent charged for the use of hill pastures. The charge for grazing a mature cow on rented pasture averaged $1.06 per month. There was considerable variation, of course, in both costs and rental charges as between different pastures and communities, but it appears that, for the Valley as a whole, rental rates were in line with costs.

Table 1. NATIVE GRASS HILL PASTURES: SEASONAL USE
Willamette Valley, Oregon, 1935

Month	Milk cows		Mature sheep		Goats	
	Proportion of total days use	Proportion of feed requirement obtained from supplemental feed*	Proportion of total days use	Proportion of feed requirement obtained from supplemental feed*	Proportion of total days use	Proportion of feed requirement obtained from supplemental feed*
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
January	3	68	7	32	8	2
February	3	68	7	28	8	2
March	5	57	8	17	8	2
April	9	30	9	.....	8	.....
May	17	29	10	.....	8	.....
June	17	27	10	.....	8	.....
July	16	34	9	.....	9	.....
August	13	42	9	.....	10	.....
September	5	38	7	.....	9	.....
October	6	38	7	.....	8	.....
November	4	64	8	7	8	.....
December	2	66	9	19	8	2
TOTAL OR AVERAGE	100	38	100	8	100	1

* Includes only those animals on pasture during the month indicated.

Table 2. HILL PASTURES: MAINTENANCE COSTS AND GRAZING VALUE
Willamette Valley, Oregon, 1934 and 1935

Item	Native grass, 54 pastures	Tame mixed grass, 20 pastures
Operator's valuation of land per acre	$ 19.20	$ 23.60
Average size of pasture, *acres*	137	109
Percentage of pasture area in grass land, *per cent*	63	71
Cost per acre		
Improvement costs*	$ 0.02	$ 0.10
Fence costs	.16	.24
Depreciation of stand	.....	.21
Taxes	.32	.37
Interest on land at 5 per cent	.96	1.18
TOTAL COST PER ACRE	$ 1.46	$ 2.10
Animal-unit days of grazing produced per acre	42	59
Cost per animal-unit day of grazing	3.5¢	3.5¢
Length of grazing season, *days*	270	270
Acres required to carry one animal unit for the grazing season	6.4	4.6
Percentage of feed requirements from supplemental sources (all stock), *per cent*	11	4

* Improvement costs include weeding and fertilizing, and slashing, burning, and seeding where performed as a maintenance operation.

Seeded pastures tend to revert to lower-quality forage plants, a fact which necessitates reseeding from time to time in locations where this is possible. A great diversity of opinion was evidenced by the farmers included in this study as to the probable length of life of a stand of grass. Many of them, particularly in cases where seeding was done on nontillable stump land, believed that they had established a permanent stand. Others estimated from 5 to 18 years.

The average estimated length of life of a mixed-grass stand was about 10 years excluding permanent stands and those to be plowed up in a regular crop rotation. For all seeded hill pastures the charge for depreciation of stand averaged .21 cent per acre. Costs of establishing a stand of grass are discussed on page 23.

It will be noted from Table 2 that for both types of pasture the major part of the cost was for interest on land. Land values were estimated by the individual operators and averaged approximately $11.00 for brush or otherwise nonpasturable land, $24.00 for native grass land, and $29.00 for tame mixed-grass land. For the total acreage, native-grass pastures were valued at $19.20 and tame mixed-grass pastures at $23.60. Interest was charged on these values at the arbitrarily selected rate of 5 per cent per annum.

COMPARISON OF NATIVE AND TAME MIXED PASTURE TYPES

Type of grass cover and extent of improvement for pasture purposes were the main differences between the native grass and tame mixed-grass hill pastures included in this study. Soils, as nearly as could be ascertained, were similar for the two types, and the class of animals pastured was likewise similar. The higher production of tame mixed-grass pastures, then, appears to be due to the seeding of grass mixtures. A comparison of the two types (Table 2) shows that while the improved type costs more per acre per year to maintain, the cost per unit of forage produced is the same and the higher value placed on tame-grass pasture land appears to be justified by the higher yield obtained.

VALLEY PASTURES

Farmers on the main valley floor have a much wider range of pasture types from which to choose than do those on hill lands. The grass pasture types discussed in this section; native, tame mixed, and rye grass, are adaptable to about the same soils and growing conditions, and in many cases represent alternate choices on the part of the farm operator. The leguminous types, alfalfa, and red and alsike clover, have a much narrower range of adaptability.

A total of 192 records were obtained on the grass pastures included in this classification, and 46 on the leguminous ones.

DESCRIPTION OF GRASS PASTURES

Native grass. The forage cover of these pastures was a mixture of true native and introduced grasses and weeds that had become established by natural means. Approximately three-fourths of the total acreage included in this pasture type was grass land, the balance being largely nonproductive because of brush, stumps, trees, streams, etc. Of the grass-land acreage nearly half was tillable land that had been allowed to revert to pasture by the voluntary growth of grass and weeds.

Rye grass. In this group were included all pastures that had a forage cover containing 50 per cent or more rye grass of either perennial or common species.* This grass was found on all classes of soil. It was generally seeded

* Perennial rye grass (*Lolium perenne*) is also called English rye grass, and common rye grass (*L. multiflorum*) is also called domestic or Italian rye grass and is an annual, although stands may last longer due to reseeding.

by drilling on tillable land following a grain crop and was usually seeded without a nurse crop. Some of the stands had been previously used for seed production but in general they were seeded for pasture purposes. About three-fourths of these pastures were in a rotation with other crops. The balance were permanent pastures.

Tame mixed grass. Included in this classification are improved valley-land pastures that have been seeded to various combinations of grasses. Nearly three-fourths of the total acreage was grass land, leaving one-fourth of the

Figure 4. Native-grass pasture on Class 1 valley-land soil. This field is subject to flooding when the Willamette River overflows its banks.

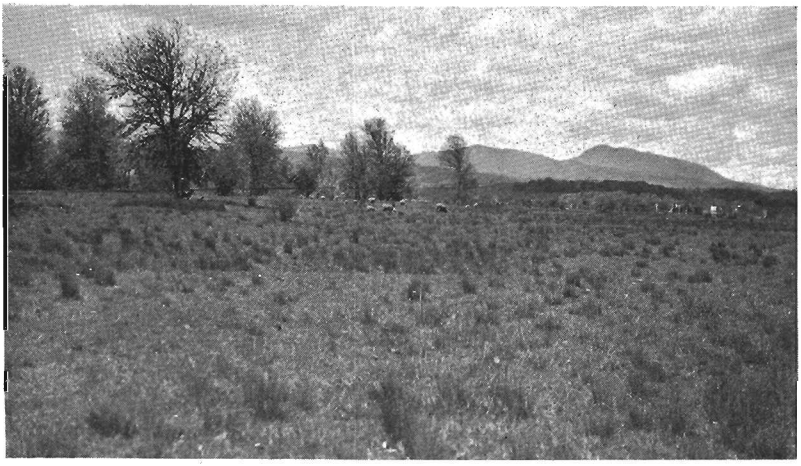

Figure 5. Native-grass pasture on Class 4 (Dayton) soil.

total unproductive as far as pasture was concerned. About half of the grass land was tillable and had been cropped. The tillable land was seeded largely on a prepared seedbed and the nontillable on ashes following a burn.

A few of these pastures were seeded to a single kind of grass but most of them were seeded with various combinations of the grasses and clovers listed below:

Domestic (Italian) rye grass	Tall oat grass
Perennial (English) rye grass	Reed canary grass
Red top	Bluegrass (Kentucky)
Bent grass	Timothy
Orchard grass	White clover
Meadow fescue	Red clover
Plantain	Alsike clover
Velvet grass	

While tame mixed-grass pastures occurred on all classes of soil, few of them were found on Class 4 (Dayton series) soils.* On these soils, rye grass and some of the native grasses were about the only ones seeded for pasture.

DESCRIPTION OF LEGUMINOUS PASTURES

The forage cover of the pastures included in this grouping was largely leguminous, but varying amounts of grass were present in most of them. In general, leguminous pastures are of better quality than grass pastures and are used mainly for dairy cattle as contrasted with several of the grass-pasture types that are grazed to a large extent by sheep or goats.

Alfalfa. Alfalfa-hay production in the Willamette Valley has increased from about 10,000 acres in 1929 to an estimated 50,000 acres in 1939. This large increase in alfalfa-hay production has likely been accompanied by a corresponding increase in the acreage of alfalfa used for pasture. Pasturing of this crop is usually confined, however, to utilization of the third crop and aftermath rather than season-long use. No attempt was made in this study to determine costs or grazing value of any except full-time pastures, because of interrelated use and joint costs on fields used primarily for hay.

The average age of alfalfa fields included in this study was 4 years, with 3 years remaining life as estimated by operators. The stands were estimated to contain 74 per cent alfalfa, 22 per cent forage grass, and 4 per cent weeds and barren spots. One operator grew alfalfa on hill-land soil, the balance used good-quality bottom land.

Red and Alsike clover. These pastures were found largely on soils of the second- and third-class land types such as Willamette, Amity, Wapato, and on good-quality hill soils of the Olympic, Melbourne, and similar series. In a few cases, Alsike clover was found on soils of the Dayton series. Soil condition determines not only how good a crop of clover may be grown, but also limits the use of companion crops in establishing a stand. The nurse-crop method of reducing the cost of establishing clover cannot be used with success on infertile or poor-quality land. The average age of the clover pastures included in this study was 1.5 years and the operators stated that they planned on using them for another 1.5 years.

* See page 11 for the soil classification used.

GRAZING VALUE OF VALLEY-LAND GRASS PASTURES

Native grass. Valley-land native-grass pastures produced an average of 50 animal-unit days of grazing per acre during a nine-month season, which extended from the first of March through November. About 5.4 acres would thus be required to graze an animal unit (1 cow or 5 sheep) for the season. Many of these pastures, however, were grazed the year around with supplemental barn feed being provided during the winter months, particularly for milk cows and horses. Yields varied with the grade of the soil, first-quality soils producing about 30 per cent more days of grazing per acre than did the poorer-quality soils (Table 3).

Cattle predominated on all of the valley-land grass pastures studied, whereas sheep were the predominant type on hill-land pastures.

Table 3. NATIVE GRASS PASTURES: RELATION OF PASTURE YIELD TO LAND TYPE
Willamette Valley, Oregon, 1934 and 1935

Land types	Pastures	Average size of pasture	Proportion of acreage in grass	Proportion of feed from pasture	A.U. days per acre	Land value per acre	Cost per A.U. day of grazing
	Number	*Acres*	*Per cent*	*Per cent*	*Number*		*Cents*
Class 1*	24	85	76	84	68	$38.00	4.6
Class 2	†	.....	.....	.....	.....	.....	.....
Class 3	38	126	68	78	47	34.00	7.4
Class 4	21	142	91	87	47	28.00	5.0
ALL PASTURES‡	103	116	75	83	50	33.60	5.0

* See page 11 for a description of these land types.
† Only five records on land Class 2 were available, which was too small a sample to show accurate results.
‡ Of the 103 records obtained on this class of pasture, 15 covered pastures having two or more land types. These were not included in this tabulation.

Rye grass. Rye-grass pastures produced an average of 82 animal-unit days of grazing per acre for a grazing season averaging 8½ months in length. It would therefore require 3.1 acres to carry an animal unit (1 cow or 5 sheep) for the season. Yields varied from less than 50 to more than 250 days of grazing per acre; 60 per cent of the operators obtained a yield of less than 100 days per acre, 31 per cent obtained between 100 and 200, and 9 per cent obtained more than 200.

Sheep grazed on these pastures the year around, and milk cows were on them from 4 to 6 months during the spring and fall. Sheep accounted for nearly half of the total number of grazing days produced, and milk cows for all but about 10 per cent of the balance.

Tame mixed grass. These pastures produced an average of 96 animal-unit days of grazing per acre annually. The main pasture season extended from the fore part of April through October, a period of approximately 7 months. To carry one cow for this pasture season it would require about 2.2 acres.

GRAZING VALUE OF LEGUMINOUS PASTURES

Alfalfa. Dairy cattle were turned on alfalfa pasture the middle of April and were taken off the latter part of September, a period of 160 days.

During this season alfalfa produced 240 animal-unit days of grazing per acre. At this rate 1.5 animal units were grazed per acre, or, stated in another way, about .7 acre was utilized to carry one animal unit for the season. Pasture value was not uniform throughout the period, as rather extensive supplemental feeding and utilization of grain and hay stubble were resorted to during the latter part of the season. These pastures provided approximately 72 per cent of the total feed required by the animals while on pasture.

Figure 6. Early spring pasture on tame mixed grass.

This is the only pasture type included in the study on which hogs constituted an important grazing unit, accounting for 15 per cent of the total use. Dairy cattle accounted for 77 per cent and all other stock for the remaining 8 per cent.

In answer to a question regarding seriousness of bloat on alfalfa pasture, 11 of the 14 operators reported none during the current pasture season. The three reporting bloat had suffered no loss for the season but had experienced considerable trouble from it. Only 2 of the 14 operators reporting had ever had losses from bloat. Despite the low losses reported, however, the seriousness of the bloat problem should not be minimized. On lush pasture danger is ever present, and avoidance of loss is the reward for continual watchfulness and care. The loss of even one good cow may wipe out the profits of a whole season's operations.

Red and Alsike clover. This pasture type, like all the legumes, was utilized principally by milk cows, more than three-fourths of the total grazing being so used. Horses, sheep, and young cattle accounted for the balance. The pasture season averaged 141 days in length, from the latter part of April through the middle of August. During this period these pastures carried an average of 164 animal-unit days to the acre. It would therefore require about 0.9 acre of red or Alsike clover pasture to carry an animal unit (1 cow or 5 sheep) for the season.

MAINTENANCE COSTS OF VALLEY-LAND GRASS PASTURES

Native grass. The average annual cost for maintaining native-grass valley-land pastures was $2.49 per acre (Table 4). Of this amount taxes accounted for $0.56 and fencing and minor improvements for $0.25 per acre. The remainder of $1.68 was the charge for interest at 5 per cent on the valuation placed on the land by the operator. Land covered with brush and trees was valued at approximately $16.00 per acre and open grass land at $40.00 per acre, the two items thus averaging $33.60 per acre for the pasture area taken as a whole.

The cost of grazing an animal unit (1 cow or 5 sheep) was 5 cents per day, or $1.50 per month. This cost is higher than that for hill pastures by 45 cents per month, but it is at least partly offset by the better quality forage produced. This better quality is evidenced by the fact that dairy cattle rather than sheep or goats predominate.

Rye grass. The average annual cost of maintaining rye-grass pastures was $4.36 per acre, or 5.3 cents per animal-unit day of grazing, for the 82 days of grazing produced per acre (Table 4). Of the total cost per acre, taxes accounted for $0.87, fence and improvement costs for $0.46, and depreciation of the stand of grass for $0.35. The balance of $2.68 per acre was for interest at 5 per cent on the $53.60 average valuation placed on the land by the operators.

Tame mixed grass. Annual maintenance costs for this pasture type averaged $4.74 per acre, or 4.9 cents per animal-unit day of grazing, for the 96 days produced per acre. The monthly cost of furnishing grazing for an animal unit (1 cow or 5 sheep), therefore, was about $1.50. The principal cost was the charge for the use of land (interest at 5 per cent on the value of the land as estimated by the operator) with taxes and fence cost being the next most important items (Table 4).

Table 4. VALLEY-LAND GRASS PASTURES: MAINTENANCE COST AND GRAZING VALUE
Willamette Valley, Oregon, 1934 and 1935

Item	Native grass, 103 pastures	Rye grass, 28 pastures	Tame mixed grass, 61 pastures
Operator's valuation of land per acre	$ 33.60	$ 53.60	$ 60.80
Average size of pastures, *acres*	116	41	45
Percentage of pasture area in grass land *per cent*	75	82	74
Cost per acre			
Improvement costs*	$ 0.06	$ 0.08	$ 0.11
Fence costs	.19	.38	.30
Depreciation of stand	.....	.35	.16
Drainage assessments	.....	.....	.15
Taxes	.56	.87	.98
Interest on land at 5 per cent	1.68	2.68	3.04
TOTAL COST PER ACRE	$ 2.49	$ 4.36	$ 4.74
Animal-unit days of grazing produced per acre	50	82	96
Cost per animal-unit day of grazing, *cents*	5.0	5.3	4.9
Length of grazing season, *days*	270	255	210
Acres required to carry one animal unit for the grazing season	5.4	3.0	2.2
Percentage of feed requirements from supplemental sources (all stock), *per cent*	17	16	18

* Improvement costs include weeding, ditching for drainage, slashing, and burning and seeding where performed as a maintenance operation.

The total labor cost was 10 cents per acre for the approximately one-half hour used per acre. Over half of this amount was for fence repairs and the balance for maintenance and improvement work, such as slashing, burning, and seeding.

MAINTENANCE COSTS OF LEGUMINOUS PASTURES

Alfalfa. For the 240 days grazing produced per acre, the average cost per animal-unit day was 5.2 cents, and the average cost per acre was $12.40 (Table 5). Maintenance operations on alfalfa pastures consisted of fertilizing, cultivating, weeding, and fence repair. On an acre basis these operations required 1.5 hours of man labor and 2.7 hours horse work. The land used for these pastures was valued by the operators at $102.20 per acre.

Red and Alsike clover. The average annual net cost of maintaining clover pasture was $8.14 per acre, or 5 cents per day, for the 164 animal-unit days of grazing produced per acre. Labor requirements and land value were similar to those of alfalfa pastures, the main difference in the cost per acre being in the amount of fertilization practiced, in the charge for depreciation of stand, and in the credit for hay cut from clover pasture (Table 5). Hay was harvested from only 3 of the 32 clover pastures covered.

Table 5. ALFALFA AND RED AND ALSIKE CLOVER PASTURES: MAINTENANCE COST AND GRAZING VALUE

Willamette Valley, Oregon, 1934 and 1935

Item	Alfalfa, 14 pastures	Red and Alsike clover, 32 pastures	Proportion of pastures reporting the item	
			Alfalfa	Clover
			Per cent	*Per cent*
Operator's valuation of land per acre	$102.20	$102.80	.....	.....
Average size of pasture, *acres*	9.2	17.0	.....	.....
Cost per acre				
Fertilizing	$ 1.09	$ .37	64	50
Cultivating and weeding	.43	.16	50	19
Fence maintenance	.81	.69	100	100
Drainage assessment	.....	.16	.....	3
Depreciation of stand	3.53	1.41	100	88
Taxes	1.43	1.61	100	100
Interest on land at 5 per cent	5.11	5.14	100	100
TOTAL GROSS COST	$ 12.40	$ 9.54	.....	.....
Credit for hay	.....	1.40	.....	9
TOTAL NET COST	$ 12.40	$ 8.14	.....	.....
Animal-unit days of grazing per acre	240	164	.....	.....
Cost per animal-unit day of grazing	5.2¢	5.0¢	.....	.....
Length of grazing season, *days*	160	141	.....	.....
Acres required to carry one animal unit for the grazing season	0.7	0.9	.....	.....
Percentage of feed requirements from supplemental sources (all stock), *per cent*	28	31	.....	.....

COST OF ESTABLISHING HILL OR VALLEY-LAND GRASS PASTURES

Methods of seeding the pastures included in this section, both hill and valley land, varied from scattering seed on the ashes of a burn to preparing a seedbed with a plow and harrow. The expected life of the resulting stand also showed great variation. Some of the operators who seeded pasture on tillable land planned on leaving the land in grass for 3 or 4 years as a part of a crop rotation, others planned on a semi-permanent stand that would last, they estimated, from 6 to 20 or more years. Those seeding on nontillable land mainly did so with the expectation of pasturing the land indefinitely.

Tame mixed-grass pastures. The average gross cost of establishing tame mixed grasses on tillable land and maintaining them for the first year was $7.65 per acre (Table 6). From this gross cost $1.96 credit for pasture used the year of seeding was subtracted to arrive at a net cost of $5.69 per acre. During the year of seeding these pastures produced an average of 49 animal-unit days of grazing per acre, which was credited at the operator-estimated rental rate of 4 cents per day to arrive at the $1.96 credit.

All but 2 of the 11 operators from whom seeding information was obtained seeded pasture mixtures without a nurse or companion crop and all obtained a good stand. To plow or disk the land, cultivate it, seed it, and care for it for the first year required an average of 3 man hours of labor and 6 hours of horse work per acre. Seed cost an average of $2.16 per acre, which was for a mixture including most of the grasses and clovers mentioned previously as being adaptable to this region.

Table 6. GRASS PASTURES: COST OF ESTABLISHING AND OPERATING FOR FIRST YEAR
Willamette Valley, Oregon, 1934 and 1935

Item	Tame mixed grass, 11 pastures	Rye grass, 7 pastures
Average size of pastures, *acres*	55	23
Animal-unit days of grazing produced per acre (year of establishing)	49	58
Cost per acre		
Fertilizing	$ 0.06	$ 0.26
Soil preparation	1.94	.42
Seed	2.16	1.06
Seeding	.47	.75
Fence maintenance	.19	.27
Miscellaneous	.04	.02
Taxes	.86	.74
Interest on land at 5 per cent	1.93	2.48
TOTAL GROSS COST OF ESTABLISHING	$ 7.65	$ 6.00
Credit for pasturage produced	$ 1.96	$ 2.35
TOTAL NET COST OF ESTABLISHING	$ 5.69	$ 3.65

A sample mixture that would cost about $2.25 per acre at prices prevailing in 1940, suitable for use on third-class land such as the soils of the Amity series, is shown below:

English rye grass.....5 pounds
Italian rye grass.....5 pounds
Bent grass.....1 pound
(2 would be preferable)
Alsike clover.....2 pounds
Chewings fescue.....2 pounds

This mixture would vary greatly depending on soil conditions, whether land was shaded or not, the relative prices of these and other seeds, the amount to be invested, and numerous other factors. The basic grasses on most soils in the Willamette Valley are the rye grasses. Other grasses, and legumes, are added to these in whatever amount and mixture seems expedient, necessary, and economically feasible at the time.

The cost of converting nonplowable brush or tree-covered land to a seeded pasture is made up of the cost of slashing and burning the brush and trees, the seed, cost of seeding, and regular maintenance operations, such as repairing fence. In most parts of the Willamette Valley wood is of sufficient value that its sale pays for the cost of piling and burning the slashings remaining after the wood is removed. Seed costs from $1.00 to $2.00 per acre and can be sown by hand at the rate of from 5 to 10 acres per man-day. Seeding is usually done immediately following the burn, for ashes that have not been excessively rained on make an excellent seedbed. Few operators reported success in obtaining a stand on nontillable land without a burn, except where frost had cracked the topsoil and forest duff so that the seeds were allowed to penetrate below the surface.

Rye-grass pastures. Rye-grass pastures were usually established by seeding on corn, rape, oat, or other cropland with but little seedbed preparation. The cost, which was therefore mainly for seed, seeding, taxes, and interest on the investment, averaged $6.00 gross per acre and $3.65 net after $2.35 credit was taken for the 58 days of grazing obtained the first year (Table 6).

Common rye grass is a winter annual, but many of the operators with this type of pasture planned on leaving it undisturbed for from 2 to 10 or more years, since it tends to reseed if not overgrazed. Pure stands of common rye grass are usually sown on the poorer types of soil because of the low initial cost. Over a period of years mixed grasses and clovers yield better and are of superior quality to rye grass on soils adapted to their growth.

COST OF ESTABLISHING LEGUMINOUS PASTURES

Alfalfa. Five records were obtained on the cost of establishing a stand of alfalfa. These records are believed to be reliable and their averages to reflect conditions as they existed in 1934 and 1935, even though the number of cases is limited.

The total gross cost of establishing and maintaining a stand of alfalfa the first year was $23.49 an acre, from which a credit of $1.08 was deducted for 23 days of grazing to give a net cost of $22.41 (Table 7). All of the stands were seeded alone in the spring, four of them following a grain crop and the other following red clover. A total of 11.2 hours man labor, 25.4 hours horse work, and 1.7 hours tractor work were required the year of establishing. One of the five operators applied lime at the rate of 1 ton to the acre, and two operators used manure at the rate of 7 tons per acre. Seed was planted on well-prepared seedbeds at the rate of 16.5 pounds per acre, the Grimm variety being used by all operators at a cost per pound of $0.22. On the average an 86-per-cent stand was obtained, the balance being in weeds and bare spots.

Red and Alsike clover. No uniform method was used in establishing a stand of this pasture type. Of the 26 pastures on which this information was given 73 per cent were sown with a nurse crop, generally grain, 20 per cent alone, and 7 per cent were volunteer crops. The average seeding rate was 10

pounds per acre and seed cost 15 cents per pound. Seed was generally hand broadcast.

Table 7. LEGUMINOUS PASTURES: COST OF ESTABLISHING AND OPERATING FOR FIRST YEAR
Willamette Valley, Oregon, 1934 and 1935

Item	Alfalfa, 5 pastures	Red and Alsike clover, 6 pastures
Average size of pasture, *acres*	19	21
Animal-unit days of grazing produced per acre (year of establishing)	23	74
Cost per acre		
Fertilizing	$ 5.93	$ .....
Soil preparation	4.54	2.03
Seed	3.63	1.50
Seeding	.97	.16
Weed control	.34	.13
Fence maintenance	.63	.50
Taxes	1.37	1.34
Interest on land at 5 per cent	6.08	4.51
TOTAL GROSS COST OF ESTABLISHING	$ 23.49	$ 10.17
Credit for pasturage produced	1.08	3.49
TOTAL NET COST OF ESTABLISHING	$ 22.41	$ 6.68

The total gross cost of planting and maintaining a stand for the first year was $10.17 (Table 7). No credit for use of a companion crop was made because all seeding records were for clover seeded alone. A credit of $3.49 per acre was allowed, however, for the 74 days pasture obtained the first year to arrive at a net cost of $6.68 per acre for stands seeded alone. For stands established with a nurse crop, two-thirds of the gross cost as shown in Table 9 was arbitrarily charged to the nurse crop and one-third or $3.39, to the clover pasture. By charging depreciation of stand to individual records on the basis of method of establishing and on the estimated life of stand, an average annual cost of $1.41 for depreciation of stand was determined.

SPECIAL PASTURES

The pastures grouped under the classification of "Special" pastures are those that are used for particular purposes or under particular circumstances. The five pasture types included in this section are: Reed canary grass, irrigated Ladino clover, Sudan grass, rape, and sweet clover. Each is discussed separately, for each has certain peculiarities in use or adaptability that differentiates it from other pasture types.

REED CANARY GRASS

Description. Reed canary grass (*Pharlaris arundinacea L.*) is a coarse perennial 2 to 8 feet tall with leafy stems, usually stout enough to prevent lodging. It tends to grow in dense tussocks or bunches 2 to 3 feet in diameter, spreading underground by short, scaly, creeping branches or rootstocks. Reed canary grass pasture is a crop that, while high yielding, will grow on land often unsuited to other profitable crops, since it grows best on moist or swampy land. Profitable utilization of poorly drained fields is often a serious problem. For these situations Reed canary grass offers a high-yielding pasture crop that has

an extraordinarily long life. The original stand of this grass in Oregon, planted more than 50 years ago near Fishtrap, Coos County, is still in existence.

Maintenance cost. Annual maintenance costs for Reed canary-grass pastures averaged $9.27 per acre or 3.1 cents per day for the 302 animal-unit days of grazing produced per acre (Table 8). The cost for grazing an animal unit (1 cow or 5 sheep) for a month, therefore, would be $0.93, which is less than for any other pasture type studied and may be compared with $1.05 per month for hill pastures and $1.50 for valley-land grass pastures. Supplemental feed, it should be noted, accounted for 40 per cent of the total feed requirements of dairy cows on this pasture compared with 25 and 35 per cent respectively for the grass pastures mentioned.

The use of fertile bottom land valued by the operators at an average of approximately $124 per acre brought the charge for interest to $6.18 per acre. Taxes amounted to $1.86, fence maintenance to $0.78, and miscellaneous cost to $0.45 per acre. Labor requirements were low, averaging 1⅓ hours man labor per acre. This labor was largely expended in repairing fences.

Grazing value. These pastures produced an average of 302 animal-unit days of grazing per acre, which ranks Reed canary grass as one of the heaviest producers of forage in the Willamette Valley in locations suited to its requirements. It is fairly palatable and withstands moderate grazing, being consumed more readily if not allowed to make too rank a growth. All milk cows pastured on this grass were provided some supplemental feed, since its rapid, rather soft growth makes it a somewhat washy feed and cows usually eat less of it than in the case of more palatable grasses.

Table 8. REED CANARY-GRASS PASTURES: MAINTENANCE COST AND GRAZING VALUE
Willamette Valley, Oregon, 1934 and 1935

Item	Reed canary grass, 17 pastures
Operator's valuation of land per acre	$123.60
Average size of pastures, *acres*	12
Percentage of pasture area in grass land, *per cent*	100
Cost per acre	
Improvement costs*	$ .45
Fence costs	.78
Taxes	1.86
Interest on land at 5 per cent	6.18
TOTAL COST PER ACRE	$ 9.27
Animal-unit days of grazing produced per acre	302
Cost per animal-unit day of grazing	3.1
Length of grazing season, *days*	195
Acres required to carry one animal unit for the season	.6
Percentage of feed requirements from supplemental sources (all stock), *per cent*	26

* Improvement costs are for reseeding, ditching, weeding, and cultivating.

Barn feed supplements accounted for about 40 per cent of the total feed requirements of milk cows on these pastures, which is a higher average rate of feeding than was found on other pastures. Good gains on beef cattle and

heifers were reported on this grass alone, no supplemental feed being used. For all stock on these pastures supplemental feed accounted for about 26 per cent of their total feed requirements.

Reed canary grass was used almost exclusively for cattle. Milk cows accounted for 47 per cent of the total use, other cattle 48 per cent, and stock other than cattle for only 5 per cent. Danger of foot rot and liver fluke has eliminated it as a sheep pasture except in occasional well-drained locations.

The grazing season extended from mid-April to the latter part of October, a period of approximately 6½ months. During this period these pastures carried an average of about 1⅓ cows per acre.

Method of establishing a stand. On overflow land fall plowing is common and the seed is broadcast on the mud just after the water is off in the spring. Rate of seeding is usually 6 to 8 pounds per acre. While spring seeding is preferred, fall seeding may be necessary on land that dries out very rapidly in the spring.

On land that is wet all the time, soil preparation may be impossible. On such land the practice is to grow a row or two of Reed canary grass in the garden, plow it up early in the spring, and scatter the roots and stems over the surface of the swamp, stamping them into the mud if possible. A very small piece of root or even a stem not attached to the root will usually establish itself in wet ground in a short time.*

IRRIGATED LADINO CLOVER

Description. Ladino clover (*Trifolium repens*, variety *latum*), a native of Italy, is also known as giant white or Italian white clover. It is a very large variety of common white clover, has rather short tap roots and produces fleshy stems that lie above ground and commonly produce roots at the joints. Ladino clover is a perennial of medium long life, is less hardy than common white clover, is not drouth resistant, and will not grow successfully in wet, poorly drained locations.† It is grown almost entirely under irrigation in this region, and the pastures studied were all irrigated.

Like all clovers, best growth is made in fertile soil, well supplied with moisture. It can be grown, however, on poor-quality soils if adequate moisture is supplied. Location of an irrigated Ladino clover pasture on the farm is influenced more by the availability of a dependable water supply than by considerations regarding soil types, since it will grow on almost any irrigable land.

Irrigated Ladino pasture meets severe competition from other crops for the use of land for two reasons: Bottom land of good quality is usually used, and land so situated as to have available a dependable source of irrigation water assumes an additional value because of increased production possibilities. For these reasons Ladino pasture operates under high fixed costs for taxes and interest on land. Unless ample production is realized from the pasture, cash crops adaptable to supplemental irrigation may prove to be better able to repay fixed and operating expenses and to return a profit.

Grazing value. The pasture season of Ladino clover began the fore part of April and continued through October, with but little diminution of forage during July and August. It is largely to this sustained summer production

* For more complete data on uses and culture of this grass see Schoth, H. A., "Reed Canary Grass," U.S.D.A. Farmers' Bul. 1602, 1938.

† See Schoth, H. A., "Ladino Clover for Western Oregon," Oregon Experiment Station Bulletin 117, 1936, for methods of obtaining and managing a stand of Ladino clover.

that irrigated Ladino clover owes its popularity and its value in the dairyman's pasture program.* The seasonal production of Ladino clover is shown graphically in Figure 15, Appendix B.

For the average pasture season of 7 months, the 39 Ladino clover pastures studied had an average carrying capacity of almost 2 animal units per acre. Yields on the 39 pastures varied considerably: 15 per cent of them carried more than three cows or their equivalent per acre, 48 per cent carried more than two, 92 per cent carried more than one, and only 8 per cent carried less than one cow for the season.

Figure 7. Irrigated Ladino clover pasture on College Farm, Corvallis.

On the basis of total production, as well as in sustained summer production, irrigated Ladino clover excels all other pastures covered by this survey. An average of 342 animal-unit days of grazing per acre for all pastures was reported. Pastures irrigated by gravity flow showed a lower yield, 298 animal-unit days per acre, than did those for which water was pumped, 374 animal-unit days per acre. This differential in favor of pumping is probably due at least in part to the greater care taken of pastures where, since pumped water costs money, the operator makes every effort to get the highest production possible. No pasture irrigated from gravity sources carried as many as 3 cows to the acre, whereas 22 per cent of those for which water was pumped carried this many or more.

Because of the relatively high cost of establishing a stand and of purchasing and installing equipment for irrigation, dairymen are thus far the largest users of this pasture type. More than 80 per cent of the total animal-unit days of grazing reported on all 39 pastures were utilized by dairy cows. Since the

* See Ewalt, H. P., and Jones, I. R., "The Value of Irrigated Pastures for Dairy Cattle," Oregon Experiment Station Bulletin 366, 1939, for data based on experimental Ladino clover pastures in the Willamette Valley.

fields are damp much of the time, danger from liver fluke, as in the case of Reed canary grass, is a deterrent factor in the use of irrigated pasture for sheep in areas where this pest is present.

There is always danger of bloat in feeding succulent forage such as this. Of the 37 operators reporting, 10 had experienced some trouble from bloat. One operator had lost one cow, and another two cows; these, however, were the only losses reported.

Figure 8. Lush grazing in midsummer on irrigated Ladino clover.

Maintenance cost. The average cost per day for the 342 animal-unit days of grazing produced per acre was 6.3 cents (Table 9). There was great variation in cost, the 20 per cent of the pastures having the lowest costs produced an animal-unit day of grazing for an average of 4.2 cents and the high 20 per cent at a cost of 10.4 cents. High costs were primarily the result of low yields, but high pumping costs and high land values were also factors.

The pastures included in this study that were supplied with water by pumping cost an average of $25.68 per acre for maintenance, of which $10.96 was for irrigating. Of this amount $3.10 was for labor, $4.15 for interest and depreciation on equipment, $0.35 for repairs, and $3.36 for fuel, oil, and power for pumping. Aside from this large item, the costs of maintaining Ladino clover pastures, whether irrigated by pumping or by gravity ditches, were, as would be expected, just about the same (Table 9).

All of the operators included in this study used some form of strip borders and irrigated by flooding. Several operators were using canvas pipe or slip-jointed galvanized pipe to distribute the water to the lands between the borders. Others used a main ditch with check boxes for water diversion.

The total labor requirement amounted to 11.8 hours per acre, of which 10.6 hours or 91 per cent were utilized in irrigation, the balance being distributed over routine pasture work. Pastures irrigated by pumped water were given an average of 6.7 irrigations requiring about 2.1 hours per acre for each irrigation. Pastures supplied by gravity flow received 8.7 irrigations requiring .8 hour per acre each time over. The total labor cost for all operations amounted to $2.71 an acre, or 12 per cent of the total cost.

Table 9. IRRIGATED LADINO CLOVER PASTURE: MAINTENANCE COST AND GRAZING VALUE
Willamette Valley, Oregon, 1934 and 1935

Item	Cost per acre		
	Water pumped, 25 pastures	Water from gravity flow, 14 pastures	All 39 pastures
Operator's valuation of land per acre	$148.00	$162.40	$153.00
Average size of pastures, *acres*	12	13	12
Cost per acre			
Fertilizing	$ 0.78	$ 0.38	$ 0.60
Soil preparation	.....	.....	.....
Seeding	.....	.....	.....
Cultivating	.....	.....	.....
Weeding	.21	.15	.19
Irrigating	10.96	1.80	7.47
Fence	.91	.41	.74
Depreciation of stand	3.10	2.52	2.90
Drainage assessments	.46	.....	.33
Taxes	2.04	1.60	1.88
Interest on land at 5 per cent	7.40	8.12	7.65
TOTAL GROSS COST	$ 25.86	$ 14.98	$ 21.76
Credit for hay and seed	.18	.15	.16
TOTAL NET COST	$ 25.68	$ 14.83	$ 21.60
Animal-unit days of grazing produced per acre	374	298	342
Cost per animal-unit day of grazing	6.9¢	5.0¢	6.3¢
Length of grazing season, *days*	207	207	207
Acres required to carry one animal unit for the grazing season	.5	.6	.6
Proportion of total feed requirements from supplementary sources (milk cows only) *per cent*	28	28	28

Fertilization was practiced on only 19 of the 39 Ladino pastures included in this study. Thirteen pastures were treated with landplaster (gypsum) at an average rate of 100 pounds to the acre, 2 received an application of manure, 3 were treated with superphosphate, and 1 received both landplaster and superphosphate. While this practice is indisputably a beneficial one, no particular difference could be noted between the yields on the fertilized and unfertilized pastures included in this study. This is due, no doubt, to the continuing effect of previous applications on the pastures not fertilized during the years of this study, and to the great variations found in soils and management practices.

Establishing a stand. Fitting of fields for irrigation is of paramount importance if successful irrigation by gravity flow is to be practiced. Each individual field presents its own problem, hence the costs of grading and preparation vary greatly from field to field. No data were collected on this phase of the problem.

The gross cost of seeding and maintenance for the first year averaged $23.82 per acre (Table 10). The largest single item was for interest on land, which was valued at an average of $158 per acre. The total labor requirement per acre was 20 man hours and 16 horse hours.

The original cost of equipping a farm for irrigation by pumping averaged $473.52, or $32.99 per acre irrigated. This unit served an average of 20.6 acres of which 57 per cent was pasture, the balance being in such crops as alfalfa or clover for hay or seed, mint, potatoes, berries, and orchard. When

operators were asked their opinion on whether or not pasture required more water than other crops, all of the 17 replying believed that pasture did require more.

The total life of a pumping system was estimated by operators to be 14.5 years. Based on an original average cost of $473.52 for the unit the yearly depreciation would be $32.66, and the annual interest charge $11.84 computed on

Figure 9. One of seven irrigated Ladino clover pastures at O.S.C. prior to grazing. In 1934 this 5-acre pasture produced 412 cow-days of grazing per acre. It was used in 7- to 9-day rotations six times during the season.

Table 10. IRRIGATED LADINO CLOVER PASTURE: COST OF ESTABLISHING AND MAINTAINING THE FIRST YEAR

Willamette Valley, Oregon, 1934 and 1935

Item	Amount	Labor	
		Man	Horse
		Hours	*Hours*
Pastures, *number*	9	.....	.....
Average size of seeding, *acres*	10	.....	.....
Animal-unit days of grazing per acre (year of establishing)	93	.....	.....
Cost items			
Fertilizing	$ 0.36	0.4	0.4
Soil preparation	3.98	5.0	13.8
Seed	3.38	2.0	1.0
Seeding	.40	.....	.....
Irrigating	5.71	12.0	.....
Fence	.39	.4	.....
Miscellaneous	.17	.2	.8
Taxes	1.53	.....	.....
Interest on land at 5 per cent	7.90	.....	.....
TOTAL GROSS COST	$ 23.82	20.0	16.0
Credit for 93 days grazing at $0.049 per day..	4.54	.....	.....
TOTAL NET COST PER ACRE	$ 19.28	.....	.....

the average value. This total fixed annual cost of $44.50 may be prorated to each acre served; therefore each additional acre put under irrigation reduces the fixed cost per acre. It is believed that the use of supplemental irrigation on suitable crops in conjunction with pasture in order to use the plant at or near its maximum capacity is a sound policy, and that the savings in fixed and overhead costs will materially reduce the cost of pasture.

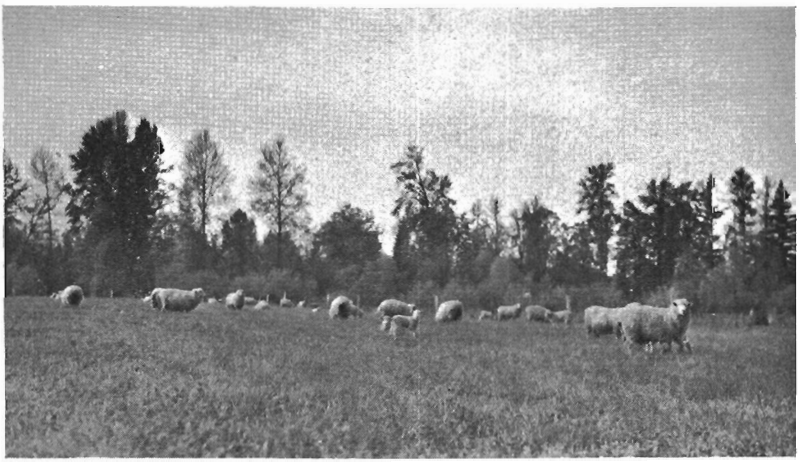

Figure 10. Sheep on early spring growth of vetch and oats. Data on precrop grazing such as this were not included in this study.

SUDAN GRASS PASTURES

Description. Sudan grass, an annual belonging to the sorghum family, furnishes good-quality succulent forage during July, August, and September, when such feed is scarce and of particular value for producing dairy cows. As an emergency forage crop, this grass is of particular value, since seeding may be done late in the spring. It is adaptable to a wide variety of soil conditions, but is found in the Willamette Valley principally on the rather inferior "white" and "half white" soils of the Dayton and Amity series.

Sudan-grass pastures are in direct competition with field crops such as grain and hay for the use of land. Advantages of Sudan grass that justify its use in the pasture program are that it furnishes green feed during a period when such feed is at a premium; that it may be sown late in the spring, thereby not interfering with the rush of spring work; and that it may be used as an emergency or catch crop when needed.

Culture.* A firm seedbed is considered essential in obtaining a stand of Sudan grass. Planting is usually done in late May or in June either by drill or by hand broadcasting. Because delay in sowing is advisable with this crop, it does not compete with grain and other crops for the operator's time in the early spring. From 20 to 35 pounds of seed per acre were sown, generally as a pure stand, although several operators included red or alsike clover in the hope

* See Schoth, H. A., and Rampton, H. H., "Sudan Grass, Millets, and Sorghums in Oregon," Oregon Experiment Station Bulletin 361, 1939, for more complete data on methods of obtaining a stand and various uses of Sudan grass and other sorghums.

of obtaining a stand for a second year. This practice is not recommended, since this quick-growing annual exhausts most of the available moisture for its own growth, offering severe competition to companion crops.

Grazing value. For a 101-day grazing season, beginning about the first of July, the 15 pastures included in this survey produced 156 animal-unit days of grazing per acre, which amounts to carrying slightly more than 1.5 animal units to the acre. Pasturing was mainly by cattle, 85 per cent of the total animal-unit days of grazing being utilized by milk cows, and but 2 per cent by stock other than cattle. Stock on these pastures received 32 per cent of their total feed requirements from supplemental feeding.

Table 11. SUDAN-GRASS PASTURE: MAINTENANCE COST AND GRAZING VALUE
Willamette Valley, Oregon, 1934 and 1935

Item	Sudan grass, 15 pastures	Labor		
		Man	Horse	Tractor
		Hours	*Hours*	*Hours*
Operator's valuation of land per acre	$ 52.20	.....	.....	.....
Average size of pastures, *acres*	10	.....	.....	.....
Cost per acre				
Fertilizing	$ 0.10	0.1	0.2	.....
Soil preparation	4.43	7.2	17.3	2.3
Seed	3.08	.....	.....	.....
Seeding	.51	.8	1.7	.2
Fence costs	.61	.2	.....	.....
Taxes	.86	.....	.....	.....
Interest on land	2.61	.....	.....	.....
TOTAL COST	$ 12.20	8.3	19.2	2.5
Animal-unit days of grazing produced per acre	156	.....	.....	.....
Cost per animal-unit day of grazing	7.8¢	.....	.....	.....
Length of grazing season, *days*	101	.....	.....	.....
Acres required to carry one animal unit for the grazing season	.6	.....	.....	.....
Proportion of total feed requirements from supplemental sources (all stock), *per cent*	32	.....	.....	.....

Growers were asked their opinion as to the value of Sudan grass pastures; all were satisfied with results obtained, several reporting increased milk production when cows were put on in July. No cases of bloat or poisoning were reported in this study, although a very limited number of cases of prussic-acid poisoning have been reported to the United States Department of Agriculture for the country as a whole. A few cases of such poisoning have been reported in Oregon. This poisonous condition arises after a severe drouth or freeze, when hydrocyanic (prussic) acid develops in the plant.

Sudan grass is palatable and is relished by stock if grazed intensively; old growth is woody and will not be used if any other feed is available. Ordinarily the grass is allowed to reach a height of around 8 inches before grazing begins.

Cost. Cost per animal-unit day of grazing was 7.8 cents for the average of 156 animal-unit days produced per acre (Table 11). The total cost per acre amounted to $12.20, of which $4.66 or 38 per cent represented a cash outlay.

The land on which these pastures were growing was valued at approximately $52.00 per acre.

Sudan grass was sown at the rate of about 26 pounds per acre when seeded alone and at the rate of 23 pounds when seeded with a companion crop of clover seeded at the rate of 12 pounds per acre. In 1935 Sudan-grass seed cost an average of 12 cents and clover 15 cents per pound.

Annual pastures such as Sudan grass make a much larger demand on labor than do perennial nonirrigated pastures. The average total requirements were 8.3 man hours, 19.2 horse hours, and 2.5 tractor hours per acre.

RAPE*

Use and adaptability. Rape, an annual or biennial forage plant closely related to cabbage and kale, is of particular value in the Willamette Valley for the fattening of late spring lambs. On the 29 rape pastures studied, lambs accounted for 65 per cent of the total animal-unit days of grazing, mature sheep for 28 per cent, and cattle for only 7 per cent. Rape is not considered to be a very desirable feed for milking dairy cows since there is some danger of tainting the milk. Rape is a rich feed, comparable to the legumes, and with sheep and cattle there is some danger of bloat. The usual precautions taken in pasturing similar crops should be adopted.

Rape is grown on cultivated land and thus competes directly with cash crops and other forage crops. Because of this competition, rape is often sown on poor land for which it is not well adapted, resulting in frequent failures and sparse crops. In general, rape may be expected to give the best results when sown on soil that will grow red or sweet clover. The use of the better grades of lands is repaid by higher yields and lower cost per sheep-day grazed (Table 12).

Table 12. RAPE PASTURE: RELATION OF YIELD TO COST PER SHEEP DAY
Willamette Valley, Oregon, 1934 and 1935

Variation in number of sheep days of grazing produced per acre	Pastures in groups	Average sheep days per acre	Sheep per acre for 3-month season	Average cost per sheep day	Average value of land per acre
	Number	*Days*	*Number*		
Under 250	6	195	2.2	$0.046	$65.00
250-374	9	315	3.5	.025	65.00
375-499	4	435	4.8	.025	84.00
500-624	4	510	5.7	.019	75.00
625-749	2	670	7.4	.017	91.00
750-1,000	1	930	10.3	.010	85.00
More than 1,000	3	1,480	16.0	.009	94.00
ALL PASTURES	29	465	5.2	$ .020	$74.00

Rape is commonly used as a nurse crop for clover, more than half of the stands covered in this survey being so used. This crop is also often utilized as a weed-control measure, because sheep eat and destroy most weeds if forced to graze closely. Weeds not so destroyed are generally clipped just prior to seed formation.

Rape is usually planted during a period extending from the latter part of April to early June and is ready to pasture 6 to 8 weeks afterwards. The pas-

* See Hyslop, G. R., and Schoth, H. A., "Rape," Oregon Extension Bulletin 499, 1937, for a more complete discussion of cultural practices, varieties, etc.

tures included in this study were grazed from the middle of July to the fore part of November, a period of 106 days. During this season, however, the pastures were idle for an average of 16 days to allow the crop to recover from heavy grazing. Some spring pasture is often available the year after seeding. This should be utilized early if a seed crop is to be harvested.

Figure 11. Fair stand of rape on No. 2 class soil.

Grazing value. The 2 years covered by this survey were characterized by unusually hot, dry summers. It is believed that rape fields suffered considerably and that the yields here reported are below normal. For the 1935 pasture season the 15 pastures covered averaged 75 animal-unit days of grazing per acre and for 1934 the 14 pastures studied averaged 111 or an average of 93 per acre for the 2-year period. This amounts to 465 sheep days, which, during a 3-month pasture season, would allow for the grazing of a little better than five sheep or lambs to the acre.

The cost of producing a day of grazing on special pastures such as rape should not be compared with costs on other pastures without considering the value of the grazing produced by each. Rape pasture is particularly valuable for the fattening of lambs for market. Lambs on good rape pasture make fast gains in weight, about ½ pound per day, hence the operator can pay more for this type of pasture than for ordinary kinds on which cash gains could not be made.

Cost. The average cost of rape pasture was $9.44 per acre or $0.02 per sheep day for the 465 sheep days grazed per acre (Table 13). Of this cost about 40 per cent was cash or out-of-pocket expense for taxes, seed, hired

labor, fuel, etc. The prevailing rental charge for ordinary stands of rape is 1 cent per sheep per day in most sections of the Willamette Valley.

Figure 12. Fat lambs getting fatter on an excellent stand of rape.

Table 13. RAPE PASTURE: MAINTENANCE COST AND GRAZING VALUE
Willamette Valley, Oregon, 1934 and 1935

Item	Rape, 29 pastures	Labor		
		Man	Horse	Tractor
		Hours	*Hours*	*Hours*
Operator's valuation of the land per acre	$ 73.60	.....	.....	.....
Average size of pastures, *acres*	38	.....	.....	.....
Cost per acre				
Fertilizing	$ 0.04	.....	.....	.....
Soil preparation	2.77	2.8	2.2	1.2
Seed (rape and clover)	.90	.....	.....	.....
Seeding	.38	.7	1.2	.4
Fence	.43	.2	.....	.....
Taxes	1.24	.....	.....	.....
Interest on land at 5 per cent	3.68	.....	.....	.....
TOTAL PER ACRE	$ 9.44	3.7	3.4	1.6
Sheep days of grazing produced per acre	465	.....	.....	.....
Cost per sheep day of grazing	2¢	.....	.....	.....
Length of grazing season, *days*	90	.....	.....	.....
Sheep carried per acre for the season, *number*	5.2	.....	.....	.....

There was great variation from the average cost, however, as the high-cost 20 per cent of the operators produced pasturage at an average cost of 3.5 cents per sheep day while the low-cost 20 per cent produced it at a cost of 1.1 cents. This variation in cost was largely due to differences in yield, which in turn were apparently the result of differences in quality of soil (Table 12).

The average annual labor requirement was 3.7 hours man labor, 3.4 hours horse work, and 1.6 hours tractor work. Rape was seeded at the rate of about 3 pounds per acre, and clover at 8.4 pounds when used as a companion crop.

Rape seed cost 8 cents and clover seed 15 cents per pound during the years of this survey. Sixty per cent of the operators seeded with drills; the balance broadcast the seed by hand.

The costs discussed above are based on the assumption that the rape pasture is to bear the full cost of establishment. When used as a nurse crop for clover, however, the clover may be assumed to bear half, two-thirds, or perhaps all of the cost (except for the rape seed). In this event rape pasture would cost little, but, conversely, the clover stand might be rather costly.

WILLAMETTE SWEET CLOVER

Description. Willamette sweet clover was developed at the Oregon Agricultural Experiment Station and is a stem-rot-resistant strain of common white sweet clover (*Melilotus alba*). It was selected from a single stem-rot-resistant plant in 1921, and is a biennial white-flowered clover. Previous to the development of this strain, it was practically impossible to grow sweet clover successfully west of the Cascade Mountains in either Washington or Oregon on account of a fungous disease known as stem rot. The Willamette strain can be differentiated from the ordinary white-flowered variety only by its resistance to stem rot. Seed of this strain is commonly available from commercial seed houses in the Willamette Valley.

Cost and grazing value. During the 2 years of this survey most farmers growing sweet clover harvested it for seed the second year of its growth. For this reason an insufficient number of records were obtained to measure accurately either cost or carrying capacity for the second year. From the records that were obtained it appears that each acre will support in the neighborhood of 300 animal-unit days of grazing the second year at a cost of approximately $18.00 per acre, or 6 cents per animal-unit day of grazing.

The pasture season for second-year stands extended from the latter part of April to the fore part of November, a period of some 200 days. For this almost 7-month season these pastures carried about 1½ cows to the acre. All of the operators fed supplemental feed to milk cows to the extent of about one-third of their total feed requirements. The usual practice was to offer them both hay and grain; probably in part an effort to prevent bloat. None of the operators reported any serious trouble from bloat and most of them were of the opinion that sweet clover caused less bloat than other leguminous plants such as alfalfa or red clover.

Cost of establishing a stand. A total of 13 records were obtained on the cost of establishing a stand of Willamette sweet clover. These costs are for stands sown on tillable land and averaged $14.37 per acre (Table 14). It is possible to secure a good stand on nonplowable land of good quality by sowing in ashes following the burning of slash, and the cost for this kind of seeding will be much less than the cost when sown on a prepared seedbed on cultivated fields.

Approximately 50 per cent of the operators applied landplaster, using it at the rate of 75 pounds to the acre. Eight of the 13 operators seeded broadcast by hand, the others using either alfalfa seeders or grain drills with grass seeding attachments. Seed was applied at the rate of 12.2 pounds per acre. No companion or nurse crops were used and all seeding was done in April on spring-prepared seedbeds. Seed cost averaged 18 cents a pound, or $2.20 per acre.

During the year of establishing, 71 animal-unit days of grazing per acre were produced, which were believed by the operators to be worth 4.7 cents per day at going rates for pasturage. This pasture occurs during July or August, thus providing some succulent feed during the first year at a period when such feed is of special value.

Table 14. WILLAMETTE SWEET CLOVER: COST OF ESTABLISHING A STAND AND MAINTAINING IT THE FIRST YEAR

Willamette Valley, Oregon, 1934 and 1935

Item	Sweet clover, 13 pastures	Labor		
		Man	Horse	Tractor
		Hours	*Hours*	*Hours*
Operator's valuation of land per acre	$ 90.20	.....	.....	.....
Average size of seeding, *acres*	9	.....	.....	.....
Animal-unit days of grazing produced per acre (year of establishing)	71	.....	.....	.....
Cost items				
Fertilizing	$ 0.37	0.2	0.3	.....
Soil preparation	3.90	5.8	12.0	.....
Seeding	2.82	1.0	2.4	.....
Fence (interest, depreciation, repairs)	1.13	.2	.....	.....
Miscellaneous costs	.11	.3	.2	.....
Taxes	1.53	.....	.....	.....
Interest on land at 5 per cent	4.51	.....	.....	.....
TOTAL GROSS COST PER ACRE FIRST YEAR	$ 14.37	7.5	14.9	.....
Credit for hay	.20	.....	.....	.....
Credit for pasture (71 days at 4.7¢)	3.34	.....	.....	.....
TOTAL NET COST PER ACRE FIRST YEAR	$ 10.83	.....	.....	.....

SOUTHERN OREGON PASTURES

DOUGLAS COUNTY HILL PASTURES

Use and adaptability.* Hill pastures in this region are handled in an extensive manner and are sometimes designated as ranges. They are included in this study of farm pastures since they are integrally owned units of regular farm businesses.

The present cover of these hill pastures is a mixture of native and naturalized species augmented in many cases by seeded mixtures of cultivated species. Grazing has long been important in this area. The census of 1870 reported 94,963 head of sheep in Douglas County, nearly 90 per cent as many as were reported in the census of 1935.

This hill land, in most cases, has no use alternative to grazing by sheep, goats, and cattle. Much of it was once under cultivation but has been allowed to revert to pasture. In pasture improvement lies the principal hope of increasing production and decreasing costs on this important land type.

* For data regarding the farm organization and management of sheep and cattle ranges operating on hill lands somewhat comparable to those of Douglas County, see Hochmuth, H. R., and Gorton, W. W., "Ranch Organization and Range Land Use in Coos and Curry Counties, Oregon," Oregon Experiment Station Bulletin 381, 1940.

Grazing value. An average of 34 animal-unit days (170 sheep days) of grazing were produced per acre. Computed on the basis of a year-long pasture season, 10.7 acres of pasture were utilized to carry one animal unit. Converted to sheep units, this would amount to 2.1 acres per head per year.

Figure 13. Newly seeded grass on cut-over land, Douglas County.

Figure 14. Erosion attacks an overgrazed Douglas County hill pasture.

Of the total pasturage produced 83 per cent was utilized by sheep and goats, 10 per cent by beef cattle, 4 per cent by horses, and 3 per cent by dairy cattle. Goats, which accounted for 18 per cent of the total, were kept primarily to destroy brush and utilize browse that would otherwise go to waste. Profit from the sale of goats and their mohair was considered to be secondary to their land-clearing function.

These hill pastures were grazed by goats the year around, and by sheep for an average of 336 days annually. Goats, except in rare instances, received no supplemental feed while on pasture; sheep were fed an average of 115 pounds of hay and 4 pounds of grain per head per year as a supplement to pasture. Sheep were removed from hill pasture only during severe storms and when aftermath pasture was available. Lambing and kidding commonly occurred in the open field.

Maintenance cost. The average net cost per acre for maintaining this pasture type was $0.83 per acre or about one-half cent per sheep day (Table 15). Taxes were almost the only cash operating cost reported.

Table 15. DOUGLAS COUNTY HILL PASTURES: MAINTENANCE COST AND GRAZING VALUE, 1935 and 1936

Item	25 hill pastures
Operator's valuation of land per acre	$ 11.20
Average size of pasture, *acres*	803
Proportion of pasture area in grass land, *per cent*	85
Cost per acre	
Fence (interest, depreciation, repairs)	$ 0.14
Taxes	.13
Interest on land at 5 per cent	.56
TOTAL COST PER ACRE	$ .83
Animal-unit days of grazing produced per acre	34
Cost per animal-unit day of grazing	2.7¢
Sheep days of grazing produced per acre	170
Cost per sheep day of grazing	0.5¢
Acres required to carry one sheep for a year-long grazing season	2.1

During the 2 years of this survey, 1935 and 1936, very little maintenance work was done on these pastures. Work was principally on fence, and this amounted to only 1/10 hour per acre. Costs of burning, slashing, and seeding, when performed as a development practice, were not considered to be maintenance costs. These are discussed in the following section. Although a negligible amount of pulling and grubbing of sweet briar, oak grub, and other brush was done, the value of these practices appears to be undoubted. The growth of unpalatable species of brush such as sweet briar in a pasture cuts down the grass acreage and thus reduces the carrying capacity in direct proportion to the area covered.

The pastures studied averaged 803 acres, of which 117 acres or 15 per cent were covered by brush and stumps and considered by the operators to afford but little grazing. This uncleared land was valued at approximately $5.50 per acre, and open pasture land at $12.20 per acre. The value of all land in pasture averaged $11.20 per acre.

Improvement costs. In Douglas County, as in many other sections of western Oregon, are cut-over hill lands well adapted to grazing when cleared of brush and trees and seeded to adapted pasture plants. The costs of these improvements are extremely variable due to differences in cover, topography, and other conditions.

Of the three steps in the conversion of cut-over or brush land to pasture—slashing, burning, and seeding—the former is ordinarily most costly per acre covered, but it is seldom performed on entire acreages. Eighteen operators were interviewed in 1936 regarding these costs and the average cost per acre covered was: slashing $5.67, burning, $0.58, and seeding $1.98.

Slashing was done at the average rate of 2 acres per man day. Much slashing was done by contract at from $5.00 to $7.00 per acre, depending on the density and size of the material to be slashed and the labor situation in the vicinity. Burning may be from an uncontrolled accidental fire and thus cost-free or, as in several instances covered by this survey, at the rate of only 1 or 2 acres per day. The average rate when controlled was 5.3 acres per man day. Burning was commonly done by a crew of from three to six men.

Seeding was done exclusively by hand in this county but emergency seedings in Coos and Curry Counties have demonstrated that seeding by airplane is a fast and generally satisfactory means of seeding extensive acreages. Hand seeding was done at an average rate of 7 acres per man day at a cost of $0.48 per acre. Seed mixtures used varied considerably in cost and composition but averaged about $1.50 per acre.

Fence cost. The total cost of building a woven-wire fence in areas such as this, where fence rows had to be cleared of brush and snags, amounted to about $0.90 per rod. Of this amount, $0.15 was for posts, $0.35 for woven wire, $0.09 for two strands of barbed wire, and $0.31 for labor. The actual cost to the operator who did his own work was mainly for wire because posts could be cut on most pastures at no cost except for labor. Woven-wire fence was thus constructed for somewhat less than 0.50 per rod, plus the operator's own labor and farm-grown materials.

It is not the usual practice to fence the entire boundary of newly seeded hill pastures in this region. Natural barriers such as dense timber, brush, or rivers on one or more sides of the pasture in conjunction with fence confine the stock rather effectively.

JACKSON COUNTY IRRIGATED PASTURES

Description. Irrigated pastures in this region are found principally on the tillable croplands of the valley floor. These pastures occupy land suitable for cropping and thus compete directly with hay and grain production. All but one of the pastures included in this classification were considered by operators to be permanent plantings and were not used in a regular crop-rotation system.

Various mixtures were used in establishing stands of pasture plants, most of them including Ladino clover and English rye grass. A mixture recommended by local growers for this area is made up of Ladino clover 2 pounds; English rye grass 4 pounds; domestic rye grass 4 pounds; meadow fescue 2 pounds; and orchard grass 2 pounds per acre.* Pastures included in this study had a cover composed of 56 per cent white, alsike, and Ladino clovers, and 44 per cent tame mixed grasses and timothy.

* Seed mixture from published report of the 1936 Jackson County Agricultural Conference, page 22.

Grazing value. These mixed-grass pastures produced an average of 210 animal-unit days of grazing per acre. For the 6-month pasture season this amounts to carrying 1.2 animal units per acre.

Grazing of dairy cattle commenced the middle of April and extended to the latter part of October, a period of 183 days. Seven of the 10 herds of dairy cows on which records were taken were provided an average of 10.4 pounds of hay and 2.3 pounds of grain per head per day as a supplement to pasture. This accounted for about 40 per cent of their total feed requirements. The other three herds were given no supplemental feed. Other stock were not fed while on pasture except horses when working.

Maintenance cost. The average net cost for maintaining this pasture type was $11.48 per acre or 5½ cents per day for the 210 animal-unit days of grazing produced per acre (Table 16). Cash costs for such items as taxes, irrigation water, hired labor, repair materials, etc., accounted for 48 per cent of the total gross cost.

Irrigation was the largest item of cost for this pasture type, accounting for 36 per cent of the total gross cost. Irrigation water cost $3.21 per acre, and labor for applying it $2.25. Ten of the 12 pastures received water from regularly organized irrigation ditches at a cost of from $4.00 to $5.00 per acre. The other two used gravity-flow water from private sources at no cost except for ditch maintenance.

Pastures were irrigated an average of 11 times during the season, irrigation starting about May first and continuing until the latter part of September. This operation required 7.4 hours per acre for the season or nearly .7 hour each time over. The labor requirement for all operations was 8.9 man hours and 2.5 horse hours per acre.

Table 16. JACKSON COUNTY: COST AND GRAZING VALUE OF TAME MIXED-GRASS IRRIGATED PASTURES

1935 Pasture Season

Item	12 pastures
Operator's valuation of land per acre	$ 92.20
Average size of pastures, *acres*	25
Proportion of acreage in grass land, *per cent*	100
Cost per acre	
Fertilizing	$ 1.98
Cultivating and weeding	.08
Irrigating	2.25
Irrigation water costs	3.21
Fence costs	.54
Depreciation of stand	.10
Taxes	2.20
Interest on land at 5 per cent	4.61
TOTAL COST	$ 14.97
Credit for hay harvested	3.49
TOTAL NET COST	$ 11.48
Animal-unit days of grazing produced per acre	210
Cost per animal-unit day of grazing	5.5¢
Length of grazing season, *days*	180
Acres required to carry one animal unit for the grazing season	0.8
Proportion of total feed requirements from supplemental sources (all stock) *per cent*	12

All of the pastures except one were fertilized: 8 received landplaster (gypsum) at the rate of 100 pounds per acre, 2 received sulphate of ammonia at the average rate of 117 pounds per acre, and 4 were fertilized with manure at the rate of 4.6 tons per acre. Three pastures received both manure and commercial fertilizer. Landplaster cost $0.65 and sulphate of ammonia $2.28 per hundred pounds. Manure was considered by the operators to be worth $1.00 per ton. Fertilizing required 1.1 hours man labor and 2.1 hours horse labor per acre fertilized. Spreaders were used for the application of all three kinds of fertilizer. Other operations performed were cultivating, weeding, and fence maintenance, which required a total of .4 man hour and .4 horse hour per acre.

CONCLUSIONS

The cost of an animal-unit day of grazing was 3½ cents on the hill lands in native grass and the same figure for similar land seeded to tame grasses. In the case of the valley-floor lands, the cost of a day's grazing on all types of pastures, except special pastures, was approximately 5 cents. This uniformity of cost might give the impression that the kind of pasture was of no significance, but such an impression would be very far from the facts since the owners placed a much higher value on the more productive land. This tendency to value pastures in proportion to their productivity is shown by the following summary table:

Table 17. HILL PASTURES

Kind of cover	Animal-unit days grazing per acre per year	Proportion of brush and waste	Value of land per acre
	Days	*Per cent*	
Native grass	42	37	$ 19.20
Tame mixed grasses	59	29	23.60
Valley-floor pastures			
Native grass	50	25	33.60
Tame mixed grasses	96	18	60.80
Rye grass	82	26	53.60
Alfalfa	240	....	102.20
Red and alsike clover	164	....	102.80

The brush and waste land was reported by the owners as having little or no grazing value. The value of the entire pasture therefore depended on the land in grass rather than in brush. It is obvious that the removal of brush from many of these pastures would have increased their productivity and consequently their value.

The native hill pastures were valued at $19.20 an acre although they contained on the average 37 per cent of brush and timber, which, according to the owners, had little or no grazing value. On the basis of production, the 37 per cent brush, therefore, had no value while the 63 per cent actually in grass was worth $30.50 an acre. We find a similar situation with reference to the pastures seeded to tame grasses. Here the percentage of brush of little or no grazing value was 29 per cent. On the basis of production the 71 per cent actually in grass had a real value of $33.24.

In addition to brush removal, the other major factor in increasing productivity, and thereby value, was seeding to tame grasses. The data in the

table above show that there was a marked increase in production and in value resulting from the seeding of tame grasses. In case of the valley-floor pastures a still greater increase resulted from the seeding of legumes.

Inspection of these figures naturally raises a question as to whether the native-grass pastures were on the poorer lands. This was not the case. In fact, a substantial part of these native-grass pastures was on the best grade of land. Native-grass pastures on the best grade of land were valued slightly higher than native-grass pastures on poorer land, but less than tame mixed-grass pastures on the best land.

Apparently the operators in the past have not fully appreciated the possibilities of pastures and of pasture improvement, but this condition seems to be changing. The values that the owners placed on their lands in this study indicate that they now recognize fully the differences in productivity. This in turn points toward an increased interest in pasture improvement that is certain to produce results in the future. This pasture improvement will in some cases involve brush removal, in other cases seeding to improved grasses, and in some cases both brush removal and seeding. In this connection it should be pointed out that very few of the tame-grass pastures studied had been seeded to the type of grass mixture now being recommended and used. On the contrary, most of the pastures had been seeded to grasses that are now being superseded by newer grasses of greater productivity and longer life.

The study also indicates the very great value of special summer pastures, such as irrigated Ladino, Sudan grass, and rape. Farmers generally seem to recognize this and are increasing their acreage of these pastures, especially irrigated Ladino and Sudan grass. On the other hand, the frequency of insect infestation has retarded the expansion of the rape acreage.

Appendix A

FENCE COSTS, WILLAMETTE VALLEY

Under the assumption that the pasture must be enclosed, all of the fence around the pasture, plus division fences within the boundaries of the pasture, was charged to the pasture except line fence built by adjoining owners. The ratio of line fence to the total fence required is small (perhaps 1 to 4) and in addition many operators found it necessary to build all of the line fence because the adjoining land owner was satisfied with an inferior fence. For these reasons it is probable that pastures bear well over 75 per cent of the total costs of building and maintaining the fences around and within them.

Both barbed- and woven-wire fences are common in the Willamette Valley and there are still a few old board and rail fences in use. Three or four strands of barbed wire were used where cattle only were to be pastured. Some woven-wire fence was constructed without a barbed wire on top but most operators used either one or two strands in addition to the woven wire. Barbed wire costs around 4 cents a rod in 80-rod rolls and woven wire from 25 to 40 cents in 20-rod rolls depending on quality, design, and height.

All operators used wooden posts, mostly cedar, which cost 10 to 12 cents when purchased and somewhat less when cut on the farm and priced at what the farmer would get for them at the farm. Posts were spaced about a rod apart.

The number of rods of fence built per man per day varied from as low as 12 to as much as 40 and averaged about 20. These variations were largely due to differences in type of fence built, topography, whether fence rows had to be cleared, and differences in soil characteristics for digging post holes.

Labor was paid at the rate of approximately $2 per day. This rate is lower than for most other operations, because fence was usually built during the slack winter months when wage rates were at the low point for the year. This rate is based on payments made in 1934, which was a period of low farm wages.

The cost of building fence in 1934, as found in this study, was as follows for the Willamette Valley:

	Four strands of barbed wire	*Woven wire and two strands of barbed wire*
Barbed wire	$0.16	$0.07
Woven wire		.32
Posts	.12	.12
Labor	.10	.10
TOTAL	$ .38	$ .61

The cost of maintaining a rod of fence is made up of charges for interest on the present value, depreciation, and repair costs. Interest and depreciation together averaged 3.7 cents per rod for woven-wire fence and 2.7 cents for barbed-wire. Repair costs averaged 1.4 cents per rod for both types, which makes a total maintenance cost of 5.1 cents for woven-wire and 4.1 cents for barbed-wire fence. The total average expected life of fence was estimated by the operators at 22 years for woven wire and 17 years for barbed wire.

The per-acre cost of building and maintaining fence is dependent to a large extent on the size of the field. To enclose a 5-acre field would require 113 rods of fence, or 22.6 rods per acre. For a 10-acre field, 160 rods would be required, or 16 rods per acre. At 61 cents a rod the cost of fencing a 5-acre tract would be $13.79 per acre and of fencing a 10-acre tract $9.76 per acre.

The larger the field the smaller the amount of fence, per acre, required to enclose it. The amount of fence required to enclose square fields of different acreages is shown below.

Acres in field	*Rods of fence*	*Acres in field*	*Rods of fence*
5	113	80	452
10	160	100	506
20	236	160	640
30	277	320	905
40	320	640	1,280
		1,000	1,600

It will be noted that, while a 1,000-acre field is 100 times as large as one of 10 acres, the distance around the larger one is only 10 times as much as it is around the small one.

Fence-maintenance costs per acre, of course, vary with the size of the field in the same manner as do construction costs. To take an actual example, the acreage by size groupings, rods of fence, fence costs, and yields of 103 native-grass valley-land pastures are shown in Table 18. It will be noted that fields averaging 12 acres in size required 17 rods of fence per acre and that the cost of maintaining this fence averaged $0.71 per acre. Fields averaging 27 acres required about 10 rods of fence per acre and the cost per acre for fence maintenance was only $0.49. Larger fields required progressively less fence and the cost per acre steadily decreased. Yield per acre, however, was greater on small than on large fields.

Table 18. RODS OF "OWNED" FENCE AND ANNUAL COST PER ACRE FOR FENCE ON PASTURES OF DIFFERENT SIZE GROUPS*

103 Native-Grass Valley-Land Pastures, Willamette Valley, 1934 and 1935

Range in size of field	Pastures included	Average size of field	"Owned" fence per acre	Fence-maintenance cost per acre	Animal-unit days grazing produced per acre†
Acres	*Number*	*Acres*	*Rods*		*Number*
Under 20	11	12	17.0	$0.71	78
20-39	18	27	9.7	.49	58
40-59	10	49	7.4	.33	51
60-99	20	73	6.0	.27	53
100-199	28	132	3.4	.22	46
200 and over	16	356	2.6	.10	33
ALL PASTURES	103	116	3.9	.19	42

* "Owned" fence is the total amount of fence used in connection with the pasture except for that portion of the line fence built and maintained by the adjoining property owner.

† Days of grazing adjusted for amount of supplemental feed fed to livestock while on pasture.

Appendix B

PASTURE YIELD EXPRESSED IN TERMS OF FEED EQUIVALENT

There is often a desire on the part of farmers, county agricultural agents, and others interested in pasture production to state pasture yields in terms of some tangible unit, such as tons of hay. This procedure is fraught with danger from a technical standpoint because it attempts to state in definite terms that which is indefinite and measurable only through the use of standards set up under conditions other than those present on farm pastures. Full recognition is given to these difficulties, but it is believed that the value of the data so obtained outweighs objections; hence pasture yield has been computed in terms of digestible nutrients and converted to the feed equivalent of alfalfa hay (Table 19).

The method employed to arrive at this measure of pasture yield was, briefly:

1. The feed requirements of each class of livestock on each pasture were computed, based on the data at hand. In the case of dairy cows average weight, milk test, and production were available and for most other animals weight was known. Feed requirements in terms of total digestible nutrients were taken from Morrison's "Feeds and Feeding."* The average daily feed requirements of the different classes of livestock included in this study expressed in pounds of digestible nutrients per head were:

Dairy cows	15.41	Sheep	2.25
Young stock	7.26	Goats	2.00
Other cattle	11.92	Horses	14.85

2. From the total feed required, as expressed in terms of digestible nutrients, was subtracted the nutrients furnished by supplemental feeding. The digestible nutrient content of the different classes of feed was considered to be: hay 50 per cent, concentrates 70 per cent, and succulents 15 per cent. For the study as a whole the proportion of the total feed requirements provided by pasture while the stock was on pasture was: milk cows 66 per cent, other cattle 94 per cent, sheep 95 per cent, goats 99 per cent, and horses 90 per cent.

3. The net production of digestible nutrients obtained from the pasture was converted to terms of alfalfa hay on the basis of 1 pound of digestible nutrients being the equivalent of 2 pounds of alfalfa hay. The production of pastures in terms of these units and the cost per unit was as shown in Table 19. To illustrate the method used: A 1,000-pound cow giving 25 pounds of 4.5-per-cent milk requires about 16.6 pounds of digestible nutrients per day. If 5 pounds of hay and 2 pounds of grain were fed per day, a total of about 4 pounds of nutrients would be supplied from this source, leaving 12.6 pounds to be furnished by the pasture. If an acre of pasture produced 100 days of grazing for this cow, the production in terms of digestible nutrients would be 1,260 pounds. This is the feed equivalent of 2,520 pounds, or approximately 1.3 tons, of alfalfa hay.

* Morrison, F. B., "Feeds and Feeding," 20th edition, Morrison Publishing Company, Ithaca, New York.

Table 19. YIELD AND COST OF NUTRIENTS PRODUCED BY PASTURE

Kind of pasture	Pastures included	Total digestible nutrients	Alfalfa hay equivalent	Cost per acre	Cost per ton of hay equivalent
	Number	*Pounds*	*Tons*		
WILLAMETTE VALLEY					
Hill pasture					
Native grass	54	437	0.44	$ 1.46	$3.30
Tame mixed grass	20	625	.62	2.10	3.40
Valley pasture					
Native grass	103	530	.53	2.49	4.70
Tame mixed grass	61	1,085	1.08	4.74	4.40
Rye grass	28	902	.90	4.36	4.80
Alfalfa	14	2,602	2.60	12.40	4.80
Red and alsike clover	32	1,689	1.69	8.14	4.80
Special pastures					
Reed canary grass	17	3,292	3.29	9.27	2.80
Ladino clover (irrigated)	39	4,174	4.17	21.60	5.20
Sudan grass	15	1,513	1.51	12.20	8.10
Rape	29	1,049	1.05	9.44	9.00
SOUTHERN OREGON					
Douglas County					
Hill pastures	25	*	*	.83	.....
Jackson County					
Irrigated pastures	12	2,547	2.55	11.48	4.50

* Not computed.

SEASONAL PRODUCTION

The pasture season in the Willamette Valley is not well defined. Grass continues green throughout the winter and becomes dormant during the dry summer season except in moist locations or where supplemental irrigation is practiced. The seasonal yield of three representative pasture types, in terms of pounds of total digestible nutrients produced per acre, is shown in Figure 15.

Ladino-clover pastures were used but little until April, and from then until October produced at a high and relatively steady rate. Tame mixed-grass pastures had about the same relative rise in the spring but after the peak of production in June a steady decline in yield took place. Native-grass hill pastures produced at a low rate throughout the year and furnished only slightly more than twice as much forage at the peak as in the winter months.

Differences in class of livestock grazed on these pastures should be noted in connection with seasonal use. Ladino clover was used primarily for dairy cattle; tame mixed grass for dairy cattle, beef stock, and sheep; and native-grass hill pasture largely for sheep, goats, and beef cattle. Winter pasture is largely restricted to sheep and goats.

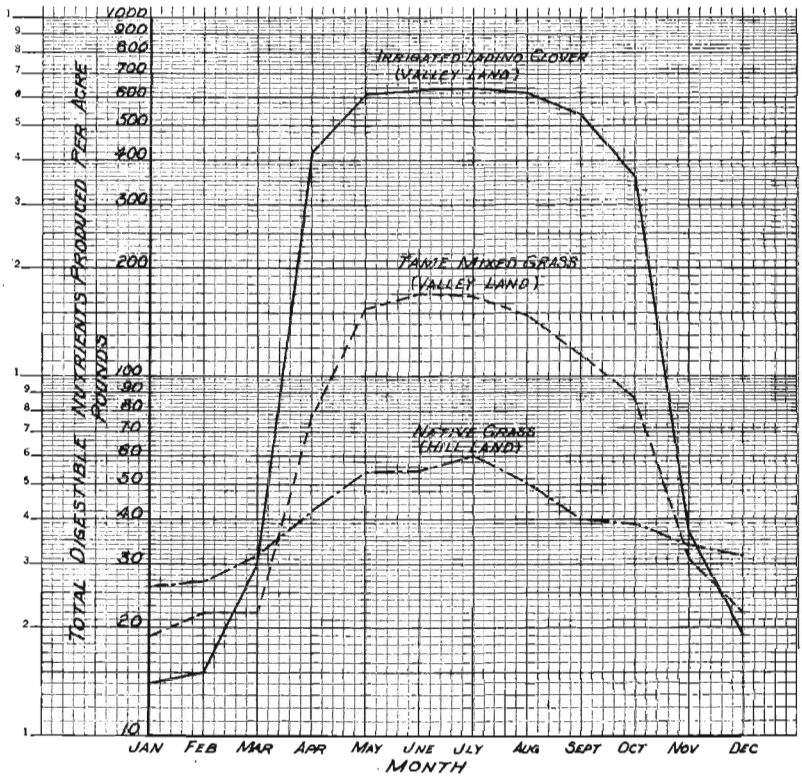

Figure 15. Variation in pasture yield by months, Willamette Valley, 1935.

Appendix C

METHODS AND TERMS USED

As far as was practicable, conventional methods of analyzing the data were used. This study, however, deals with a farm enterprise the production of which was determinable only by measuring use by animals. In the absence of exact units of production and well-defined methods, considerable freedom was exercised in working out procedures designed to accomplish the purpose of this study.

Sampling. Random sampling was used, the names of prospective cooperators being furnished by the county agricultural agent of each county surveyed. All classes of farms and farmers were included. It is believed that a representative sample was thus obtained.

Source of data. Each cooperating farmer was visited by a trained enumerator, and a record on costs and production was obtained. Field sheets were checked each evening, and errors found were corrected immediately, if necessary by contacting the operator a second time.

Analysis. Analysis was made principally by cross-tabulation and comparison. Weighted arithmetic means were used for all averages except when results for different years were combined and averaged. In these cases unweighted averages were used.

Discarding or omitting records. Records were discarded only for patent abnormalities or because incomplete in essential details. Records were omitted from individual sorts only when the factors being studied were omitted. All such omissions are noted by showing the number of cases involved in each table.

Renters computed as owners. Most of the cooperators were owners. In order to make records of renters comparable, they were computed on the same basis as owners. Thus, taxes, water assessments, fence repairs, and interest on land were charged against pastures in lieu of the cash or share rental actually paid.

Land value. Land was valued at the asking price of similar land in the vicinity as estimated by each operator. All interest charges were computed at the uniform rate of 5 per cent.

Taxes. Taxes were apportioned to the pasture as equitably as could be determined from the operator and from tax records in the county assessor's office.

Machinery and equipment. The cost of operating machinery or equipment used on pastures was prorated to the pasture according to use. This cost included cash expenses, depreciation (computed on the straight-line basis), and interest charged on the inventory value.

Depreciation of stand. The original cost of establishing a stand of pasture was distributed evenly over the estimated life of the stand. Volunteer, native, or permanent stands were not subject to any depreciation.

Man labor. Only man labor directly engaged on pasture work has been included, no attempt being made to prorate the item of management. Man

labor, whether hired or not, was charged at the going wage rate for the job at the time performed. The average wage was 22 cents per hour in 1934 and 26 cents per hour in 1935.

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

Credits. Credit was given for hay or seed harvested from pastures. Where such credit was excessive the record was discarded as being primarily a crop record rather than a pasture record.

Irrigation water. Irrigation water was charged to pastures at the actual rate paid by the owner of the land, including special assessments, operation and maintenance charges, etc. In cases where a pumping system was used, the equipment charges were computed. If pastures were given more or less water than the other irrigated land on the farm, the water charge was adjusted accordingly.

Animal unit. An animal unit was considered to be 1 mature cow or horse, 5 sheep or goats, 8 hogs, or 100 poultry. Two head of young stock were computed as being equivalent to one head of mature stock of like kind. The conversion factors used are the conventional ones except in the case of hogs. Most studies of farm organization consider 5 hogs to be equivalent to an animal unit but in this study of grazing it was considered, since hogs are commonly fed a considerable amount of concentrates, that it would require 8 hogs to eat as much grass as 5 sheep or a cow.

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