ECONOMIC COMPARISONS OF ALTERNATIVE LAND-USE SYSTEMS ON SELECTED FARMS IN THE OREGON WHEAT-SUMMERFALLOW AREA

by

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CHAPTER I

INTRODUCTION

Oregon wheat farmers were called upon to expand wheat production in response to wartime or world emergency demands during and immediately following World War II. Large quantities of wheat were required for export to needy countries overseas. In order to meet the demand and in response to high prices, farmers greatly increased plantings. This, together with improved production practices, favorable weather, and higher yields contributed to record crops in recent years. Since 1952, greatly reduced export demand resulted in large wheat stocks. Consequently, acreage allotments were introduced for the 1954 crop whereby wheat acreages were cut back by 20 per cent from the previous year's plantings. For the 1955 crop, the overall reduction in acreage of wheat for farms will range up to about 40 per cent of the 1953 crop.

Economic impacts of acreage allotments are reduced farm incomes, loss in capital position, and less production efficiency. Farmers regard an income cut after a long period of profitability in wheat farming as a drastic measure, especially when prospects for other farm commodities and the general economy are good. Farmers stand to lose net worth as the value of assets declines with reduced
income-earning capacities. Production inefficiency results from reduction in scale of operations and from changes in the proportioning of factors of production.

**Farmer Problems in Adjusting to Acreage Allotments**

Managerial problems exist whenever farmers lack sufficient knowledge to decide on a course of action, to take action, and to bear risk. Today, more than ever, there is uncertainty in wheat farming as knowledge of future yields, prices, government programs, and production methods is imperfect. The wheat farmer presently is confused by lack of knowledge about future opportunities in wheat, and yet his main managerial task is the development of a general set of production plans for the future. Difficulties in planning wheat farming businesses consist of problems relating to both estimation of future income possibilities in growing wheat, and to those involving what use to make of available resources removed from wheat production (1, pp.30-36). Emphasis will be given in this study to farmers' problems in choice of alternative land-use systems for diverted wheat acres.

Substantial adjustments in farm organization are necessary under an acreage allotment program. The question faced by individual farmers is what to do with the acreages diverted from wheat production. What alternative crops are there for wheat if the best land is retained in wheat? The
Immediate problem is to find employment for resources on individual farms. That is, how can operations be adjusted to utilize available land, labor, and machinery? All such resources will be rendered partially idle by the reduction in wheat acreages unless suitable substitutes are found. The problem is especially difficult in the Oregon dryland wheat area where there are few alternative enterprises physically and economically feasible. Farmers in this area have limited income opportunities for resources diverted from wheat production.

Decision making in choice of alternative crops and livestock involves technical and economic problems. The basic technical problem of wheat farmers is their need to adapt limited available knowledge to particular resource situations. Only limited knowledge is available about crops other than wheat in the Oregon wheat-summerfallow area because farmers generally have little experience in them. In addition, only a small amount of research has been carried out on input-output relationships for alternative crops in the area. Finally, physical production possibilities are different for particular farms. Farm resource situations vary with size of farm, amounts of rangeland, livestock facilities, soil, rainfall, and other physical factors.

The economic problem in selecting alternative farming systems primarily is one of evaluating alternatives on
the basis of economic criteria. These include income possibilities, investment required, flexibility, and conservation. Various uses of resources need to be appraised by these criteria under conditions of uncertainty. Uncertainty in planning for use of diverted acres exists because of insufficient knowledge about major economic variables. In appraisal of production alternatives, the major economic variables to consider are price-cost relationships, capital requirements, and government policies.

Purposes of the Study

The main purpose of this study is to provide the basis for increased farmer knowledge in use of diverted acres. The majority of farmers may have some notion as to future expectations in wheat production and in alternative enterprises to wheat, but generally farmers are in doubt regarding what action they should take. Increased farmer knowledge about input-output relationships and relative profitabilities for alternative crops and livestock is desirable. It is required if uncertainty connected with plans for use of diverted acres is to be reduced. Resource classifications, price-cost relationships, and production data used in selection and comparison of alternatives will be adapted specifically to the Oregon wheat-summerfallow area in this study.
The study primarily is concerned with two major questions. These are: (1) What are the practical alternatives for use on diverted acres in the Oregon wheat-summer-fallow area? and (2) How do these alternatives compare on the basis of economic criteria? Specific objectives regarding answers to these questions are as follows:

(a) To select practical production alternatives adaptable to different resource situations under limited and unlimited opportunities to grow wheat and other cash crops.

(b) To estimate incomes expected from each selected alternative by using realistic input-output data and price relationships.

(c) To examine the selected alternative land-use systems in terms of additional economic criteria, namely, costs of adjustment, flexibility, and conservation.

The analysis begins in the next chapter with a description of the problem area and methodology used in the study. Resource situations are classified, and technical and economic information required in the evaluation of alternatives are assembled. Chapter 3 deals with the selection of practical alternatives for varying resource situations, problem areas, and government policy with respect to acreage allotments. Chapter 4 includes short-run income comparisons of selected alternatives. Also, in Chapter 4,
alternatives are compared on the basis of estimated adjustment costs and flexibility advantages. Conservation as a long-run criterion is considered in Chapter 5. Principles of conservation and empirical analyses are used to place conservation in a realistic position for evaluating alternatives in the Oregon wheat-summerfallow area.
CHAPTER II

DESCRIPTION OF STUDY AREA AND METHODOLOGY

A description of the study area is given in the first part of this chapter. This description includes physical and climatic characteristics, and a separation of the area into geographic divisions on the basis of productivity and erosion problems. Most of the chapter, however, deals with the method of study, including sources of data, method of analysis, and criteria used in evaluating land-use alternatives.

Description of Study Area

The study area comprises the wheat-summerfallow land of the Columbia Basin in northeastern Oregon (Figure 1). It includes the wheat regions of Morrow, Gilliam, Sherman, and Wasco counties, and part of the wheat area in Umatilla county. The elevation in the area ranges from less than 500 feet near the Columbia River to more than 2,500 feet at the foothills of the mountains. Croplands often are interspersed with deep canyons and/or rangeland. Soils generally become more shallow and heavier in texture with increase in elevation. The soils range from deep, light textured, rapidly permeable to shallow with a medium texture.

The study area is divided into geographic divisions according to productivity and type of erosion problems.
Figure 1. The Study Area with Outline of Productivity and Erosion Problem Sub-Areas.
On the basis of rainfall and soil characteristics, two general productivity levels can be distinguished. They are referred to as the wheat-summerfallow area of low productivity and the wheat-summerfallow area of high productivity. The area is further divided with respect to kind of erosion problems. The two erosion areas comprise those localities with water erosion problems and those with wind erosion problems.

The wheat-summerfallow area of low productivity comprises a large part of Sherman, Gilliam, and Morrow counties, and the southwestern part of Umatilla county. Normal precipitation for most of the area ranges from 10 to 14 inches per year. Rainfall increases from lower to higher elevations. The wheat-summerfallow area of high productivity is located in northwestern Umatilla county, northwestern Sherman county, and central Wasco county. For the most part, these localities lie within the 12 to 16 inch rainfall zone.

Wheat yield limits for the two productivity areas cannot be precisely determined because of soil and rainfall variations within each area. Yields averaged 16.8 bushels for the low productivity area, and 26.6 bushels per acre in the high productivity area in the period 1928-47 (10).

Erosion problems generally are more serious in the low productivity areas. Most of Sherman and Gilliam counties are affected by water erosion difficulties, as are
the wheat growing areas in southern Morrow and Umatilla counties. The general area of wind erosion is the northern part of Sherman and Morrow counties, and western Umatilla county. Both water and wind erosion problems, however, may be found in the areas of high productivity. Farmers in central Wasco county are known to experience water erosion difficulties. Also, wind erosion seriously affects some highly productive wheatlands in northwestern Umatilla.

**Method of Study**

The first phase of the study pertains to the determination of the practical alternatives to wheat on farms in the Oregon wheat-summerfallow area. A consensus of farmers' experiences and opinions mainly are used as a basis for determining the set of practical alternatives. Economic comparisons of the alternatives are made in the second part of the study.

The methodology for the thesis is outlined in the remainder of this chapter under three main divisions. These are: (1) sources of data from which the thesis is developed, (2) method of analysis used in comparing the relative incomes of alternatives, and (3) criteria used in addition to money income in making economic comparisons.

**Sources of Data**

Information obtained from a farm survey provided
primary data for determining the practical land-use alternatives on diverted wheat acres. Physical input-output data and prices used in making economic comparisons of alternatives were derived from secondary sources.

Farm Survey. A survey of wheat farmers was carried out in the Oregon wheat-summerfallow area during the fall of 1954 by the Oregon Agricultural Experiment Station and Agricultural Research Service, U.S.D.A. It was initiated to study the problems that farmers face in adjusting to the wheat allotment program. The important objectives of the survey were: (1) to determine how farmers adjusted to wheat allotments in the past, and what their plans were in the future, (2) to study adjustment problems as related to resource situations, and (3) to obtain general information on farmer experiences and opinions on production alternatives to wheat.

The farm sample was stratified on the basis of the number of acres in cropland, the amount of rangeland, and productivity class. Information on the size of farms, acres of cropland, and the amount of non-cropland was obtained for each community in a county from the Agricultural Stabilization Committee offices in the five counties of the study area. Communities were rated as to productivity by soil specialists of the Soil Conservation Service and Oregon State College.
Farms were classified according to size in acres of cropland and acres of non-cropland. The aim was to obtain farms of different acreages of cropland, with and without significant amounts of rangeland. Significant amounts of rangeland were those acreages sufficient for carrying at least 20 animal units of cattle on range, assuming 30 acres of rangeland were required per unit. Size groups were represented as three and one-half section, two, and one section cropland farms, with and without significant amounts of rangeland. For sampling purposes, an equal number of farms was selected at random from each of the following modal groups:

(a) Large farms with significant amounts of rangeland
   1801 - 3000 acres of cropland
   601 acres and over of non-cropland

(b) Large farms with insignificant amounts of rangeland
   1801 - 3000 acres of cropland
   0 - 500 acres of non-cropland

(c) Medium farms with significant amounts of rangeland
   901 - 1600 acres of cropland
   601 acres and over of non-cropland
Medium farms with insignificant amounts of rangeland
901 - 1600 acres of cropland
0 - 400 acres of non-cropland

Small farms with significant amounts of rangeland
300 - 800 acres of cropland
601 - 3000 acres of non-cropland

Small farms with insignificant amounts of rangeland
401 - 700 acres of cropland
0 - 300 acres of non-cropland

Information obtained in the survey was used in classifying resources and developing a set of land-use alternatives for economic comparisons. Classification of farms on basis of major resource variables, including size, amount of rangeland, and facilities for livestock provided a basis for appraising the feasibility of different land-use systems for the study area as a whole. The feasibility of production alternatives depended also on productivity and soil erosion problems of the farmers.

The main criterion for selecting a set of feasible alternatives was the practicability of systems as based on a consensus of farmers' experiences and opinions. The consensus of farmer opinions was used to select practical
alternatives because of inadequate information available for deducing a set of alternatives. However, the general land-use possibilities for appraisal by farmers logically were deduced in drawing up the survey schedule.

Source of Budgeting Data. Physical input-output data used in the budget analysis were obtained from several sources. The most important source was unpublished data from a regional study of the economics of conservation farming in the Pacific Northwest area (10). Some of the data from the economics of conservation study were adjusted on the basis of more recent input-output estimates. These more recent estimates mainly were derived from a study of wheat farms in Wasco county, an analysis of recent experimental data, and the information obtained in the survey.

Prices of inputs and outputs used in the budgets were, as nearly as possible, for the year 1954. These prices were used since the analysis determining relative incomes of alternatives was for a short-run period of time. Purchase prices of farm machinery and some production supplies were obtained from a dealer in the study area, and other prices paid by farmers were taken from U.S.D.A. reports (13, 14). Prices for 1954 were not available for all items used in production. Prices for these items were estimated by adjusting prices in a previous period by use of index numbers (16). For example, prices for equipment
supplies such as fuel, oil, and repair parts were adjusted by the index of Motor Vehicle Supplies (1910-14). Similarly, construction prices were corrected to the 1954 level by the index of farm building and fencing material (1910-14).

Farm product prices used in the budget analysis were prices for the months in 1954 in which most of the individual products were marketed (15). The price of wheat used was 82.5 per cent of old parity or $2.04 per bushel. This was slightly lower than the October, 1954 price of wheat. Barley and cattle prices received were those of October, 1954. The price of hay was obtained by adjusting the all-hay price for Oregon in October, 1954 with the price of grain hay relative to all hay in 1951 (6, pp.30, 45). A feed price of wheat was calculated on its feed value, relative to barley, and based on the price of barley.

Method of Analysis

The method of analysis consists of budgeting procedures in deriving relative incomes of various alternatives. Essentially, the method is to rank the alternatives on the basis of how each compares with the income from a basic system of wheat production. A description of the farm situations budgeted also is included in this section. Finally, assumptions regarding the size of wheat allotment in effect are stated.
Budgeting Procedure. The farm budget method is used to estimate the income potential of various farm plans. The method is well adapted to comparing incomes from alternative systems of farming under various assumptions. The factors constant or nearly the same for all alternatives do not affect relative incomes, and, therefore, are not included in formal budgets. Emphasis is placed upon the factors which account for differences in incomes from various systems; it being reasoned that these factors are the variables conditioning the choice of an alternative.

The incomes derived through budgetary procedures are stated as percentages of the income estimated for an all wheat production system. Alternative farm systems involving various uses of diverted acres are compared to a basic system of no diverted wheat acres. Then, the alternatives are ranked according to their income-earning potential relative to the basic system. Net farm income is not determined, but relative incomes are derived by subtracting variable costs from gross farm income. The variable cost figure is comprised of those direct costs that vary with alternative production systems, and indirect costs occurring from additional capital investment in adjusting to particular alternatives. The main items of cost considered fixed to all the alternatives are land taxes, interest on real estate and major machinery, and production expenses on allotted wheat acreages.
Three major groups of variables are analysed in budget comparisons of the alternative land-use systems. These are: (1) gross farm income, (2) direct costs, and (3) differences in indirect costs. Gross farm income is derived from total sales of all commodities associated with a particular land-use alternative. Direct costs are those which vary with the amount of output or are unique for specific enterprises, while indirect costs are the result of additional capital costs needed for transition to the adjusted situation. The main task in the analysis is to determine these three major budget items for each relevant alternative, and to explain the reason for differences in these items among alternatives. In this way, the farmer may detect the income and cost differences he can expect in adjusting to one system compared to what he might expect from an alternative system.

Gross farm income is made up of sales of wheat, barley or beef, and the important direct costs include hired labor, crop expenses, and costs of operating power equipment. Crop expenses consist of crop insurance, weed sprays, and fertilizer when useable. Seed requirements, however, are deducted from saleable grain and not treated as a crop expense. Costs of operating power equipment include fuel, oil, and repair parts for tractors, trucks, and combines. Annual repair costs, depreciation, property taxes,
and interest are the important indirect costs connected with additional capital investment. Repair costs and deprecia-
tion are associated only with additional buildings, improvements and machinery. Interest and taxes, however, are charged on all additional capital, including livestock added in various alternative systems.

**Situations for Study.** In order to study the effect of variations in resources, a single farm was chosen which could be adjusted to represent different sizes and amounts of rangeland. The criteria for selecting this farm were its divisibility into different sizes, and its adjustability into rangeland and non-rangeland situations. The methodology used consists of either subtracting or adding a tract to obtain the desired farm size falling within the modal size group for the area. Different assumptions regarding productivity and erosion problems can be made for the selected farm.

The tracts of land belonging to the farm selected for study are shown in Figure 2. The farm consists of three tracts. The total number of acres for the non-rangeland situation amounts to 2,254 acres of which 2,144 acres are cropland. This is only slightly less than the three and one-half sections of cropland making up typical farms in the area. When tract two is deleted, a farm in the medium-sized group is obtained. It includes a total of
Figure 2. Map of Selected Farm With Outline of Separate Tracts.
1,280 acres consisting of 1,170 acres of cropland and 110 acres of land unfit for cultivation or grazing and farmstead. Forty-four acres of cropland are seeded down to a grass waterway. To obtain a farm in the small-sized group, tract three is deleted so that the total land remaining in tract one is 640 acres. This includes 530 acres of cropland, and the remainder is rough land, farmstead, and buildings. For rangeland situations, 1,000 acres of rough pasture, and 500 acres of wasteland are added to each size group.

The three size groups depicted by the farm selected compare closely to modal sizes in the area. Actual inventories of land resources as recorded in field schedules averaged 2,130 acres of cropland for large farms, 1,260 acres for medium farms, and 570 acres for small farms. The average amounts of rangeland for the corresponding size groups in the insignificant rangeland classification were 260 acres, 311 acres, and 145 acres. In the significant rangeland situations, large farms averaged 1,606 acres of non-cropland, medium farms 1,510 acres, and small farms 1,370 acres of non-cropland.

Although the influence of size differences in selecting among various land-use systems is not treated in formal economic comparisons, expected effects of size on relative incomes are arrived at through reasoning processes.
The budgeting analysis in this thesis is just a portion of the total budgeting to be done in the completed study in which all three sizes will be used. Budgets are limited here to the medium-sized situation with and without significant amounts of rangeland.

**Wheat Allotment and Diverted Acres.** A wheat allotment amounting to 65 per cent of the base acreage is assumed for purposes of this study. This means that 35 per cent of the average numbers of acres in crop over a two-year period is diverted from wheat production. Calculation of the wheat allotment is shown for a medium-sized farm with 563 acres normally planted in grain and 44 acres in grass. In each year, 212 acres are diverted from wheat \((607 \times 0.35 = 212)\). The allotment is, therefore, 351 acres \((563 - 212 = 351)\). Similarly, wheat allotments for large farms and small farms amount to 667 acres and 163 acres respectively.

**Criteria for Appraising Alternatives**

The economic criteria used in evaluating the alternatives in this study relate to two time periods. These are short-run and long-run criteria. Short-run and long-run time periods may be defined in terms of the alternatives considered. For purposes of this study, a time period of from two to three years is assumed to represent the short-run; the long-run is then, any period exceeding
that length of time. In general, the time span of farmers' production plans does not exceed the short-run. The short-run criteria are income, flexibility, and costs of adjustment. Stability of income from year-to-year as a criterion for evaluating alternatives is not considered in the study. Conservation is considered as a major factor in long-run planning.

**Short-run Criteria.** For the short-run, farmers usually conceive of money income as the main criterion for making decisions. It is for this reason that major emphasis is placed on relative incomes in the economic comparisons of alternatives. Flexibility is the ability to change readily from one crop to another, or from one enterprise to another at low cost. This is a desirable feature of farm planning when uncertain of the future profitability of the different crops or enterprises. Therefore, alternatives also are ranked in terms of flexibility.

Costs of adjustment are other short-run considerations since we can logically expect costs to be the chief limiting factors to some farmers in adopting particular alternatives. These costs become less significant in the longer time period when initial outlays are spread over a greater number of years. They include the capital investments required in shifting to an alternative land-use system, initial establishment costs to be allocated over
the life of the system, and transition labor requirements in making the adjustment.

**Conservation.** Farmers are generally less interested in long-run conservation systems than are the professional people who are concerned with use of soil resources. Lack of knowledge about the benefits of soil conservation is advanced as the major reason why farmers have been slow in adopting recommended farming systems. We would expect that farmers will use conservation systems when they have sufficient knowledge of conservation, and may observe with a reasonable amount of certainty that it will be profitable over time. It is, therefore, appropriate that conservation be considered as a criterion for appraising alternatives in the long-run. The conservation practice of trashy fallow, however, is considered in the short-run in this study. Trashy fallow is a system using subsurface tillage methods so that a cover of stubble mulch is left on the surface. It differs from the regular summerfallow practice of moldboard plowing in which stubble is worked into the top layer of soil.

In view of the uncertainty of conservation advantages in longer planning periods, it appears that the main task confronting us is primarily one of increasing knowledge about conservation. Accordingly, some principles of conservation, together with statistical analyses are
presented in Chapter 5 in developing a hypothesis explaining the state of the conservation problem in the Oregon wheat-summerfallow area. Finally, alternatives are ranked on the basis of conservation.

Summary

The study area comprised the wheat-summerfallow land of the Columbia Basin in northeastern Oregon, including the wheat areas of Morrow, Gilliam, Sherman and Wasco counties, and part of Umatilla county. It was divided into problem localities according to level of productivity and type of erosion problems.

The study was composed of two major phases: (1) determination of practical alternatives to wheat, and (2) economic comparisons of these alternatives. Farm survey data and secondary data from various sources were used in the study. The main method of comparing the alternatives was budgeting. This facilitated an income comparison in which gross farm income, direct costs, and indirect costs were taken into account. In addition to income, flexibility, costs of adjustment, and conservation were considered in appraising the alternatives.
CHAPTER III

SELECTION OF PRACTICAL LAND-USE ALTERNATIVES

The purpose of this chapter is to select a set of practical alternatives for use on farms in the Oregon wheat-summerfallow area. Delineation of relevant land-use systems is based primarily on farmers' experiences and on their ideas regarding general production possibilities under varying resource situations and opportunities to grow wheat and other cash crops. Accordingly, three divisions of the chapter are: (1) appraisal by farmers of basic production possibilities for use on diverted acres, (2) consideration of the major elements in their land-use plans, and (3) selection of the alternatives.

Farmer Appraisal of Production Possibilities

The basic ways farmers in the wheat-summerfallow area can use land taken out of wheat are: (1) grow feed grains as cash crops or as feed for farm use, (2) seed to grass for pasture or conservation purposes, (3) grow small grains for hay and/or pasture, (4) let diverted acres remain idle in stubble or in double summerfallow, and (5) grow other cash crops such as grass seed or safflower. These were the general land-use possibilities included in the survey schedule for appraisal by farmers. Outlined
in this section is a consensus of farmer opinion expressing the practicability of each alternative group for the study area as a whole.

Grain Alternatives

Barley, oats, and rye are the feed grain alternatives to wheat. Of these, only barley received major consideration by the farmers surveyed. Oats may do well where moisture is relatively high but are risky for the area as a whole. Rye has limited value as a feed grain, and there is danger of it becoming a weed when grown on wheatland.

Next to wheat, farmers rank barley as their best crop. Yields of barley compare favorably with wheat. Another important factor influencing the shift to barley is the greater amount of production know-how as compared to many land-use alternatives. This is because production methods for barley are similar to those for wheat.

There are definite economic advantages associated with favorable production aspects of barley. Income per acre is the main consideration. Wheat farmers recognize barley as a major cash-crop alternative with good income-earning potential. Also, barley has cost advantages over other alternatives since it requires nearly the same production methods, machinery, and market facilities as wheat. In addition to income and cost advantages in growing barley, wheat farmers regard it as the alternative involving least
amount of uncertainty. This follows because of their greater knowledge in production and marketing of barley than any other crop except wheat. A further advantage of barley is its flexibility as a cash crop alternative. Shifts back to wheat production easily can be made from barley at low cost.

Freedom to grow barley depends, however, on provisions of the allotment program. Under total compliance regulations on growing cash crops, barley is restricted because of the lack of production history for a base acreage. The possibility of enforcement of compliance regulations in the future is sufficient reason for appraising alternatives such as grass, grain hay, pasture, and idle. Although cash crops other than barley receive little attention from farmers, they too could be limited by provisions of the control program.

Erosion problems associated with growing spring grains in some regions are recognized as a further limitation of the barley alternative. These problems are likely to occur whenever spring grain is grown and erosive land is left fallow during the winter. Current varieties of fall barley are susceptible to winter freezing. Few farmers have experienced success with fall seeded barley.

Grass Alternatives

Most of the farmers in the study had some experience
in growing grass on dryland. Their experience usually was associated with grass seeded either as an incentive adjustment in earlier wheat allotment programs, or on steep slopes for prevention of soil erosion. Crested wheat grass was the predominant grass grown in the area. It was rated a reasonably good source of pasture on wheat farms. Keeping the grass pastured down and alternating cattle on and off in short periods appeared to be the best management practice for deriving maximum carrying capacity. Farmers reported the quality of grass hay to be poor.

Practically no interest was shown in a rotation plan involving grass and wheat-summerfallow. Decreases in subsequent wheat yields following grass, difficulty in establishing stands of grass, and inadaptability of grass in rotation to livestock enterprises were stated as the important production disadvantages of grass grown in rotation. Over one-half the farmers in the survey who had experience in wheat after plowing crested wheat grass indicated yields were less than if grass had not been grown. Some farmers were convinced wheat yields do not return to the normal level until at least the third crop after grass. Others stated the time required to establish grass of two or three years prohibits its use in rotation with wheat. Inadaptability of grass in rotation to facilities for livestock involves problems of fencing with changing pasture areas and inaccessibility of available water facilities in
stocking certain fields. Lack of rangeland adjacent to
seeded grass pasture further complicates use of the grass-
wheat fallow rotation.

Oregon wheat farmers expressed a strong preference
for permanent grass rather than the grass-wheat rotation
system when the alternatives reduce to these two. Over
90 per cent would seed grass down permanently on specific
acres. They reasoned this to be more advantageous than
the rotation system if grass is seeded according to least
productive land, land expensive to operate, or erosive
land having steep slopes, wind affected fields, and thin
soil. Furthermore, wheat farmers like to select parti-
cular fields for planting grass according to facilities
for livestock.

Perhaps the most significant reason why farmers
generally were not interested in grass was that they did
not normally plan in long-run intervals. In most cases,
farmers were reluctant to make any plans beyond next
year's crop because they were uncertain of the opportunity
to grow wheat and what alternative would be the best choice
for the future. Farmers naturally were inclined to go slow
on enterprises such as grass which require long periods to
pay off. For this reason, grass was given little considera-
tion since several years are needed before maximum benefits
can be obtained. Although most farmers agreed that grass
was the leading conservation crop by virtue of its benefits
in building and holding soil, an increase in conservation through grass seedings was not planned because of uncertainty of the benefits of grass in the long run.

Along with the uncertainty involved in growing grass on diverted acres, wheat farmers recognize grass as the most inflexible of all land-use alternatives. They look upon seeding grass as a loss in income potential from less permanent alternatives such as cash grain crops. A grass rotation requires a farmer to keep some of his best cropland in grass for as long as four years in a twelve-year rotation, while grass permanently seeded down has greater inflexibility if grown on good cropland.

Even in short-run planning periods, farmers do not consider grass as an important alternative especially when cash crops may be grown. Factors contributing to loss in net income and increased costs associated with grass are the reasons for its non-acceptance. In the first place, sales of products from grass are limited because of relatively low carrying capacities and yields. Also, farmers considered the relationship of livestock prices to cash grain prices in recent years unfavorable for grass-livestock enterprises on wheat farms in the area. Farmers point out that large amounts of capital are required for adjusting into grass systems. For example, increased investments are necessary whenever a farmer cannot utilize grass under his present resource situation without making
substantial adjustments.

**Grain Hay and/or Pasture Alternatives**

About one-half the farmers interviewed had some experience in growing small grains for pasture and/or hay. One practice was to utilize the wheat entirely for pasture. Another method was to pasture wheat but to remove the livestock before causing a significant reduction in yield. Complete utilization of wheat for pasture was the practice of interest in this study. The carrying capacity of wheat pasture depended upon the way it was handled. Yields of wheat hay grouped around a mode of one ton per acre for the farms surveyed. Both wheat pasture and hay were said to be of excellent quality for livestock.

Flexibility and prevention of soil erosion are the important advantages derived from the grain hay and pasture alternative. It is a highly flexible use of expensive summerfallow land in short-run periods. Erosion prevention measures are derived from the practice of seeding all acres to grain in the fall, followed by pasturing in the spring. In this way, land is not left in fallow over the winter when erosion hazards are greatest.

Inability to utilize grain pasture on wheat farms is noted to be its main disadvantage as an alternative land-use system. Many farmers emphasise their need for larger livestock enterprises in order to utilize all the wheat
pasture that can be grown on diverted acres. These farmers do not rate grain pasture as a practical alternative unless they are prepared to add livestock and livestock facilities. Insufficient rangeland to carry stock throughout the pasture year may be the limiting factor. However, farmers who have more livestock facilities give a higher rating to the grain pasture alternative.

Investment in haying equipment, and high labor costs required in putting up hay were emphasised by farmers as limiting factors. Added to these costs are the costs of preparing summerfallow which altogether makes the growing of grain-hay an expensive operation. Some farmers state that grain hay is no better than a break-even proposition, where it is either more economical to buy hay or grow hay, depending on the local price.

**Alternatives on Idle Land**

In the survey, farmers were asked to comment on the feasibility of leaving land idle in stubble or in double summerfallow. Idle in stubble could be handled in a rotation of wheat stubble and summerfallow, or the stubble land could be taken out of wheat production. Idle in double summerfallow is a rotation of wheat, fallow and fallow.

Although no income is derived from land left in stubble, it can be the best alternative from the standpoint
of least costs if weed control measures do not have to be taken. Least-cost ways of handling diverted acres receive major consideration by farmers who do not have facilities for livestock. As a conservation measure, leaving land in stubble reduces both wind and water erosion. Stubble may also have some pasturing advantages if native grasses come back sufficiently well for grazing purposes. In rating the practice of clean double summerfallowing diverted acres, farmers pointed out prevention of weeds, increases in subsequent wheat yields, and the high degree of flexibility as important advantages. Double summerfallow is the most flexible way in which farmers can keep their land under uncertainty of the wheat allotment program.

Leaving land idle in stubble is a non-income proposition and for this reason many farmers do not consider it a real alternative. Also, the weed problems involved may be a serious limiting factor. The greatest disadvantage to double summerfallow is the erosion problem; steep slopes or wind blown fields can never be left this way without serious soil losses. Double summerfallowing is costly since it means working land from which no income is derived.

Other Alternatives

Farmers recognized few possibilities other than feed grains, grass, grain hay and pasture, or the idle
systems for use on diverted acres. Small grains for green manure purposes were suggested by some farmers. Grass for seed was considered feasible, but field peas were said to be restricted by lack of moisture. Safflower was given little consideration, although it is a cash crop having about the same culture as wheat.

Elements Conditioning Farmer Plans

Farmer plans for use of diverted acres were conditioned by several major factors. Government policy in respect to the wheat allotment program was found to be the most important element in farmer choice of alternatives. Nearly as important was the variation in resource situations, particularly size of farm and facilities for livestock. In addition, productivity differences, erosion problems, and farmers' tenure position had some influence on plans for use of diverted acres.

Government Policy

Two important aspects of government policy of significance to farmer choice in land use are: (1) opportunity to grow wheat, and (2) opportunity to grow other cash crops. Generally, the study presupposes limited opportunity to grow wheat. In this case, the major policy variable is the opportunity to grow cash crops on diverted acres. However,
some consideration is given to a situation of unlimited opportunity to grow wheat in the budgeting.

If cash crops are permitted under the program, barley will be grown predominantly on diverted acres. About 85 per cent of the land taken out of wheat in 1954 was diverted to barley when total compliance restrictions were in effect. Nearly the same amount will be seeded to barley in 1955 according to plans reported by the farmers interviewed.

The main influence of total compliance or restrictions on growing cash crops depends on the time duration in which farmers can expect regulations to be in force. Under uncertainty of limitations on cash crops from year to year, the effects of total compliance are: (1) increased emphasis of grain hay and/or pasture, (2) increased emphasis of idle in stubble or double summerfallow, and (3) little interest in grass except on unproductive or erosive land.

In a state of uncertainty, farmers will stay in a position to change plans quickly. This was indicated in farmer plans before cash crop restrictions were lifted for 1955 when over half were going to seed all summerfallow land in wheat and use the excess over the allotment for hay and pasture. Another 25 per cent had plans for idle. These were flexible plans permitting maximum wheat production in 1955 should the program be changed by spring. Also, these alternatives would permit shifts to wheat or any other profitable crops the following year. When total compliance
regulations continue beyond two or three years, staying in a flexible position becomes less important to wheat farmers. Grass for conservation or livestock purposes, therefore, receives an increasing amount of attention as time goes on. Evidence of this was found in the adjustment survey when 50 per cent of the farmers planned to seed grass if confronted with continued wheat allotments and compliance regulations.

Size of Farm and Amounts of Rangeland

Major resource variables which condition the use of diverted acres are size of farm and amounts of rangeland. Farmer interest in grass increased with increase in acreage operated. Over two-thirds of the farmers operating three section farms indicated a preference for grass or some combination of grass under limited opportunity to grow wheat and other cash crops. Operators of medium-sized farms were less interested with about 56 per cent choosing a grass system, while only 25 per cent of the farmers operating one section would adjust to grass as an alternative.

For all sizes, the interest in grass was less by those farmers without significant amounts of rangeland. However, farmers in the small-sized group with significant rangeland also showed little interest in grass. There are two possible explanations on why this is so. First, the likelihood of large farms having suitable areas adaptable
to grass is greater; that is, single parcels can be seeded down for economic pasture operations. Second, there are income and cost factors. Large cropland farmers are in a better position to withstand reduced incomes or the extra costs involved in establishing grass. They can adjust to a smaller number of grain acres by cutting down hired labor, or by selling capital equipment whereas small farm operators cannot readily make these adjustments.

Fifty-six per cent of the farmers with one section and with rangeland, 20 per cent of the farmers with two sections, and 14 per cent of the farmers in the large group preferred grain hay and/or pasture as an alternative. This relationship is the reverse of that for grass. Operators of small farms are least interested in grass, but most interested in grain hay or pasture; the opposite is true for large farms.

Operators of small farms are more interested in grain hay or pasture because they have much greater need for flexibility than operators of larger farms. The unfavorable consequences of inflexibility are more serious on small farms. A further reason why operators of small farms prefer grain hay and/or pasture is their ability to utilize it in conjunction with range-livestock operations. One-third of cropland acres used for grain hay and/or pasture can be utilized on a small farm with livestock, but that much cannot always be used on a large farm when
numbers of livestock are the same for each size.

Idle alternatives were found to be more important on medium and small farms without significant amounts of rangeland than on large farms without rangeland. This is because large farms without significant range contain more livestock, as well as more potential for livestock. The relationship between preference for idle alternatives and size of farm then is related to the number of livestock or facilities for livestock rather than to size. Hence, farmers with livestock facilities are least interested in idle when they can utilize land for growing feed.

**Productivity**

Farmers sampled in three soil productivity areas did not differ in their choice of alternative land-use systems. Owing to higher than usual rainfall in low productivity areas during the survey year, there was little difference in wheat yields between areas. Therefore, the only advantage derived by classifying farms in productivity groups was to give a geographical distribution over the five counties studied. We can, however, reason that productivity of land on particular farms may limit the alternatives farmers use on diverted acres.

**Soil Erosion**

Danger of soil erosion is an important factor in
farmers' choice of land-use systems and it may be the main consideration in restricting the choice of some alternatives. In areas where serious wind erosion problems prevail, leaving land idle is not practical. The farmers' primary objective is to keep the land in crop. Also, in water erosion areas, farmers express little preference for spring seeded grains which leave land idle through the winter months. Grass is a first alternative for those farmers who have thin washy land or steep sloping land subject to gullyng. Finally, summerfallow practices vary with erosion problems; trashy fallow methods are more popular than regular fallow practices where a conservation measure is required.

Tenure Position

It was expected that tenure position would have an influence on farmer adjustment plans. We would expect decisions in regard to the use of land to be made jointly by landowner and tenant. In the survey, tenure was found to bear little relationship to decisions made. One-half of the farm operators, regardless of whether they were owners, part owners or full tenants, preferred grass or grass combinations for alternatives under certainty as to limited opportunity in growing wheat. The second choice in terms of number of farms was either grain hay and pasture, or idle combinations, with tenure apparently having no
significant influence on farmer preferences. For 1955 adjustment plans representing decisions made under conditions of uncertainty, tenure again had no effect.

The true effect of tenure on farmer decisions may not have been determined in the survey. Failure to derive relationships may have been the result of false security of tenure given farmers by the way survey questions were phrased. For instance, when a condition of certainty was assumed for several years to come, it is conceivable that tenant farmers understood this to mean they would have guaranteed tenure for the same period.

Another possible reason for the lack of relationship between tenure and decisions is that Oregon wheat farmers have unusually strong security of tenure. Many farmers classified as tenants were actually related to the landowners; sons operating the parents' ranch was found to be a common situation. If the father still lived on the ranch or nearby, the decisions generally were made jointly between himself and the operator son. Also, farmers classified as part owners often rented only small parts of total land operated, and their decisions mainly were those of owners. Some tenants had several landlords owning different parcels of their land. In this case, the landlord depended on the operator's decisions which were made on the basis of the whole operating unit.
Selection of the Alternatives

On the basis of the preceding discussion of the alternatives, the following may be set forth as the logical courses of action farmers will take under different situations:

(1) Barley will be grown predominantly on diverted acres if total compliance is not in effect.

(2) Acres taken out of wheat will be used mainly for grain hay or pasture on farms with livestock enterprises, under limited opportunity to grow cash crops in the next two or three years. This assumes about the current state of knowledge on future wheat growing opportunities. Farmers without livestock facilities will look for least cost ways of handling diverted acres, either by leaving them idle in stubble or double summerfallow. Only small amounts of grass will be seeded in this short period with uncertainty.

(3) Grass will receive more attention for livestock and conservation purposes under the same limitations in longer periods of time.
Based on these propositions, practical alternatives for economic comparison are listed below for two resource situations related to facilities for livestock:

**Diverted acres on farms without facilities for livestock.**

(a) Barley
(b) Crested wheat grass.
(c) Crested wheat grass and grain hay.
(d) Idle in stubble.
(e) Idle in summerfallow.
(f) Idle and grass.

**Diverted acres on farms with facilities for livestock.**

(a) Barley.
(b) Crested wheat grass.
(c) Crested wheat grass and grain hay.
(d) Grain pasture and hay.
(e) Barley and grain hay.
(f) Crested wheat grass, grain pasture, and grain hay.

The above alternatives are not intended to be a complete list of possibilities in use of diverted acres. They appear to be relevant ones in the minds of farmers and, for this reason, they are chosen for further study.
Farmers appraised production possibilities for use on diverted wheat acres on the basis of physical and economic factors. Physical adaptability of basic alternatives to different problem areas and resource situations received major consideration in farmer appraisals. Important economic objectives of farmers in their short-run plans were: (1) maximization of income, (2) least costs when income alternatives were not adaptable, and (3) flexibility. Farmer plans generally were for short-run periods because of uncertainty in opportunity to grow wheat, together with uncertainty of the future profitability of alternatives to wheat.

Elements considered for their effect on farmer plans were: (1) government policy, (2) resource variables, (3) productivity, (4) erosion, and (5) tenure position. Most important among these were government policy and resource variables. Government policy was the significant factor contributing to uncertainty in farmer planning. The main resource variable influencing farmer decisions was facilities for livestock.

Major courses of action that farmers were expected to take under different situations were: (1) grow barley on diverted acres if permitted under the allotment program, (2) grow grain for hay and/or pasture on farms with
livestock facilities or leave land idle on farms without facilities for livestock, under limited opportunity to grow cash crops in the next two or three years, and (3) grow grass for livestock or conservation purposes under limited opportunity to grow cash crops over longer periods of time. Based on these propositions, basic alternatives selected for economic comparison were barley, grain pasture, grain hay, idle, and grass.
CHAPTER IV

ECONOMIC COMPARISONS OF SELECTED ALTERNATIVES

Farmers' questions in regard to making adjustments focus on economic factors. How much will it cost to make the adjustment? How much income will one system earn compared to other alternatives? What flexibility advantages will one system have over another? Accordingly, the alternatives selected in Chapter 3 are compared in the following sections on the basis of: (1) costs of adjustment, (2) income, and (3) flexibility.

Costs of Adjusting to Selected Alternatives

Costs required for adjusting into selected alternatives are shown in Table 1 for medium-sized farms with and without facilities for livestock. Adjustment costs logically are considered first in economic comparisons of alternatives since they may be a prohibitive factor in making adjustments. Farmers give a great deal of consideration to the necessary outlays of capital in adding the machinery, livestock facilities, and livestock associated with different land-use plans.

A wheat farmer does not incur additional investment by shifting acres into barley or leaving land idle. However, substantial capital outlays are necessary in
Table 1. Costs of Adjusting to Selected Alternatives, Medium-Sized Farm With and Without Facilities for Livestock 1/

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Crested wheat grass

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Grass and grain hay

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Idle and grass

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Barley and grain hay

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Grain pasture and hay

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Grass, grain pasture and hay

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For footnotes see following page.
Footnotes, Table 1

1 Not included in the table are the following alternatives for which no additional capital is required: barley, idle in stubble, and idle in summerfallow.

2 Additional capital required is estimated on basis of 1954 prices.

3 Additional costs for livestock facilities include the following for farms without livestock facilities: fencing... 10 miles at $320 per mile; water facilities... $200; building improvements... $2,300; electric fence... 2 miles at $100 per mile. For farms with livestock facilities, 2 miles of electric fence at $100 per mile are added.

4 Grass machinery consists only of a grass seed attachment when seeding in stubble. Add $650 in grass machinery for seeding in fallow.

5 Value of livestock added to basic system with no diverted acres.

6 Cost of establishing grass in stubble at $2.63 per acre including $2.40 per acre for seed, and $0.43 per acre for seeding operations. See tables 2 and 3 for number of acres in grass for selected alternatives.

7 Same as for footnote 3.

8 Includes mower, side-delivery rake, field bale loader, and elevator. Custom hire baler for medium-sized farm with less than 125 tons of hay.

9 Same as for footnote 6.

10 Not an alternative on farms with facilities for livestock. Includes 25 per cent of diverted acres in grass and 75 per cent idle in summerfallow.

11 Same as for footnote 6.

12 Not alternatives for farms without livestock facilities.

13 Four miles of electric fence added for grain pasture.

14 Same as for footnote 6.
adjusting to grass-livestock enterprises. Farmers with about an average acreage of cropland, but without livestock facilities, will need about $14,000 for establishing a grass-livestock enterprise. This includes outlays for livestock facilities, livestock, grass machinery, and costs of establishing grass in stubble. The same adjustment for farms already established in a livestock enterprise requires only about $7,600 because livestock facilities do not have to be added in this case. The important livestock facilities required in shifting from a basic wheat situation are fencing, stock-water facilities, and building improvements.

In non-livestock situations for farms with average amounts of cropland, the grass and grain hay alternative requires about $13,700 additional capital. This nearly equals the amount necessary when all diverted acres are used for grass. A decrease in livestock purchases is offset by extra investment in haying equipment. A capital cost of about $6,200 is incurred when acres are diverted to grass and grain hay in livestock situations. This represents a difference of about $1,400 in investment needed between the grass-grain hay and the grass alternatives, with the grass-grain hay requiring the lesser amount. The smaller adjustment cost for grass-grain hay is largely the result of smaller outlays for livestock. Additional cattle carried over and above the number on
rangeland is 22 head compared to 43 head added when all diverted acres are put in grass.

Idle and grass as an alternative on farms with no livestock facilities requires little outlay when the grass is seeded for conservation purposes. However, farmers must meet approximate capital costs of $6,950 in adjusting to a combination of grass, grain pasture, and hay, $4,500 for grain hay and pasture, and $2,000 for grain hay grown in conjunction with barley.

Farmers who use diverted acres for grain pasture and hay will add fewer livestock than those who use crested wheat grass and grain hay together, owing to the longer grazing period of the grass and the earlier time of year in which it is ready for pasture. Also, grain pasture requires an equal number of acres in summerfallow each year, and consequently, has less carrying capacity for livestock per diverted acre than the grass. This is the reason why a smaller amount of capital is required in adjusting to the grain pasture alternative.

Adjustment costs for alternatives involving grass either in livestock or non-livestock situations are increased if farmers prefer to seed grass on prepared land instead of in stubble. Seeding costs are more than doubled when land is cultivated for seeding. The cost per acre was estimated at $6.42 including costs of grass seed, nurse crop seed, operating costs, and hired labor in
preparing the seed bed and seeding. The cost per acre for seeding in stubble was estimated to be $2.85.

In addition to actual capital outlay, varying amounts of labor are required for making adjustments into the selected land-use alternatives. In shifting to all grass on farms without livestock, an estimated 1000 man-hours of extra labor are needed during transition. This includes approximately 700 hours for building fences, 200 hours for seeding grass, and the remainder for construction of other livestock facilities. Decreasing amounts of labor are required for all other alternatives for both resource situations, ranging from an estimated 950 man-hours for grass and grain hay on farms without livestock facilities to 80 man-hours for the grain pasture and hay alternative in livestock situations.

Income and Cost Comparisons of Selected Alternatives

Relative income figures were derived for selected alternative land-use systems on diverted acres by use of budgeting procedures. These were used to rank alternatives on the basis of estimated income-earning potential. The income figures were a differential of gross farm income less direct costs that vary with inputs and those indirect costs that occur from additional capital investment in adjusting to particular alternatives.
Medium-Sized Farms Without Facilities for Livestock

Relative incomes from alternatives which farmers may adjust to when they do not have facilities for livestock are shown in Table 2 as a percentage of the income under the basic system of full wheat production. Full wheat production is the situation of normal wheat growing with no diverted acres. An income amounting to $18,355 was derived by subtracting costs of hired labor, equipment operations, and crop expenses from gross income. This income figure is higher than a farm income figure would be because all farm depreciation and repair costs have not been deducted. It was calculated for a wheat price of $2.04 per bushel or 82.5 per cent of old parity. There were no indirect expenses deducted because capital charges which are the same for all alternatives were not considered.

The relative income from growing barley on diverted acres amounted to 84.4 per cent of the basic income. This and other percentage comparisons may vary slightly as other costs are deducted from the gross farm income. Idle in stubble derived an income equal to 61.0 per cent, idle in summerfallow 60.7 per cent, and idle and grass 60.7 per cent of the income derived from full wheat production. Incomes earned from the grass with grain hay alternative, and the grass alternative were 58.7 per cent
Table 2. Incomes and Costs for Selected Alternatives, Medium-Sized Farm in Area of Low Productivity and Without Facilities for Livestock

<table>
<thead>
<tr>
<th>Item</th>
<th>Use of Diverted Acres</th>
<th>No Diverted Acres</th>
<th>Unit</th>
<th>Regular Tillage</th>
<th>Subsurface Tillage</th>
<th>Barley</th>
<th>Idle in Summer-fallow</th>
<th>Grass and Grain Hay</th>
<th>Grass</th>
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<tbody>
<tr>
<td>Barley</td>
<td></td>
<td></td>
<td>Ac.</td>
<td>212</td>
<td>-</td>
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<tr>
<td>Grain hay</td>
<td></td>
<td></td>
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<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Corn</td>
<td></td>
<td></td>
<td>Ac.</td>
<td>-</td>
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<tr>
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<tr>
<td>Bulls</td>
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<td></td>
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</tr>
<tr>
<td>Cow</td>
<td></td>
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<td>39</td>
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<td>Total animal units</td>
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<tr>
<td>Production</td>
<td></td>
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<tr>
<td>Wheat A/4</td>
<td>Dol.</td>
<td>11,260</td>
<td>10,134</td>
<td>13,464</td>
<td>13,464</td>
<td>13,464</td>
<td>13,464</td>
<td>13,464</td>
<td>13,464</td>
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<tr>
<td>Barley A/4</td>
<td>Dol.</td>
<td>5,088</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>Sales</td>
<td>Dol.</td>
<td>1,927</td>
<td>1,836</td>
<td>1,862</td>
<td>1,288</td>
<td>1,451</td>
<td>1,398</td>
<td>1,378</td>
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<td>Gross farm income</td>
<td>Dol.</td>
<td>14,042</td>
<td>13,464</td>
<td>13,464</td>
<td>13,464</td>
<td>13,464</td>
<td>13,464</td>
<td>13,464</td>
<td>13,464</td>
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<tr>
<td>Labor requirements</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hired labor A/4</td>
<td>Dol.</td>
<td>605</td>
<td>605</td>
<td>605</td>
<td>605</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Operator labor</td>
<td>Dol.</td>
<td>688</td>
<td>1,700</td>
<td>1,036</td>
<td>828</td>
<td>760</td>
<td>1,015</td>
<td>1,037</td>
<td>1,207</td>
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<td>Total labor requirements</td>
<td>Dol.</td>
<td>1,293</td>
<td>1,605</td>
<td>1,654</td>
<td>1,654</td>
<td>1,654</td>
<td>1,654</td>
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<td>1,654</td>
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<tr>
<td>Direct expenses</td>
<td>Dol.</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
</tr>
<tr>
<td>Hired labor A/4</td>
<td>Dol.</td>
<td>666</td>
<td>660</td>
<td>441</td>
<td>416</td>
<td>416</td>
<td>416</td>
<td>416</td>
<td>416</td>
</tr>
<tr>
<td>Equipment operations A/4</td>
<td>Dol.</td>
<td>1,636</td>
<td>1,027</td>
<td>1,286</td>
<td>1,286</td>
<td>1,286</td>
<td>1,286</td>
<td>1,286</td>
<td>1,286</td>
</tr>
<tr>
<td>Crop expenses A/4</td>
<td>Dol.</td>
<td>767</td>
<td>762</td>
<td>740</td>
<td>476</td>
<td>476</td>
<td>476</td>
<td>476</td>
<td>476</td>
</tr>
<tr>
<td>Livestock expenses</td>
<td>Dol.</td>
<td>34</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td>Establishment expenses A/4</td>
<td>Dol.</td>
<td>69</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Total direct expenses A/4</td>
<td>Dol.</td>
<td>3,608</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
<td>2,900</td>
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<tr>
<td>Indirect expenses A/4</td>
<td>Dol.</td>
<td>-</td>
<td>-</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>Machinery repairs</td>
<td>Dol.</td>
<td>172</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Building and improvement repairs</td>
<td>Dol.</td>
<td>259</td>
<td>-</td>
<td>-</td>
<td>11</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Machinery depreciation</td>
<td>Dol.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Depreciation on buildings and improvements</td>
<td>Dol.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Property tax</td>
<td>Dol.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Interest on livestock A/4</td>
<td>Dol.</td>
<td>322</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Interest on other capital A/4</td>
<td>Dol.</td>
<td>283</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Total indirect expenses A/4</td>
<td>Dol.</td>
<td>603</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Total expenses</td>
<td>Dol.</td>
<td>3,269</td>
<td>2,964</td>
<td>2,964</td>
<td>2,964</td>
<td>2,964</td>
<td>2,964</td>
<td>2,964</td>
<td>2,964</td>
</tr>
<tr>
<td>Comparative income A/4</td>
<td>Dol.</td>
<td>20,355</td>
<td>-3,000</td>
<td>-2,667</td>
<td>-7,160</td>
<td>-7,216</td>
<td>-7,216</td>
<td>-7,216</td>
<td>-7,216</td>
</tr>
<tr>
<td>Income in per cent of basic</td>
<td>Per</td>
<td>100.0</td>
<td>-</td>
<td>-4.3</td>
<td>-6.2</td>
<td>-6.7</td>
<td>-6.7</td>
<td>-6.7</td>
<td>-6.7</td>
</tr>
</tbody>
</table>

For footnotes see following page.
Footnotes, Table 2

1 Based on 35 per cent of total cropland.
2 Combination of 75 per cent idle in summerfallow and 25 per cent crested wheat grass.
3 Animal units are based on a carrying capacity of 0.78 animal units per acre for crested wheat grass, and yield of grain hay of 1.0 ton per acre.
4 Yield of wheat is 20 bushels per acre.
5 Yield of barley is 24 bushels per acre.
6 Price of wheat is $2.04 per bushel. Seed requirements are deducted from total production for amount of sales.
7 Price of barley is $1.10 per bushel. Seed requirements are deducted from total production for amount of sales.
8 Livestock prices are for 1954 with cows at $14.40 per hundredweight and calves at $15.50 per hundredweight. At average prices for 1949-53, value of sales are $3,461 for the crested wheat grass alternative and $2,409 for the created wheat grass - grain hay alternative. Livestock income off grass is reduced by 20 per cent to allow for no income in first two years of a 10 year stand of grass.
9 Costs of equipment operations include fuel, oil, and repair parts for tractors, combine, and trucks.
10 Crop expenses include crop insurance and weed spray.
11 Hay expenses are based on a cost of buying hay at $20 per ton for the crested wheat grass alternative, and a custom baling cost at $7 per ton for the crested wheat grass - grain hay alternative.
12 Establishment cost for grass is allocated as a direct cost over 10 year stand of grass.
13 Indirect expenses are based on the following rates:
   Machinery repairs ..... 4.0 per cent of purchase price.
   Building and improvement repairs ... 5.0 per cent of construction costs for fences; 3.5 per cent for water developments; 1.5 per cent for buildings.
   Machinery depreciation .... 10 per cent of 62.5 per cent of purchase price.
   Depreciation on buildings and improvements .... 5.0 per cent of construction costs for fences; 3.5 per cent for water developments; 1.5 per cent for buildings.
   Property tax .... 1.0 per cent of purchase price.
   Interest on livestock .... 5.0 per cent of purchase price less 20 per cent.
   Interest on other capital .... 5.0 per cent of 62.5 per cent of purchase price.
14 Incomes of alternatives are expressed as plus or minus amounts in terms of basic wheat system using regular tillage methods.
Barley on Diverted Acres. Growing barley on acres diverted from wheat was shown to be the best income-earning alternative to full wheat production. Farmers operating medium-sized farms derived an income amounting to 84.4 per cent of the basic system by growing barley on 35 per cent of their cropland. Reduction in value of grain sold mainly was responsible for the difference in income between the two systems. We would expect this when barley at $1.10 per bushel replaces wheat at $2.04 per bushel on more than one-third of the cropland. A 20 per cent yield increase for barley over wheat did not compensate for the reduction in total value of sales under price relationships prevailing in 1954.

The substitution of barley for wheat made little difference in the direct costs. Small increases in operating costs for barley were offset by reduced weed spraying requirements for the spring planted barley as compared to the wheat seeded in fall. Also, indirect costs were the same for growing barley in combination with wheat as for growing wheat by itself since there were no differences in major production equipment for the two grains. Slightly greater amounts of operator labor were needed for barley.

Barley became more favorable relative to wheat with assumed lower prices of wheat than $2.04. With
wheat at $1.73 per bushel, representing 82.5 per cent of new parity, the income from full wheat production was reduced to $15,071. On this basis, barley on diverted acres produced a relative income of $13,439 or 89.2 per cent of the basic system on a medium-sized farm without rangeland. With a price for wheat of $1.50, the income with barley on diverted acres increased to a relative of 94.3 per cent. The $1.50 price was an estimated feed grain price for wheat. The estimated price was based on a pound-to-pound feed value of wheat to barley where barley is 90 per cent the feed value of wheat (3, p.356).

A break-even price of barley was determined in the budgeting. It was the price of barley required to compensate for additional costs of growing barley as compared with no cost for diverted acres. For the medium-sized farm, an estimated 4,787 bushels of barley were produced for sale. The additional cost of growing barley on diverted acres was $1,106. Therefore, a price of $.25 per bushel was the break-even price of barley. However, if operator labor was considered as a cost, then the price of barley would have to be $.30 per bushel to meet relevant production expenses.

Diverted Acres Left Idle. When diverted acres were left idle, the relative income was considerably less than that derived from growing barley on extra acres.
However, the idle alternatives produced higher income on farms without livestock facilities than did the grass systems of farming under 1954 livestock prices. Land was left idle in stubble, in summerfallow, and in summerfallow with small portions of diverted acres seeded to permanent grass. A farmers' income was estimated at 61.0 per cent of the income from full wheat production if he did nothing but spray stubble for weeds as a way of handling extra acres. By summerfallowing all diverted acres or by seeding down 25 per cent of them in grass with summerfallow, incomes amounted to 60.7 per cent of the basic wheat income. Preparation of summerfallow involved extra cultivations and costs of equipment operation were greater than land left in stubble. While the reduction in income was nearly equal for the three ways of handling idle land, greater amounts of operator labor were involved in double summerfallowing than in the stubble alternative.

The cutback in production and sales of wheat explains nearly all the reduction in income caused by leaving diverted acres idle. However, the decrease in income was greater than the reduction in gross sales, indicating that direct costs did not decrease proportionately with lesser wheat production. Under a hypothetical situation of non-use of diverted acres, a 35.0 per cent cutback in wheat production caused a 38.3 per cent reduction in income. This means that direct costs per dollar of gross
sales were greater for the reduced acreages of wheat than under full wheat production. In other words, a farmer was unable to decrease direct costs in the same proportions that his gross income decreased.

Hired labor, equipment operation costs, and crop expenses were the main expense items reduced in going from full wheat production to a situation of idle diverted acres. These were decreased approximately one-third. Reduced wheat acres resulted in less cultivation, harvesting and hauling of grain which, in turn, meant smaller tractor, combine, trucking, and hired labor costs. Also, smaller acreages involved decreases in crop insurance and weed spray expenses.

In the short-run, no reductions in indirect costs were associated with leaving land idle. In the long-run, however, a farmer would be expected to reduce machinery inventory by not replacing extra items which are fully depreciated. In an adjusted situation of less wheat production, machinery required for a medium-sized farm could conceivably be reduced to that required for a small-sized farm. This would permit reductions in farm capital by an estimated $3,000 and corresponding decreases in capital charges of $360 per year. These include less machinery repairs, depreciation, interest, and property taxes associated with the smaller inventory of machinery.
Grass and Grain Hay on Diverted Acres. Under 1954 livestock prices, a system of permanent grass and grain hay on diverted acres was not as profitable as leaving land idle. Relative income derived from the grass and grain hay alternative was only 58.7 per cent as much as the income from full wheat production on a medium-sized farm without rangeland. This represented a 2.3 per cent reduction in income from leaving land idle in stubble. There was also a considerable increase in the amount of operator labor required for livestock by using the grass and grain hay alternative on diverted acres.

Smaller gross income was the main factor causing the grass and grain hay alternative to be relatively less profitable than straight wheat production. Only a nominal livestock enterprise could be added where some of the land needed for pasture was utilized in grain hay and summer-fallow. Consequently, income added from livestock sales amounted to only 20 per cent of the reduction of income which resulted from less wheat sales. Direct costs were less for the grass and grain hay alternative than for a situation of no diverted acres, but the reduction was little because haying expenses nearly offset the decreases in hired labor, equipment operation, and crop expenses from the production of less wheat.

Additional indirect expenses further limited the income earning potential of the grass and grain hay
alternative. Repairs and depreciation on added livestock facilities, haying machinery, and grass machinery were major cost items. Interest on investment in livestock and other additional capital also reduced the profitability of growing grass and grain hay on diverted acres.

Grass on Diverted Acres. Among the possible alternatives on medium-sized farms with no rangeland, the seeding of crested wheat grass was least profitable under 1954 livestock prices. Income from grass was estimated at only 57.6 per cent of the basic system primarily because livestock sales made up only one-quarter of the loss in gross income from reduced wheat production. Direct expenses were higher for the grass alternative than for other alternatives since it was necessary to buy hay. Purchases of hay more than offset reduced expenses of hired labor, equipment operating costs, and crop expenses resulting from the cutback in wheat grown. Also, direct costs were increased by an establishment cost for grass allocated among all the years that diverted acres are in grass. Indirect costs arising mainly from repair, depreciation, and interest costs on capital added in adjusting to the grass-livestock enterprise further reduced the profitability of the grass alternative.

Under average livestock prices for the period 1949-53, the use of crested wheat grass for pasture on all
diverted acres became the second most profitable alternative to wheat. It was preceded only by barley in income earned. The income of the grass-livestock alternative amounted to 63 per cent of that derived from full wheat production.

Grass on all diverted acres was slightly higher in profitability than the grass and grain hay combination at the more favorable livestock prices. This was because it became more economical to raise beef and buy hay than to grow hay for a smaller production of livestock.

A break-even price of livestock was estimated at $19.20 per hundredweight. It was the weighted average price for cows and calves required to cover additional costs associated with a livestock enterprise as compared with costs of leaving land idle in stubble. In calculating the break-even price, allowance was made for no livestock income in the first two years of the ten year stand of grass. This was done by reducing the income from livestock for the year budgeted by one-fifth the value of cattle sold. The price of $19.20 per hundredweight covered annual direct and indirect expenses associated with the added livestock enterprise. The main direct expense was for the purchase of hay. Indirect expenses included allocated yearly costs for repairs, depreciation, and interest on machinery and livestock facilities for the ten year period. Interest charged on investment in livestock was averaged over eight years since no livestock
were added in the first two years of grass. The break-even price of $19.20 was for the adjustment into a grass-livestock enterprise from a situation without livestock facilities.

**Subsurface Tillage.** Farmers may want to use a trashy fallow system in erosion problem situations. They are interested in the income and costs associated with adjusting from regular moldboard methods of fallow preparation. Additional machinery required for subsurface tillage includes a graham hoe, chisel type plow, a deep furrow drill, and a rotary hoe. The investment required to add this equipment was estimated to be $4,310.

By using trashy fallow on a medium-sized farm of low productivity, yields were reduced by 10 per cent of the yields obtained under regular tillage methods (10). This resulted in a reduction in value of grain sales of about $2,300. In turn, the income derived by using a trashy system amounted to 83.7 per cent of the basic income when regular fallow methods were practiced. Direct charges were essentially the same for either tillage method but indirect expenses were increased when trashy fallow machinery was added to inventory. Depreciation, repairs, interest and taxes were the added capital charges incurred in making the adjustment to subsurface tillage. However, if a farmer had already adjusted to a trashy
fALLOW system, then his indirect charges were only slightly higher than those of regular fallow. In this case, income earned by using trashy fallow methods was estimated at 85.7 per cent of the income from the basic wheat system using regular fallow.

The value of trashy fallow, however, has been to maintain yields over a period of years in erosion problem situations. Yield and income comparisons made above applied only to the effect of using subsurface tillage implements in place of the moldboard plow. Where yield declines through erosion were evidenced, reduced incomes resulting from subsurface tillage would be compensated by benefits of trashy fallow in the long-run.

Medium-Sized Farms with Facilities for Livestock

Relative incomes of selected alternatives for medium-sized farms with facilities for livestock are shown in Table 3. Incomes are expressed as a percentage of the income from a basic wheat-livestock system with no diverted acres. The income derived from the basic system was about $19,400 when 1954 livestock prices were used in the budget analysis. Under 1949-53 prices of livestock, the basic income figure was estimated at $21,080. These incomes were for a medium-sized farm equipped with livestock facilities and a basic livestock enterprise of 50 animal units. Capital costs which were the same for all
Table 3. Incomes and Costs for Selected Alternatives, Medium-Sized Farm in Area of Low Productivity and With Facilities for Livestock

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>No Diverted Acres</th>
<th>Barley</th>
<th>Barley and Grain Hay</th>
<th>Grass</th>
<th>Grass and Grain Hay</th>
<th>Grass and Grain Hay 3/</th>
<th>Grain Pasture and Hay</th>
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</thead>
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<td>Rangeland</td>
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<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Diverted acres</td>
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<td></td>
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<td></td>
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<tr>
<td>Barley</td>
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<td>125</td>
<td>-</td>
<td>85</td>
<td>-</td>
<td>94</td>
<td>106</td>
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<tr>
<td>Grain pasture</td>
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<td>-</td>
<td>87</td>
<td>-</td>
<td>75</td>
<td>106</td>
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<tr>
<td>Summerfallow</td>
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<td>212</td>
<td>-</td>
<td>85</td>
<td>167</td>
<td>212</td>
<td>-</td>
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<tr>
<td>Creasted wheat grass</td>
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<td>-</td>
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<td>Livestock</td>
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<td>42</td>
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<td>50</td>
<td>50</td>
<td>50</td>
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<td>Production</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>Barley 2/</td>
<td>Bu.</td>
<td>5,080</td>
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<td>-</td>
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<td>20,600</td>
<td>20,600</td>
<td>20,600</td>
<td>20,600</td>
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<td></td>
<td></td>
<td></td>
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<td>Wheat 5/</td>
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<td>21,624</td>
<td>13,484</td>
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<tr>
<td>Barley 7/</td>
<td>Dol.</td>
<td>-</td>
<td>5,266</td>
<td>3,104</td>
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<td>3,104</td>
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<td>21,855</td>
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<td>1,188</td>
<td>1,126</td>
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<td>Equipment operations 2/</td>
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<td>740</td>
<td>577</td>
<td>408</td>
<td>597</td>
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<td>638</td>
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<td>54</td>
<td>97</td>
<td>76</td>
<td>83</td>
<td>68</td>
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<td>54</td>
<td>54</td>
<td>97</td>
<td>76</td>
<td>83</td>
<td>68</td>
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<td>Hay expenses 14/</td>
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<td>1,764</td>
<td>2,040</td>
<td>2,455</td>
<td>3,507</td>
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<td>Establishing grass 15/</td>
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<td>5,897</td>
<td>5,890</td>
<td>4,172</td>
<td>4,647</td>
<td>3,420</td>
<td>3,687</td>
<td>3,581</td>
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<tr>
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<td>63</td>
<td>63</td>
<td>63</td>
<td>63</td>
<td>63</td>
<td>63</td>
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<tr>
<td>Total indirect expenses</td>
<td></td>
<td>1,976</td>
<td>2,664</td>
<td>2,626</td>
<td>2,626</td>
<td>2,626</td>
<td>2,626</td>
<td>2,626</td>
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<tr>
<td>Total expenses</td>
<td></td>
<td>5,897</td>
<td>5,890</td>
<td>4,172</td>
<td>4,647</td>
<td>3,420</td>
<td>3,687</td>
<td>3,581</td>
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<td>Comparative income 17/</td>
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<td>5,943</td>
<td>-2,867</td>
<td>-4,409</td>
<td>-5,882</td>
<td>-6,106</td>
<td>-6,627</td>
<td>-6,847</td>
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<td>Income in percent of basic</td>
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<td>100.0</td>
<td>85.2</td>
<td>77.3</td>
<td>62.7</td>
<td>62.4</td>
<td>68.3</td>
<td>64.9</td>
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For footnotes see following page.
Footnotes, Table 3

1 Based on 35 per cent of total cropland.
2 Portion of diverted acres in grain pasture is spring seeded grain.
3 Animal units are based on 1000 acres of range, and feed production on cropland with the following productivities:
   - Grain hay yield .... 1.0 ton per acre.
   - Grain pasture (fall seeded) carrying capacity .... 1.0 animal units per acre.
   - Grain pasture (spring seeded) carrying capacity .... 0.75 animal units per acre.
   - Crested wheat grass carrying capacity .... 0.78 animal units per acre.
One thousand acres of rangeland .... 50 animal units.
4 Yield of wheat is 20 bushels per acre.
5 Yield of barley is 24 bushels per acre.
6 Price of wheat is $2.04 per bushel. Seed requirements are deducted from total production for amount of sales.
7 Price of barley is $1.10 per bushel. Seed requirements are deducted from total production for amount of sales.
8 Livestock prices are for 1954 with cows at $14.40 per hundredweight and calves at $15.50 per hundredweight. At average prices for 1949-53, value of sales for the selected alternatives are as follows: barley .... $4,755; crested wheat grass .... $7,978; crested wheat grass - grain hay .... $6,389; grain pasture and hay .... $3,164; barley and grain hay .... $4,755; crested wheat grass - grain pasture and hay.... $8,909.
9 Costs of equipment operations include fuel, oil, and repair parts for tractors, combine, and trucks.
10 Crop expenses include crop insurance and weed spray.
11 Hay expenses are based on a cost of buying hay at $20 per ton or a cost for custom hay baling at $7 per ton.
12 Establishment cost for grass is allocated as a direct cost over 10 year stand of grass.
13 Indirect expenses are based on the following rates:
   - Machinery repairs .... 4.0 per cent of purchase price.
   - Building and improvement repairs .... 5.0 per cent of construction costs for fences;
   - 3.5 per cent for water developments;
   - 1.5 per cent for buildings.
   - Machinery depreciation .... 10 per cent of 62.5 per cent of purchase price.
Footnotes, Table 3 (Continued)

Depreciation on buildings and improvements .... 5.0 per cent of construction costs for fences; 3.5 per cent for water developments; 1.5 per cent for buildings.

Property tax .... 1.0 per cent of purchase price.
Interest on livestock .... 5.0 per cent of purchase price less 20 per cent.
Interest on other capital .... 5.0 per cent of 62.5 per cent of purchase price.

14 Incomes of alternatives are expressed as plus or minus amounts in terms of basic wheat-livestock system.
alternatives were not considered since they have no effect on relative incomes.

Income from barley grown on all diverted acres was estimated at 85.2 per cent of the basic income. The barley and grain hay alternative was next in profitability for livestock situations. The income derived from growing barley and grain hay together was about 77.3 per cent of the basic income. Relative incomes for other selected alternatives for situations with livestock facilities in comparison with basic systems were: 69.7 per cent for grass, 69.4 per cent for grass and grain hay, 68.3 per cent for grass with grain pasture and hay, and 64.9 per cent for grain hay and pasture.

**Barley on Diverted Acres.** Barley was the number one alternative to wheat as in the situation without livestock facilities. The income when barley was grown on diverted acres was estimated at 85.2 per cent of the basic wheat-livestock income. Reduction in income was caused by substituting barley for wheat on diverted acres when the price of barley was only about half the price of wheat. Again, small differences in total direct and indirect costs were involved in production of the two grains.

**Barley and Grain Hay on Diverted Acres.** When hay requirements were produced on diverted acres in conjunction
with barley, income earned was less than that derived from
growing barley on all diverted acres. It amounted to a
little more than 77 per cent of the basic wheat-livestock
income. This means wheat farmers will want to plant all
their extra acres in barley and buy hay. The main reason
for the difference in income was that barley was more
valuable than hay. Also, there were cost differences of
significance. Direct expenses for producing hay were
less than that for barley, but indirect expenses were
greater. Depreciation, repair, and interest charges on
capital invested in haying machinery were responsible for
the greater indirect costs associated with growing hay.
Although the operator worked less hours on the barley-hay
alternative, hired labor costs were more than if barley
was grown on all diverted acres.

Grass on Diverted Acres. Diverting wheat acres
to crested wheat grass was shown to be the best alterna-
tive next to barley for farms which had livestock facili-
ties. This supported the relationship suggested in
farmer answers in which the preference for seeding grass
was greater if farmers had facilities for livestock.
Income estimated from growing grass on all diverted acres
was 69.7 per cent of the income from a basic wheat-livestock
system. The corresponding income earned by putting
all diverted acres in grass on farms without livestock
facilities was 57.6 per cent of basic. For the five year average of livestock prices, incomes were estimated at 76.9 per cent of the basic income for farms with livestock facilities and 63.2 per cent of the basic income for farms without facilities for livestock.

Smaller incomes from grass compared to the basic wheat-livestock system resulted mainly from reduced value of products. When crested wheat grass was seeded on diverted acres, 40 additional animal units could be budgeted as compared with the numbers of animal units in the basic system with a livestock enterprise. This is an 80 per cent increase in livestock. However, income from livestock was increased by only 65 per cent by the additional 40 animal units. The non-proportionate increase in income was the result of averaging livestock income from grass over 10 years when it was derived in an eight-year period. The increase in annual livestock income at 1954 prices compensated for only one-quarter of the decrease from less wheat sales. For average 1949-53 livestock prices, the increase in beef income made up 40 per cent of the loss in wheat income.

Total expenses were decreased when a grass-livestock enterprise replaced a third of the wheat production. The decrease resulted from smaller direct costs which more than compensate for increased capital charges on the
investment in added grass machinery and livestock. Direct expenses were lower for the grass alternative because reduced costs of hired labor, equipment operations, and crop expenses offset costs of buying additional hay. Operator labor requirements were increased when grass was grown on land taken out of wheat production.

**Grass and Grain Hay on Diverted Acres.** Growing grain hay in conjunction with crested wheat grass pasture resulted in an income estimated at 69.4 per cent of the income from the basic wheat-livestock system. This was only slightly less income than earned by using all extra acres for grass under 1954 livestock prices. The opposite was true of the adjustments made from a situation without livestock facilities where grass and grain hay was slightly more profitable than the grass alternative. This indicates an advantage in maximizing the use of pasture when livestock could be added without incurring excessive indirect expenses. The main difference in profitability between grass grown on all diverted acres and the grass-grain hay combination on farms with livestock facilities was the greater gross revenue from grass. Increased gross income resulted from a larger number of cattle sold from grass grown on all diverted acres than from grain hay and grass grown together.
Grass, Grain Pasture, and Grain Hay on Diverted Acres. Grain planted in the spring for pasture purposes in combination with grass was expected to have advantages over grain pasture or grass pasture alone. Spring grain was ready for grazing when crested wheat grass made its least contribution to the pasture program. In a complimentary relationship between grass and grain pasture, cattle would be carried on grass in the spring, and through the summer on grain pasture. The effect of complementarity in the two pasture sources was to increase the size of cattle enterprise.

Budgeting results show, however, that income from grass and grain pasture, together with grain hay on diverted acres was less than the income from grass pasture and grain hay. The combination of the two pasture sources and grain hay derived an estimated income equal to 68.3 per cent of the income from a basic wheat-livestock system. Grass as the single source of pasture and grain hay earned a relative income of 69.4 per cent. The two pasture system, however, derived a slightly higher income than the grain pasture and grain hay alternative.

Gross returns were greater for the combined pasture system than for either grass or grain pasture used alone because complementarity of the two pastures resulted in more livestock production and sales. However, increased direct and indirect expenses for the grass-grain pasture
and grain hay alternative more than offset the higher returns. This is the reason for the income reduction when grain pasture was added to a system of grass and grain hay. Increases in direct expenses mainly were caused by larger haying costs in carrying extra cattle over winter. Hired labor, operating costs, and crop expenses were necessarily higher for the alternative with grass and grain as sources of pasture than for single pasture systems because it included a larger livestock enterprise. Also, the two pasture program required greater investment and increased indirect charges.

Grain Pasture and Hay on Diverted Acres. The growing of grain pasture was less profitable than grass pasture on diverted acres because grain did not provide as complete a pasture program as grass. Income from the alternative of grain pasture and hay was estimated to be 64.9 per cent of the income derived from the basic wheat-livestock system. This compared to 69.4 per cent when grass pasture was used with grain hay. Although wheat pasture carried more animal units per seeded acre than crested wheat grass, its duration was short and it was not as timely as grass. Fall seeded grain was not ready for pasturing until May or June, while crested wheat grass was pastured in March. This meant that the winter feeding period was longer when grain pasture was used and,
therefore, hay requirements were greater. In addition, grain pasture required an equal amount of summerfallow each year which resulted in less pasture than grass provided. For the medium-sized farm with facilities for livestock, 70 animal units were carried when crested wheat grass and hay were grown on diverted acres, whereas 63 animal units were stocked when grain pasture replaced grass pasture.

Smaller livestock sales associated with grain pasture as compared to grass pasture accounted for much of the reduced income between the two systems. Grain pasture also involved greater direct expenses than grass. These included more hired labor, equipment operation, crop, and haying costs. Costs of summerfallow and seeding were not reduced from the basic wheat livestock situation because the number of acres in grain was the same in either case. There were, however, savings in harvesting costs.

Effect of Productivity on Income Potential of Alternatives

The preceding income comparisons among selected alternatives were made for low productivity situations. Now, we consider the effect of productivity in ranking alternatives on the basis of income. Productivity differences made little difference in relative profitability of the alternatives. This was because yields of the different crops varied nearly in proportion to the differences in
yields of wheat. Wheat yield for the low productivity level was 20 bushels per acre, and barley yield was 24 bushels. These yields were assumed to be 30 and 36 bushels per acre respectively for high productivity areas. The yield differential of barley in each case was 120 per cent of the wheat yield. Similarly, yields of pasture and hay were assumed to be proportionate to differences in wheat yields. Therefore, estimated incomes for the selected alternatives differed by about the same percentage for high productivity areas as they did for the low productivity areas.

There were differences in high and low productivity areas not shown by ranking of the alternatives budgeted. Farmers in high productivity areas had some additional production possibilities to those selected for economic comparison. For example, alfalfa grown for pasture or seed were possibilities on some farms. Also, farmers in high productivity areas were able to use fertilizer economically.

Income comparisons were made in the budgeting for the basic wheat system with and without fertilizer applied. The use of fertilizer was found to be a profitable practice on high productivity farms. Income from using fertilizer on the medium-sized farm was estimated at 122 per cent of income for the basic wheat system without fertilizer. This increase in income meant that nearly two-thirds of
the income lost through a 35 per cent reduction in wheat production could be regained by using fertilizer.

The increase in income largely was the result of increased yields from fertilizer. Yield increases of eight bushels per acre were obtained by applying 30 pounds of actual nitrogen per acre in the form of anhydrous ammonia. This was the modal rate of application and yield response from use of anhydrous ammonia fertilizer as reported by farmers in the survey. Gross income by using fertilizer at this input-output relationship was about 28 per cent above that derived when no fertilizer was applied. Increased direct expenses, however, reduced the additional income from fertilizer.

Cost of fertilizer at $0.14 per pound of actual nitrogen was the main direct expense incurred.

**Effect of Size on Income Potential of Alternatives**

Preferences for land-use alternatives were obtained from farmers in the survey according to the size of their grain growing operations and the number of acres they diverted from wheat. Size did not affect the use of barley on diverted acres as it was the most profitable alternative regardless of size. Size differences did affect choice of pasture alternatives.

Effects of size on relative incomes of alternatives were not budgeted in this study. Expected deviations
from medium-sized farm comparisons were used in explaining two size income relationships. These were: (1) greater profitability of grass on large farms, and (2) greater profitability of idle on small farms relative to incomes from other alternatives.

**Grass on Diverted Acres.** Higher returns were expected to result from grass-livestock alternatives on large farms owing to increased gross incomes together with non-proportionate increases in total costs. Value of sales will increase directly with size of livestock enterprise, but total costs will not increase in the same proportions. This is because of size efficiencies which keep operating costs down; for example, livestock labor requirements per head are less for large than for small cattle enterprises. Similarly, indirect expenses per unit decline when livestock facilities are utilized more economically.

**Idle on Diverted Acres.** The relative profitability of leaving land idle depends on the size of farm or the number of acres diverted from wheat. On small farms without facilities for livestock, incomes from idle alternatives are expected to be higher relative to incomes from other alternatives. This is because of increased indirect costs associated with utilization of diverted acres. For example, indirect costs resulting from added investment in livestock facilities on small farms are high
compared to the limited number of livestock added. For a medium-sized farm without rangeland, an income equal to 61.7 per cent of the basic wheat income resulted from the non-use of diverted acres. This compared with the 58.7 per cent derived from the grass and grain hay alternative. While idle alternatives on small farms will not be more profitable than on medium or large farms in absolute terms, we expect them to be more profitable relative to other alternatives. Therefore, income for the grass and grain hay alternative on small farms would be lower than 58.7 per cent for the same alternative on medium farms.

Selected Alternatives Ranked on Basis of Flexibility

Farmers consider flexibility as one of the most desirable features of farm planning. Wheat farmers seek to maintain a high degree of flexibility which allows them to change readily into more profitable crops or enterprises at low cost. A large portion of this chapter has been spent in ranking alternatives on the basis of income potential, but alternatives with the highest incomes do not always offer the greatest amount of flexibility in land use. Flexibility, therefore, may be a deciding factor in farmers' land-use decisions when there is little difference among relative incomes of the alternatives. It remains then to rank alternatives on the basis of their
flexibility advantages.

**Alternatives for Farms Without Facilities for Livestock**

On the basis of income potential, practical alternatives for farms without facilities for livestock ranked in the following order: (1) barley, (2) idle in stubble, (3) idle in summerfallow, (4) idle and grass, (5) grass and grain hay, and (6) grass. A significant thing about the relative incomes of these alternatives was the narrow spread between them. With the exception of barley, the incomes ranged from 61.0 per cent of the basic wheat system for idle in stubble to 57.6 per cent for the grass alternative.

Because of the small income differences, flexibility has a major role in the determination of most suitable alternatives in short-run planning. Therefore, the above ordering conditioned by flexibility of alternatives is as follows: (1) idle in summerfallow, (2) idle and grass, (3) idle in stubble, (4) grass and grain hay, and (5) grass.

Leaving land idle in summerfallow offers maximum flexibility whereby farmers can maintain a state of readiness for growing profitable crops every year. Idle in combination with 25 per cent of the diverted acres in grass is second in terms of flexibility since 75 per cent of the extra acres are clean summerfallowed in that
alternative. Idle in stubble, the alternative ranking first in income is quite inflexible when land is not worked each year. This shift in ordering is significant because the small income advantage of idle in stubble is readily offset by the disadvantage of its relative inflexibility in the situation without facilities for livestock. Thus, if erosion problems do not exist, idle in summerfallow should have preference over idle in stubble in short-run planning. The grass and grain hay alternative is less flexible than idle in stubble, but seeding down grass on all acres is the least flexible use of land under the diverted acre program. Farmers hesitate to seed grass at high costs when future incomes from grass-livestock enterprises are uncertain over the ten-year stand of grass. Also, with the addition of livestock and facilities for livestock, flexibility permitting the return to grain farming is further decreased.

Alternatives for Farms with Facilities for Livestock

There is more nearly an inverse relationship between income potential and flexibility for livestock situations than for non-livestock alternatives. Again, the spread in relative incomes is narrow if barley alternatives are not considered. The other selected alternatives for this resource situation ranked according to decreasing incomes are: (1) grass, (2) grass and grain
hay, (3) grass, grain pasture and hay, and (4) grain pasture and hay. Significant in this ordering is that income decreases as the proportion of grass used on diverted acres increases. The range in relative incomes is from 69.7 per cent of the basic income for the grass alternative to 64.9 per cent for the grain pasture and hay alternative.

For flexibility, the above alternatives are ranked exactly opposite to what they are in terms of income. This follows because grass is the least flexible use of diverted acres. In choosing among these alternatives under restrictions on growing barley, a farmer would likely do best in the short-run by going into grass and grain hay. In this way, he can attain a considerable amount of flexibility at the loss of only a small amount of income. Important here, however, will be long-run planning. For example, conservation advantages may be the determining factor affecting farmer choice of alternatives that are equal in income and flexibility advantages. Also, farmer preferences are important where choices must be made between income and flexibility in the short-run.

**Summary**

Selected alternatives for two resource situations were ranked in this chapter on the basis of: (1) costs of adjustment, (2) income, and (3) flexibility.
No adjustment costs were incurred in adjusting to barley on diverted acres, but large amounts of capital were required for alternatives including livestock. For medium-sized farms, costs amounted to about $14,000 for shifting into the grass-livestock alternative on farms without facilities for livestock and $7,600 for farms with livestock facilities. Adjustment costs for grass and grain hay alternatives were about $13,700 in situations without livestock facilities, and $6,200 in situations with facilities for livestock. Approximate costs of adjustment for other alternatives on farms having facilities for livestock were: $6,950 for grass-grain hay and pasture, $4,500 for grain pasture-grain hay, and $2,000 for barley with grain hay.

Income from growing barley on diverted acres was estimated at 84.4 per cent of the income derived from full wheat production on farms without facilities for livestock. Relative incomes for other selected alternatives expressed as percentages of the basic income were estimated as follows: idle in stubble at 61.7 per cent, idle in summer-fallow and idle with grass both at 60.7 per cent, grass and grain hay at 58.7 per cent, and grass at 57.6 per cent.

The decrease in income between barley and other selected alternatives was caused by the decreased sales of a cash crop. Differences among incomes of remaining alternatives resulted both from income and cost differences.
Barley income was approximately 85 per cent of the income from the basic wheat-livestock system for farms with livestock facilities. Income from barley and grain hay was estimated at 77.3 per cent of the basic income. Relative incomes for grass, grass-grain hay, grass-grain hay and pasture, and grain pasture-grain hay alternatives were 69.7 per cent, 69.4 per cent, 68.3 per cent, and 64.9 per cent respectively. Significant in these comparisons were the higher incomes associated with the greater proportions of diverted acres in grass. Decreases in income when cash crops were not grown were caused by reduced values of livestock production per acre, together with increased costs involved in livestock and haying enterprises.

Non-cash crop alternatives for farms without livestock facilities, ranked according to decreasing flexibility advantages were: (1) idle in summerfallow, (2) idle and grass, (3) idle in stubble, (4) grass-grain hay, and (5) grass. For flexibility, alternatives other than barley ranked exactly opposite to what they did on the basis of income in situations with livestock facilities. The order was: (1) grain pasture and hay, (2) grass-grain pasture and hay, (3) grass-grain hay, and (4) grass. The order was reversed because incomes increased but flexibility decreased with larger proportions of diverted acres in grass.
CHAPTER V

SOIL CONSERVATION IN THE OREGON WHEAT-SUMMERFALLOW AREA

Lack of knowledge of future benefits from soil conservation has been advanced as the major reason Oregon wheat farmers have been slow in adopting conservation systems. In past studies, emphasis was given to soil conservation systems for prevention of soil erosion, but when economically compared with soil exploiting systems of grain farming, lower net returns were derived from conservation systems (9, pp.30, 54, 65).

The purpose of this chapter is to focus attention on the fundamentals of conservation and attempt to place it in a realistic position for evaluation of alternative land-use systems. Three main divisions of the chapter deal with: (1) some principles of conservation, (2) the state of the soil conservation problem in the Oregon wheat-summerfallow area, and (3) the ranking of selected alternatives on the basis of conservation advantages.

Principles of Conservation

Outlined in this section are the important principles in conservation, including the meaning of conservation, the place of resources in conservation, and the safe minimum standard of conservation. The special problem of
Meaning of Conservation

There are many definitions offered to explain the term conservation. Bunce says conservation is a concept relating to maximizing individual and social wealth over time. He points out that conservation has a different meaning with reference to different types of resources. In one case, conservation may involve a reduction in rate of consumption, while in another, it suggests an increased rate of consumption (4, pp.1-4). Wantrup emphasizes the view that conservation does not mean non-use of resources, but is the full utilization of resources. A popular notion is that conservation expresses time distribution of physical inputs. In this sense, conservation is accomplished by changing the distribution of physical inputs to attain the best time pattern of use on basis of the knowledge available. Hence, conservation is concerned with the 'when of use'. Conservation may increase use of a resource above the present level, may keep it constant, or may slow down the decrease (5, pp.48-54).

Heady says that conservation is merely a problem of allocating scarce resources between time periods (8, pp.768-772).
Conservation principles are concerned with the use of resources in various forms. Resources are classified into three groups: (a) fund or stock resources which are exhaustible and do not increase with time, (b) flow resources which are inexhaustible with different amounts available for use in different time periods, (c) biological resources involving the annual productivity of plant and animal life (4, pp.4-6). Wantrup points out that a resource is a relative concept changing with the ends-means scheme; that is, with the resource user, with his objective, with the state of technology, and with existing social institutions. Resources are variables in a social setting in which man, his objectives, his knowledge, and his institutions are other variables. Hence, resources are not fixed.

Ex ante resources reflect the point of view of the resource user under the technology and social institutions which he operates. Ex post resources are historical and statistical, representing the influence of changing technology and institutions. In effect, these terms convey an important consideration often omitted in our thinking about conservation: Today's resources may not be resources tomorrow, and are only resources in the sense that present and future human wants are satisfied from the
services and products derived from them.

These distinctions introduce the thought that situations may exist where preservation of resources is uneconomical. The point of view held by some students of resource use is that destructive exploitation may be warranted by prevailing economic forces which produce desirable transformation of resources. It has been suggested that progress in technology can solve all resource problems whereby the only resources worth saving are human intelligence and the cultural climate favorable to technological progress (5, pp.15-31).

**Safe Minimum Standard of Conservation**

The real contingency faced in non-conservation is a state of irreversibility in use of flow resources whereby it becomes uneconomical to halt and reverse depletion. Where irreversible, the rate of depletion exceeds a safe minimum standard. The safe minimum standard varies with costs of reversing depletion in relation to returns from the resource. Hence, it may be conceived as a region when considering varying price cost relationships in conservation. Costs of maintaining the safe minimum standard are small if action is taken in time, and proper methods of conservation are employed. In fact, the economic rationale of a safe minimum standard is based on the proposition that costs of maintaining it are small in relation
to losses which irreversibility of depletion might entail. However, a state of irreversibility is uncertain under changing conditions. This means conservation could result in social loss if technology and wants change so that present resources no longer are resources.

What should conservation policy be if the safe minimum standard has been passed and irreversibility of use exists? Perhaps no effort should be wasted in maintaining a safe minimum standard if natural decreases in resources are taking place. Then the policy question becomes one of deciding whether the avoidance of natural irreversibility necessarily should be an objective (5, pp. 251-267).

**Conservation of Soil Resources**

We have examined some theoretical aspects of general resource use and now turn to soil resources and some of the difficulties contained therein. Land conservation is a unique problem because agriculture land resources are complex. Land is partly a fund resource, partly a flow resource, and partly a biological resource. It is, therefore, characterized as a composite resource (4, pp. 7, 8). This affects the rate of using soil resources since an increase in use of the composite may be perfectly compatible with a decrease in use of the components. For example, the effects of sheet erosion, leaching, or loss
of organic matter may be obscured if crop yields are regarded as an indication of the state of conservation.

What is the position of the safe minimum standard in relation to soil resources? Is it defined in terms of use rate or in terms of conservation practices? Some define a safe minimum standard in soil conservation as the avoidance of gullies, but it may also be defined in terms of a safe yield (5, pp.257-259). An objective of erosion control efforts may be a permissible rate of soil erosion or safe minimum standard. This is a certain annual rate of top soil loss per acre of land. Justification for using any recommended conservation practice may rest primarily upon the idea of a permissible rate of soil fertility losses (7, p.948).

Many feel the basic objective of all conservation must be the introduction of land-use systems which permanently stabilize soil assets at their present level. This point of view fails to recognize that exploitation of land resources may be beneficial to both the farm operator and society as a whole. Exploitation is economic when costs of production are lower than they would be if fertility were maintained (4, pp.69, 70). When potential productivity of the soil is decreasing at an irreversible rate, we have a state of uneconomic exploitation except when the decrease is from the virgin fertility level.
We may differentiate among certain farm practices by keeping in mind that conservation measures are those which maintain original output over time and are not those which merely increase production in the short-run. Prevention of gullying is a conservation measure since future production diminishes as original labor and capital are added to non-gullied land in marginal areas. Sheet erosion is not yet directly related to future production if its rate is at a fraction of an inch per year on deep top soil. Under this condition, the same application of non-conservation inputs results in nearly equal output during successive production periods. The original production level can always be restored by replacing the quantity of elements originally supplied by nature.

The State of the Conservation Problem

in Oregon's Wheat-Summerfallow Area

What is the state of the conservation problem in the Oregon wheat-summerfallow area? This is a necessary question to consider in light of recommendations regarding the alternatives which farmers might adopt for use on diverted acres. Therefore, this section deals with the following: (1) application of general conservation principles to the study area, (2) analysis and interpretation of wheat yield data in developing a hypothesis explaining the state of conservation in Oregon's wheat area.
as a whole, and (3) permissible rate of soil depletion which avoids irreversibility in soil resources.

**Application of Conservation Principles for the Wheat Area**

Earlier studies were undertaken to measure the economic consequences of soil erosion on wheat yields in eastern Oregon (11). The relation between soil depth, loss of surface soil, and wheat yields indicated that if soil erosion continued at the present rate, productivity of many farms soon would be reduced below the profit level. It was concluded that wheat yields declined in relation to the amount of topsoil losses and eventually would diminish to zero. For example, it was estimated in one area that remaining topsoil will be removed within 100 years unless conservation farming systems are adopted (11, p.19). Also, the soil was said to lose its productive capacity as topsoil is removed because the rate of loss is accelerated through time.

How serious are the soil losses indicated above in terms of conservation theory presented earlier? Soil is a composite set of resources which are only resources in terms of the ends-means scale of economics. These resources are not fixed but vary with technology, changing social institutions, and in terms of demand for the derived products. Thus, we may question whether or not present resources used in producing wheat will be
resources in the future when considering the changing emphasis in the wheat position. There are few competing uses for which the dryland wheat area is adaptable. A declining per capita consumption of wheat and expected decreases of a permanent nature in export requirements together are more than likely to offset increases in demand from population increases. This means the long-run demand for wheat will continue to diminish.

Even if we could expect a continued demand for wheat, and wheatland remained a resource, we would need to allocate its use over time. Although future resource needs for wheat production likely will not be eliminated completely, we might expect these needs will be greatly reduced. Hence, it appears that present use of resources should be preferred over future use when we are uncertain wheat resources will be of the same importance in the future. Following this line of reasoning, we might conclude that a high rate of present use of wheat resources will maximize welfare between time periods. This is consistent with equating the marginal rate of substitution of goods in consumption with the marginal rate of goods in production. One will readily ask, "Why use more resources now when we have wheat surpluses anyway?". This may be justified because it means use of more stock resources of the soil and less flow resources such as human energy. In other words, it means exploitation instead of
conservation and not necessarily more wheat.

The foregoing theory bears some consideration, but we have ignored the dynamic nature of technology which has implications in regard to resource use over time. We assumed that technology will not find new uses for wheat and other alternative grains. There is some possibility, too, that new uses will be found for soil resources. These might erroneously be exploited if used in the vein of the previous discussion. Likewise, too much emphasis should not be given to the premise that we will face an overall decline in demand for wheat in future years. We cannot ignore the realistic possibility of future international emergencies when a demand for the basic foodstuffs by the peoples of the world will occur again. Also, though the demand for wheat may decline, the demand for other agricultural products may increase. Other areas will then be taken from the production of wheat whereby the Oregon wheat area may have a greater relative advantage, or less relative disadvantage, than it now has. Hence, we need to retain a hold on the position that soils of the Pacific Northwest wheat area will continue to be resources in the immediate future years at least.

Analysis and Interpretation of Wheat Yield Data

We turn now to some empirical data on wheat yield and soil productivity changes over time. The main
objective of the following analysis was to develop a hypothesis on whether soil resources in the Oregon wheat-summerfallow area were being depleted at a permissible rate. The problem was to determine whether the wheatland soils were being managed by farmers such that application of current and anticipated technologies could restore or exceed earlier wheat yields.

Statistical regressions were used to study the trend of wheat yields over time. We were interested in yield trends as a measure of changes in productivity; for example, of losses in productivity of wheatland and the extent in which losses could be restored by increased technology in wheat farming. One set of estimating equations was derived from experimental data representing the change in yields under a state of constant or nearly constant technology.

The first part of the analysis was designed to study the decrease in wheat yields over time under the wheat-summerfallow system of growing wheat. Yield data from the Pendleton experimental sub-station in Umatilla county were used in a regression with the major factors that logically affect winter wheat yields including seasonal rainfall, fall rainfall, and the time factor (2, p.2). The trend was measured for a 22 year duration of the rotation, and the following equation was
\[ Y = 35.0 - 0.5575X_1 + 1.0952X_2 + 1.341X_3 \]

where:

- \( Y \) = yield of wheat in bushels per acre
- \( X_1 \) = duration of rotation in years
- \( X_2 \) = seasonal rainfall in inches
- \( X_3 \) = fall rainfall in inches

All the coefficients of \( X \) terms in the equation were significant at the .05 level for the 't' test. Our interest was in the \( X_1 \) coefficient which indicated that wheat yields decreased about 0.5 bushels per year on the average since the rotation started in 1931. This amounted to a one bushel decrease in each cycle of the rotation. The estimate in productivity loss in this analysis was for an average rainfall or an estimate after correcting for the effect of upswing in rainfall during the experimental period.

Under a similar analysis carried out for the Moro experiment sub-station in Sherman county, a downward direction in trend of wheat yields was indicated by the sign of regression coefficients. However, the variation in yields for this set of experimental data was not explained sufficiently by factors included in the regression analysis. These included rainfall, evaporation, and time in years. Although the regression coefficient for seasonal rainfall was significant, evaporation and time
factor coefficients were not significantly different from zero at the .05 level for 't'. This means the decline in wheat yields in this case could be the result of chance only.

In any case, were not these declines in yield expected since fertility could not be economically maintained at the virgin soil level? It was natural that we have a drop in productivity because continuous production of any crop, soil conserving or exploitative would give us some decline in yield, except perhaps permanent grass. To utilize all wheatland in grass, however, would render it useful for pasture only, which represents a change in value of composite soil resources. Also, one aspect of conservation was the minimisation of non-use of flow resource components.

From the results of the preceding analysis, we may tentatively conclude that the experimental data provided some evidence of decreasing soil productivity for wheat production over time in the wheat-fallow rotation system. The question of practical significance, however, is whether farmers experienced similar decreases in wheat yields under wheat-summerfallow rotations. Unless farmers changed production methods enough to hold up the yield of wheat, we would probably find gradual declines in trends of actual wheat yields for the area as a whole over the same period.
Indication of topsoil losses and corresponding declines in wheat yields is not convincing evidence that any permanent stage of low productivity has been reached in Oregon wheat soils. This doubt is especially justified when declining yields were shown under a constant state of technology. Consequently, a more realistic analysis was carried out to show the historical yield pattern through past years. It was designed to measure the effect of changing technology in reversing a decline in wheat yields. The important question remaining to answer about the state of conservation in Oregon's wheat-land resources is: Have soil resources reached a point of irreversibility in productivity?

The following statistical analysis was an attempt to measure the effects of changes in technology on yields of wheat for Umatilla county from 1939 to 1953 inclusive. The method was to isolate the effect of time or duration of rotation on wheat yields by removing the effects of rainfall. The time factor was used as a variable to reflect changes in technology throughout the years, namely, increased fertilizer applications and the use of high yielding varieties. In graphic analysis, a curvilinear line, concave from above, appeared to be the best approximation in estimating original observations. Yields decreased until the 1946 crop year, and then there was a general upward swing since that time. An explanation
for this could be that previous to 1945, yields decreased with decreasing soil fertility and heavy wartime cropping practices. The recent increases in yields were more than likely the result of increased use of fertilizer which was available at the end of the war, in addition to new varieties introduced about that time.

The best estimation equation statistically derived for fitting the data included a linear factor for rainfall and a curvilinear factor for time. Interaction between time and rainfall was not found significant so it was omitted from the equation. The final form of the equation used was:

\[ Y = 23.5 + 0.7423X_1 - 1.5688X_2 + 0.0944X_3 \]

where:

- \( Y \) = yield of wheat in bushels
- \( X_1 \) = rainfall in inches
- \( X_2 \) = time in years
- \( X_3 = X_2^2 \)

All the coefficient values were significantly different from zero at the five per cent level. From this analysis we can say that there was a linear relationship between rainfall and yields, and a curvilinear relationship between changes in technology and wheat yields for Umatilla county from 1939 to 1953. The interpretation of the regression coefficient for rainfall was that given a 0.7 inch increase in rainfall, there was a one bushel
increase in yield on the average. Regression coefficients for time and time squared factors could not be interpreted separately because time squared had an influence on yield, opposite to that of time itself.

The regression curve of yield of wheat on time, with average rainfall, is shown in Figure 3. The estimating equation was for average yields in Umatilla county for the years 1939 to 1953. A corresponding analysis was carried out for Morrow and Gilliam counties in the same time period. The results roughly indicated the same directional relationships but regression coefficients were not statistically significant. Rainfall and changing technology did not explain enough of the variation in yields for these counties to give significant results.

Serious limitations in the use of the above analysis exist because of the short time period studied. In fact, the decline in yields indicated in Figure 3 was somewhat unrealistic as we expected from the earlier part of the analysis for experimental data that such declines would be spread over a longer period. However, the purpose of the short-run analysis was to show that increased technology had reversed declining wheat yields, and not to measure the rate at which yields either decreased or increased.

For a longer period (1928-1953), the same form of regression analysis for all three counties indicated
Figure 3. Relation of Yield of Wheat and Time in Umatilla County, Oregon, 1939-1953.
a more gradual decline in yields until the upward turning point in the regression curve was reached. This was more realistic than the short-run analysis but significant results were not obtained. A large amount of unexplained variation in earlier wheat yields caused all regression coefficients to be statistically insignificant. The signs of the coefficients, however, indicated the same directional swing in the regression curve as shown in Figure 3.

The hypothesis advanced on the basis of the preceding analyses and discussion of conservation principles is that yields have not declined beyond the safe minimum standard after about 60 years of growing wheat in the area, and productivity decline is not likely to be a problem for serious consideration in the foreseeable future. Therefore, assuming yields as the measure of productivity under changing conditions of technology, a state of irreversibility in use of wheat resources does not exist. It is recognized that some farmers experience serious conservation problems especially in wind and water erosion regions. The hypothesis is, however, an attempt to explain the state of conservation in the Oregon wheat-summerfallow area as a whole.

Although the evidence in support of the hypothesis certainly is not conclusive, it does suggest that soil fertility has not declined to a state where it is
uneconomical to restore yields. Because of limited data, we were unable to further test the hypothesis. Nevertheless, the writer believes that wider spread use of recent and potential technologies in wheat culture under favorable price-cost relationships will more than offset yield decreases from losses of soil fertility.

**Permissible Rate of Soil Depletion**

Farmers may find it uneconomical to employ new techniques to maintain wheat yields. This is so either because of capital restrictions or because it may be more economical to exploit stock resources. Hence, we are interested in the rate at which these resources are used so that the region of irreversibility in productivity will be avoided. That is, what is the permissible rate of soil loss consistent with the economics of not making major shifts to conservation systems of farming? In many cases, the rate of soil loss may be brought within the permissible rate by adopting recommended conservation practices such as subsurface tillage or strip cropping.

Determination of a permissible level of soil loss in the wheat area under study is a difficult task facing integrated research efforts of economists and soil scientists. Unfortunately, a wide gap exists between the theory and actual establishment of such a level. An abstractness
remains that needs to be made more specific in order to adopt the principle to an analytical framework. If this could be done, then an actual rate of soil loss in inches per year could be established as a permissible level for a given economic horizon.

A common sense criterion used as an approach in arriving at a safe minimum standard is the way the farmers view soil losses. Generally, individual farmers recognize the type of soil erosion on their farms that eventually might interfere with tillage operations. In this regard, the safe minimum standard is defined as avoidance of gullies or wash aways. It is conceivable in most cases that we may rely on farmer observations and judgements to recognize transformation of cropland into a state where productivity cannot be restored. We found this to be generally true in the wheat farm survey carried out in the fall of 1954. Farmers were keen to observe development of serious erosion problems, and to take necessary conservation steps to prevent losses which would affect future productivity of their land.

An economic indicator which will tell the farmer to change to a conservation type of cropping is a lowering of yields to a point where net revenues may be increased by following recommended conservation practices. The farmer will make changes to come within the permissible rate of soil loss when the comparative advantage
in relative productivities and prices swings in favor of conservation crops over exploitative crops.

A change in land-use patterns as a result of relative price changes can be expected only when two conditions are fulfilled: (1) there is a decrease in exploitative crop prices relative to prices of alternative soil-conserving crops, and (2) the new ratio of prices continues long enough so that farmers no longer anticipate a return to the old level. The economic advisability of further conservation practices may be calculated by comparing additional revenues and costs when a safe minimum standard has been determined as a base level.

**Conservation in Ranking Selected Alternatives**

We have suggested that conservation farming systems may be uneconomical either to society or the individual in the short-run, and some empirical evidence leads us to believe conservation is not a real problem in Oregon's wheatland area. Also, farmers will not adopt conservation systems if unprofitable. Therefore, income, costs of adjustment, and flexibility remain as the important short-run criteria in choice of alternatives for use on diverted acres.

However, conservation may be an important consideration of many farmers in their use of land in the long-run. It may be the determining factor if farmers
are convinced income and flexibility are not increased by exploitative land-use systems. Hence, the selected alternatives for use on diverted acres in both situations with and without facilities for livestock are ranked below on the basis of conservation advantages. Then, conservation aspects of basic alternatives are considered.

**Farms Without Facilities for Livestock**

Selected alternatives adaptable to farms without livestock facilities in order of conservation benefits are: (1) grass, (2) grass-grain hay, (3) idle and grass, (4) idle in stubble, (5) barley, and (6) idle in summer-fallow. This ranking is significant because it is nearly opposite the order given the alternatives on basis of income and flexibility. Except for barley, incomes from non-conservation alternatives are only slightly higher than those which provide the greatest conservation advantages. However, conservation is not likely to be given much consideration in this resource situation where farmers seek a maximum degree of flexibility.

**Farms With Facilities for Livestock**

For livestock situations, the selected alternatives ranked in terms of conservation are: (1) grass, (2) grass-grain hay, (3) grass-grain pasture and hay,
(4) grain hay and pasture, (5) barley and grain hay, and (6) barley. Alternatives providing the most conservation advantages in use of soil resources are those involving the larger proportions of grass. These are also the alternatives with greatest income potential but least amount of flexibility for resource situations with facilities for livestock. Important then for farms which have livestock facilities is the possibility of combining income and conservation advantages. In the situation with no facilities for livestock, maximum income and flexibility were attainable from non-conservation alternatives.

Conservation Aspects of Alternatives

Crested wheat grass offers more protection against soil erosion than does any other alternative. Farmers generally consider this to be true if a good stand of grass is established. Also, conservation benefits are derived when half the land is not summerfallowed each year. Fall seeded wheat is the next best conservation measure, whereby land is not left fallow over the winter months in which erosion hazards are greatest. Grain hay has this advantage on diverted acres.

Many farmers in water erosion areas emphasized the danger of spring seeded grains from the standpoint of erosion problems. In fact, the seriousness of the problem
in some areas in Oregon does not permit the growing of barley except at the risk of losing topsoil. Leaving diverted acres idle in summerfallow ranks poorly in terms of conservation because land is continually exposed to both wind and water erosion. Idle in stubble, however, can offer good protection against erosion hazards, and it eliminates the necessity of leaving half the diverted acres in clean fallow each year. In this regard, idle in stubble has an advantage over the grain pasture or hay alternative.

Combinations of basic alternatives on diverted acres have unique advantages to farmers who want to achieve both flexibility and conservation. Many farms include small portions of cropland subject to serious conservation problems. This includes steeply sloping land with water erosion problems and light blow soils subject to wind erosion. In these cases, a land-use system which permits the prevention of soil losses, but at the same time affords maximum flexibility, could be the farmers’ best alternative for diverted acres. Idle in summerfallow with grass offers these advantages. Grass is seeded down on the erosive land, and the remaining diverted acres are left idle in summerfallow so that flexibility is maintained on fields in which erosion does not occur. Similarly, the grass-grain hay alternative combines erosion prevention with a
reasonably flexible land-use system.

Summary

The purpose of this chapter was to place conservation in a realistic position for evaluating selected land-use alternatives. Principles of conservation and statistical regression analyses were used in developing a hypothesis on the state of the conservation problem in the Oregon wheat-summerfallow area. The hypothesis developed was that productivity has not declined to a state in which it is uneconomical to halt and reverse depletion, and that the productivity decline is not likely to be a serious problem in the foreseeable future. Also, the notion that farmers readily recognize and correct deterioration of their wheatland which will render it irreversible in productivity was advanced. Farmers were expected to allow losses in productivity as long as they could economically increase yields in the future.

Selected alternatives for farms without livestock facilities ranked on the basis of conservation advantages were: (1) grass, (2) grass-grain hay, (3) idle and grass, (4) idle in stubble, (5) barley, and (6) idle in summer-fallow. In situations with facilities for livestock, alternatives in order of conservation advantages were: (1) grass, (2) grass-grain hay, (3) grass-grain pasture and hay, (4) grain hay and pasture, (5) barley and grain
hay, and (6) barley. Alternatives which provided the maximum income and flexibility had least conservation advantages in situations without livestock facilities. Largest incomes were obtained, however, from alternatives with most conservation advantages on farms with livestock facilities.
CHAPTER VI

SUMMARY AND CONCLUSIONS

Oregon wheat farmers recently have been faced with serious adjustment problems because of acreage allotments in wheat production. The main purpose of this study was to provide the basis for increased farmer knowledge on use of diverted acres. Two major questions considered were: (1) What were the practical alternatives for use on diverted acres? and (2) How did practical alternatives compare on the basis of economic criteria?

The study area comprised the wheat-summerfallow land of the Columbia Basin in northeastern Oregon, including the wheat areas of Morrow, Gilliam, Sherman and Wasco counties, and part of Umatilla county. Farm survey data primarily were used in selecting the practical alternatives to wheat. The main method of comparing alternatives was budgeting. This facilitated an income comparison in which gross farm income, direct costs, and indirect costs were taken into account. Income comparisons were limited in the analysis to medium-sized farms. Costs of adjustment, flexibility, and conservation were other criteria used in appraising the alternatives.

Alternatives were selected for economic comparison on the basis of farmer appraisal and land-use plans.
Physical adaptability of basic systems to different problem areas and resource situations received major consideration. Important economic objectives in farmers' short-run plans were: (1) maximization of income, (2) least cost, and (3) flexibility. Farmer plans generally were for short-run periods because of uncertainty in opportunity to grow wheat, together with uncertainty of the future profitability of alternatives to wheat. Government policy was the significant factor contributing to uncertainty in farmer planning. An important resource variable influencing farmer decisions was facilities for livestock.

Major courses of action farmers planned to take under different situations were: (1) grow barley on diverted acres if permitted under the allotment program, (2) grow grain for hay and/or pasture on farms with livestock facilities, or leave land idle on farms without facilities for livestock, under limited opportunity to grow cash crops in the next two or three years, and (3) grow grass for livestock or conservation purposes under limited opportunity to grow cash crops over longer periods of time. These were the alternatives studied.

Costs of adjusting into selected alternatives on medium-sized farms ranged from about $14,000 for grass in situations without livestock facilities to about $2,000 for the barley-grain hay alternative on farms with
livestock facilities. Capital requirements for adjustments into grass-livestock systems on farms without facilities were approximately two times as large as the requirements on farms with livestock facilities.

Selected alternatives for situations without facilities for livestock were ranked as follows on the basis of income: (1) barley, (2) idle in stubble, (3) idle in summerfallow, (4) idle and grass, (5) grass-grain hay, and (6) grass. Estimated incomes expressed as percentages of income for a basic wheat system ranged from 84.4 per cent for barley to 57.6 per cent for grass. For farms with livestock facilities, selected alternatives in order of decreasing estimated incomes were: (1) barley, (2) barley and grain hay, (3) grass, (4) grass-grain hay, (5) grass-grain hay and pasture, and (6) grain pasture-grain hay. The incomes for these alternatives ranged from 85.0 per cent to 64.9 per cent of the income for a basic wheat-livestock system. The order of the alternatives ranked on the basis of flexibility differed from these rankings.

A hypothesis on conservation developed was that productivity of soils in the Oregon wheat-summerfallow area has not declined to a state of uneconomic reversibility, and productivity decline was not likely to be a serious problem in the foreseeable future. Farmers were expected to recognize and correct uneconomic deterioration.
Selected alternatives with largest proportions of diverted acres in grass provided the most conservation. Those alternatives with maximum income and flexibility advantages were least advantageous from a conservation standpoint in situations without livestock facilities. Conservation systems ranked next to barley as alternatives on farms with facilities for livestock.
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