Soil and moisture conservation practices in Montana
by Phillip T Allen

A THESIS Submitted to the Graduate Committee In partial fulfillment of the requirements for the Degree of Master of Science in Agricultural Economics at Montana State College
Montana State University
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Abstract:
The principal purpose of this study were to determine the farmers' opinion of the conservation practices used on his farm, and the changes In farm organisation and management that resulted from the use of the practices. These conservation practices represent an effort to better adapt the agriculture in the Great Plains to the limitations of the region.

The forms studied were located in the Power-Dutton Soil conservation Service Project; and the Soil Conservation Service Project In the Froid area. Schedules were filled out by about 22 farmers in each area. The two projects were different In some respects and emphasized the necessity of careful study before a set of conservation practises should be recommended for an area.

The Power-Dutton area, located In the "Triangle", will continue to be predominately a wheat growing section, since water shortage eliminates livestock development. Since the advent of conservation programs, farmers had more generally adopted a one-half fallow-one-half crop type of rotation. The restriction In wheat acreage caused by the Agricultural Adjustment Administration program was accompanied by superior methods of production—namely, the use of more summer fallowed acres, so that the curtailment In wheat acreage could not be expected to reduce production proportionately. Farmers were using strip fallow and trashy cover to control wind erosion. Although operation costs were somewhat higher because of the stripped fields, farmers believed wind erosion was definitely curbed and crop yields stabilized.

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June, 1940
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FOREWORD

"Their plight has been stated in this way: east of the Mississippi civilization stood on three legs—land, water, and timber; west of the Mississippi not one but two of these legs were withdrawn—water and timber, and civilization was left on one leg—land."1/

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The principal purposes of this study were to determine the farmers' opinion of the conservation practices used on his farm, and the changes in farm organization and management that resulted from the use of the practices. These conservation practices represent an effort to better adapt the agriculture in the Great Plains to the limitations of the region.

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PART I. INTRODUCTION

The Problem

Dust storms of the past several years have focused on public attention a serious problem resulting from misuse of land. A combination of drought years and unadapted farming practices have resulted in large acreages of cropped land being severely damaged by wind erosion. 2/ It has been suggested that the soils in the Great Plains are of such a nature that growing grain will produce conditions favorable to wind and water erosion. Conservation is possible under a cover of grass, but this means low returns. The two alternatives given are grass and a low return, or grain farming and eventual soil depletion. The soils are considered as similar to a mine, which, if used, will eventually become useless. 3/

The question which is brought up is this: Are the Great Plains to be ruined by wind erosion until farmers are forced to move out, with the land finally reverting to desert? Such an occurrence would of course have tremendous social costs.

Since the time of settlement of the Great Plains, efforts have been made to adapt the agriculture to the physical limitations of the region. The problem of conservation has become more acute because of the dry years of the past decade. It is because of this fact that there have been developed

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2/ The term wind erosion refers to the loss of soil by wind action. Conservation is defined as the maintenance or the increasing of the ability of the soil to produce plant life.

in the last few years, many new practices to meet the problem of wind erosion. These practices are making changes necessary in land use and in methods of operating machinery. The development of these practices bring up many questions. Can the soil in the Great Plains be farmed in a manner that will maintain the fertility of the soil? Will these practices which have been developed be of a nature to control wind erosion and at the same time not cause sufficient increases in operating costs or losses through reduction in acreages to make their use uneconomical?

Beginning in 1935 the Soil Conservation Service of the United States Department of Agriculture has established demonstration projects in Montana to experiment with and demonstrate the use of practices and methods of farming to prevent erosion and to conserve moisture. Since 1936 the Agricultural Adjustment Administration has been making payments for certain soil conserving practices, as well as making payments for reduction in acreages of some crops. There is little doubt that these conservation programs have caused considerable changes in farm organization and management on those farms on which the programs have been in effect.

The principal purpose of this study is to determine whether these practices which are being used to conserve soil and moisture are accomplishing their objectives and whether they are acceptable and economic from the point of view of the individual farmer. How well does the farmer believe each of these practices has worked out on his farm, does he consider the practices economical, and what changes in farm organization and management

---

If in the remainder of this study, SCS will designate the Soil Conservation Service.

AAA will designate the Agricultural Adjustment Administration.
have been caused by these practices—these were the important questions to which answers were sought. The importance of the farmer's opinion can scarcely be over-emphasized since he is the one who decides whether to use, or to continue to use, the practices on his farm.

The three purposes of this study are as follows:

1. To determine the value of soil conservation practices from the point of view of the individual farmer.

2. To determine the changes in land use that have occurred on the farms studied since the establishment of the conservation programs.

3. To trace the development and to determine the extent to which conservation practices are used on the farms studied.

Method of Procedure

This study was carried out in two demonstration areas of the SCS in Montana. The two areas are the Power-Dutton area located in Teton and Cascade counties; and the Froid area located in Roosevelt County. (Refer to figure 1.)

Twenty-two farms were studied in the Power-Dutton area. Farmers cooperating with the SCS who were interviewed were those living on their farms during the period of the study and who were at home when the interviewer called. A list of farms in the area that was considered representative was made, and the list was the basis of the sample. S/ Approximately equal

S/ In several cases roads were blocked with snow so that a farm could not be reached, or the operator was not at home at the time of the call. In these cases, another farm was selected.
Figure 1.—Location of the Power-Dutton and the Froid Soil Conservation Service projects where this study was made.
numbers of operators were interviewed in the Power and in the Dutton areas. Seventeen operators out of 42 cooperating with the SCS were interviewed. Five out of a total of about 30 operators not cooperating with the SCS were contacted. The grouping of the 22 farms according to Government programs is shown in Table I.

**Table I.** Farms studied in the Power-Dutton area, January, 1940.

<table>
<thead>
<tr>
<th>Program</th>
<th>SCS &amp; AAA</th>
<th>SCS</th>
<th>AAA</th>
<th>No Program</th>
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<tr>
<td>No. of Farms</td>
<td>15</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>22</td>
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Twenty-three farms were studied in the Froid area. Farmers cooperating with the SCS were selected on the basis of practices used and location in the area. This selection was made with the help of SCS technicians at Culbertson, the headquarters for the Froid area. Eighteen cooperators were interviewed out of a total of 45 on the project.

A selection of the operators in the area not cooperating with the SCS was made on a basis of location in the area, and an effort made to interview all those selected. Of a total of 26 operators in the area who do not cooperate with the SCS, five were interviewed.

**Table II.** Farms studied in the Froid area, March, 1940.

<table>
<thead>
<tr>
<th>Program</th>
<th>SCS &amp; AAA</th>
<th>AAA</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Farms</td>
<td>18</td>
<td>5</td>
<td>23</td>
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A schedule was filled out by the writer and each operator interviewed. This schedule was for the purpose of determining the farmer's opinion of the importance of erosion in the area, his opinion of the different conservation practices, and the changes in organization and management resulting from the use of these practices. A copy of the schedule is in the appendix, page 146.

Limitations of Data

The material presented in this study is largely based on farmers' opinions of practices which have been used for only a short period of time, and under adverse conditions.

The Power-Dutton Project was begun in 1935, while the Froid Project was started in the fall of 1936. Even the early cooperators had no more than three or four years to observe the results of conservation practices. For some of the practices that have been tried, no analysis can be made. It takes several years to get some practices effectively established, as, for example, field hedges.

In the Power-Dutton area, precipitation considerably below normal was received in 1936, in 1937, and in 1938. The following statements were taken from a Power-Dutton Project report. "Two years (1936-37) of the worst drought and insect pestilence experienced to date by farmers on

\[\text{Normal refers to the use of the term as defined by the Weather Bureau.}\]

\[\text{Refer to appendix, p. 136.}\]
this project have largely nullified work of the Soil Conservation Service.

Created Wheat Grass has been planted for the third year. Sweet clover was
seeded twice. Caragana, which started well in 1935, died because of drought
and insects." 2/  

In the Froid area, 1936 and 1937 were years of below normal precipi­
tation. In 1937 "...this year was notable for the coldest winter and
the driest spring in the history of the state, as well as for the most
devastating drought conditions ever known in the extreme northeastern
counties." 10/ The years 1938 and 1939 could not be considered normal since
June rainfall in each year was nearly twice the usual June rainfall. 11/ The
success shown in establishing Crested Wheat plantings in the Froid
area may have been greater than would have been the case during more normal
years. In 1938 precipitation in Culbertson was more than six inches above
normal.

Rust and grasshoppers in the summer of 1938 largely nullified the
influence of the favorable rainfall, and made impossible the evaluation
of the effect on yield of soil and moisture conserving practices. 12/

In many instances persons tend to rationalize their participation
in activities, and for this reason farmers' statements may be biased in


11/ Refer to appendix, p. 139.

favor of certain practices. On the other hand, some farmers are prejudiced against any change in their usual methods of operation, and their answers may not indicate the true worth of the practices.

For these reasons it is desirable that a study similar to this one be carried on for a period of years to provide adequate information of the value of soil and moisture conservation practices.

A History of Soil Conserving Practices

Most of the present day conservation problems in the Great Plains developed from the use of a type of agriculture not adapted to the area. The Great Plains were different, particularly in rainfall and soils, from any other agricultural region in the country. The effort to use on the Great Plains a type of agriculture adapted to humid conditions caused many serious problems of the present. Dust storms of the last few years are an example of man's failure to adapt the type of farming to the physical characteristics of the Great Plains.

The period of heaviest settlement into the Plains region coincided with the period of highest rainfall ever recorded in the area. This high rainfall period gave rise to the belief that such an amount of moisture could be expected. A type of agriculture was established which proved to be unadapted in periods of less rainfall.

The Homestead Law did not comply with the conditions of the Great Plains because of a lack of knowledge of the new environment on the part of the lawmakers. The area of the homestead was originally fixed at 160
acres on the theory that this area was sufficient on which to maintain a
family comfortably, and in the regions where the Homestead Law first applied
this was true.\footnote{House Report. 53th Congress, 1st and 2d Session. No. 2452.
p. 2. Quoted in Hibbard, Benjamin Horace. "A History of the Public Land
Policies." Peter Smith, New York. 1939. p. 392.} In the Great Plains, however, this was not the case,
and homesteaders were forced to limit their holdings to an area considerably
smaller than a more desirable policy would have allowed. Partly as a result
of this policy the land owner farmed more intensively than was desirable from
the standpoint of good land use.

The settlers brought with them to the Great Plains their ideas and
farming tools developed in a different environment. Plows, disks, and
harrow, all humid region tools, were brought to this new country. Disks
and harrows pulverize the soil into a condition very susceptible to damage
by wind erosion. Such tillage methods and farming practices arising from
the use of these tools were factors in causing soil blowing and other
problems of conservation.

Because of war time needs, wheat prices were high during the period
of settlement of the Great Plains. The effort was made to plant the largest
possible acreages of wheat in order to reap large profits. The extension
of wheat growing led to the use of lands not suited to cultivation, and
to poorly prepared seed beds.

The early publicity that was distributed by Governmental and private
agencies was designed to draw settlers to the state. The amount of the
publicity was large, and adjectives were not spared in picturing Montana as
the land of great opportunity. An example that might be cited was the discussion at the Dry Farming Congress held in Billings in 1909. The Congress met for the purpose of discussing dry farming problems but much of the time was given to an elaboration of the agricultural possibilities of the state. "Montana...the land of opportunity...millions of acres of fertile agricultural land waiting the rough carass of the plow to transform them into productive fields." Such publicity as this caused many persons not adapted to farming to be drawn to the state. It led to a get-rich-quick psychology. It is probable that many of the settlers drawn to this new region did not intend to make a home, but came with the idea of making large profits and leaving the area. This type of settler was interested in converting the large acreages of grass into wheat. Permanent agriculture could not be established on this basis.

Because of the belief in a prosperous future as a result of high wheat yields and prices, land values rose. Borrowing was encouraged. Farmers went into debt to buy farm machinery and land to extend their farming operations. The period was one of speculation with little attention given to establishing a permanent agriculture. When the period was ended by several years of drought, farmers were considerably in debt, and many were not able to keep their holdings.

While the conditions that have been described were a reasonable development and probably justified by the lack of knowledge and other conditions.

of the time, it is nevertheless true that the problems of soil and moisture
conservation of today are in a large part due to these early influences.
A change to soil and moisture conserving methods of farming is difficult
because it involves not only the discovery of the methods of farming, but
in addition the making of these methods acceptable to the farmers through
education and other means. This often means the breaking of prejudices or
habits that are deeply set.

Soon after the settlement of the state, Governmental and private
agencies began experiments in farming practices. Among the early publica-
tions, some space was devoted to summer fallowing. As early as 1894 summer
fallowing was recommended to increase the supply of plant food, and to
free the land from weeds. 15/ Mention was made of summer fallowing in later
publications, being recommended as a method of holding water from one year
until the next crop year.

Discussion was given to crop rotations which included alfalfa. 16/
It was believed that alfalfa or other legume could be used to replace fallow
in dry land farming. Continuous cropping with wheat was believed to take
phosphoric acid from the soil and crop rotations were recommended to
supply the deficiency. Small farms were believed to hold the key to the
State's future by permitting the settlement of a large agricultural
population.

15/ Press Bulletin No. 2. Montana Agricultural Experiment
Station. Bozeman, Montana. 1894.

16/ Crop rotations, of particular importance in maintaining soil
fertility in regions of greater rainfall, were assumed to serve the same
function here. Later, it will be observed, the value of crop rotations
in dry land farming was questioned.
Some experiments were done by the Experiment Station 17/ in methods of constructing reservoirs for the dry farm. A 1904 publication mentioned water reservoirs. "A small reservoir in a small coulee afforded opportunity to illustrate the possibility and method of constructing a small farmer's reservoir to store the flood waters. 18/ Early efforts were thus made to provide a supply of water for stock and home use.

In 1903 the Experiment Station began tests to determine the type of crops and methods of cultivation best adapted to dry land farming. The importance of moisture to farming was emphasized to a large extent. A description was given of methods which were thought to prevent loss of water by evaporation. "...never for a single minute during the entire year permit the surface of a field to give off water in evaporation... keeping always on every field a dust mulch of three to four inches of loose surface soil." 19/ It was recommended to stir this dust frequently thereby preventing the formation of a crust. A soil with a dusty, pulverized surface is extremely likely to be damaged by wind erosion.

The desirability of fall plowing to keep the land in a condition to absorb water was pointed out. However, it was also noted that in a windy country fall plowing might not be advisable since the snow would often be blown away and much of the soil lost. "Under these circumstances leave

17/ Experiment Station as used in this study refers to the Montana Agricultural Experiment Station.


all the grass and stubble possible on the land to catch and hold the snow." 20/ It should be observed that mention was made of wind damage to soil at an early date, and that the use of stubble to hold snow and protect the land from blowing was recommended.

Surface cultivation to prevent evaporation continued to be emphasized. The use of such tools as the harrow and disk was recommended to provide a dust mulch and thus prevent evaporation. "The harrow is the best implement for the conservation of moisture...the disk also is valuable in the preliminary work for forming mulches." 21/ Frequent cultivations to break crusts formed by rains continued to be suggested. Such tillage implements as the harrow and the disk tend to break up the soil aggregates and leave the soil in a condition susceptible to wind erosion.

Alfalfa was recommended to keep up the productivity of the dry land soil. "...some nitrogen gathering crop must be grown. Under a system of dry land agriculture, alfalfa is the most promising of the leguminous crops for this purpose." 22/ It had not been shown that dry land soils were depleted by cropping and that a crop rotation was necessary.

By 1910 the recommended tillage implements were, "a good mould board


breaking plow adapted to the size of the area to be farmed, a disk harrow, a set of drag harrows, and a single or double disk seed drill." 23/

There were some warnings issued during this time which showed that agriculture might need adjustment. "Many hard working farmers have totally failed this year (1908) to mature crops on dry farms." 24/ The first evidence to be found that many farmers were realizing that the type of agriculture was not adapted to the area was in a publication of 1911. Many farmers were convinced of the "necessity of a different agricultural system from that in vogue in humid or semi-humid regions." 25/ It was suggested that it would be desirable to increase the size of holding from 160 acres to a half or entire section. This was a recognition of the fact that small dry land farms were not as desirable as was formerly believed.

A bulletin published in 1911 gave the results of experiments which showed summer fallowing to be more profitable than continuous cropping. 26/

Alfalfa was still recommended as necessary to improve the soil, and the Canadian Field Pea was suggested as an addition to the rotation.

Trees and shrubs were thought to be adapted to growth on dry land. "Trees and shrubs may be successfully grown on dry lands if the principles of


25/ Montana Farmers' Institute. "Ninth Annual Report". For the year ending February 26, 1911. p. 5.

moisture conservation are observed and practiced." 27/ A bulletin published by the Experiment Station in 1912 described the value of trees and shrubs on the dry farm and gave methods of growing and caring for them.

The value of the dust mulch began to be questioned at this time. "The most effective soil mulch is granular rather than a fine dust. If pulverized too finely, soil runs together again and capillary action becomes re-established or it blows away..." 28/ The cloddy mulch was beginning to be recognized as giving greater protection against wind erosion than the dust mulch. Another method suggested to prevent blowing was the use of the corrugated roller to leave the soil rough.

Alfalfa continued to be considered as necessary in the rotation, being recommended as best grown in cultivated rows in the dry area. "...every successful dry-land farmer will ultimately grow considerable of it, both for pasture and for winter feeding for all kinds of growing stock." 29/ However, a few years later some doubt was laid on the value of the crop rotation. "Either three or four year rotations containing a green manure crop have been less profitable than similar rotations where clean fallow replaced the green manuring." 30/ In some parts of the state corn received

considerable attention and the use of corn to replace fallow was believed profitable in some cases. 31/

The effect of burning was discussed in a publication of 1916. "Burning straw...is a practice that should be strongly condemned. Some method should be found for getting this organic material back into the soil." 32/

The dry years of 1916 and 1919 caused more stress to be placed on livestock for the dry farm. "...another deduction from this dry period, based on the promising crop rotation, is that livestock must enter more largely into the work of the dry farm." 33/

Soil drifting was receiving considerable mention at this time. "...a serious problem on the dry-land farm and one that is likely to become more and more troublesome as time goes on is soil drifting... (it) may be materially reduced by proper methods of cultivation and cropping." 34/

In 1921 an important publication titled "The Use and Construction of Home Made Implements" discouraged the use of dust mulch since it tended to cause puddling and to prevent absorption of water. The use of the duckfoot cultivator was recommended to leave a ridged, lumpy surface, and the rod

31/ Atkinson, Alfred, et al. op. cit.


weeder was described for use in light soils. Soil blowing was considered, and control suggested by keeping stubble and clods on the surface by use of the new tillage implements. Ridging the soil at right angles to the prevailing wind was recommended. The bulletin described construction of several home-made types of weeders. \textsuperscript{35} In a later publication the use of the harrow on soils likely to blow was discouraged and implements such as the duckfoot cultivator and rod weeder recommended to maintain a clod mulch. Ridges at right angles to the wind, 15 to 20 rods apart, continued to be mentioned for use in control of blowing. \textsuperscript{36} Reservoirs and dams were discussed and methods for their construction given.

The cloddy surface was recommended and the use of the spike tooth harrow discouraged in publications of 1926. The duckfoot received mention as the "outstanding tillage implement for general purposes and average Montana conditions." \textsuperscript{37} It was used in connection with the plowless fallow to maintain a clod mulch and to establish ridges for the lessening of soil blowing.

The 1927 results of experiments showed that plowing under green manure crops of peas and winter rye had no beneficial effect on the yield of spring wheat. Experiments also indicated that phosphorous fertilizer did not increase


\textsuperscript{36} McKee, Clyde. "Summer Tillage in Montana". Mont. Agri. Expt. Sta. Cir. 102. 1922.

The Thirty-Fourth Annual Report of the Experiment Station also showed that turning under winter rye, field peas, sweet clover, or barnyard manure for fertilizer had not increased yields of small grains.

The burning of stubble was discussed in an Extension Bulletin published in 1929. The conclusions reached were that burning gave higher immediate yields but the ultimate effect was not known.  

This history of soil conserving practices has considered State and Experiment Station publications issued in Montana before 1930. It will be noted that ideas from humid regions are much in evidence. This is necessarily true when a new environment is settled. While problems of blowing were recognized in early studies, methods of preventing blowing had not been practiced to a large extent by 1930. Strip cropping had not received mention up to this time.

The need for a type of agriculture in harmony with the climate and soil conditions of the Great Plains was realized by some persons early in the century. The change in agriculture to a more adapted type was slow in developing, the development being retarded by favorable crop conditions in the years of settlement. The dry years of 1918, 1919, and 1920 were followed by the development of power farming and the introduction of implements better adapted to the Great Plains. Other developments have come since. There

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were, of course, many detours, some probably leading opposite to the desired direction, but this is to be expected when people come into a new and different environment.

The dry years of 1931, 1935, and 1936 brought dust storms of high intensity; soil drifted around houses and fences; and in some cases entire wheat fields were blown from the earth. Again has come the realization that if agriculture is to function under conditions of low rainfall, farming practices must be changed.

Federal Government help became more and more important as action was taken to protect farm prices, to help prevent wind and water erosion, and to encourage wise land use. Many new practices have been developed in efforts to conserve soil and moisture. Some of these practices will probably not be successful, just as earlier practices which were believed to be adapted, later proved to be unwise.

One of the purposes of this study is to consider the usefulness of practices that have been recommended in recent years.

THE POWER-DUTTON PROJECT

Description of the Area 40/

The Power-Dutton wind erosion area is located in Cascade and Teton counties near the southern tip of the portion of Montana known as the

40/ Taken largely from: Handbook, Power-Dutton Project, Montana 1. SCS. Typewritten, 7 pp. with supplementary material.
The area, when laid out, was divided into two parts, the Power Project of 14,080 acres, and the Dutton Project of 17,920 acres. This division was necessary in order to include the various types of soils subject to wind erosion in this section of the state. The Power Project begins east of the town of Power; the Dutton Project is immediately east of the town of Dutton.

**Physical Characteristics**

Rainfall.—The climate for this part of the State is described as semi-arid with low rainfall. The mean precipitation for Great Falls, 18 miles southeast of the project, from 1892 to 1930, was 15.41 inches, nearly 55 per cent or 8.37 inches of which comes in the four months of May, June, July, and August. Observations of the SCS technicians indicate that the precipitation on the project is about two inches under that of Great Falls. It is probable that the rainfall at Choteau, Montana, 22 miles west of the project in Cascade County would more nearly approach that on the project. The mean precipitation for Choteau from 1890 to 1930 was 13.48 inches of which approximately 56 per cent or 7.80 inches.

41/ "Semi-arid means that half of the years are dry and the other half are wet, rather than that there is fifteen inches of rainfall every year as over against thirty inches in humid areas. Furthermore, the wet and dry years do not come in series nor alternately, but are unpredictable in their succession." From Starch, E. A. "Type of Farming Modifications Needed in the Great Plains." Journal of Farm Economics. Vol. XXX, No. 1. February 1939. p. 114.


43/ Compare the table on the following page, table III, with appendix, p. 138.
fell during the four months of May, June, July, and August. June is the month of highest rainfall. Precipitation for the last ten years is shown in Table III for Great Falls, Montana.

**Table III. Precipitation at Great Falls, Montana, 1930 to 1939**

<table>
<thead>
<tr>
<th>Years</th>
<th>1930</th>
<th>1931</th>
<th>1932</th>
<th>1933</th>
<th>1934</th>
<th>1935</th>
<th>1936</th>
<th>1937</th>
<th>1938</th>
<th>1939</th>
</tr>
</thead>
</table>

The lowest precipitation ever recorded in Great Falls was 6.66 inches in 1904. The year of highest precipitation was in 1917 with 22.36 inches recorded. These figures illustrate well the extreme variations in rainfall which are characteristic of the Great Plains. This fact is of special importance since the average amount of moisture is small.

The method in which rainfall comes may be, depending on slope and soil conditions, of importance in making control of runoff and water erosion necessary. "Sixty-five to seventy-five per cent of the total annual rainfall is received largely in small local torrential showers, and in the more rolling sections the runoff is large." The records on the project seem to

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14/ Climatic Summary of the United States. loc. cit. p. 10.

show that rainfall does not come in the form of cloudbursts which is explained by the fact that the area is located immediately east of the Rocky Mountains. 46/

In summary, the rainfall is small in amount, with a favorable seasonal distribution, and extremes in moisture may be expected from year to year.

Temperature.——The temperature factors considered in this study are the length of the growing season, the average summer and winter temperatures, and the temperature extremes.

The average frost free period for Great Falls for 40 years of records ending in 1930 was 136 days. 47/ It is probable that the Power-Dutton growing season more nearly approximates that of Choteau with an average of 110 days. 48/

The average annual temperature, average winter and summer temperatures, and lowest and highest recorded temperatures are shown in Table IV. This

TABLE IV. CHARACTERISTICS OF THE TEMPERATURE AT CHOTEAU AND GREAT FALLS, MONTANA

<table>
<thead>
<tr>
<th>Location</th>
<th>Average Annual</th>
<th>Average Winter</th>
<th>Average Summer</th>
<th>Absolute Maximum</th>
<th>Absolute Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choteau</td>
<td>42.7</td>
<td>22.6</td>
<td>62.6</td>
<td>101</td>
<td>-42</td>
</tr>
<tr>
<td>Great Falls</td>
<td>44.4</td>
<td>25.5</td>
<td>65.7</td>
<td>106</td>
<td>-44</td>
</tr>
</tbody>
</table>


48/ Ibid. (For 24 years ending in 1930.)
table shows that extremes in temperatures are great, that winter temperatures
are low, and that summer temperatures are quite high.

Chinook winds sometimes occur in the area.

Wind. —Winds of sufficient strength to cause soil damage have been
experienced in the area. High wind velocities are a general characteristic
of the Plains region. "In no other section of the interior of the United
States are prevailing wind velocities as high as in the Great Plains...this
high rate of air movement increases evaporation, intensified drought caused
by rainfall deficiencies and high temperatures, and promotes dust blowing
on cultivated fields." 49

Topography. The topography of the Power Project is level to slightly
rolling. Slopes are long and gradual. Slopes of cultivated land run from
less than one per cent, to six per cent, with only a few locations sloping
as much as 12 per cent. Eighty per cent of all cultivated land is on
slopes of less than three per cent.

The Dutton area is more sloping than the Power area, being described
as rolling. Cultivated slopes run from one per cent to 10 per cent.
Slopes are short with 80 per cent of the cultivated land on slopes of less
than five per cent. Since slopes are not steep and the rainfall does not
come in the form of torrential showers, water erosion is not an important
problem on the project.

Soils. —The soils of the Power Project consist largely of Morton
loams and Morton silt loams with some Pierre clay loams, and Marias clay

loams. The soils of the Morton series overlie sandstones and shales. Drainage is good, water holding capacity is high, and these soils are adapted to raising small grains.

The Marias series is a heavy soil, which, when drying during the winter, frequently breaks into small granules and is susceptible to blowing. The Pierre clay loams are also heavy soils, difficult to work, and usually not farmed.

Soils in the Dutton Project consist largely of the Scobey series, including loams, silt loams, and silty clay loams. The Scobey series developed on glaciated material. This series consists of dark colored soils, one of the most productive soils for wheat in Teton County. The soils have good water holding capacity, and are of favorable tilth.

Generally speaking, the soils in the Power area are shallower and less productive than those in the Dutton area.

The soils of the Power-Dutton project are productive for raising wheat. The characteristics of these soils, especially when the soils are not correctly handled, make them susceptible to considerable erosion by wind. If correctly worked, and with sufficient rainfall, these soils will usually produce a cloddy mulch resistant to blowing.

**Economic Characteristics of the Area**

The average size of farm on the project is something over 600 acres, though definite data are not available. Approximately one-half of the operators own their farms, the remainder being tenants.
Income from crops constitutes the principal source of income for the operators. "Wheat is the most important crop and provides 95 per cent to 99 per cent of the farm income." 50/ Especially high quality, high protein wheat is raised in the area. At least one year the best wheat in the world was grown near Dutton. Wheat is the principal crop produced, spring wheat being grown most commonly for the last few years due to lack of protection for the soil during the winter months if winter wheat is grown. At the time the project was started about 15 per cent of the cultivated land was planted to mustard, most of the remainder being in wheat. Only a very small acreage of feed crops was produced.

Land use for the 32,000 acres in the entire project is shown in Table V below. These figures are for the time the project was started.

**TABLE V. LAND USE ON THE POWER-DUTTON PROJECT, 1935. a/**

<table>
<thead>
<tr>
<th>Area</th>
<th>Cultivated land</th>
<th>Grass</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>13,580</td>
<td>500</td>
<td>14,080</td>
</tr>
<tr>
<td>Dutton</td>
<td>15,920</td>
<td>2,000</td>
<td>17,920</td>
</tr>
<tr>
<td>Total</td>
<td>29,500</td>
<td>2,500</td>
<td>32,000</td>
</tr>
</tbody>
</table>


The farming system is usually one-half fallow and one-half crop.

Farmers in the area, generally speaking, are well supplied with modern
tillage equipment. Practically all farming is done with tractors, most farms being equipped with tractors, duckfoot cultivators, and other adapted equipment.

The amount of livestock in the area is small and lack of water apparently eliminates the possibility of much future development. "This part of the state is peculiar in that there is no ground water. Farmers haul water for domestic and livestock use from an artesian well in the Sun River Valley drilled by the Northern Pacific Railroad. (Another well has recently been secured north of Dutton.) This precludes the use of livestock in developing a program. There is no use for grass. Row crops cannot be grown successfully." 51/

Wheat yields per seeded acre in Teton County for the period 1919 to 1934 were 15.12 bushels; the figure for Cascade County for the same period was 11.98 bushels. 52/

In summarization, one-half of the farmers are tenants, the principal source of income is crops, and the principal crop is wheat. Incomes of farmers in the area are high compared to other dry land areas in the state. There is little livestock on the farms, and probably the area will continue to be predominately a wheat growing section. The problem then is to find the most economical method of growing wheat and to conserve the soil at the same time.


Work Program of the Power-Dutton Area

The location for the project was decided by the SCS, the Extension Agronomist, and the staff members of the Montana Experiment Station. Among the reasons given for the selection of this area were the following:

1. Wind erosion had just begun to be a serious problem.
2. The proposed project was the best dry land wheat area in the United States.
3. The farmers on the project were not on relief and, therefore, were in a position to carry on cooperative relationships to the best advantage.

The Power-Dutton project was believed to represent a variety of soil and topographic conditions characteristic of some five or six million acres of good wheat producing land.

The principal attention in the Power-Dutton area was on the establishment of straight line strips of crop alternating with fallow in a direction perpendicular to the prevailing wind. The strips were not to exceed 20 rods in width, and a considerable portion of the strips were laid out narrower.

Attention was also directed to the maintenance of a trashy cover.

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The prevailing wind in this area is from the southwest.
and clod mulch to be used in connection with stripping to reduce wind erosion and to conserve moisture. The ground was to be stirred the minimum amount necessary to control weeds and to reduce soil blowing. The disk and the harrow were not to be used, and the burning of stubble was prohibited. Experiments in rotations for dry land farming were to be carried out.

In a further effort to reduce wind erosion, experiments were to be made with five rod windbreaks planted on the west side of the farms. Caraganae in rows 20 rods apart were to be established north and south between the strips. Stock dams were to be built on some farms.

Soil drifts were to be smoothed down to make seeding possible. Contour stripping was to be experimented with in some cases, though terracing was not believed necessary on the project. Contour furrows were to be established on pasture lands.

**General Consideration of Erosion in the Power-Dutton Area**

The farmers' opinion of the seriousness of erosion is an important factor in determining whether farmers will use practices to control erosion. If the farmer believes soil losses on his farm are important, and that these losses are having a deleterious effect on crop yields and on land values, the farmer is likely to adopt measures to prevent the soil losses.

Most of the farmers in the group interviewed believed erosion was a serious problem. Of the group of 22 interviewed, only four operators stated that erosion was not a serious problem on their farms.

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56/ Refer to the appendix, p. 140, for a complete list of SCS accomplishments to date.
The group was practically unanimous in their belief that wind erosion was their serious problem. Only one operator believed water erosion was a problem. The group as a whole believed the land was sufficiently level and rainfall low enough to minimize the water erosion hazard.

Damage from wind erosion was a large problem in the area. Several operators spoke of dust storms of such intensity that it was impossible to see more than a few feet. Some had observed gravel spots beginning to show in the fields where damage had been severe.

Farmers replied to the question, do you think much soil has been lost from your farm? are shown below:

<table>
<thead>
<tr>
<th>Reply</th>
<th>Yes</th>
<th>No</th>
<th>No reply</th>
<th>Total replies</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of ans.</td>
<td>13</td>
<td>6</td>
<td>3</td>
<td>22</td>
</tr>
</tbody>
</table>

The majority of the group was of the opinion that a considerable amount of soil had been blown from their farms. Farmers had observed soil drifts piled around fences and buildings, severe dust storms, and gravel spots in fields to justify this conclusion.

Farmers stated that soil blowing has been in evidence for a considerable length of time. One member of the group interviewed said he had noticed blowing on his farm as early as 1914, while over one-half of the group had seen soil blowing before 1925. The data indicated that some wind erosion has been occurring in the area for many years. Some of the farmers were of the opinion that soil blowing began after the plant fibers were worked out of the soil. Wind erosion was not evident when
the soil was first worked.

Farmers were almost equally divided in their opinion of the effect of soil losses on crop yields. Nearly one-half of the group was of the opinion that soil losses on their farms had not reduced crop yields. Some of the group who believed wind erosion had not lowered yields, said that the soil on their land was deep and the small amount of soil lost from the top had not affected soil fertility. If the amount of rainfall was as large as formerly, many in this group believed yields would be as high as they were before blowing had taken place.

On the other hand, half of those interviewed believed yields were lowered to some extent by the loss of soil from wind erosion. A few stated it was their opinion that the best soil was lost by blowing and this did cause reductions in yields. On the spots where wind damage had been especially severe, farmers mentioned the necessity of seeding more heavily since the plants did not stool well on these areas. Some of the farmers stated that yields were considerably lowered on the blow spots, in addition to a general decrease over the entire field. Several mentioned the direct loss wind may sometimes cause by blowing crops from the ground. One in the group gave no reply.

The most common early effort to control blowing was the use of the duckfoot cultivator. The implement came into use in the area shortly after 1920, most of the farmers acquiring their machines between 1925 and 1929. Other methods used in an attempt to control wind erosion were the use of the rod weeder, the one way disk, and the cutting of the block
fields into large strips.

Summary.—1. The majority of the farmers believed that wind erosion was a serious problem on their farms. Water erosion was not considered important.

2. More than one-half of the group believed a considerable amount of soil had been blown from their farms.

3. Blowing in the area was noticed as early as 1915.

4. The group was not agreed as to the influence of blowing on crop yields.

5. The use of the duckfoot cultivator was the most common early attempt to control wind erosion in the area.

Strip Fallow on the Power-Dutton Project

The term "strip fallow" refers to the use of alternating strips of crop and fallow across a field. The strips run in a direction as nearly at right angles to the prevailing wind as possible, and vary in width according to the intensity of wind in the area, the nature of the soil, and the size of the machinery. Strip fallow offers protection from wind erosion and also permits the use of fallow each alternating year. Strip fallow used with a soil cover of trash and clods is the principal method used in the Power-Dutton area to control wind erosion (see figure 2).

The purpose of studying strip fallow was to determine the cost of establishing and maintaining it; any changes in fuel or labor costs because of stripping; and the objections to and the benefits derived from
Figure 2.—Alternating strips of crop and fallow extend in the distance. Power-Dutton Project. (SOS photo)
the strip fallow type of operation. Strip fallow was in use on 21 of the 22 farms studied in the area.

The width of the strips on the farms varied from 10 to 22 rods, nearly one-half of the farms having some ten rod strips, and only one farm having strips of a width of 22 rods. The strips have all been established comparatively recently as is shown by the data below, which give the number of farms which began the use of strips in the different years.

<table>
<thead>
<tr>
<th>Year stripping</th>
<th>1926</th>
<th>1930</th>
<th>1932</th>
<th>1934</th>
<th>1935</th>
<th>1936</th>
<th>1939</th>
<th>no answer</th>
<th>Total was begun</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of farms</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>21</td>
</tr>
</tbody>
</table>

The operator who reported the use of strips in 1926 had reference to strips 50 rods in width. There is doubt if a field with strips of this width should be classified as stripped. According to SCS records, there were only 312 acres of ten rod strips, and 685 acres of strips in 20 to 30 rod widths in the area when the project was established in 1935.

In determining the original cost of strip fallow per acre, two factors must be considered. The first of these costs is the actual labor in laying out the strips; the second cost is the loss of crop or part of a crop which may result in the first year from establishing the strips.

The labor in establishing the strips is the amount necessary to lay out the lines to be followed. The SCS laid out the strips on the farms of their cooperators, thus there was no labor cost in establishing the
strips on these farms. In cases where farmers laid out their own strips, the cost was negligible. Operators reported one man can lay out from 200 to 300 acres a day. It is probable that the strips could be laid out at a time when there is no other work to be done.

The second cost in establishing the strips is the result of the necessity of either leaving a part of the field fallow for two years, or of double cropping the field for two years. If the field is in stubble, it is necessary to double-crop the land to establish the strips; if the land is in fallow, half of the land must be left fallow the second year. 27/ If the field is in fallow when strips are established, no crop is produced on one-half of the land since it is necessary to leave this portion fallow the second year. There is some saving in cost of operation, however, since it is less expensive to fallow land than to produce a crop. There is also the possibility of an increase in yield from leaving the land fallow for the second year compared to a single year of fallow. 28/ The cost of establishing strip fallow on fallowed land is not large.

AAA payments for leaving land out of production were important in this connection. Strips were established on fallowed land, with that portion of the land which was left fallow the second year serving as the


land taken out of production to earn AAA payments.

The most common practice is to establish strips on land which is in stubble. The strips are stubbled in and the remainder of the ground is left fallow. Such a method may result in a decrease in yield since wheat following wheat does not yield as high on the average as wheat after fallow. The cost of establishing strips on stubble land is also small.

The only upkeep cost of strip fallow would be the labor required to lay out the strips a second time were such a procedure necessary. None of the group interviewed reported any upkeep cost for strip fallow.

The majority of the farmers was of the opinion that strip fallow required more labor and fuel than block farming, as is shown below. The data are for the amount of labor and fuel required to practice strip fallow compared to block farming.

<table>
<thead>
<tr>
<th>Amount</th>
<th>Less</th>
<th>Same</th>
<th>More</th>
<th>Total Replies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor required</td>
<td>0</td>
<td>4</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>Fuel required</td>
<td>0</td>
<td>2</td>
<td>19</td>
<td>21</td>
</tr>
</tbody>
</table>

Before strips were established, fields were farmed in large blocks ranging in size from 30 acres to 250 acres. After stripping was established, the lands were from 10 to 22 rods in width. The size of the lands was considerably reduced, and this was the reason farmers gave for the added costs of operation on the strips. The narrower strips, it was reported, involved more turning at the ends. The strips could not be made to fit the width of all the farm machinery, since the machinery was not all of the same width. Furthermore, it was not possible to drive accurately enough
to exactly finish the strip on the last half round using the machinery to full capacity. Consequently, farmers reported it was usually necessary to finish a strip using less than the full width of the machine on the last half round. This resulted in added labor and fuel costs since in block farming there was but one strip to finish in each land, and these lands were usually considerably wider than the width of the strip in the strip fallow system. Moving machinery from one strip to another was an added reason given for the larger amount of fuel and labor required to strip.

Another expense necessitated by strip fallow was reported by one farmer who operated two pieces of land several miles apart. When he block farmed these fields, he fallowed one piece and cropped one piece each year. Since stripping was established, it was necessary to move his farming equipment between the two pieces which increased the operating cost. This was, of course, an unusual case.

The main function of strip fallow is to prevent wind erosion. The problem of soil blowing was serious when the project was established in 1935. Strip fallow in connection with a soil cover of trash and clods is recommended by the SCS to control wind erosion. The use of the trashy cover will be considered in a later section of this report.

The majority of the operators believed that blowing was under control on their farms. Their opinion of the influence of strip fallow on wind erosion is shown in the following tabulation.
It will be observed that in every case the operators believed strip fallow had reduced wind erosion to some extent, while in the large majority of the cases it was reported that wind erosion had either been greatly reduced or had been stopped entirely.

Farmers were asked their opinion of the influence of strip fallow on water erosion. Only five in the group had observed any influence on water erosion. Four of these believed that water erosion was slightly reduced, while the fifth said that water erosion was greatly reduced by strip fallow. The effectiveness of strip fallow as a measure to control water erosion depends largely on the slope of the land in relation to the prevailing wind. The other 16 in the group stated that stripping had no influence on water erosion, most of them adding that there was no water erosion on their land.

More than half of the group believed that strip fallow had increased the moisture content of the soil as is shown by the data below which is a tabulation of farmers' opinion of the effect of strip fallow on soil moisture.

<table>
<thead>
<tr>
<th>Effect</th>
<th>No Effect</th>
<th>Slight Increase</th>
<th>Great Increase</th>
<th>No Ans.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>5</td>
<td>14</td>
<td>1</td>
<td>1</td>
<td>21</td>
</tr>
</tbody>
</table>

The group interviewed were not agreed as to the influence of strip fallow on wheat yields. It was difficult to observe the effect on yields
because of the short period of time and the unfavorable weather conditions under which strip fallow had been used. Replies are shown.

<table>
<thead>
<tr>
<th>Effect on Yield</th>
<th>Decrease</th>
<th>Same</th>
<th>Increase</th>
<th>No reply</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>1</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>21</td>
</tr>
</tbody>
</table>

Farmers in several instances observed that yields on the west or windward side of the strips were higher than further over in the strip. The increase in yield on this portion of the strip was attributed to the fact that snow drifted across the stubble strip into this part of the fallowed strip causing an increase in soil moisture.

One operator believed stripping decreased yields, basing his opinion on the observation that the outside rounds of the strips yielded less than the rounds nearer the center. He explained that grasshoppers damaged the grain around the edges of each strip.

One farmer believed an increase in yield of five to 10 bushels could be attributed to strip fallow. His explanation was that winter wheat could now be grown on his farm, while before it was necessary to leave winter protection on the ground thus necessitating the growing of spring wheat. With strip fallow established he believed winter protection from wind erosion was no longer necessary, and he planted winter wheat on his farm. One of the SCS technicians of the Power-Dutton Project expressed the same belief that winter wheat can now be grown and believed that winter wheat would exceed spring wheat in yield by five to 10 bushels.

Farmers were asked what they expected future yields to be compared
with present yields. Replies are shown.

<table>
<thead>
<tr>
<th>Future Yield</th>
<th>Same as present</th>
<th>More</th>
<th>No answer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>7</td>
<td>10</td>
<td>4</td>
<td>21</td>
</tr>
</tbody>
</table>

The results of the study show that nearly one-half of the group expected yields in the future to be increased over present yields. The most common reason given was that the strips would accumulate more moisture in the future, which would result from an increase in rainfall, and not be caused by strip fallow alone.

Most of the farmers believed their land was more valuable in strips than it would have been had the land remained in the block system. Farmers were generally of the opinion that the value of their land had remained nearly constant, whereas if stripping had not been practiced, wind erosion would have caused severe damage. Several of the operators believed their land would have been of no value if strips had not been established.

Practically the entire group believed they would have begun strip-fallowing with no Government help. In only two cases out of the 21 did the operators say they would not have begun strip fallow without such help. However, figures from the SCS show there were only 997 acres in strips when the project was established in 1935. On the other hand, wind erosion was just beginning to be a serious problem. There is little doubt, however, that both AAA payments and SCS aid in laying out strips had an important effect on the extent and speed of adoption of strip fallow.

Farmers were unanimous in agreeing that strip fallow was a permanent
part of their farming operations. The entire group intended to continue
the use of the strip fallow system.

The principal objection to strip fallow was the increased costs of
operations. These have already been discussed. Among other objections
given were the following:

1. In moving machinery from strip to strip, the headland 59 became pulverized.

2. It was difficult to seed out the ends. 60

3. It was necessary to cross strips that were cropped, and, unless
the headland was large, damage to the crop strip was the result. The
larger the headland, the more land that was left idle.

4. Soil blew into the stubble on the windward side and often made
it difficult to pull through this accumulation with machinery. One operator
suggested a way of overcoming this difficulty. He mashed the stubble down
for a few feet on the windward side of each stubble strip, thus reducing
soil drifting in this portion of the strip, and spreading the blown soil
more evenly through the stubble.

5. The first few feet around the edge of each strip were greener
than the remainder of the strip. When the strip was cut, the result was a
larger proportion of green wheat than when block fields were used.

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59/ Headland is the term used for the land at the end of each
strip which it is necessary to leave idle to provide a path to move
machinery from one strip to another.

60/ Both of these objections can be overcome by the use of the
round end strip which is recommended by the SGS. Refer to page 83 for a
picture of the round cut strip.
6. Weeds were difficult to control on the edges of the strips. To eliminate this objectionable feature, some operators seeded into the stubble for a foot or 1 ½ inches when drilling, and then summer fallowed that part seeded into the fallow, thereby leaving no space between the fallow and the crop strip.

7. Insect damage was believed to be more serious on a stripped field than on a field farmed in a single block. The principal damage was caused by grasshoppers on the edge of the crop strips.

Summary. — 1. Strip fallow refers to a type of operation in which crop strips are alternated with fallow strips across a field to offer protection from wind erosion.

2. Strip fallow has come into use comparatively recently in the Power-Dutton area.

3. The cost of establishing strip fallow was small, and no upkeep cost was reported.

4. Fuel and labor required, according to farmers' reports, was greater on strip fallow than on block.

5. Wind erosion had either been greatly reduced or stopped from the reports of the large majority of the farmers interviewed.

6. Strip fallow may have a slight advantage over block farming from the standpoint of water conservation, because of the holding of more snow on strips.

7. The effect of strip fallow on yields was not determined. If winter wheat can be grown in place of spring wheat, some increase in yield
can be expected.

6. The majority of the farmers were of the opinion that their land was more valuable now than it would have been had stripping not been established.

9. Farmers were unanimous in agreeing that strip fallow has become a permanent part of their farming system. This was proof that they believed the benefits derived from stripping were of sufficient value to offset the increased cost of operation necessitated by stripping.

10. Numerous objections were given to strip fallow, the most common one being the added cost of operation.

**Crop Residues on the Power-Dutton Project**

The use of crop residues to provide a trashy cover is an important part of the conservation program on the Power-Dutton Project. The trashy cover used with strip fallow provides the principal control measures against the hazards of wind erosion (see figure 3).

The term trashy cover refers to leaving the stubble and other crop residue on the surface. For several years implements to provide a partial trashy cover have been recommended by the Experiment Station. Examples of these implements are the rod weeder and the duckfoot cultivator which do not bury crop residue but have a tendency to bring it to the surface. These implements also promote the formation of clods on the surface, since the tendency is not to chop and pulverize the soil, but  

61/ Trashy cover is used as synonymous with crop residue though this usage may not be a correct one.
Figure 3.—A dense trashy cover of stubble offers protection from wind erosion, Power-Dutton Project. (S.C.S., photo)
rather to sift the finer materials to lower levels and to leave the clods near the surface. A clod mulch and a trashy cover are both desirable from the standpoint of wind erosion control. The use of the trashy cover while desirable in the reduction of wind erosion, may cause some difficulties in additional costs of operations, insect hazards, and others.

Most of the farmers in the area believed that trashy cover is a necessary supplement to strip fallow. When asked the question, do you consider strip fallow and crop residue both necessary to control erosion?, 16 of the group answered yes, three believed that strip fallow alone was sufficient to prevent wind damage, while three gave no answer. The group agreed that burning crop residues was generally an unwise practice since a burned field had a much greater tendency to blow.

Farmers were asked the influence of crop residue on the amount of moisture in the soil. Their replies are as shown:

| Influence Decrease Same Slight Inc. Great Inc. No ans. Total |
|-----------------|----------|---------|-------------|-------------|-------|-------|-------|
| No. of replies  | 5        | 1       | 3           | 1           | 12    | 22    |

It is evident from the answers that farmers did not agree as to the effect of crop residue on soil moisture. Of those who believed crop residue decreased soil moisture, several mentioned that stubble worked into the soil caused it to become loose and filled with many air spaces. When the stubble was burned the soil became more compact and held water better, reducing losses from evaporation. However, none in the group approved of burning, because of the increased danger of wind erosion.

Those who believed that crop residue increased the moisture content
of the soil, pointed out that the stubble in the soil made the soil more absorptive of moisture, and that the trash on top acted as a mulch in an aid to decreasing evaporation.

The group was also in disagreement about the influence of crop residue on yields. Six in the group believed leaving crop residue in the soil lowered yields; six believed yields were not influenced; seven believed crop residues in the soil increased yields; while three gave no answer.

Those who believed that crop residue on the surface of the soil reduced yields, or conversely that burning increased yields, believed that a burned field held moisture better than an unburned one, that burning killed weeds and weed seeds, and that burning killed insects to some extent. All of these influences tended to increase yields.

Those who believed that burning decreased yields were of the opinion that the soil became depleted of nutrients by cropping and that crop residue acted as a fertilizer.

The group was quite sure that leaving the crop residue on the ground required more labor than burning the field. Of the group, 16 believed more labor was required to leave the residue on the ground, five thought there was no difference in labor requirements, and one believed less labor was required. This one individual qualified his statement somewhat by saying less labor was required when the stubble was not sufficiently heavy to cause machinery to become stopped with trash. Most of the group were of the opinion that trash on the surface reduced the speed of operations.

The most common method of handling crop residues in this area was
to work the stubble down with a one way disk plow in the first fallow operation in the spring. If the stubble was heavy, a second operation with the disk plow was usually made. The duckfoot cultivator was used for the remainder of the fallowing operations, or a rod weeder was sometimes used for some of the later operations. The plow was not used to a very large extent in this area, although some of the operators spring plowed each three or four years.

The group believed that crop residue tended to increase the insect hazard. While there was not a belief of a serious increase in insect damage, the opinion was general that crop residue caused insects to increase in numbers. The reasons for this belief were that the residue protected insects and furnished breeding places for them, while burning destroyed the breeding places. Of the group, 14 believed that insects were increased by leaving the crop residue in the soil, two believed crop residue had no influence, while six gave no reply. Since the trash cover is used with strip fallow there is the possibility that insect damage could be serious on the edges of the crop strips.

Observations by the SCS staff of the Power-Dutton Project indicated that the clod mulch was not as effective as a trashy cover in preventing wind damage. Though experiments had not been carried on for a sufficient time to warrant a definite conclusion, the indications were that a trashy cover provided considerably more protection than a clod mulch. Further work in these experiments will probably produce worthwhile results.

Experiments are being made by the SCS with a new implement to
maintain a trashy cover. This implement, the Noble Weeder, is equipped with a heavy blade which runs below the surface, killing weeds and leaving stubble in nearly its original position (see figures 4 and 5). Leaving the stubble more nearly erect should aid in holding snow and in preventing wind erosion.

Summary.—1. Trashy cover refers to the leaving of crop residue on the surface of the soil. It is used in connection with strip fallow as the principal erosion control practice in the Power-Dutton area.

2. Most of the farmers in the area believed that crop residue and strip fallow were both necessary to control wind erosion.

3. The effect of crop residue on soil moisture was a debatable one according to the reports of the farmers.

4. Farmers were not agreed as to the influence of crop residue on crop yields.

5. The group was generally agreed that it required more labor to leave the residue on the ground rather than to burn it.

6. The group condemned burning as a practice since it was likely to cause conditions favorable to serious wind erosion.

7. The most common method of handling crop residues in the area was by the use of the one way disk plow, and the duckfoot cultivator. Plowing was done only occasionally.

8. The farmers believed that leaving crop residue on the surface might lead to an increase in insect numbers. When crop residue is used with strip fallow, there is the possibility that serious damage to crops
Figure 4.—The Noble Weeder, a tillage implement with a heavy blade that cuts weeds below the surface and leaves the stubble nearly undisturbed. Power-Dutton Project. (SCS photo)

Figure 5.—A stubble field after being worked with the Noble Weeder. Note the stubble rows are nearly erect. (SCS photo)
from insects will result.

9. Observations by the SCS at Dutton indicated that the trashy cover was superior to the clod mulch as an erosion control measure.

Other Practices

The period of time in which other practices have been used in this area was not sufficiently long to allow an analysis to be made of them. For a list of the other practices used in the area, refer to the appendix, page 141.

The Effect of Conservation Programs on Farm Organization and Management in the Power-Dutton Area

In this portion of the study, only those farms which were in cooperation with the SCS are considered. There were 17 farms in this group, 15 of which were also under the program of the AAA. The size of the sample obtained for those farms not cooperating with the SCS was not considered large enough to be representative.

No attempt has been made to separate the effects of the individual programs; it is not the purpose of this study to distinguish between the two; furthermore, such a procedure would be nearly impossible.

Crop Production.—The principal crop grown in this area was spring wheat. Changes in wheat production resulting from these programs as given by farmers estimates are shown in table VI. The table shows that wheat acreage has been reduced nearly 30 per cent.
TABLE VI. CHANGES IN WHEAT ACREAGE, YIELD a/ , AND PRODUCTION AS A RESULT OF CONSERVATION PROGRAMS FOR 12 b/ WHEAT FARMS IN THE POWER-DUTTON AREA

<table>
<thead>
<tr>
<th>Period</th>
<th>Acres</th>
<th>Yield per acre</th>
<th>Production (bushels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>After c/</td>
<td>2,862</td>
<td>16.75</td>
<td>47,942</td>
</tr>
<tr>
<td>Before d/</td>
<td>4,015</td>
<td>15.77</td>
<td>63,300</td>
</tr>
</tbody>
</table>

a/ No significance can be placed on yield figures because of the adverse conditions of the last few years.

b/ Of the five remaining farms, figures were not available on two of the farms, and the other three had been increased in size either by buying or renting additional land.

c/ Farmers were asked to give their average crop acreages for the period since they have joined conservation programs.

d/ Farmers were asked to give their average crop acreages for the last few years preceding the time when they joined the conservation programs.

No changes of importance were evident in the acreages of other crops grown in the area. (Note table VII) These figures show that wheat was the principal crop grown in the area and that all other crops were an

TABLE VII. CHANGES IN ACREAGES OF OTHER CROPS GROWN ON 12 WHEAT FARMS AS A RESULT OF CONSERVATION PROGRAMS IN THE POWER-DUTTON AREA

<table>
<thead>
<tr>
<th>Period</th>
<th>Feed crops</th>
<th>Misc. crops</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corn</td>
<td>Oats</td>
<td>Flax</td>
</tr>
<tr>
<td>After</td>
<td>10</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Before</td>
<td>10</td>
<td>50</td>
<td>0</td>
</tr>
</tbody>
</table>
insignificant part of the total acreage.

Accompanying the decrease in wheat acreage, was an increase in the number of acres summer fallowed. The summer fallowed acreage on the farms for the period after conservation programs were in effect was 3,432 compared with 2,490 acres before conservation programs.

There were 1,171 acres of pasture on the farms studied compared to 1,000 acres for the period before conservation programs. The total percentage changes in land use for the 12 farms is shown in figure 6 on the following page.

The significant change in crop production was the decrease in wheat acreage accompanied by an almost corresponding increase in fallowed acreage. It will be observed in figure 6 that wheat and fallow in the before period occupied 55.6 per cent of the total acreage, while the percentage for the after period was 52.8. Little change occurred in acreages of other crops or of pasture.

The decrease in wheat acreage and the increase in fallowed acreage was due more to the influence of the AAA program than to the SCS. The AAA, in addition to being a conservation program, is also a production control program, while the SCS takes acres from production or alters methods of production only as required to prevent soil erosion and to conserve moisture.

The large increase in fallowed acreage has affected a change in crop practice on many of the farms studied. The data below shows the proportion of the land summer fallowed for the period before conservation programs compared with the proportion of summer fallow after conservation
Figure 6.—Land use on 12 farms studied in the Power-Dutton area cooperating with the SCS and AAA as affected by conservation programs.
programs have been introduced:

<table>
<thead>
<tr>
<th>Proportion in Summer Fallow</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/3 fallow</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>1/2 fallow</td>
<td>8</td>
<td>16 a/</td>
</tr>
</tbody>
</table>

2/ On several of the farms the proportion of fallow was more than one-half.

In considering the effect of an increase in fallow and a decrease in wheat acreage on farm organization and management, it is necessary to know the effect on yield, labor distribution, and machinery costs. These can be approximated only. A change in method of farming from the block system to strip fallow occurred at the same time.

The increase in yield reported by farmers was too small to warrant consideration. The years since the conservation programs have been in effect have, for the most part, been years of low rainfall. The problem is to determine the yields that could be expected with rainfall conditions comparable to the period before these changes occurred. 62/

With a decrease in the acreage of wheat following wheat, an increase in yield can be expected. Wheat yields at the North Montana Experiment Station at Havre for 17 years showed wheat after fallow to yield 17.6 bushels compared to yields of 9.3 bushels when wheat followed wheat. 63/

62/ It is probable that yields would have decreased had these practices not been used, thus another problem would be to find the yields had these practices not been used.

This indicates a substantial increase in yield for summer fallow in comparison with wheat after wheat. Assuming these figures for the Power-Dutton area, it can be seen that there is little difference in total production between the one-third fallow and the one-half fallow systems. A Canadian bulletin gives yields from nine Dominion Experimental Farms from 1923 to 1930 in a wheat fallow rotation as averaging 27.4 bushels compared with an average of 23.6 bushels for fallow one year in three. The advantage of fallowing is not as evident in this instance and a greater decrease in the number of bushels produced would occur. In any event the decrease in total production of wheat as a result of changing from the one-third to the one-half fallow system would not be large.

Moreover, there was some saving in costs of operation since summer fallow is less expensive than a similar acreage of wheat, and the summer fallowing was increased while wheat was decreased. This was largely offset, it will be seen later, by the additional costs for strip fallow compared to block farming.

There was the possibility that methods of production might be improved when a smaller acreage of wheat was grown. More time was available

\[\begin{align*}
\text{One-half fallow, one-half crop.} \\
\text{In 6 years: 3 crops, 3 years of fallow} \\
3 \text{ times } 17.6 = 52.8 \text{ bushels}
\end{align*}\]

\[\begin{align*}
\text{One-third fallow, two-thirds crop.} \\
\text{In 6 years: 4 crops, 2 years of fallow} \\
2 \times 17.6 \text{ (on fallow)} = 35.2 \\
2 \times 9.3 \text{ (following wheat)} = 18.6 \\
\text{Total } 53.8 \text{ bushels}
\end{align*}\]

for seeding, and timeliness is an important consideration in seeding. On the larger farms where machinery was barely sufficient to care for the former wheat acreage, this would be an important consideration, and would likely give some increase in yield.

On the other hand, if reduction in number of bushels occurred, fixed costs per bushel would rise. This would be an important consideration on the smaller farms. Such costs as machinery depreciation, taxes, and interest on investment, would be higher per bushel. On some of the smaller farms, if the number of bushels produced were reduced by any appreciable extent, this loss would probably more than balance payments for compliance.

The increase in pasture as a result of the institution of conservation programs was small. There were 1000 acres of pasture on the 12 farms before the programs were put into effect as compared with 1171 acres in 1940. The largest increase in pasture on any farm was 56 acres, while most of the farms showed increases of 10 to 20 acres. Pasture was decreased on one farm because land in pasture was plowed for crop use. The pasture established on the farms was crested wheat grass. Only limited success was experienced with these grass plantings. The increase in pasture did not result in an increase in livestock production on most farms. Little change would be expected in livestock numbers from such a small increase in pasture since it takes about 30 acres per animal unit in Teton County.

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66/ The weather data in the appendix, page 136, shows that moisture conditions during the period were unfavorable to the establishment of the grass.

Livestock.—The changes in livestock as reported by farmers are shown in table VIII. It will be noted that no increase can be attributed to the conservation programs. It appears that pasture can be utilized to supplement the native range on most farms. Although lack of groundwater probably precludes any very extensive development in livestock.

**TABLE VIII. LIVESTOCK ON 17 FARMS IN THE POWER-DUTTON AREA FOR THE PERIOD BEFORE CONSERVATION PROGRAMS WERE IN EFFECT COMPARED WITH JANUARY, 1940**

<table>
<thead>
<tr>
<th>Number of dairy cows a/</th>
<th>Number of farms having the specified number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
</tr>
<tr>
<td>None</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>1</td>
</tr>
</tbody>
</table>

a/ Other livestock in the area was not important enough to list.

production, one or two dairy cattle for each farm to provide products for home use would be an excellent goal unless water must be hauled an excessive distance. In this connection the efforts of the SCS to establish
stock dams are commended since these dams will serve as community water supplies.

**Labor requirements.**—On the farms studied, the important change had been a decrease in wheat, an increase in fallow, with little change in acreage of other crops or of pasture, and little change in livestock. As to farm operations, the change had been general from the block to the strip fallow type of operation. Emphasis has also been placed on the maintenance of a trashy cover, and burning has been prohibited. What was the effect of these changes on labor requirements?

Farmers were asked whether less, the same, or more labor was required now that soil conserving practices were being used on their farms. Their replies are shown.

<table>
<thead>
<tr>
<th>Effect on Labor</th>
<th>Less</th>
<th>Same</th>
<th>More</th>
<th>No answer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of replies</td>
<td>0</td>
<td>11</td>
<td>3</td>
<td>3</td>
<td>17</td>
</tr>
</tbody>
</table>

*a/ This group consisted of the 3 who rented or bought additional land.

More than one-half of the group believed that no change had occurred in labor requirements on their farms. The reduction in labor because of a decrease in wheat acreage was matched, they believed, by an increase in labor required to strip farm. Three farmers reported more labor required on their farms now than formerly. If winter wheat can be grown because wind erosion is now under control, a better distribution of labor will result.

**Fuel Requirements.**—Fuel requirements are dependent upon decreases
resulting from less wheat acreage and more fallowed acreage, and increases resulting from strip fallow in place of block farming. Farmers were asked the total fuel requirements for their farms at the present compared to the period when soil conserving practices were not used. Replies are listed below.

<table>
<thead>
<tr>
<th>Amount required at present</th>
<th>Less</th>
<th>Same</th>
<th>More</th>
<th>No answer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humber</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>17</td>
</tr>
</tbody>
</table>

Opinion was almost exactly divided on the effect of conservation practices on fuel requirements. The conclusion is that farmers believed fuel requirements had not been changed appreciably.

It was not necessary to purchase new machinery to carry out soil conserving practices, although three farmers have recently purchased some new equipment. One farmer bought a one way disk and a rod weeder; a second farmer purchased a rod weeder; while the third acquired a duckfoot cultivator. In every case this equipment was purchased to modernize present equipment and could not be charged to a conservation program.

Farmers were asked if they believed the benefits of the conservation practices were sufficient to justify their use. The answer in every case was yes.

No conclusions could be made on the total cost of establishing the recommended conservation practices to the farmer. Most of the cost was the labor required to help establish some of the practices, while in some cases machinery and some materials were furnished by the farmer.
Farmers were asked if the productivity of their farms had been changed because of the use of soil conservation practices. Replies are shown to the question.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Less</th>
<th>Same</th>
<th>More</th>
<th>No answer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>0</td>
<td>9</td>
<td>6</td>
<td>2</td>
<td>17</td>
</tr>
</tbody>
</table>

More than one-half of the farmers believed the use of these practices had no effect on the productivity of their farms. Of the nine who reported no change, four believed productivity would increase in the future. The four believed that, with years of better rainfall, more moisture would be held in the soil which would tend to increase productivity. There was no evidence that the group believed soil fertility to be increased by the use of conservation practices. Farmers' replies to the question of the future productivity of their farms compared to the present are shown below.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Less</th>
<th>Same</th>
<th>More</th>
<th>No answer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>0</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>17</td>
</tr>
</tbody>
</table>

Of the five who believed future productivity would be higher than the present productivity, four were farmers who did not believe the productivity of their farms had yet increased. The six who believed productivity would continue at the present level, believed all the benefits from moisture conservation had been realized and that no increase would occur in the future. Farmers were generally of the opinion that if

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65/ Productivity is defined as the ability of the soil to produce crops.
productivity in the future was higher, it would be the result of greater rainfall, but that yields had been stabilized by the use of the conservation practices.

When asked the influence of the conservation programs on their net incomes, ten of the farmers said their incomes had been increased, while three said it was unchanged, and four gave no answer. More than one-half of the group believed their net incomes to be increased as a result of following the SCS and AAA programs. Since several of the years when the programs were in effect were years of almost complete crop failure, farm incomes were augmented by the AAA payments. The small loss in number of bushels by reducing wheat acreages and increasing fallow would be more than offset by AAA payments.

The SCS program probably had little effect on net incomes since the cost of establishing the practices to the individual farmer was small, and no increases were shown in any other lines of production. The main effect on incomes was due to the change from block farming to strip fallow. Farmers did not believe strip fallow had increased yields; also, costs of operations were reported to have been increased. These two influences may have temporarily lowered income by a small amount. It is certain that income had become more stabilized since soil fertility was being maintained, whereas with the block fallow system in use, soil fertility would probably have been reduced year by year because of wind erosion.

Another important effect which may result from controlling wind
erosion is a change from spring wheat to winter wheat production. Average yields expected from winter wheat are larger than from spring wheat.

Value of Farm.—It is reasonable to suppose that the programs of soil conservation have had an influence on the value of the farms. Farmers were asked how the value of their farms compared to the value before conservation programs were established. Replies are shown.

<table>
<thead>
<tr>
<th>Effect on Value</th>
<th>Less</th>
<th>Same</th>
<th>More</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of replies</td>
<td>0</td>
<td>4</td>
<td>13</td>
<td>17</td>
</tr>
</tbody>
</table>

Most of the farmers believed the value of their farms had been increased. Some mentioned that while the value had not actually increased, the value of their land would have been reduced considerably had wind erosion continued. Those who reported increases in the value of their land, attributed the increase largely to the establishment of strip fallow and other practices on their farms.

Farmers were quite uncertain of the future value of their land. Five believed the future value would be the same as the present value, four thought the future value would be larger, while eight gave no reply. This would indicate that there was no belief that the effect of these practices is cumulative and that fertility would be increased in the future.

Erosion Control.—The primary purpose of these practices is to control erosion. How well was this being done in the opinion of the farmers? Farmers were asked the influence of all the practices on wind
Most of the farmers believed the problem of soil blowing was well controlled. More than three-fourths of the group said wind erosion had either been greatly reduced or stopped entirely. This was an important conclusion since wind erosion was a serious problem when the SCS project was started in 1935.

The influence of the practices on water erosion was not important. Of the 17 replies, six answered their farms did not wash; eight believed water erosion had been slightly reduced; while three believed water erosion had not been affected.

Summary.—1. The principal changes in crop production as a result of conservation programs in the Power-Dutton area was a decrease of wheat acreage of nearly 29 per cent with an almost comparable increase in summer fallow. Practically all the farms now had 50 per cent or more of the cropland in summer fallow, while this was the case on less than one-half of the farms before conservation programs were introduced.

2. Total bushels of wheat produced will probably not be much smaller than the amount produced before conservation programs, when similar weather conditions give a basis for comparison. Wheat yields will be larger because of the increase in acres fallowed and better methods of
caring for the crop.

3. Fixed costs per bushel were higher, especially on the smaller farms, if the number of bushels produced was less than formerly.

4. Acres of permanent pasture were increased a small amount by the program.

5. No corresponding increase was shown in livestock. Pasture will be used to supplement native range on most farms. Though lack of stock water rules out an extensive livestock development, one or two dairy cows for each farm to furnish products for the home is desirable. Stock water dams built by the SCS will aid in such a development.

6. Little change was apparent in labor or fuel requirements because of conservation programs, according to farmers' reports.

7. New machinery required to carry out soil conservation practices was small in amount.

8. Farmers believed unanimously that the use of the soil conserving practices was justified on their farms.

9. No conclusions were made on the cost of establishing the practices.

10. Farmers did not generally believe the productivity of their farms had been increased or did they expect the productivity to increase in the future.

11. Winter wheat production may be possible in the area now that blowing is being controlled. If this change occurs, a better distribution of labor will result, and a considerable increase in yields may be expected.
13. Farmers as a whole believed the value of their farms was increased by the use of conservation practices.

14. Farmers were not agreed as to the effect of conservation programs on the expected future value of their farms.

15. The conservation practices proved effective in controlling wind erosion while little influence had been noticed on water erosion. Water erosion does not occur to any appreciable extent in the area.

PART III. THE FROID PROJECT

Description of the Area 69/

The Froid Project is located in Roosevelt County in Northeastern Montana, beginning seven miles north of the town of Culbertson. The size of the project is 32,000 acres.

Rainfall.--The climate in this area is semi-arid with a mean rainfall slightly lower than that of the Power-Dutton project. The average precipitation for Culbertson since the establishment of the weather bureau was 11.97 inches, of which slightly less than 62 per cent, or 7.39 inches, fell in the four months of May, June, July, and August. 70/ Precipitation for the last ten years at Culbertson is shown in table IX. The project was begun in the fall of 1936. The years of 1934 and of 1936 were the worst


and the third worst droughts on record. Subsoil moisture was at a low point by the end of 1936. Compared with the all time low of 4.65 inches in 1933, the highest precipitation ever recorded was 22.43 inches for 1905. Extreme fluctuations characterize the precipitation in the area.

Flash rains are quite common on the project. "Records show frequent intense precipitation. Downpours ranging from one-third to one-half inch in 10 minutes are not unusual." 71/ Runoff is rapid following a flash rain and has resulted in gully ing on parts of the project (see figure 7).

The rainfall on the Froid Project is small in amount, extreme variations from year to year can be expected, and quick rains with high runoff are not uncommon.

Temperature.—The average length of the growing season for 26 years of records to 1930 for Culbertson was 117 days. 72/ The characteristics of the temperature are shown in table X. Great extremes are present in temperatures, the average winter temperature is low and the average

71/ Boatright, William C. op. cit. p. 4.

72/ Climatic Summary of the United States. loc. cit. p. 15.
Figure 7.--Flash rains in the Froid area often flood roads, cause gullies to form in fields. (SCS photo)
summer temperature quite high. In this respect the project does not differ appreciably from the Power-Dutton project.

Wind.—In contrast to the Power-Dutton project with a prevailing wind direction, there is apparently no prevailing direction for wind movements in the Froid area. "The question of prevailing wind is a debatable one...the most disastrous winds from a soil blowing standpoint come from the northwest, but nearly equally devastating winds come from the north, from the west, and from the south." 73/ The fact that no prevailing wind can be expected must be taken into consideration in attempting wind erosion control.

Topography.—The Froid area was surveyed by detailed methods in 1936. This survey showed the acres of land in the different slope classes. (see table XI.) The slope on nearly one-half of the area is subject to water erosion if cultivated. Water erosion, while somewhat of a problem,
TABLE XI. ACRES OF LAND IN DIFFERENT SLOPE CLASSES ON THE FROID AREA, ACCORDING TO A SURVEY IN 1936 a/.

<table>
<thead>
<tr>
<th>Slope class b/</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Urban</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres in each</td>
<td>16,173.8</td>
<td>13,412.8</td>
<td>222.8</td>
<td>666</td>
<td>843.6</td>
<td>31,940.8</td>
</tr>
</tbody>
</table>

a/ Source: Boatright, William C. op. cit. p. 28.

b/ A slope. Nearly level with little water erosion. Under 3 per cent slope. B slope. Slopes that erode under cultivation. Three to 9 per cent. C slope. Slopes suitable for close growing crops if cover is maintained throughout the year. Nine to 15 per cent. D slope. Slopes too steep for cultivation. Suited to permanent cover. More than 15 per cent.

is much less serious than wind erosion, however.

The soils in the Froid Project are in a belt of dark grayish brown soils. Large amounts of organic matter occur in the surface soil with carbonates occurring at lower depths. These soils developed from glacial drifts, either being deposited in place or being carried from the glacier and redeposited. Various types of the Williams series are the principal soils in the area.

The Williams loam and the Williams fine sandy loam together occupy nearly 90 per cent of the land area of the project. These soils are moderately deep, dark at the surface, and have compact but friable subsoils. They occur on gently rolling areas and are among some of the most productive small grain soils in the area. Some of the other soils in the area are lighter and more subject to wind erosion than the soils.
of the Williams series.

Economic Characteristics of the Area.—The average size of farm in the Froid area has been given as 399 acres. Tenancy is high in the area, only about 45 per cent of the farms being owner-operated. Financially, the farmers in this area are not well off. Roosevelt County was included in the group of Montana counties that had 55 per cent or more of land delinquent in current tax levies at the beginning of 1934.

The sale of crops makes up the principal part of the income, though livestock is much more important than in the Power-Dutton area. Stock water is not usually a problem in the Froid area.

Spring wheat is the principal crop. Generally, wheat of high quality is produced. Oats are the next crop in importance, though corn and sorghums are used to a considerable extent as a substitute for fallow and to furnish feed for livestock. Barley and rye are used as feed crops or temporary pasture.

Crop yields are not high, and are subject to great variations due to fluctuations in rainfall. Average wheat yields per seeded acre for Roosevelt County from 1919 to 1934 were 9.0 bushels. In 1934

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75/ Boatright, William G. op. cit. p. 6.
78/ Starch, E. A. op. cit. Table 2, p. 8. (from AAA data).
the acreage of harvested cropland was 133,626 acres compared with 183,574 acres of failure. This year was the worst drought on record but low incomes as a result of drought are not unusual.

Livestock in the area, according to a project survey, showed the average number of livestock on each farm in 1935 to consist of 13 cattle, 5 hogs, 59 head of poultry, and 4.6 horses and work stock. The sale of cream constitutes the principal source of livestock income, though some of the operators raise beef cattle.

Farming Systems.—The farming system consists of wheat and livestock. The farmers are not well equipped with modern tillage machinery, although most of the farm work is done with tractors. Duckfoot cultivators and rod weeder are uncommon on the project. Fallowing was practically discontinued in the early 1930's because of serious wind erosion. If land is left without crop, it is quite commonly left idle rather than being fallowed. Row crops have been substituted for fallow to a considerable extent in the area.

Fallowing is usually done each spring, the drill being pulled behind the plow and the tillage and seeding operations accomplished at the same time.

In summary, the size of the farms average about 400 acres, more than one-half of the farms are operated by tenants, and crop income is


80/ Boatright, William G. op. cit. p. 10.
more important than livestock income. Crop yields are low and crop failures not uncommon. Wheat is the principal crop, with other crops being raised to feed livestock. Fallowing is not practiced to any appreciable extent because of the susceptibility of fallow to wind erosion. Few tools to work fallow are available on the farms; most farmers are equipped with tractors and use the mould board plow each spring.

**Work Program of the Froid Demonstration Area**

With the advice of the State Planning Board, the Montana Agricultural Experiment Station, and the Montana Extension Service, an area of 32,000 acres was selected for survey by detailed methods in 1936. The Froid demonstration area was established on this location after the survey was completed. The area was believed to be representative of soil and erosion conditions in Roosevelt and neighboring counties. It was an area in which severe wind erosion was taking place.

The emphasis on this project was to prevent erosion by contour tillage and other means, and to establish buffer strips between the contour strips to eliminate irregularities. The buffer strips and other acreages retired to grass were to furnish hay and some pasture for livestock. The effort was to be made to establish a diversified type of agriculture.

Contour tillage with grass buffers was to be used on nearly all the cultivated land. With the buffer strips and the retirement of

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cropland to grass, reduction in cropland of approximately one-third was hoped to be accomplished. Some straight strips for wind erosion control were to be used when the slope did not warrant contouring.

Emergency tillage practices such as listing were necessary in some years to help prevent blowing. Burning of stubble was prohibited in the contracts.

Trees and shrubs were to be used to some extent to provide wind-breaks. Several rows of shrubs were to be planted along the sides of fields in some cases to reduce wind velocities. Field hedges in the center of the crop strip or along the edges of buffer strips were to be experimented with.

Stock dams or reservoirs were to be built on a number of farms as a part of the plan to allow livestock to be raised. Flood irrigation systems were to be installed on some farms to provide supplemental livestock feed, for gardens, or for other purposes.

Terraces were to be used on cropland retired to grass when the slope of the land justified such structures. In some cases, cropland was to be terraced. Pasture furrows were also to be experimented with, and check dams were to be used to aid in gully control.

**General Consideration of Erosion in the Area**

Wind erosion was a serious problem in the area according to interviews with 22 farmers. Of the entire group, twenty believed that erosion was a serious problem on their farms, while two did not consider
Wind erosion was the most important type of erosion affecting their farms, the farmers said, but water erosion was something of a problem also. In the group, 21 believed that wind erosion was the most serious type of erosion, while one considered neither wind nor water erosion to be serious. Several mentioned severe dust storms and one farmer told of sleeping with a damp cloth over his face at night to keep from breathing the dust. (See figures 7 and 8.)

Water erosion presented problems on many of the farms because of the steepness of the slopes and the flash nature of the rains. Of the group, 17 mentioned that soil losses from water erosion were sometimes observable.

Blowing has been evident in the area for several years, farmers said. Although most of the group had not noticed blowing before 1930, one farmer said that he had seen dust blowing on his farm as early as 1913. Blowing was an acute problem by 1935 following the severe drought of 1934 according to the farmers. The fact that blowing has been observed comparatively recently indicated that wind erosion was a new problem in the area.

More than one-half of the farmers who were interviewed believed a considerable amount of soil had been blown from their farms. When asked, do you think much soil has been lost from your farm?, 12 farmers replied in the affirmative, nine answered no, while one gave no reply. This indicated that erosion was important in causing soil loss in the area.
Figure 8.—A dust storm in the Froid area, 1936. (SCS photo)

Figure 9.—Severe wind erosion in the Froid area has piled soil deep in this fence row. (SCS photo)
Though soil losses on over one-half of the farms were thought to be considerable, farmers generally did not believe that erosion had reduced yields. Several mentioned that in spite of blowing crop yields were as high as ever. Replies as to the effect of blowing on crop yields are shown:

<table>
<thead>
<tr>
<th>Effect</th>
<th>Decrease in Yield</th>
<th>No Effect</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of replies</td>
<td>7</td>
<td>15</td>
<td>22</td>
</tr>
</tbody>
</table>

The farmers who believed yields were decreased by soil losses, said that fertility had been lost from the soil.

The most common early method used to control wind erosion was the use of the duckfoot cultivator. Eight of the farmers reported use of this implement as the first attempt to control blowing. Most of the cultivators were not purchased until after 1930, only three being used before that time. Some farmers told of spreading straw or manure on the blow spots in an effort to control wind erosion. As a partial control effort, many farmers abandoned use of the summer fallow. Farmers reported that serious wind erosion caused the use of the summer fallow to be stopped almost entirely. In some cases feed crops such as cane or corn were substituted in place of the fallow.

Summary.—1. Farmers were practically unanimous in agreeing that wind erosion was a serious problem in the area.

2. Water erosion presented problems on many of the farms studied.

3. Blowing has been especially noticeable in the last few years, although some farmers reported blowing before 1920 in the area.
4. Over one-half of the farmers believed a considerable amount of soil had been lost from their farms.

5. The majority of the group did not believe that crop yields had been affected by soil losses.

6. The use of the duckfoot cultivator was the first method used to reduce soil blowing. Most of the duckfoot cultivators have come into use since 1930. Only eight of the farmers reported the use of this implement.

7. Summer fallowing was generally discontinued and in some cases cane or corn was substituted in its place, after wind damage became serious.

**Contour Strip Cropping on the Froid Project**

Contour strip cropping is one of the most important practices in the SCS program on the Froid Project. Contour strip cropping refers to the production of crops in strips of varying widths, with the strips running crosswise to the line of slope and approximately on the contour. Grass buffer strips are planted in the irregularities between the strips to allow the crop strips to be practically the same width for the entire length (see figure 10). Contour strip cropping is used in the area primarily as a wind erosion and moisture conservation practice. It has been mentioned that there is no prevailing wind in the Froid area. Although most damaging winds come from the northwest, serious blowing may come from the north, west, south, or east. It is for this reason that contour strips which change direction as the slope changes are believed by some persons
Figure 10.—An airplane view of a portion of the Froid Project showing both contour and straight strips. Note the round end strips which have been seeded to grass. (SCS photo)
to be more effective in control of wind erosion than straight strips which run in one direction only.

The buffer strips, placed between each crop strip in eight foot widths, are widened as necessary to reduce irregularities in the crop strips. In addition to this function, buffer strips also provide some protection from soil loss by reducing water runoff and aiding in wind erosion control.

Contour stripping was used on 15 of the farms studied. A total of 5,292 acres were in contour strips of which 4,124 acres were in crop strips, and 1,168 acres in grass buffers.

Contouring was begun on the project in 1936; however, farmers reported that most contour strips were established in 1937. Three of the farmers began contouring in 1936, and two in 1939. Contour stripping has been used only a short time, and information covering a longer period of time will be necessary before definite conclusions can be drawn.

There was no original cost of establishing the strips according to 15 of the farmers interviewed. Three believed there was some cost. As far as the actual strips were concerned, lines were surveyed by the SCS. Contour strips were not found on any of the farms not cooperating with the SCS. The drilling expense of the buffer strips and in some cases the furnishing of materials for the relocated fences were the costs to the farmer for establishing the strips. The seed for the buffer strips and the labor to build the fences were provided by the SCS. The principal cost of establishing the contour strips was the cost of
drilling the grass buffers which will be considered later.

None of the group interviewed attributed any upkeep cost to maintaining the strips.

Fuel and labor requirements, the farmers believed, were definitely increased by contour stripping. Replies to the amount of fuel required on contour strips compared to block farming are shown:

<table>
<thead>
<tr>
<th>Fuel required</th>
<th>Less</th>
<th>Same</th>
<th>More</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of replies</td>
<td>1</td>
<td>3</td>
<td>12</td>
<td>16 a/</td>
</tr>
</tbody>
</table>

a/ Two of the group farmed with horses. One believed that the draft was lighter when farming on the contour. The other believed the amount of work required was greater on the contour strips.

It will be observed that one member of the group believed less fuel was required on the contour strips than in block farming. This farmer was of the opinion that the fuel consumed in going from one strip to another was more than offset by going faster on the contour strips. The three farmers who believed fuel requirements were practically the same were of the opinion that losses in stripping were about equal to the fuel saved by travelling on the level rather than more up and down the slope.

The majority of the group, however, believed more fuel was required on the contour strips. The reasons given for the additional fuel required were principally the same as in straight stripping—that each strip must be finished up and usually an extra half round at less than full machinery capacity was required. This tendency was considerably more pronounced
on the contour strips, farmers reported, since in many cases fields were reduced to much smaller sizes and were more irregular than the straight strips.

There was also the necessity of moving from one strip to another, which involved more labor than moving from one straight strip to another, since the ends of adjacent contour strips were often a considerable distance apart because of variations in slope.

In plowing the contour strips, the usual practice was to begin in the center of the strip, throwing the first furrows of the two half rounds together. It was necessary to make several rounds before the width of the plowed strip was sufficient to permit turning across the end without making a loop in the turn. The smaller tractors were more flexible and turned shorter, though not many of the farmers owned tractors of this type.

Formerly when the land was handled in large blocks $\frac{31}{1}$ and plowing was begun on the outside of the land, the extra turning involved in beginning each strip was eliminated. It was necessary to plow out the corners of the lands which would offset some of the advantages of block plowing.

A practice has been developed in the Froid area which will overcome some of the disadvantages of contour stripping but which would involve other difficulties referred to later. This practice, an inside grass

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$\frac{31}{1}$ Lands varied in size from 30 acres to 160 acres or more before stripping, while the strips were mostly 8-10 rods in width.
buffer strip, is an oval shaped grass strip near the center of the crop strip. The inside grass buffer and the round end buffer on the ends of the strip, eliminate the many turns in the center of each strip.

Farmers also reported that the plow tended to slide downhill when operating, with the result that a fuller width was taken on the half of the round when the furrow slice was thrown uphill than was the case on the other half of the round. The result was that the lower half of the land was completed first, and that an extra half round or more was required to complete the upper portion of the land. This difficulty can be partially eliminated by laying out the plowing so that the lower half of the strip was wider than the upper half. With the inside grass buffer strip this method would not prove successful when the direction of plowing was reversed. Another solution was putting an attachment on the drawbar of the tractor to regulate the width taken by the plow. 62/

Differences in labor requirements on contour strips were similar to differences in fuel requirements as reported by farmers. Sixteen out of 18 farmers believed that contour stripping required more time. One farmer thought the same labor was required and one believed less was required.

Contour striping in this area was one of the methods used to reduce wind erosion. How well did farmers believe wind erosion was being controlled? Replies to the influence of contour strip cropping on wind erosion report:

erosion are shown below.

Effect: Slightly Reduced  Greatly Reduced  Stopped  Total
No. of replies: 3  5  10  18

The results of the survey indicated that contour stripping has been very effective in accomplishing wind erosion control. Though several farmers mentioned that no real test had occurred yet in the form of intense wind blowing, most of the farmers were of the opinion that wind erosion would not be damaging regardless of the severity of the blowing.

Several in the group mentioned that contour stripping was not as effective as straight stripping in control of wind erosion, since in some cases contour strips ran in the same direction as the most severe wind—this was undoubtedly the case on certain slopes, though it has been mentioned that there was no prevailing wind in the area.

The group was not positive as to the influence of contour stripping on water erosion. Replies to this question are listed below.

Effect: Not Reduced  Slightly Red.  Greatly Red.  Stopped  No. ans.  Total
No. of replies: 3  6  5  3  1  16

The opinion of the farmers of yields in the future compared to present yields is shown:
Future Yields  | Same as Present | Increased | No reply | Total
---|---|---|---|---
No. of replies | 5 | 10 | 3 | 18

More farmers anticipated increased yields in the future than have observed them at present.

The subject of buffer strips will be considered. The purposes of the buffer strip, as previously mentioned, are to take up irregularities in slope, and to aid in erosion control and moisture conservation.

On the farms studied, buffer strips occupied 1,768 acres compared with 4,124 acres in crop strips. The reduction in cropped acres for the average field was nearly 50 per cent.

There was a small cost to the farmer in getting the stands of grass started. The SCS provided the seed and the drill, and the farmer furnished the power. It usually took about two years, the farmers said, to get the stand of grass established. This caused a loss of the use of the land in buffer strips for two crops. All of the farmers interviewed were cooperating with the AAA program. There was idle land taken from crop production on each farm and the buffer strips were considered as idle. Thus no crop would have been grown on the land during that period if buffer strips had not been established. The AAA program served an important part in the establishment of the buffer strips.

The cost of seeding the grass is discussed in the section on vegetative cover, page 100. The early seedings on the project were mixtures of crested wheat grass, western wheat grass, and sweet clover. The strips were largely crested wheat grass after they became established.
Most of the farmers utilized the grass in the strips for hay, while some made additional use of it as late fall pasture. Farmers reported there was some waste in putting up the hay, because it was sometimes impossible to get the mower into the narrower strips. (The hay must be cut before the wheat is harvested.) Part of the hay was not cut and therefore this portion was not usually utilized. Though farmers could likely cut more of the crop if they would take the necessary trouble, this factor was a disadvantage. Also a considerable amount of labor was required to haul the hay, since the operator had to collect the hay on strips located at various places on the farm. This was more of an inconvenience than an added expense.

It was impossible to determine the return per acre on the land in buffer strips since farmers did not know how much of their strips had been cut, and some did not report the yields of the hay. If a yield of two-thirds ton per acre were assumed \( \text{\$2/} \) and a value per ton to the farmer of \( \text{\$7.00 \$4/} \), the return per acre would be approximately \( \text{\$4.67} \). If wheat yields averaged nine bushels per acre, and a price of \( \text{\$2.00} \) per bushel were assumed, the use of the buffer strips would result in only a small loss once the strips were established. Furthermore, some farmers said that the poorer land was taken from production by the buffer strips so that crop yields on the land retired would not be as large as the average.

\( \text{\$2/} \) For the yield reported by farmers, refer to appendix, page 137.

\( \text{\$4/} \) Farmers estimated the hay was worth an average of \( \text{\$7.25 per ton} \) for use on their farms.
yields. An added consideration reported by some farmers was that contour strips with buffer strips were more effective in controlling wind and water erosion than were strips without the buffers.

On the other hand, buffer strips provided harboring places for insects, farmers said, and there was a tendency for the sweet clover in the buffer strips to spread into the crop strips and intermingle with the wheat.

Farmers were asked their opinion of the influence of contour strip cropping on the value of their land. Replies are shown.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Less valuable</th>
<th>Same</th>
<th>More</th>
<th>No reply</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>1</td>
<td>5</td>
<td>11</td>
<td>1</td>
<td>18</td>
</tr>
</tbody>
</table>

More than one-half of the group believed contour stripping with buffers had increased the value of the land as a result of controlling wind erosion. Farmers generally believed that the value of their land had been increased because of contour stripping, though several mentioned that straight strips would have functioned as well.

The SCS was responsible for the establishment of practically all the contour strips. Of the 18 in the group, only one said he would have tried contour stripping if Government help had not been available.

The costs involved and the benefits farmers derived from contour stripping have been discussed. The important question now is: will this new practice become a permanent part of the Farmer's system of operation? Thirteen farmers said they intended to maintain the contour
strips on their farms. Five will change from contour strips to straight strips. The indications were that the majority of the group would wait several years to see the results of contouring.

Farmers gave a number of objections to contour stripping with buffer strips. Several of these have already been considered—added costs of farm operations; more insect damage especially with buffer strips; the spreading of sweet clover into the crop strips; and the difficulty of harvesting the buffer strips. Other objections mentioned were:

1. More difficult to plow on the contour since the wheel of the tractor was not kept in the furrow as in straight plowing; instead the tractor had to be guided so the proper width was plowed. The same consideration was true with horses.

2. A serious objection several farmers had to the practice was that there was almost no possibility of a rotation. By seeding a large acreage of cropland to grass buffers, it became necessary for the farmer to crop the remainder of the land year after year, and on many of the farms there was no possibility of the use of fallow. If buffer strips were to be plowed up and used as a part of the rotation, such a procedure would involve the relocating of contour lines and would be unsatisfactory. Several farmers said they would prefer straight strips with part of the strips in grass, and include these in a long time rotation. If a rotation were to be used including a grass crop or fallow, it would be necessary to enlarge the size of the farming unit or to retire less cropland.

3. Another criticism was the contouring of fields of very small
slopes. One farmer did not cooperate with the SCS because it would have been necessary for all his land to be contoured. Much of his land was level, he said, and in his opinion contouring was not necessary.

3. Some farmers said that so much cropland had been retired on their farms that sufficient acreage was not left to raise crops.

Summary.—1. When technical help was available there was little actual cost in establishing the contour strips.

2. The AAA payments for taking land from production were important in establishing the contour strips with grass buffers since the grass buffers were sown on land which would have been idle under the AAA program.

3. Farmers reported that fuel and labor requirements were increased by the use of contour strips. Many believed it was more expensive to farm contour strips than straight strips.

4. The contour strips have been effective in controlling wind erosion, though some of the farmers believed straight strips would have been as effective.

5. Farmers believed water erosion had been reduced and over one-half of the group believed the moisture content of the soil was increased by contour strip cropping.

6. Farmers generally did not report increased yields from contour stripping though more than one-half of the group anticipated benefits in the future. Farmers did not believe they had been repaid in the form of larger yields for the additional operating costs on the contour strips compared with straight strips.
7. Farmers utilized the buffer strips for hay and, although there were several minor difficulties reported from the use of the buffers, the loss in income from the use of the buffers was not large.

8. Farmers generally reported the value of the land was increased by contour stripping with buffers.

9. Practically no contour strips would have been established without Government help.

10. Most of the farmers intended to give contour stripping an opportunity to prove its value.

11. The most important objection to contour stripping with grass buffers was the small opportunity of establishing a crop rotation including grass or summer fallow.

Straight Strip Cropping on the Froid Project

Straight strip cropping in the Froid area was different from the system used in the Power-Dutton area in that intertilled crops were usually substituted for fallow in the Froid area. Buffer strips were also used on a few of the straight strips in the Froid area. Straight strips in the Froid area were similar in other respects to those used in the Power-Dutton area.

There were 4,102 acres of straight strips on 14 of the farms studied in the Froid area. On half of the farms, strips were started in 1937, while they were begun on four farms before 1937, and on three farms after that year.
Most of the farmers reported no cost in establishing the strips since the lines were laid out by the SCS.

The farmers believed more fuel and labor were required on the stripped fields than on the blocked fields.

Fuel required on stripped land compared to block.  Labor required.

<table>
<thead>
<tr>
<th></th>
<th>Fuel</th>
<th>Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>More</td>
<td>13</td>
<td>13</td>
</tr>
</tbody>
</table>

Before strip cropping was begun, lands varied in size from 50 acres to 160 acres or more. After strips were established, fields varied in width from two to 20 rods, with the most common width being 10 rods.

The group believed straight stripping was very effective in controlling wind erosion but had little influence on water erosion.

<table>
<thead>
<tr>
<th>Effect on wind erosion</th>
<th>Effect on water erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not reduced</td>
<td>0</td>
</tr>
<tr>
<td>Slightly reduced</td>
<td>0</td>
</tr>
<tr>
<td>Greatly reduced</td>
<td>5</td>
</tr>
<tr>
<td>Stopped</td>
<td>8</td>
</tr>
<tr>
<td>No answer</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
</tr>
</tbody>
</table>

The group did not believe that straight stripping had much influence on the moisture content of the soil or upon yields of crops, answering no effect to both questions. About one-half of the group believed future yields would be increased, principally because more
favorable climatic conditions were expected.

Buffer strips were used with straight strips on three of the farms studied. The use of buffer strips was considered in the study of contour strip cropping.

Twelve in the group believed they would have begun straight stripping without government help, while one said he would not have, and one gave no reply. The entire group intended to continue straight stripping as a permanent part of their farming system.

In summary, the farmers believed that straight strip cropping was proving as effective as contour strip cropping in wind erosion control, the primary erosion problem in the area. The contour strips, according to the farmers, were much more effective in curbing water erosion and in increasing the moisture content of the soil. It remains to be seen whether contour stripping possesses advantages in higher yields over straight stripping.

**Crop Residues on the Froid Project**

In the Froid area the most common method of handling crop residues was to plow under the stubble in the spring, following this operation with the drill. Often plowing and drilling were done in a single operation, the drill being pulled behind the plow. Summer fallowing was not practiced to a very large extent; the use of fallow was quite generally abandoned after wind erosion became a serious hazard. Wheat was usually planted following wheat, or after feed crops of corn or cane which were substituted
for fallow.

Modern tillage implements such as the duckfoot cultivator or the rod weeder were not used to a very large extent in this area. Trash was usually plowed under instead of being left on the surface. However, the ground was not left unprotected for a very long period, since immediately following plowing the crop was planted.

The use of tillage implements to maintain a trashy cover in the Power-Dutton area was in contrast to the practice followed in the Froid area.

The entire group interviewed on the Froid project believed that strip fallow and the saving of crop residue were both necessary to control blowing. Burning of stubble was not practiced by any of the group unless the growth was too heavy to permit handling in any other manner. The group believed burning was an important factor in causing wind erosion. They were also quite certain that burning had a tendency to decrease soil moisture. Farmers' opinion of the influence of crop residue on soil moisture is shown:

<table>
<thead>
<tr>
<th>Effect</th>
<th>No effect</th>
<th>Slightly increased</th>
<th>Greatly increased</th>
<th>No. ans.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>2</td>
<td>19</td>
<td>1</td>
<td>1</td>
<td>23</td>
</tr>
</tbody>
</table>

The group believed that incorporating crop residue into the soil acted as a mulch, and also made the soil more absorptive.

The group believed that saving crop residue rather than burning it tended to increase yields. Replies to this question are shown.
Effect of Residue on Yields

<table>
<thead>
<tr>
<th>Effect</th>
<th>Less</th>
<th>Same</th>
<th>Increased</th>
<th>No ans.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>2</td>
<td>2</td>
<td>17</td>
<td>2</td>
<td>23</td>
</tr>
</tbody>
</table>

The opinion of several of the group was that burning increased yields immediately, but that over a period of years yields were reduced since the soil was depleted of plant nutrients by burning.

Leaving crop residue on the ground involved more labor than burning according to the majority of the farmers. Fourteen in the group believed more labor was required when burning was not practiced, while six believed less labor was necessary. Two thought labor requirements were the same in each case while one gave no answer. When the plow could go through the stubble at no reduction in speed, there was little extra labor involved in plowing the stubble under.

The opinion of the group was evenly divided as to the effect of crop residue on insects. Eleven believed insects were increased by incorporating crop residue in the ground; eleven believed crop residue had no influence on insects, while one gave no reply. The possibility of insect damage, according to farmers' replies in each area, was not as likely in the Froid area as in the Power-Dutton area. This suggested that trashy cover might cause insect hazards that were not present when the stubble was plowed under.

Summary. In this area the most common method of caring for crop residues was to plow in the spring. This method was in contrast to the use of the trashy cover in the Power-Dutton area which was maintained.
by such implements as the duckfoot cultivator and the rod weeder. Fallow
was not used to an appreciable extent in the Froil area, and this made
necessary the getting rid of stubble so the next crop could be sown.

2. The group believed that strip cropping and the retention of
crop residues were both necessary to prevent blowing. Burning was
considered a harmful practice from the soil blowing standpoint.

3. The group believed that crop residues increased soil moisture,
and that yields were increased by the saving of crop residues.

4. Farmers believed the handling of crop residues without resort
to burning involved more labor.

5. The group was not agreed as to the influence of crop residues
on insects.

Permanent Vegetative Cover

On the farms studied, all acres of cropland were retired to grass
in addition to the acreage in buffer strips. An average of about 50 acres per
farm was retired on 16 farms. The smallest amount retired on any farm
was eight acres, and the largest amount was 105 acres.

Most of the farmers reported the grass plantings were begun in
1937. Nearly one-half of the planting was begun in that year, while the
remainder was planted in 1938 or 1939. The grass used for permanent
cover was usually crested wheat sown in the fall with a deep furrow drill.

The SCS usually furnished the seed and the drill for planting,
while the farmer provided the labor and power to seed the grass. Farmers
estimated this cost to be about 40¢ per acre for labor, fuel, and machinery costs. With crested wheat grass seed now selling for from 10¢ to 15¢ per pound and about four pounds of seed required per acre, it can be seen that the cost of seeding the grass would not be large even if the farmer bore all of the cost.

About one-half of the farmers said that land of average productivity had been used for the grass retirement. In the other half of the cases, rough land or land otherwise poorly adapted to crop production, was retired. This was a desirable method of retirement from the standpoint of farm production.

Most of the farmers in the project used the grass acreage for pasture, though some used it for hay. Of the 16 interviewed, 12 of the group used the grass for pasture, three for hay, while one farmer used it for both hay and pasture.

Sufficient time had not elapsed to determine the economic returns received from the grass. The year 1939 was the first crop for many of the farms, and the rain for June of that year was above normal and came so that little runoff occurred. The returns for 1939 could not be considered representative. However, many of the farmers believed the grass was more valuable to them than the grain crop would have been. This was probably true, since pasture was the limiting factor in livestock production for many of the farms in the area. Most of the farmers were able to utilize the pasture for livestock. One farmer said this grass

Refer to appendix table A, page 137, for yield.
pasture enabled him to keep a few dairy cows which provided milk and butter for the home, and enough cream to pay for groceries. Though it would be difficult to put a money value on the pasture for this farm, it can be seen that the pasture was an asset.

The help provided by the SCS was the principal reason given by farmers for establishing the grass acreage. Ten farmers in the group would not have retired the land without government help, while six believed such assistance was unnecessary. The AAA program also had an effect in getting the practice started. As one farmer said, "The AAA gave me a lot of idle land, and the SCS wanted me to put in grass, which I did on the idle land." The entire group expected to leave the grass acreage permanently.

In some of the pastures, terraces were built by the SCS for the prevention of water erosion and the reduction of runoff. All 10 of the farmers on whose farms terraces had been built said these terraces had prevented runoff. This fact should be important in increasing the moisture content of the soil and ultimately increasing the growth of grass. All of the farmers believed that water erosion was reduced because of the establishment of the terraces, and that terraces were necessary on the land.

Farmers objected to the unevenness of the land caused by terracing.

Summary.--1. The average number of acres retired per farm (exclusive of the buffer strips) was 50 with eight acres being the smallest amount retired on any farm, and 105 acres the largest amount.
2. The cost to the farmer for seeding the grass was the power necessary to pull the drill.

3. Average wheat ground was retired in about half of the cases reported by farmers, while in the other half of the cases, land of less than average productivity was retired.

4. The retired land was commonly used for pasture, though in a few cases it was used as hay.

5. Though it was too soon to determine the returns that can be expected from the land, farmers generally believed the land was more valuable than when in crop production. There was a shortage of summer pasture on several of the farms studied.

6. Most of the farmers would not have established permanent pastures without Government help.

7. Terraces on pastures were proving successful on the project.

Water Facilities in the Froid Area

As a part of the program to increase livestock in this area the SCS constructed various types of storage dams for stock water purposes. The dams were of two general types—the dug-out type and the dam type. The dug-out type of structure was constructed quite simply and cheaply by scooping out a quantity of dirt in the proper location, and piling the dirt on the downstream side of the scooped-out hole to serve as a dam.

The dam type of reservoir was built by constructing a dam across
a draw in the correct location. Costs of construction were considerably higher on the dam type of structure than on the dug-out type.

Reservoirs were built on 14 of the farms studied in this area. Twenty reservoirs were reported on these farms, of which 13 were of the dug-out type, and six were of the dam type, while one was not classified. Most of the dams were built in 1939 so that the time they had been in use was very short. A part of the construction was done in 1938, and a part in 1937, though over one-half of the reservoirs were built in 1939.

The SCS built the reservoirs in all cases, so the cost to the individual farmer was very small. One individual reported a cost on one reservoir of about $10 for fencing material.

The reservoirs were used to provide stock water and were usually located in pastures. Farmers were asked the influence of the stock reservoirs on the value of their pastures. Most of the replies were based on the convenience of having water in pastures. In some cases it saved the farmer the labor of pumping water, and it assured a more adequate supply of water. In a few instances it made possible the utilization of the pasture, since without water the pasture could not have been used.

Of the 14 operators who were interviewed, three believed the reservoirs had no influence on the value of their pastures, while 11 believed the value of the pasture was increased. The farmer's valuation of the reservoir depended almost entirely upon the circumstances peculiar to the water supply and pastures on his farm.

Farmers did not believe these structures had much influence on
water erosion. Many of the group said that washing had not occurred in
the drained area formerly. In two cases farmers reported that water
erosion had been reduced.

The help of the SCS was the most important reason given by farmers
for the establishment of reservoirs on their farms. Of the group of 14,
only two believed they would have built the reservoirs without Government
help.

Several farmers reported that wildlife was being increased by
the presence of the ponds. Some farmers mentioned seeing ducks on the
reservoirs.

Summary.--1. Reservoirs for stock water purposes used in the
Froid area were of two general types—the dug-out type, and the dam type.

2. Reservoirs were useful in providing stock water on many of
the farms.

3. Farmers reported practically no cost in getting the reservoirs
built, the SCS doing the construction work.

4. Farmers generally believed that stock water reservoirs were
useful on their farms and that the value of their pastures was increased
by these structures. Several farmers mentioned special approval of the
serviceability and economy of the dug-out type of reservoir.

Diversioa Ditches for Flood Irrigation

Flood irrigation systems have been built on seven of the farms
studied in the Froid area. The systems were constructed by the SCS with
little cost to the farmer. Two of the systems were built in 1937, three in 1938, and two in 1939; they have not been in operation for a sufficient time to determine the upkeep costs that will be required. Most of the farmers believed labor would be necessary to repair the dikes.

The amount of land irrigated by these systems on the seven farms averaged slightly more than eight acres per farm, with one farm having only one acre and one farm having 27 acres under irrigation.

The farmers were generally agreed that the flood irrigation systems had increased the assurance of a feed supply in dry years. The land under irrigation was used to grow alfalfa in some cases.

Most of the group were of the opinion that the flood irrigation system had no influence on water erosion. Some farmers objected that top soil from land that was to be irrigated was taken to build dikes.

Most extensive research must be done before any recommendations of the practicability of flood irrigation in the area can be made. An amount of irrigated land to provide a garden for each farm when practical from the standpoint of slope and drainage would be a worthwhile goal.

**Contour Furrows**

Contour furrows are furrows on the approximate contour, usually in a pasture, for the purpose of decreasing water runoff, thereby reducing soil erosion and increasing the moisture supply in the soil.

The lines the furrows are to follow are first laid out, after which the furrows are plowed. The SCS constructed the furrows on the
farms of their cooperators; therefore, there was no original cost to the farmers.

Contour furrows were used on seven of the farms studied. The acreage of pasture that was furrowed on six of the farms was 141, while the figure was not obtained for the other farm. On four of the farms studied, the practice was started in 1937; two were begun in 1938; and one in 1939.

Farmers were asked the effect of pasture furrows on water runoff. The replies are shown:

<table>
<thead>
<tr>
<th>Effect</th>
<th>No effect</th>
<th>Retarded</th>
<th>Prevented</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

Farmers were of the opinion that pasture furrows reduced runoff considerably. It was pointed out by one farmer that contour furrows also held snow to some extent.

The replies of the group concerning the influence of pasture furrows on growth and carrying capacity are shown:

<table>
<thead>
<tr>
<th>Effect</th>
<th>None</th>
<th>Increase</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of replies</td>
<td>6</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

Farmers had not yet noticed a beneficial influence on grass growth as a result of the pasture furrows, though, as noted before, farmers believed runoff was reduced by the furrows.

Four of the group expected beneficial effects in the future,
while three believed the growth of grass would not be influenced.

Objections listed to this practice by farmers were mostly concerned with the inconvenience of the pasture furrows. Several mentioned they could not drive their cars after the cows though this did not appear to be a very crucial objection. Some mentioned that Russian Thistles collected on the furrows.

Summary.—1. Pasture furrows were used on seven of the farms studied. The furrowed acreage for six of the farms was 141.
   2. Farmers believed the furrows were decreasing water runoff.
   3. Farmers did not believe the growth or the carrying capacity of the grass had been increased by the pasture furrows, though some expected benefits to be realized in the future.
   4. Inconvenience was the most common criticism of pasture furrows.

Effect on Farm Organization and Management in the Froid Area

It is the purpose of this portion of the study to consider the changes in farm organization and management for 17 farms in the Froid area cooperating with the SCS and under the AAA program. On one farm studied figures on crop production were not available since more land was purchased after the programs went into effect. Thus there are 17 farms cooperating with both programs that are discussed, while five farms not under the SCS program are considered separately.

Crop Production.—The most important change in crops produced on the 17 farms was the decrease in wheat acreage shown in table XII.
The total acreage of crops grown for grain had been considerably reduced with practically all of this decrease being represented by wheat. The average acreage reduction per farm was 109 acres. The change in crops grown on these farms were similar to the changes shown on the farms cooperating only with the AAA.

Fallow and Idle.—Changes in amounts of fallow or idle land were not of importance. Very little land had been fallowed in the project since serious wind erosion began in the 1930’s. There was a slight decrease in idle and fallowed acres. (See table XIII.)

Feed Crops.—A small decrease in the acreage of feed crops grown in the area was evident. (Note table XIV.)
TABLE XIII. CHANGES IN IDLE AND FALLOW LAND ON 17 FARMS COOPERATING WITH THE SCS AND THE AAA, FROI D AREA

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
<th>Increase</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fallow</td>
<td>260</td>
<td>137</td>
<td></td>
<td>123</td>
</tr>
<tr>
<td>Idle</td>
<td>410</td>
<td>228</td>
<td></td>
<td>182</td>
</tr>
<tr>
<td>Total</td>
<td>670</td>
<td>365</td>
<td></td>
<td>305</td>
</tr>
</tbody>
</table>

TABLE XIV. FEED CROPS GROWN AFTER CONSERVATION PROGRAMS COMPARED WITH THE ACREAGE GROWN BEFORE FOR 17 FARMS COOPERATING WITH THE SCS AND AAA, FROI D AREA

<table>
<thead>
<tr>
<th>Crop</th>
<th>Before</th>
<th>After</th>
<th>Increase</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millet</td>
<td>75</td>
<td>27</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Corn</td>
<td>540</td>
<td>423</td>
<td></td>
<td>117</td>
</tr>
<tr>
<td>Cane</td>
<td>95</td>
<td>122</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td>85</td>
<td>25</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Rye</td>
<td>30</td>
<td>0</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>825</td>
<td>597</td>
<td>27</td>
<td>255</td>
</tr>
</tbody>
</table>

Farmers estimated that the reduction in acres of feed crops had reduced the hay and other feed by about 300 tons for the 17 farms, or an average of nearly 18 tons decrease per farm.
Permanent Hay.—Accompanying this decrease in feed crop acreage was a large increase in the acreage of permanent hay, largely crested wheat grass grown in the buffer strips. There was no permanent hay reported on the farms before the programs were in effect; 1,960 acres were reported at the time of the survey, an average increase of 115 acres per farm. It will be noted that this average increase in hay per farm was very close to the average reduction in wheat acreage of 109 acres. The smallest increase in acres of permanent hay on any farm was 22 acres, while the largest increase was 196 acres. Farmers reported that 1,567 acres produced 1,082 tons of hay, an average of about 64 tons per farm. The yield of nearly two-thirds ton per acre for the crested wheat grass in 1939 was probably above average because of the favorable June rainfall. On the other hand, a larger acreage will be harvested in the future as the new stands become established.

Pasture.—An increase had been shown in the acres of pasture on the farms studied. (Refer to table XV.)

This table shows a total increase in pasture of 461 acres. A considerable decrease in temporary pasture was more than offset by a large increase in acres of crested wheat pasture. Farmers were of the opinion that crested wheat had a greater carrying capacity than either the range land or temporary pasture. If this was the case, the amount of grazing available on the farms had increased more than the acres indicated. Total changes in land use are shown in figure 11.

Table XVI shows changes in land use on farms not cooperating
TABLE XV. CHANGES IN PASTURE FOR 17 FARMS COOPERATING WITH THE SCS AND THE AAA AS A RESULT OF CONSERVATION PROGRAMS, FROID AREA

<table>
<thead>
<tr>
<th>Kind of pasture</th>
<th>Before</th>
<th>After</th>
<th>Increase</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crested wheat</td>
<td>0</td>
<td>699</td>
<td>699</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>599</td>
<td>599</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall and winter pasture a/</td>
<td>72</td>
<td>94</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Temporary pasture</td>
<td>320</td>
<td>80</td>
<td></td>
<td>240</td>
</tr>
<tr>
<td>Total</td>
<td>991</td>
<td>1,472</td>
<td>721</td>
<td>240</td>
</tr>
</tbody>
</table>

a/ Refers to 72 acres unfenced range, and 22 acres buffer strips.

TABLE XVI. CHANGES IN LAND USE ON FOUR FARMS COOPERATING WITH THE AAA IN THE FROID AREA

<table>
<thead>
<tr>
<th>Crop</th>
<th>Acreage before</th>
<th>Acreage after</th>
<th>Increase</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>1,240</td>
<td>720</td>
<td></td>
<td>520</td>
</tr>
<tr>
<td>Idle or fallow a/</td>
<td>85</td>
<td>610</td>
<td>525</td>
<td></td>
</tr>
<tr>
<td>Feed crops</td>
<td>170</td>
<td>165</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Pasture</td>
<td>95</td>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,590</td>
<td>1,590</td>
<td>525</td>
<td>525</td>
</tr>
</tbody>
</table>

a/ This land was practically all idle.
Figure 11.--Changes in land use on 17 farms cooperating with the SCS and the AAA as a result of conservation programs. Froid area.
with the SCS. The changes are shown graphically in figure 12. This figure indicates that of the farms under the AAA program the only changes of importance had been the decrease in wheat acreage and the increase in idle land. This was in contrast to the farms also cooperating with the SCS which showed increased acreages of permanent hay and pasture in amounts more than equal to the decrease in wheat acreage. The increase in hay and pasture on the 17 farms cooperating with the AAA and the SCS could be attributed to the influence of the SCS.

The decrease in wheat acreage, not considering the effect of contouring, under conditions similar to those prevailing prior to the introduction of the conservation programs, could be expected to result in a similar decrease in total bushels of wheat produced. There was no change of importance in idle or fallowed ground—there was even a slight decrease. The reduced wheat acreage did not result in more wheat being planted after fallow than was formerly the case. Therefore, the only possibility of increased yields, not considering contouring, would result from more careful preparation of the ground, and more care in handling the crop. These considerations could not be expected to have much influence on yields.

In determining the farmers' opinion of the influence of contouring on yields, farmers were asked the average yields on their fields before contouring. They were then asked if contouring increased, decreased, or had no influence on yields, and were asked to estimate the influence in bushels per acre. The figures (increased, decreased, or same) were added to or subtracted from the average yield figure before
Pasture 6%  
Feed Crops 10.7%  
Idle or Fallow 5.4%  
Wheat 77.9%  

Before

Pasture 6%  
Feed Crops 10.4%  
Idle or Fallow 38.3%  
Wheat 45.3%  

After

Figure 12.—Changes in land use on four farms cooperating only with the AAA. Froid area.
the fields were contoured. Therefore, the yield shown in the after column in table XVII is not the yield actually received, but the yield farmers expected on contoured fields when climatic conditions are similar in the before and after period.

**TABLE XVII. CHANGES IN LAND USE, YIELD, AND TOTAL PRODUCTION FOR AN AVERAGE FARM a/ IN THE FROID AREA Cooperating WITH THE SCS AND AAA AS A RESULT OF CONSERVATION PROGRAMS**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Before</th>
<th>After conservation programs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres</td>
<td>Yield</td>
</tr>
<tr>
<td>Wheat</td>
<td>315</td>
<td>8 3/4</td>
</tr>
<tr>
<td>Oats</td>
<td>25</td>
<td>29</td>
</tr>
<tr>
<td>Other grain b/</td>
<td>15</td>
<td>15.1</td>
</tr>
<tr>
<td>Feed crops a/</td>
<td>49</td>
<td>1.1</td>
</tr>
<tr>
<td>Hay, permanent</td>
<td>115</td>
<td>2/3 Ton</td>
</tr>
<tr>
<td>Pasture</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Woodland d/</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Idle or fallow</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>501</td>
<td></td>
</tr>
</tbody>
</table>

a/ Sum of the acreage and production on the 17 farms, divided by 17.

b/ Other grains are corn, rye, or barley.

c/ Feed crops are corn, cane, millet, oats, or rye cut for fodder or hay.

It will be noted in table XVII that total bushels of wheat produced after conservation programs were considerably below the production in the
other period. The decrease in crop income may have been offset by the reduction in costs of operation, the income received from the acres sown to hay and pasture, the AAA payments, and the possibility of a more stable income.

**Machinery Operating Costs.**—Farmers were asked their opinion of the fuel requirements on their farms at the present time compared to the amount required before conservation programs were in effect. Replies are shown:

<table>
<thead>
<tr>
<th>Less fuel (now)</th>
<th>Same</th>
<th>More</th>
<th>No answer</th>
<th>Farm with horses</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>17</td>
</tr>
</tbody>
</table>

Farmers believed fuel requirements were somewhat reduced from previous requirements, although there were several who reported no decrease. Farmers believed that the effect of the reduction in acreage on fuel, was partially offset by the increased fuel needed to farm on contour strips. There were some farmers who believed less fuel was required on the contour strips because the machinery was run more nearly on the level than formerly. Generally, farmers did not report much decrease in fuel cost to accompany the decrease in crop acreages. Saving in wear and repairs on machinery were probably realized because of the decreased acreage farmed.

**Fixed Costs.**—The equipment on most of the farms was purchased with the intent of devoting the greater part of the farm acreage to wheat production. Though large scale operating units were not found on
the farms studied, the tractors were generally capable of handling larger acreages of crops than were grown on most farms. The fixed costs of farming, i.e., interest on investment, taxes, and depreciation, have increased per bushel as wheat production has decreased.

If the size of the operating unit is not increased, it is probable that smaller machinery better adapted to the reduced crop acreages on these farms will gradually be acquired. This will reduce investment in machinery and decrease fuel requirements. Farmers reported that the smaller, more flexible tractors were better adapted to the smaller fields made necessary by strip farming.

**Livestock Adjustments.**—In this portion of the study it should be remembered that livestock in this area was reduced to a low point following the dry years of 1936 and 1937. It is difficult to build up a herd when most of the parent stock is sold off. Livestock prices are high and farmers do not have sufficient funds to restock.

With the large increase in tons of hay available, an increase in livestock could be expected, subject to the limitation noted. The data below shows farmers' response to the increased hay and pasture.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Number of replies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still below former levels because of drought</td>
<td>2</td>
</tr>
<tr>
<td>Livestock numbers approximately the same</td>
<td>6</td>
</tr>
<tr>
<td>Increase in livestock because of conservation programs</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>
Two farmers in the area reported their livestock herds were not built up to the size before the drought years. One of the farmers said he intended to build his herd up to its former size. The other said he had more summer pasture available but did not state an intention of increasing livestock in the future.

Of the six who had not increased their livestock, two intended to increase their herds in the future, and a third will utilize the feed on another unit.

Nine of the farmers interviewed or slightly more than one-half of the group had increased their herds to a larger size than that maintained before conservation programs were in effect. This increase in the relatively few years since the programs were introduced indicated quite an immediate response to the increased hay available on the farms. The figures for livestock before conservation programs were in effect (see table XVIII) are probably not as high as the actual livestock numbers on the farms at that time. As previously noted, a survey of livestock in the area made by the project staff, SCS, Culbertson, showed the average livestock per farm in 1935 to be 13 cattle, four hogs, 59 head of poultry, and 4.6 horses and work stock.

The average for these nine farms before conservation programs were in effect as shown by table XVIII was 9.3 cattle, and three work stock. Either the livestock on these farms was below the average for the entire area which was unlikely, or farmers' estimates were not correct.

Average numbers of livestock per farm for the nine farms with
TABLE XVIII. CHANGES IN LIVESTOCK ON NINE FARMS IN THE FROID AREA COMPARED TO CHANGES IN PASTURE AND AVAILABILITY OF RANGE AS A RESULT OF AAA AND SCS CONSERVATION PROGRAMS

<table>
<thead>
<tr>
<th>Farm</th>
<th>Livestock a/</th>
<th>PASTURE</th>
<th>No. Cows</th>
<th>Stock</th>
<th>Stock</th>
<th>Before</th>
<th>March, 1940</th>
<th>Before</th>
<th>March, 1940</th>
<th>Cr. Avail. b/</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Milk : Beef : Young Work</td>
<td>Milk : Beef : Young Work</td>
<td></td>
<td>Temp. : Range</td>
<td>Cr.</td>
<td>Temp. : Range</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>3 : 4 : 13</td>
<td>3</td>
<td>40</td>
<td>105</td>
<td>32 : 105</td>
<td>32</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>4 : 5 : 9</td>
<td>3 : 25</td>
<td>72 b/ : 30.5 : 72 b/</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>6 : 6 : 3 : 11 d/ : 12 : 3</td>
<td>25</td>
<td>72.5 : 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>4 : 6 : 6 : 23 d/</td>
<td>126 : 38 : 126 : 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>4 : 5 : 30</td>
<td>187 : 53 : 187</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>3 : 7 : 12 : 3 : 10 : 12 : 8</td>
<td>32</td>
<td>32</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a/ No account was taken of hogs or chickens.
b/ Meaning the farmer could secure additional range.
c/ Range unfenced, for fall and winter pasture.
d/ Mixed beef and milk.
e/ Eight of these were two year old heifers, and five were steers.
increased livestock in March, 1940, were 25 cattle, and 1.5 horses. These figures show a considerable increase in comparison with either the farmers' estimate of previous production, or with the results of the survey for 1935.

The livestock increase was due to the grass plantings of the SCS since the study showed that on the five farms not cooperating with the SCS, but under the AAA, no increase in livestock had taken place on any of the farms. There had been no increase in feed or in pasture on these farms, so that an increase in livestock would not be expected.

Table XIX shows that the nine farms which increased livestock were the farms with the largest amount of pasture available.

<table>
<thead>
<tr>
<th>Kind of pasture</th>
<th>Total for nine farms which increased livestock</th>
<th>Total for 17 farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crested wheat</td>
<td>511</td>
<td>699</td>
</tr>
<tr>
<td>Range a/</td>
<td>502</td>
<td>693</td>
</tr>
<tr>
<td>Temporary pasture</td>
<td>55</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,074</strong></td>
<td><strong>1,472</strong></td>
</tr>
</tbody>
</table>

a/ Includes fall and winter pasture.

The farms which increased livestock had a large portion of the total pasture in the area. The acreage of pasture per farm for the 17
farms in March, 1940, averaged 67, while the average acreage for the farms which showed no increase in livestock was only 50, compared with 119 acres on those farms that did increase livestock. It should be noted also that of a total of 481 acres increase in pasture because of the conservation programs on the 17 farms, 396 acres of this increase was accounted for on the nine farms that showed increased livestock.

The indications were that those farms which were able to increase their livestock were the farms which had the most pasture available, and which showed the greatest increase in pasture. This difference, however, did not account for all the increase in livestock on the nine farms.

Range Available.—It will be noted in table XVIII that of the nine farms that showed increases in livestock, seven had range available that could be used if necessary.

On the other hand, of the eight farmers who had not increased livestock production, four said they needed additional summer range; two had range available but did not contemplate increasing their livestock. The fact that four out of eight farmers who had not increased their livestock needed summer range; and that seven of the nine who had increased their livestock had summer range available, indicated that lack of summer range had prevented livestock increase on several of the farms studied. Also, present renting costs were high, two farmers mentioning they paid 50¢ per head per month for range.

This observation of the shortage of summer range has been made by the SCS in Culbertson. The solution offered is the establishment of a
Soil Conservation District with a community pasture.

In discussing the problems of Roosevelt County, a recent publication from that county suggested the formation of a grazing district for the area designated as E which includes the Froid Project. "The biggest handicap confronting the farmer in increasing his livestock enterprise in most sections is lack of grazing lands...The formation of grazing districts...appears to be the only solution to this problem in the eastern part of the county." 36/

Since there was a lack of pasture in comparison with the amount of hay on several of the farms, a reduction of the acreage in permanent hay, with or without an increase in pasture, would achieve a better balance between pasture and hay. A consideration of this action will be included in the section titled "Cropping Practices."

Feed Reserves.—In nearly every interview in the area farmers said they were building large feed reserves of hay to protect against crop failures. Large stacks of crested wheat grass hay could be seen on many of the farms. (See figure 13.) Some of the farmers said they had sufficient feed reserves to carry them through two years of crop failures.

The feed reserves are very important in maintaining a permanent agriculture and giving a degree of security to the farm income. Formerly in dry years, farmers were forced to pay high prices for hay. Several farmers reported buying hay of only mediocre quality for $25 per ton.

Figure 13.—The picture on the left shows buffer strips eliminating irregularities between contour strips. Hay cut from buffer strips, shown in the photo on the right, is building abundant feed reserves on many of the farms. Froid area. (Photo on left—SCS)
At those prices farmers cannot keep all of their herd, and must sell off livestock, often at sacrifice prices. When good years return farmers find livestock available only at high prices. Many of them purchase low quality stock because they can afford no better. A good herd may be sacrificed because of drought. There is no doubt that ample feed reserves are a decided asset to a farm, and most of the farms in the area were accumulating feed reserves.

Better Feeding Plus Better Livestock.—Many farmers in the area said they were able to feed their livestock better since more hay was available. Income might be increased through increased production per head. The need of better livestock was being realized by some farmers in the area, though generally livestock was not of high grade. On some of the farms pureblood stock was being purchased and the foundation being made for a high producing herd. While most of the farms were not showing improvement in quality of livestock, much development will likely come through educating the farmers to acquire better herds.

Some farmers believed that livestock were a help in maintaining soil fertility. It was also mentioned that livestock gave a better yearly distribution of labor on these farms.

Cropping Practices.—Figure 11, page 112, shows that the average farm did not have much opportunity to use summer fallow or practice other crop rotation, if the present crop acreage and acreage in permanent grass were to be maintained.

In some areas of the state where dry land farming is carried on,
summer fallowing is a highly recommended practice. Experiments at the North Montana Experiment Station showed that yields were nearly doubled when summer fallowing was practiced compared with continuous cropping. At the North Montana Experiment Station showed that yields were nearly doubled when summer fallowing was practiced compared with continuous cropping. 87/88/ In a study of successful Montana farms, one of the conclusions reached was that "clean, early summer fallow is a requisite to successful wheat farming in the dry land sections." This study was made of all successful farms in Montana according to a certain definition, but there was a concentration of the successful farms in the North Central Montana "Triangle" area.

Because summer fallowing has proven profitable at other places in the state is not proof that it would be profitable in the Froid area. Soil and climatic conditions may be sufficiently different in this area that the use of summer fallowing would not be justified.

Farmers abandoned the use of summer fallowing when wind erosion became severe in the area. Now that erosion is under control, it would likely be possible to return to the use of summer fallow. Experiments should be made in this area to determine whether summer fallowing has the advantage in the Froid area that it shows in other areas.

Several farmers in the group said they desired to use a long time rotation including grass, but that such a rotation was impossible with the grass in buffer strips spread throughout the field.

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It has been shown in the study of livestock that some of the farms were deficient in pasture and had more hay than could be utilized to advantage. It has also been noted that cropland was too limited on many of the farms to allow the use of grass rotation or summer fallow. What would be desirable adjustments on these farms to utilize the hay and to permit summer fallowing if its use were found to be profitable?

The first solution has already been stated: making available outside range for summer grazing. This would achieve a balance between hay and pasture but would not influence the amount of cropland except that the small amount of temporary pasture might be reduced.

A second solution and one that has many merits would be the increasing of the size of operating unit through renting or buying additional cropland. This solution, however, would be in the nature of a long time adjustment, and would not be in the scope of this study.

A third solution would be the reduction of the acres retired to grass on the farms. Crop land on a farm should not have been retired without sufficient consideration of the needs of the farmer as well as the conditions of erosion on the farm. Two farmers said that the retirement of cropland to grass did not leave sufficient acreage for the planting of the allotted wheat acreage, and the growing of grain crops for livestock. The Land Use Report for Roosevelt County recommended that 15 per cent of the land in area E be sown to grass and legumes. 89/ The

89/ Roosevelt County Community and County Agricultural Planning Committee, op. cit. p. 27.
SCS retired approximately one-third of the cropland to grass on the farms of their cooperators. If the per cent of land in grass and legumes were fairly similar for the entire area E, then it is seen that the amount of land recommended by county and community committees to be permanently retired was less than one-half of the amount retired to permanent cover on the farms cooperating with the SCS.

The principal part of the land retired to permanent cover was that acreage put in buffer strips. Assuming that all of this retirement was necessary to eliminate irregularities in the crop strips, then the only method of increasing the cropland would be by changing from contour stripping to straight stripping which would not require such a large acreage of land in buffer strips.

Contour stripping, farmers reported, had almost completely stopped wind erosion. The same statement, however, was also true of straight stripping in the area. Farmers generally reported higher operating costs on the contour strips than on the straight strips. The only justification for the use of contour strips would be any increased yield that may result from better moisture conservation, or the prevention of water erosion.

After two or three more years the results of contouring should be known. If contouring does not prove profitable, then straight strips should be established. It is probable that some of the more sloping fields will show increases in yields, while the more level fields will not. Straight strips may be established with narrow buffers between if the buffers are believed necessary to control erosion. If the farmer
desires it, some of the strips may be in permanent grass.

If part or all the fields are changed to straight strips, there will be an increase in cropland which will allow the use of more summer fallow assuming that the AAA base remains the same. If part of the straight strips are sown to grass, it might be feasible to use an electric fence or other temporary fence and utilize this grass as pasture. These straight strips of grass could readily be included in a long time rotation, though the value of such a rotation has not yet been proven.

It is quite probable that one of the reasons that difficulty was experienced with soil blowing on summer fallowed land was that tillage implements to maintain a trashy cover were not used on many of the farms in the area.

The SCS recognized the need of more modern tillage equipment. The agreements between the SCS and the farmers stipulated that the purchase of such implements as the duckfoot cultivator and the rod weeder were to be made as soon as the farmers were financially able.

More modern tillage implements would probably be a profitable investment for most farmers, if summer fallowing were found to be profitable.

Labor Requirements.—Farmers were asked to compare the total labor requirements on their farms at the present time with the amount necessary before conservation programs were begun. There were a number of considerations to be taken into account, farmers reported. Decrease in wheat acreage had been accompanied by an increase in pasture and hay. On most farms, contour stripping had been substituted for block farming. On
several farms livestock had been increased. Farmers' replies to the effect of conservation programs on labor requirements are shown. It was evident

<table>
<thead>
<tr>
<th>Effect</th>
<th>Less labor</th>
<th>Same</th>
<th>More</th>
<th>No answer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>1</td>
<td>10</td>
<td>5</td>
<td>1</td>
<td>17</td>
</tr>
</tbody>
</table>

that farmers did not believe there was much difference in the amount of labor required to operate their farms. Several farmers said the labor required to care for the hay and livestock about equaled the amount saved by the decrease in wheat acreage. Several farmers said the conservation programs had given a better distribution of labor on their farms.

Cost of Establishing the Practices.—Farmers reported that the cost of getting all the practices established on their farms had been very small. The principal cost was the seeding of the grass buffers and the cropland retired to permanent grass.

New Machinery.—Very little new machinery was required by farmers to come into the conservation programs. Although farmers agreed in their contracts with the SCS to buy new tillage machinery as soon as they became financially able, as yet no new machinery for tillage purposes had been purchased on the farms studied.

The only purchases reported necessary were hay forks, ropes, mower sickles, and similar equipment to handle the hay on the farms. In one case a new mowing machine had been purchased.

Farm Income.—Farmers were asked their opinion of the effect of conservation programs on their farm income. Replies are given.
<table>
<thead>
<tr>
<th>Effect</th>
<th>Decrease</th>
<th>No influence</th>
<th>Increased</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>0</td>
<td>7</td>
<td>10</td>
<td>17</td>
</tr>
</tbody>
</table>

The data below shows the replies of the five farmers cooperating with the AAA.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Decrease</th>
<th>No influence</th>
<th>Increased</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

The farmers believed that the loss in income because of the decrease in wheat acreage under the AAA was offset by the savings in operation costs and the payments for compliance. Under the AAA program only, the decrease in wheat acreage was accompanied by an increase in idle acreage, and not by an expansion of acreages of other crops, and with no increase in livestock.

On the farms cooperating with the SCS and the AAA, permanent hay and pasture were increased, and livestock was increased on over one-half of the farms. The majority of the farmers in this group believed that the conservation programs had increased their incomes.

Farmers were asked if they believed the use of the entire set of practices was justified on their farms. The replies of 1¼ of the group were in the affirmative. Two believed that the use of the practices was not justified, each giving as the reason that the reduction in acreage because of cooperation with the SCS left too few acres of cropland for the AAA base and for feed for livestock. One farmer gave no reply.

Farmers were asked if the productivity of their farms had been
changed as a result of conservation programs, and the expected productivity in the future. One farmer believed his farm had decreased in productivity, 11 said that productivity had not been changed, while five believed that it had been increased. The person who believed that his farm was less productive at the present time was one of the two whose cropland was not sufficient. Those who said productivity was the same thought the increase in hay production about balanced the decrease in wheat production. The farmers who believed productivity had been increased thought that yields were increased and that more livestock and hay had resulted, which more than balanced the decrease in wheat production.

For productivity in the future two expected it to be the same, three gave no answer, and 12 expected an increase. Some said that the grass would become better established, and that livestock would increase soil fertility.

Value of Farm.—Farmers were quite certain that the value of their farms had been increased because of conservation programs. Only one in the group thought the value had declined, and he was the individual mentioned above whose cropland was too small in amount. He also said there was much more compulsion in farming in accordance with government programs, and that this reduced the value of his farm to him. One in the group believed his farm was of the same value as before, while 15 believed the value had been increased. This indicated quite favorable reaction to the programs. Six expected the value in the future to be the same, three gave no answer, while eight expected the future value of their
farms to increase.

Erosion Control.—Farmers were asked how well wind erosion was being controlled on their farms now that the practices were all established. Replies are shown below. They need no comment.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Slightly reduced</th>
<th>Greatly reduced</th>
<th>Stopped</th>
<th>No. of replies</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of replies</td>
<td>1</td>
<td>5</td>
<td>10</td>
<td>1</td>
</tr>
</tbody>
</table>

Farmers' replies to the effect of conservation programs on water erosion are shown. The replies indicate that farmers believed a considerable measure of water erosion control has been achieved.

The Effect of AAA on the Establishment of the Practices.—The program of the AAA has played an important part in the establishment of some of the practices in the area. The program of the AAA made payments for the reduction in acres of certain crops, and for the use of certain approved practices many of which were soil conserving in nature.

Reduction in crop acreages because of the AAA program left considerable acreages of idle land on the farms. Since farmers had idle land they consented to the sowing of buffer strips and to the retiring of cropland to permanent cover, since this land had to remain from crop production anyway.

Farmers were in desperate circumstances in 1936 when the SCS
began operation and many of them would have consented to nearly any measures to reduce wind erosion. However, it is not likely that farmers would have allowed this large acreage to remain from crop production when better climatic conditions returned had not AAA payments been made to continue acreage reductions.

On farms where the SCS retirement program reduced acreage below those allowed for crop production by the AAA, farmers reported dissatisfaction.

The AAA program had an important influence on the establishment of the practices in the area studied.

**Summary.**—1. Principal changes in land use for 17 farms cooperating with the SCS and the AAA has been a reduction in wheat acreage and an increase in permanent hay and pasture. Farmers in the AAA program only, decreased wheat and increased idle land.

2. Reduction in wheat acreage was not accompanied by any change in method of production which would increase yields except that farmers reported contouring increased yields slightly.

3. Farmers did not generally report as much saving in fuel requirements as the decrease in crop acreages would apparently cause. Farmers reported higher operating costs on contour strips.

4. Smaller machinery better adapted to the reduced crop acreage will be a desirable adjustment unless the size of the farming unit can be increased on many of the farms studied.

5. Slightly over one-half of the farmers have increased livestock
on their farms because of the AAA and the SCS program.

6. Lack of pasture and summer range was the limiting factor in livestock production on some of the farms studied.

7. A Soil Conservation District or a grazing district has been suggested to provide summer range for farms in the area.

8. Farmers reported large feed reserves and the ability of feeding livestock better since more hay was available.

9. Better quality livestock were needed on many of the farms studied.

10. The retirement of approximately one-third of the cropland to permanent cover on the farms cooperating with the SCS precluded the use of summer fallowing or other crop rotation to a very large extent on most of the farms studied.

11. Modern tillage machinery will be necessary on many of the farms if summer fallowing is to be practiced.

12. Reduction of the acreage in buffer strips would make possible more summer fallowing, or the using of grass in a long time rotation. Buffer strips cannot be reduced at present if contour strips are to be continued since the buffers are necessary to eliminate irregularities in the crop strips. Contour stripping should be continued until the results of yield on contouring compared to straight strips are known.

13. Farmers believed labor requirements have not been changed to any degree on their farms.

14. Only small purchases of haying equipment were necessary to
take advantage of conservation practices on the farms studied.

15. The effect of the AAA has been to maintain income at about the same level as formerly with a more stable income, and increased income during dry years.

16. The SCS program, by putting idle land to grass, increased income according to the majority of the farmers.

17. Nearly all the farmers believed the practices were justified for use on their farms.

18. Farmers generally reported the same productivity on their farms as formerly, but many expected this productivity to be increased in the future.

19. Farmers believed their farms had been increased in value by the conservation programs.

20. Farmers believed wind erosion was almost completely under control, and water erosion greatly reduced by the set of conservation practices.

21. The AAA program had an important effect on the establishment of the practices in this area.
TABLE A.--FARMERS' ESTIMATES OF ACRES AND PRODUCTION OF CROPS FOR THE PERIOD IMMEDIATELY PRECEDING CONSERVATION PROGRAMS, AND THE PERIOD IN WHICH CONSERVATION PROGRAMS HAVE BEEN IN EFFECT, FROID AREA, SURVEY MARCH, 1940

<table>
<thead>
<tr>
<th>Crops for grain</th>
<th>Before (acres)</th>
<th>After (acres)</th>
<th>Before (bushels)</th>
<th>After (bushels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>5,737</td>
<td>4,500</td>
<td>46,860</td>
<td>32,130</td>
</tr>
<tr>
<td>Oats</td>
<td>432</td>
<td>494</td>
<td>12,385</td>
<td>13,050</td>
</tr>
<tr>
<td>Barley</td>
<td>65</td>
<td>62</td>
<td>1,410</td>
<td>1,208</td>
</tr>
<tr>
<td>Rye</td>
<td>70</td>
<td>0</td>
<td>720</td>
<td>0</td>
</tr>
<tr>
<td>Corn</td>
<td>105</td>
<td>95</td>
<td>1,725</td>
<td>1,713</td>
</tr>
<tr>
<td>Total</td>
<td>6,029</td>
<td>4,111</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feed Crops</th>
<th>Before (tons)</th>
<th>After (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millet</td>
<td>75</td>
<td>27</td>
</tr>
<tr>
<td>Corn</td>
<td>540</td>
<td>423</td>
</tr>
<tr>
<td>Cane</td>
<td>95</td>
<td>122</td>
</tr>
<tr>
<td>Oats</td>
<td>85</td>
<td>25</td>
</tr>
<tr>
<td>Rye</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>825</td>
<td>597</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Permanent hay</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crested wheat mixture</td>
<td>1,933</td>
<td>1,082 b/</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>27</td>
<td>116</td>
</tr>
<tr>
<td>Total</td>
<td>1,960</td>
<td>1,123</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Idle or Fallow</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fallow</td>
<td>260</td>
<td>137</td>
</tr>
<tr>
<td>Idle</td>
<td>410</td>
<td>228</td>
</tr>
<tr>
<td>Total</td>
<td>670</td>
<td>365</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pasture</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crested wheat</td>
<td>599</td>
<td>599</td>
</tr>
<tr>
<td>Range</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Fall &amp; winter pasture</td>
<td>320</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>991</td>
<td>1,472</td>
</tr>
</tbody>
</table>

| Woodland        | 10            |
| TOTAL           | 6,515         | 6,515        |

a/ As explained on page 113, production for the after period was assuming climatic conditions comparable to the before period.

b/ Estimated production from 1,567 acres which had been cut for hay.
**TABLE B.—PRECIPITATION ON THE POWER-DUTTON PROJECT, 1936 TO 1939, WITH NORMAL DISTRIBUTION FOR GREAT FALLS, MONTANA. a/**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.</td>
<td>.24</td>
<td>.04</td>
<td>.3</td>
<td>.12 T</td>
<td>.63</td>
</tr>
<tr>
<td>Feb.</td>
<td>1.52b/ 1.52b/</td>
<td>.18</td>
<td>1.02b/</td>
<td>.28 .40</td>
<td>.14 .25</td>
</tr>
<tr>
<td>Mar.</td>
<td>.46</td>
<td>.70</td>
<td>.69</td>
<td>.17</td>
<td>.14</td>
</tr>
<tr>
<td>Apr.</td>
<td>.36</td>
<td>.25</td>
<td>.17</td>
<td>.28</td>
<td>.13</td>
</tr>
<tr>
<td>May</td>
<td>1.21</td>
<td>1.22</td>
<td>.23</td>
<td>.20</td>
<td>3.77 .02</td>
</tr>
<tr>
<td>June</td>
<td>.31</td>
<td>1.56</td>
<td>2.93</td>
<td>2.71</td>
<td>2.29 3.20</td>
</tr>
<tr>
<td>July</td>
<td>.10</td>
<td>.20</td>
<td>.53</td>
<td>1.14</td>
<td>1.11 2.36</td>
</tr>
<tr>
<td>Aug.</td>
<td>.41</td>
<td>.36</td>
<td>.51</td>
<td>.60</td>
<td>.60 .70</td>
</tr>
<tr>
<td>Sept.</td>
<td>.96</td>
<td>.92</td>
<td>1.03</td>
<td>1.10</td>
<td>1.24 1.01</td>
</tr>
<tr>
<td>Oct.</td>
<td>.23</td>
<td>.12</td>
<td>.09</td>
<td>.06</td>
<td>.97 1.14</td>
</tr>
<tr>
<td>Nov.</td>
<td>.08</td>
<td>--</td>
<td>.11</td>
<td>1.02</td>
<td>.20 .31</td>
</tr>
<tr>
<td>Dec.</td>
<td>.28</td>
<td>.56</td>
<td>.22</td>
<td>--</td>
<td>.02 T</td>
</tr>
<tr>
<td>Total</td>
<td>6.06</td>
<td>6.73</td>
<td>6.70</td>
<td>8.13</td>
<td>11.35 13.57</td>
</tr>
</tbody>
</table>

---

*a/ Records for Great Falls in 1939 were for 47 years. Definition of normal—see footnote a, table C, appendix.

*b/ Estimated from Great Falls Weather Records.**

**Source:** Soil Conservation Service Records, Dutton, Montana.
TABLE 6.—PRECIPITATION AT CULBERTSON, MONTANA, 1937 TO 1939, WITH NORMAL DISTRIBUTION. a/

<table>
<thead>
<tr>
<th>Months</th>
<th>1937</th>
<th>1938</th>
<th>1939</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0.25</td>
<td>0.58</td>
<td>0.30</td>
<td>0.19</td>
</tr>
<tr>
<td>February</td>
<td>0.07</td>
<td>0.32</td>
<td>0.09</td>
<td>0.27</td>
</tr>
<tr>
<td>March</td>
<td>0.33</td>
<td>0.96</td>
<td>0.15</td>
<td>0.46</td>
</tr>
<tr>
<td>April</td>
<td>0.27</td>
<td>0.63</td>
<td>0.79</td>
<td>0.86</td>
</tr>
<tr>
<td>May</td>
<td>0.18</td>
<td>1.48</td>
<td>1.92</td>
<td>1.78</td>
</tr>
<tr>
<td>June</td>
<td>0.65</td>
<td>5.11</td>
<td>5.30</td>
<td>2.66</td>
</tr>
<tr>
<td>July</td>
<td>1.89</td>
<td>3.41</td>
<td>0.77</td>
<td>1.76</td>
</tr>
<tr>
<td>August</td>
<td>0.76</td>
<td>1.30</td>
<td>1.28</td>
<td>1.19</td>
</tr>
<tr>
<td>September</td>
<td>2.48</td>
<td>2.45</td>
<td>0.38</td>
<td>1.28</td>
</tr>
<tr>
<td>October</td>
<td>1.44</td>
<td>1.52</td>
<td>0.63</td>
<td>0.81</td>
</tr>
<tr>
<td>November</td>
<td>0.09</td>
<td>0.57</td>
<td>--</td>
<td>0.39</td>
</tr>
<tr>
<td>December</td>
<td>0.15</td>
<td>0.19</td>
<td>0.65</td>
<td>0.30</td>
</tr>
<tr>
<td>TOTALS</td>
<td>8.56</td>
<td>12.52</td>
<td>12.26</td>
<td>11.97</td>
</tr>
</tbody>
</table>

a/ Normal: "Departures of precipitation with 15 years or more of records are computed from a normal or 'standard mean', adjusted to a uniform 35-year period." (USDA Weather Bureau.) Records at Culbertson began in 1900.

### TABLE D.—ACCOMPLISHMENT REPORT OF THE POWER-DUTTON PROJECT, DUTTON, MONTANA

<table>
<thead>
<tr>
<th>Land Conversions</th>
<th>Before Planning</th>
<th>After Planning</th>
<th>Attained by Oct. 31, 1939</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres % of Total</td>
<td>Acres % of total as Planned</td>
<td>Acres % of Planned</td>
</tr>
<tr>
<td>Crop land</td>
<td>21,965 86%</td>
<td>21,253 63.2%</td>
<td>21,449 100.5%</td>
</tr>
<tr>
<td>Hay</td>
<td>24 .09%</td>
<td>722 2.5%</td>
<td>671 93%</td>
</tr>
<tr>
<td>Pasture</td>
<td>2,974 11.6%</td>
<td>2,801 11.5%</td>
<td>2,665 95%</td>
</tr>
<tr>
<td>Windbreaks &amp; Fri</td>
<td>30 .12%</td>
<td>229 .9%</td>
<td>222 97%</td>
</tr>
<tr>
<td>Mistic</td>
<td>697 2.7%</td>
<td>688 2.4%</td>
<td>683 98%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25,690</td>
<td>25,690</td>
<td>25,690</td>
</tr>
</tbody>
</table>

**Stripping Practices**

<table>
<thead>
<tr>
<th>Approximate width of strips, windstripping</th>
<th>Before Planning</th>
<th>After Planning</th>
<th>Attained by Oct. 31, 1939</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 rods</td>
<td>312</td>
<td>5,080</td>
<td>5,079</td>
</tr>
<tr>
<td>13 rods</td>
<td></td>
<td>508</td>
<td>508</td>
</tr>
<tr>
<td>16 rods</td>
<td>1,821</td>
<td>1,667</td>
<td></td>
</tr>
<tr>
<td>20 rods</td>
<td>12,876</td>
<td>13,216</td>
<td></td>
</tr>
<tr>
<td>22 to 30 rods</td>
<td>685</td>
<td>151</td>
<td>151</td>
</tr>
<tr>
<td>Total Windstripping</td>
<td>997</td>
<td>20,436</td>
<td>20,621</td>
</tr>
<tr>
<td>Field striping</td>
<td>0</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>Contour strip cropping</td>
<td>0</td>
<td>635</td>
<td>646</td>
</tr>
<tr>
<td>Not stripped</td>
<td>20,968</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Total crop land</td>
<td>21,965</td>
<td>21,253</td>
<td>21,449</td>
</tr>
</tbody>
</table>
TABLE D. Sheet 2  

<table>
<thead>
<tr>
<th>Accomplishments</th>
<th>Before</th>
<th>After Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per cent of cropland in strips</td>
<td>16.4</td>
<td>99.6</td>
</tr>
<tr>
<td>Per cent of cropland in contour strips</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>Per cent of cropland in field strips</td>
<td>0</td>
<td>.3</td>
</tr>
<tr>
<td>Per cent of cropland in windstrips</td>
<td>16.4</td>
<td>96.3</td>
</tr>
<tr>
<td>Cover crop &amp; crop residues, acres</td>
<td>997</td>
<td>21,253*</td>
</tr>
<tr>
<td>Grass land, acres</td>
<td>2,598</td>
<td>3,523</td>
</tr>
<tr>
<td>Grass, acres seeded, included in above</td>
<td></td>
<td>722</td>
</tr>
<tr>
<td>Controlled grazing, acres</td>
<td>0</td>
<td>2,801</td>
</tr>
<tr>
<td>Dams</td>
<td>20</td>
<td>26**</td>
</tr>
<tr>
<td>Dams, acre feet</td>
<td>139.4</td>
<td>376.1</td>
</tr>
<tr>
<td>Contour pasture furrows, acres completed</td>
<td>0</td>
<td>170</td>
</tr>
<tr>
<td>Diversions, linear feet completed</td>
<td>0</td>
<td>15,965</td>
</tr>
<tr>
<td>Water spreading, acres completed</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>Terracing, acres completed</td>
<td>0</td>
<td>211</td>
</tr>
<tr>
<td>Shrub hedges, miles planted</td>
<td>0</td>
<td>37</td>
</tr>
<tr>
<td>Windbreaks, miles planted</td>
<td></td>
<td>(30 acres trees in farmsteads before project) 7.5</td>
</tr>
<tr>
<td>Trees &amp; shrubs planted (not including replants)</td>
<td></td>
<td>183,574</td>
</tr>
<tr>
<td>Fences removed, miles</td>
<td></td>
<td>15.5</td>
</tr>
<tr>
<td>Fences constructed, miles</td>
<td></td>
<td>7.2</td>
</tr>
<tr>
<td>Soil drifts leveled, miles</td>
<td></td>
<td>70.5</td>
</tr>
</tbody>
</table>

* Refers mostly to use of crop residues for trash cover.

** In addition to 6 dams constructed, 3 of the 20 original dams were repaired and enlarged. Some of the balance of the original 20 dams are damaged so they are of no value.
TABLE E.--ACCOMPLISHMENT REPORT OF THE FROID PROJECT,
CULBERTSON, MONTANA, TO APRIL 4, 1940

<table>
<thead>
<tr>
<th>Land Conversions</th>
<th>Before Planning (Acres)</th>
<th>After Planning (Acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land Uses</strong></td>
<td><strong>Cultivated</strong></td>
<td><strong>Permanent Hay</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Pasture or Range</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Woodland</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Wildlife</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Idle Farmstead &amp; roads</strong></td>
</tr>
<tr>
<td>Cultivated</td>
<td>17,061.2</td>
<td>4,184.7</td>
</tr>
<tr>
<td>Permanent Hay</td>
<td>11,067</td>
<td>11,067</td>
</tr>
<tr>
<td>Pasture or Range</td>
<td>1,950.8</td>
<td>1,945.3</td>
</tr>
<tr>
<td>Woodland</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Wildlife</td>
<td>45</td>
<td>2</td>
</tr>
<tr>
<td>Idle</td>
<td>12</td>
<td>31</td>
</tr>
<tr>
<td>Farmstead &amp; roads</td>
<td>897.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Total acreages</td>
<td>19,960</td>
<td>11,071.5</td>
</tr>
<tr>
<td>NET CHANGES</td>
<td>-5,949.7</td>
<td>+1,772.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accomplishment Report</th>
<th>Unit</th>
<th>Planned</th>
<th>Accomplished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contour furrows &amp; ridges</td>
<td>Acres</td>
<td>607</td>
<td>579</td>
</tr>
<tr>
<td>Pasture and/or range</td>
<td>Acres</td>
<td>1,956.3</td>
<td>1,701.8</td>
</tr>
<tr>
<td>Cultivated land</td>
<td>Acres</td>
<td>5,957.2</td>
<td>5,147.2</td>
</tr>
<tr>
<td>Animal units</td>
<td>Number</td>
<td>564</td>
<td>564</td>
</tr>
<tr>
<td>Contour cultivation</td>
<td>Acres</td>
<td>7,816.7</td>
<td>7,146.7</td>
</tr>
<tr>
<td>Crop residues</td>
<td>Acres</td>
<td>10,994.6</td>
<td>10,004.1</td>
</tr>
<tr>
<td>Diversions</td>
<td>Lin. Ft.</td>
<td>21,615</td>
<td>17,168</td>
</tr>
<tr>
<td>New fences built</td>
<td>Rods</td>
<td>9,230</td>
<td>9,230</td>
</tr>
<tr>
<td>Fences relocated</td>
<td>Rods</td>
<td>6,507</td>
<td>6,507</td>
</tr>
<tr>
<td>Gully structures</td>
<td>Number</td>
<td>87</td>
<td>56</td>
</tr>
<tr>
<td>Planting: new permanent pasture</td>
<td>Acres</td>
<td>1,618</td>
<td>1,396.5</td>
</tr>
<tr>
<td>Planting: permanent hay</td>
<td>Acres</td>
<td>4,722.2</td>
<td>3,650.1</td>
</tr>
<tr>
<td>Planting: hedges</td>
<td>Lin. Ft.</td>
<td>465,523</td>
<td>389,139a</td>
</tr>
<tr>
<td>Rotations approved</td>
<td>Acres</td>
<td>11,161.1</td>
<td>10,490.8</td>
</tr>
<tr>
<td>Strip cropping</td>
<td>Acres</td>
<td>10,863.4</td>
<td>10,213.4</td>
</tr>
<tr>
<td>Water storage structures</td>
<td>Number</td>
<td>35</td>
<td>34</td>
</tr>
<tr>
<td>Water storage</td>
<td>Acre Ft.</td>
<td>52.25</td>
<td>52.25</td>
</tr>
<tr>
<td>Terracing</td>
<td>Acres</td>
<td>816.1</td>
<td>692.6</td>
</tr>
<tr>
<td>Water spreading</td>
<td>Acres</td>
<td>179</td>
<td>168</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>Acres</td>
<td>1,343.3</td>
<td>1,107.3</td>
</tr>
<tr>
<td>Hammocks leveled</td>
<td>Acres</td>
<td>286</td>
<td>286</td>
</tr>
<tr>
<td>Fences removed, erosion control</td>
<td>Rods</td>
<td>7,295</td>
<td>7,295</td>
</tr>
</tbody>
</table>

* 74 miles.
Field Windbreaks on the Froid Project

Field windbreaks are several rows of trees or shrubs planted along the edge of a field to protect the field from wind damage, and help to conserve moisture. Because of the short period of time the windbreaks had been used in the area, little growth of the plants had occurred. For this reason, no complete analysis could be made of this practice.

Replies to questions are included here without comment.

Windbreaks were established on four of the farms studied.
Years established: two in 1937; two in 1938.
Cost of establishing. None to the farmer.

<table>
<thead>
<tr>
<th>Acres required by windbreak</th>
<th>Acres in protected field</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2</td>
<td>160</td>
</tr>
<tr>
<td>1 1/2</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>160</td>
</tr>
<tr>
<td>8</td>
<td>194</td>
</tr>
</tbody>
</table>

Why did you establish this practice? Government help was responsible.

Will this practice become a permanent part of your farming system?

   Yes, in all cases

Objectionable features:

   Rows not wide enough to cultivate conveniently.

Do you anticipate increasing benefits in the future? Yes, in all cases.
Field Hedges

Field hedges have been experimented with on the Froid Project. These hedges are planted in single rows either in the center of the crop strip, or along the edge of the buffer strips. Field hedges were tried on 12 of the farms studied.

Years of establishment:

<table>
<thead>
<tr>
<th>Year</th>
<th>1937</th>
<th>1937 &amp; 38</th>
<th>1938</th>
<th>1938 &amp; 39</th>
<th>1939</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

Cost of establishing. None to the farmer.

Amount of land required

<table>
<thead>
<tr>
<th>Acreage</th>
<th>1 A.</th>
<th>3 1/2</th>
<th>1 1/2</th>
<th>1 1/2</th>
<th>13</th>
<th>3 1/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>160 A.</td>
<td>100</td>
<td>(not given)</td>
<td>160</td>
<td>200</td>
<td>320</td>
</tr>
<tr>
<td>332</td>
<td>56</td>
<td>230</td>
<td>553</td>
<td>266</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Why did you establish this practice? Government help responsible in 11 cases; one farmer would have experimented with the hedges without help.
Will these hedges become a permanent part of your farming system?

Yes said eight; no said four.

Objectionable features:

Thistles gather in hedges. Horses and cattle will damage the trees if turned into the field to pasture off the buffer strips. Inconvenient to farm around the hedges in the crop strip. Grasshoppers and beetles damage the plants. Difficult to cultivate and keep clean.

Farmers suggested the hedges be planted along the edge of the grass buffers.

Do you anticipate increased benefits in the future?

Nine said yes; three, no.
SCHEDULE FOR SOIL CONSERVING PRACTICES

General ____________________________ Name ____________________________ Sch. No. _______

Legal Desc. ____________________________ Address ____________________________ Gov. Prog. _______

1. Do you consider erosion a serious problem on your farm?
2. Which type of erosion is most important?
3. When did you first notice erosion on your farm?
4. Do you think much soil has been lost from your farm?
5. Have you observed decrease in yields or other detrimental effects which you attribute to erosion?
6. What and when was your first attempt to stop erosion and conserve water?
7. What soil conserving practices do you follow now?

Straight Strip Cropping Schedule No. _______ Gov. Prog. _______

No. of Acres ________________

1. Year practice was started?
2. Original cost per acre?
3. Upkeep cost per acre?
4. Fuel required: (less, same, more) as same acreage not stripped.
5. Labor: (Less, same, more) as same acreage not stripped.
6. Width of lands before strip cropping?
   After?
7. Wind erosion: (not reduced, slightly reduced, greatly reduced, stopped) by strip cropping.
8. Water erosion: (not reduced, slightly reduced, greatly reduced, stopped) by strip cropping.
9. Moisture content of soil: (decreased, same, slightly increased, greatly increased).
10. Yields of close drilled crops per acre: (decrease, same, increase).
    How much?
11. Yields of intertilled crops per acre: (decreased, same, increased).
   How much?

12. What do you think yields in future will be?

13. If buffer strips are in grass, what use do you make of the grass?

14. What is acreage of these strips?

15. What value per acre is the grass worth to you?

16. Value of land now as compared to before strip cropping: (less, the same, more). How much?

17. Why did you establish this practice? Gov. help: Yes____ No____.

18. Has this practice become a permanent part of your farming system?

19. What are the most objectionable features to strip farming?

20. How could this practice be improved?

Contour Strip Cropping

<table>
<thead>
<tr>
<th>Schedule No.</th>
<th>Gov. Prog.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Acres</td>
<td></td>
</tr>
</tbody>
</table>

1. Year practice was started?

2. Original cost per acre?

3. Upkeep cost per acre?

4. Fuel required: (less, same, more) as same acreage not stripped.

5. Labor: (less, same, more) as same acreage not stripped.

6. Width of lands before strip cropping?
   After?

7. Wind erosion: (not reduced, slightly reduced, greatly reduced, stopped) by contour strip cropping.

8. Water erosion: (not reduced, slightly reduced, greatly reduced, stopped) by contour strip cropping.

9. Moisture content of soil: (decreased, same, slightly increased, greatly increased).

10. Yields of close drilled crops per acre: (decreased, same, increased).
    How much?
11. Yields of intertilled crops per acre: (decreased, same, increased). How much?

12. Do you think yields in future will be larger?

13. If buffer strips are in grass, what use do you make of the grass?

14. What is acreage of these strips?

15. What value per acre is the grass worth to you?

16. Value of land now as compared to before contour strip cropping: (less, the same, more). How much?

17. Why did you establish this practice? Gov. help? Yes No.

18. Has this practice become a permanent part of your farming system?

19. What are the most objectionable features to contour strip farming?

20. How could this practice be improved?

Crop Residues

1. Do you think crop residues and strip fallow are both necessary to control blowing? Yes No.

2. Water conservation: (not increased, slightly increased, greatly increased) by keeping residues on the surface.

3. What do you think is the effect of crop residue on insects?

4. It requires (less, same, more) labor to leave residue on ground rather than burning it?

5. Yields: (less, same, more) when residue is saved rather than burned.

6. How would you suggest handling crop residues?

Use of permanent vegetative cover Schedule No.Gov. Prog.

Retiring of cropland Acres retired

1. Year retired?

2. Type and value of land retired?

3. Return per acre on land before retiring?

4. Cost per acre to retire land?
5. Use product of land is put to?
6. Return per acre on land after retiring?
7. Value per acre of land after retiring?
8. Would you have retired this land with no government help?
9. Is this land permanently retired?
10. What are some of your objections to retiring this land?
11. Has the terracing of crop land retired to grass (prevented, reduced, not reduced) water erosion?
12. In controlling water erosion, have pasture terraces on crop land retired to grass proven (more effective, as effective, less effective) than retired land?
13. How would you have improved this practice?

Renovating land in permanent cover. Acres ________________

1. Types of practices and years done.
2. Cost of practices per acre.
3. Yield and carrying capacity (less, same, more). How much? Do you think this will increase in the future?
4. Value of land: (less, same, more). How much?
5. Has this practice become a permanent part of your system?
6. Why did you begin this type of work? Gov. help? Yes____ No____.
7. What are your objections to these practices?
8. How could this practice be improved?

Water Facilities Schedule No. ________________ Gov. Prog. ____________

Reservoirs. Dug-out Type Dam Type

1. Year of construction?
2. Cost of construction?
3. Cost of maintaining?
4. Use made of water?

5. Effect on value of land: (less, same, more). How much per acre?

6. Water erosion: (not reduced, slightly decreased, greatly decreased, stopped).

7. Why did you build this reservoir? Government help? Yes _____ No______.

8. What are your objections to structures of this type?

9. How do you think improvements could be made?

   Diversion ditches for flood irrigation. (including dams).

1. Year of construction?

2. Cost of construction?

3. Cost of maintaining?

4. Water erosion: (not reduced, slightly reduced, greatly reduced, stopped) by these structures.

5. Acreage of land irrigated?

6. Is the land under flood irrigation worth (less, same, more) than the land before irrigation? How Much?

7. Does the flood system give (less, same, more) assurance of feed supply in dry years?

8. Why did you begin this practice? Government help? Yes ____ No______.

9. Has flood irrigation become a permanent part of your farming system?

10. What are your objections to this practice?

11. How could this practice be improved?

Windbreaks

Schedule No. ___________________ Gov. Prog. ____________

No. of acres protected _____________.

1. Year windbreak was established?

2. Cost of establishing per acre of protected land?

3. Amount of land required by the windbreak?

4. Yield per acre of land taken from production by windbreak?
5. Wind erosion: (not reduced, slightly reduced, greatly reduced, stopped) by windbreak.

6. Water erosion (not reduced, slightly reduced, greatly reduced, stopped) by windbreak.

7. Have windbreaks (not reduced, slightly reduced, greatly reduced, stopped) damage from hot winds?

8. Have windbreaks (not reduced, slightly reduced, greatly reduced) wind shattering of ripened grain?

9. Have windbreaks (not increased, slightly increased, greatly increased) snow accumulations on crop strips?

10. Yields: (less, same, more). How much? What do you think yields in the future will be?

11. Have windbreaks been (a large factor, of little importance, of no importance) in increasing wildlife?

12. Have windbreaks provided (considerable protection, little protection, no protection) to livestock in winter?

13. Why did you establish this practice? Government help? Yes ___ No ___.

14. Will this practice become a permanent part of the farming system?

15. What do you consider the objectionable features?

16. How could it be improved?

17. Do you anticipate increased benefits in the future?

Hedges

<table>
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<tr>
<th>Schedule No.</th>
<th>Gov. Prog.</th>
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<table>
<thead>
<tr>
<th>No. of acres protected</th>
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</table>

1. Year hedges were established?

2. Cost of establishing per acre of protected land?

3. Amount of land required by the hedges?

4. Yield per acre of land taken from production by hedges?

5. Wind erosion: (not reduced, slightly reduced, greatly reduced, stopped) by hedges.
6. Water erosion (not reduced, slightly reduced, greatly reduced, stopped) by hedges.

7. Have hedges (not reduced, slightly reduced, greatly reduced, stopped) damage from hot winds?

8. Have hedges (not reduced, slightly reduced, greatly reduced) wind shattering of ripened grain?

9. Have hedges (not increased, slightly increased, greatly increased) snow accumulations on crop strips?

10. Yields (less, same, more). How much?

11. Have hedges been (a large factor, of little importance, of no importance) in increasing wildlife?

12. Have hedges provided (considerable protection, little protection, no protection) to livestock in winter?


14. Will this practice become a permanent part of the farming system?

15. What do you consider the objectionable features?

16. How could it be improved?

17. Do you anticipate increased benefits in the future?

Contour furrows on pasture land

<table>
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<tr>
<th>Acres</th>
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<tr>
<td>_____</td>
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</table>

1. Year established?

2. Cost of establishing?

3. Contour furrows (have no effect on, retard, prevent) runoff?

4. Effect on growth of grass and carrying capacity? Do you think that this will increase in the future?

5. Objections to this practice?

6. How would you improve this practice?

Effect on Farm Org. and Mgm. Schedule No.Gov. Prog.

<table>
<thead>
<tr>
<th>Acres</th>
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</table>

1. Acres of cropland now farmed? Amt. of product? Value?

3. Proportion of land fallowed before and after?

4. Acres pasture and hayland now? Product?

5. Acres pasture and hayland before? Product?

6. Livestock now? Income from?

7. Livestock before? Income from before?

8. Labor (less, same, more) required now than before. How much?

9. Machinery: what new machinery was it necessary for you to buy in order to carry out soil conserving practices?

10. Fuel required (less, the same, more) than before?

11. Is the labor saved and increased production sufficient to justify this cost?

12. What do you think the total cost of establishing these practices amounted to?

13. Has the productivity of your farm become (less, same, more)? How much? What do you expect this to be in the future?

14. Net income (less, same, increased). Now much?

15. Value of farm (less, same, more)? How much per acre? What do you expect the value to be in the future?

16. Have the practices as a whole (not reduced, slightly reduced, greatly reduced) wind erosion?

17. Have the practices as a whole (not reduced, slightly reduced, greatly reduced) water erosion?

Amount paid for rental of cropland on which soil conserving practices are used?
___________________________________ When soil conserving practices are not used? _______________

Amount paid for renting range land:

Per acre ____________________________________ Per Head ________________________________


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