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by EVERETT C. WEITZELL

EROSION CONTROL BY CONTOUR FARMING

WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION
MORGANTOWN

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IN COOPERATION WITH THE BUREAU OF AGRICULTURAL ECONOMICS AND WITH THE SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

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Economic Implications of Soil Conservation In Marshall County

by Everett C. Weitzell[1]

THE LAND OF MARSHALL COUNTY has long been depended on as a source of food first for the westward pioneers and later for the concentrated industrial areas that rapidly developed in the surrounding rich mineral areas. Unlike some sections in West Virginia, the rural people of this county generally have not depended on non-agricultural sources of income. Farming has been their chief occupation. Their temperaments and abilities have fitted them well for farming in the rugged hills of northern West Virginia. The profitableness of their agricultural production has encouraged them to be enterprising and reasonably progressive.

The Northern Panhandle of West Virginia is probably the most intensively farmed section of the state, despite the fact that other areas have topography and soils more favorable to intensive culture. The physical handicaps that have been encountered here seem to have encouraged the development and use of more progressive farming practices. Strip cropping, pasture management, rotation culture, and the growing of legume forage undoubtedly have been more generally practiced in this locality than in other parts of the state. Hence the program of soil conservation has met with general approval and acceptance. The realization of the value of fertility-building and soil-conserving practices has long prevailed. The lack of bottom or nearly level land on most farms has made it necessary to prevent erosion in order that productivity might be maintained.

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Objectives of This Study

In October 1935 the Soil Conservation Service, United States Department of Agriculture, designated this area as a soil-conservation demonstration project. With the assistance of the Civilian Conservation Corps and of a technical staff, the work of establishing demonstrations in erosion control and in soil and moisture conservation on privately-owned farms was assumed.

In connection with the above operations a cooperative project between the West Virginia Agricultural Experiment Station, the Bureau of Agricultural Economics, and the Economic Research Division of the Soil Conservation Service, United States Department of Agriculture, was inaugurated for the purpose of measuring the progress and effect of the program of soil and water conservation on the agriculture of the area. In accordance with this objective, farm practice and income records were obtained for farms in the area for the year 1935, before the program was established. The survey was repeated for the year 1937 for the purpose of isolating and measuring tendencies toward change and progress as a result of the soil-conservation program. It is planned that three additional annual resurveys will be made.

This report is planned to point out economic implications of, and tendencies toward, changes resulting from the planned and managed program of soil and moisture conservation. The application of such a program involves many considerations, and its economic success may mean much to farming of hill land.

Description of Area

This demonstration area, specifically known as S.C.S. W.VA. Project II, is located in the north-central portion of Marshall County, West Virginia. The area comprises the water-sheds of Middle Grave Creek and Little Grave Creek, both of which are tributaries of the Ohio River. It contains approximately 27,300 acres. Records on 84 out of the 200 farms in the area, distributed as shown in Figure 1, were obtained for the two years 1935 and 1937. The analysis used in this study is based on data obtained for these years.

Background of Agriculture

From about 1780 to 1840 the hillside land of this area was cleared of timber and devoted to the production of cash grains.

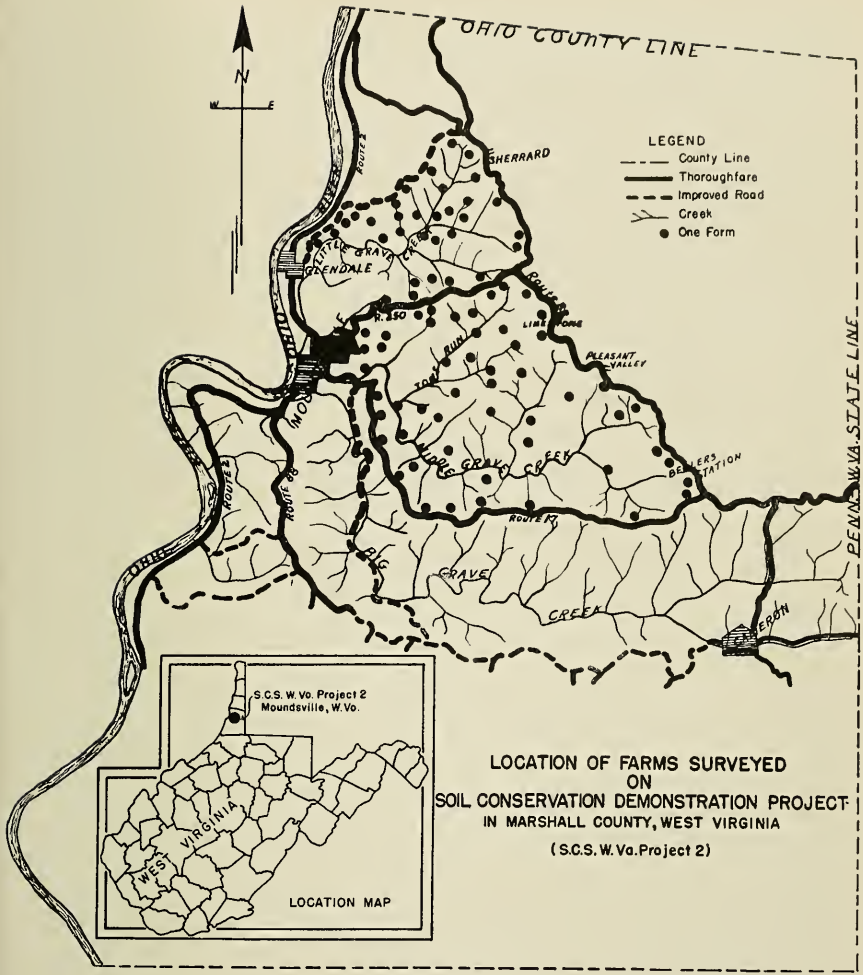

FIGURE 1

Corn, wheat, oats, and rye were the important crops in the area.

A rapid exhaustion of soil fertility by soil-depleting cropping practices soon resulted in low crop yields. Low yields together with keen competition in grain production from the rapidly developing, more fertile territory to the west were responsible for a decided decline in the growing of cash grains early in the Nineteenth Century. At this time fine-wool sheep replaced grain farming to an appreciable extent. This type of production was suited to the rough hilly land which produced pastures of

good quality. Although their importance in the production program has since been shared by other types of livestock, sheep still are important on many farms.

Rapid industrial expansion in the Ohio Valley territory created excellent markets for milk, milk products, fruit, and truck crops. During the past decade dairy production has commanded a major position in farm production, while recent developments in transportation and retail marketing have lessened the demand for local vegetables and small fruits. But they are still important sources of income to an appreciable number of farmers.

Beef-cattle production has never been important in this area. An extensive type of farming, utilizing large acreages of pasture and forage land, is unsuited in an area which for numerous reasons developed as an area of comparatively small farms. This is especially true if intensive crop farming can produce greater total net returns per farm.

Swine production was relatively important along with a grain type of farming during the early development of the area. Poultry has consistently been an important supplementary enterprise for farms in this locality. Chickens furnish food for the farm families, and a ready market is available for poultry products. This enterprise has gained in importance in recent years.

Marshall County is underlain with valuable deposits of coal, oil, and gas. However, the present income from such resources to farmers in this area is negligible. Most of such rights have been disposed of in the past. Some of the wealth from these properties, together with investments made in nearby industries, is still held in small amounts by some farmers, but most of them are dependent on the soil for their livelihood.

The problems of erosion and soil depletion have been recognized for many years by the better farmers as signified by the following statement in the Soils Survey of 1909. "In the cultivation of the steep slopes the farmers, as a rule, cultivate the upper half one year and the lower half the following year. When the steeper slopes are broken for corn the best farmers leave one and sometimes more narrow strips of sod about the middle of the field, and following the contour of the hill; and where there are slight depressions, old gullies, or little runs, they are likewise left in sod, and the brush and stones which accumulate in the fields are usually disposed of by dumping into these depressions to aid in checking further gullying and erosion."[2]

Climate

The usual climate for the area is moderate. Periods of very cold winter weather are of short duration. The usual length of growing seasons is 150 days.

[2]Caine, Thomas A., et al., Soil Survey of the Middlebourne Area, Bureau of Chemistry and Soils, 1909.

The alternate freezing and thawing during winter months is conducive to serious erosion. Sloping soils are heaved and loosened so that subsequent run-off carries much of the fine-textured topsoil from the hillsides. Such action is common on soils not provided with enough winter cover.

Average annual rainfall varies around 40 inches. The rainfall for 1935 was slightly less than 40 inches while the total rainfall for 1936 was 45 inches. Nevertheless the rainfall for June, July, and August in 1935 exceeded that for the same period during 1936 by 4.6 inches. From the standpoint of erosion, the rainfall is conducive to serious run-off. Rains often fall in heavy showers of short duration at the rate of 3 to 4 inches per hour, 4 or 5 times annually, after extremely dry periods. This causes the small particles of soil to be removed rapidly from the steep slopes. The lack of organic matter in the shallow soils permits practically no ground water to be retained. As a result, in some years the dry summer weather, coming between the extremely heavy showers, seriously injures crop and pasture production.

Topography

The terrain is sharply rugged, and most of the farm land has appreciable slope. There is practically no level land except infrequently on narrow ridge tops. The valleys are very narrow and generally are used for pasture and woodland, because of their extreme slopes. Farm land, roads, and homesteads are located on top or near the top of the network of narrow ridges. The tops of ridges range in altitude from 1000 to 1300 feet above sea level.

More than 92 percent of all land has an average slope of over 15 percent, and 63 percent has a slope of over 25 percent. The majority of the land having a slope of over 40 percent is in pasture and woods, but much land is cultivated which has a slope of from 25 to 40 percent.

The hillside soils of the area erode very rapidly if the soil cover is of poor quality. Although much of the farm land in this

TABLE 1—*Proportion of land of various slopes devoted to different types of land use in Moundsville project area*

Land use	Percentage of area in each slope class					
	All land	A 0-5%	B 5-15%	BB 15-25%	C 25-40%	D Over 40%
Cropland	39.6	84.3	32.9	68.3	42.9	4.7
Pasture	29.8	9.0	10.5	23.7	45.3	23.9
Woodland	24.5	.4	---	.9	8.7	68.8
Idle land	2.7	.9	3.7	2.8	2.8	2.6
Other land	3.4	5.4	52.9	4.3	.3	---
All land	100.0	3.7	3.5	28.9	32.8	31.1

area is steeper than that found in other localities, erosion seems to be controlled to a greater extent. According to the Reconnaissance Erosion Survey this area is classed as having only moderate sheet erosion with occasional gullies.

Soils[3]

The soils of the area may be classified into three general divisions: (1) upland residual soils, (2) river and creek terraces, and (3) alluvial or river-bottom soils. The parent rock of the upland soils is usually composed of micaceous sandstone and shale, both calcareous and non-calcareous, interstratified with thin bedded limestone.

In considering the texture and structure of surface and subsoil in relation to erosion, the soils of the area may be divided into five main groups. The soils of Group 1 belong to the Westmoreland series and consist of the lighter textured gravelly silt loam, stony silt loam, shaly silt loam, and silt loams. These types are residual and are formed in part from calcareous shale and limestone, and may be situated in any topographical position from ridge top to stream beds. They constitute approximately 85 percent of the area. Soils of this group are moderately erosible and have greater depth than the non-calcareous soils. In their present state they generally lack lime and organic matter, but are reasonably productive if soil-conserving and fertility-building practices are employed. The primary need of these soils is enough fertility to maintain a good vegetative cover, which will check erosion.

Group 2 consists of upland residual soils of a non-calcareous origin. The composing types are the silt loam and gravelly silt loam of the Muskingum and Tilsit series. These soils occur in small areas and make up less than 4 percent of the area. They are generally confined to the nearby level areas on the ridge tops and are deeper than the hillside soils. With an occasional

TABLE 2—*Extent of various soil series in Moundsville area*

Group	Soil series	Acres	Percentage of area
1	Westmoreland	23,716.7	86.9
2	Muskingum	976.3	3.6
2	Tilsit	55.5	.2
3	Belmont	256.8	1.0
4	Huntington	1,198.9	4.4
4	Linside	119.1	.4
5	Wheeling	876.7	3.2
5	Chenango	67.3	.3
Total		27,267.3	100.0

[3]Data concerning soils, slope, and erosion in the Moundsville project demonstration area were adapted from unpublished information assembled by E. R. Leadbetter, soil surveyor, Soil Conservation Service, Moundsville, West Virginia.

exception, these soils are well drained and are only moderately erosive. They generally require more lime than the Westmoreland soils.

Group 3 consists of the Belmont series and other minor types of residual soils having a clay base, and heavier subsoil than characterizes the major soils of the area. They occur on intermediate slopes but are very erosible because of the comparatively impervious subsoils. Gullies and slips are often associated with these soils.

Group 4 represents the Huntington and Linside soils of the first bottom lands, which are the products transported from the residual upland soils. They represent less than 5 percent of the area, but because of their level and fertile character they present few, if any, erosion problems. Overflowing streams often affect the first bottom land.

Group 5 consists of the silty, sandy, and gravel terrace soils of the Wheeling and Chenango series along the Ohio River. Although these soils are fertile and well drained, they are of little agricultural importance in this area. Industrial and metropolitan areas cover practically all of these soils in the immediate vicinity.

TABLE 3—*Distribution of soil series on various slopes in Moundsville project area*

Soil series	Percentage of land area				
	A 0-5%	B 5-15%	BB 15-25%	C 25-40%	D Over 40%
Westmoreland	---	.4	24.4	31.2	31.0
Muskingum	---	.1	2.4	1.0	.1
Tilsit	---	---	.2	---	---
Belmont	---	.1	.4	.4	---
Huntington	3.3	1.1	---	---	---
Linside	.5	---	---	---	---
Wheeling	---	1.8	1.3	.1	---
Chenango	---	---	.2	---	---
Total	3.8	3.5	28.9	32.7	31.1

Erosion

Erosion may be defined as the action of weather on the earth's surface, which tends to disintegrate and transfer rock and soil to lower levels in the direction of the flow of wind and water. Many factors may influence the rate and intensity of erosion. They may be listed in two groups: (1) geologic or natural factors and (2) accelerating factors. The first group includes those factors in nature causing erosion of land regardless of its agricultural use. The second group includes the same primary natural factors which, however, are accelerated and intensified by the use of land for agriculture.

Three types of erosion are common to the Moundsville area: *sheet* erosion, *gully* erosion, and *surface slips*. Sheet erosion is

TABLE 4—*Extent of erosion on Moundsville project area*

Erosion class	Acreage	Percentage
Slight sheet erosion,[1] occasional gullies	1,987.2	7.3
Moderate sheet erosion,[2] occasional gullies	14,366.5	52.7
Moderate to severe sheet erosion,[3] frequent gullies and slips	8,264.9	30.3
Severe sheet erosion,[4] frequent gullies and slips	1,869.2	6.9
Very severe sheet erosion,[5] gullies and slips	779.5	2.8
Total	27,267.3	100.0

[1]Less than 25 percent of "A" horizon removed.
[2]Twenty-five to 50 percent of "A" horizon removed.
[3]Fifty to 75 percent of "A" horizon removed.
[4]Over 75 percent or all "A" horizon removed and upper part of "B" horizon removed.
[5]Sheet erosion of the "B" and "C" horizon, or parent material.

the most common and is constantly carrying from the surface soil its most valuable elements of plant growth. Water is the primary erosive agent in the area. It is aided by other climatic factors such as freezing and thawing, droughty periods, and the intensity of rainfall. The type and nature of the soil also affects the rate and severity of erosion. Little can be done to eliminate these natural causes.

Those factors which are principally the result of practices employed in utilizing the soil, and which accelerate the natural process of erosion, are the ones which may be modified. They include: (1) failure to grow sufficient soil cover during the entire year, particularly during the periods of heavy rainfall and of freezing and thawing; (2) failure to replace the fertility removed from the soil by harvested crops; (3) continued cultivation of infertile land which produces a minimum of cover; (4) cultivation of large sloping areas resulting in rapid run-off of

TABLE 5—*Extent of erosion on various classes of land in Moundsville project area*

Land-use class		Slight erosion	Moderate erosion	Moderate to severe erosion	Severe erosion	Very severe erosion
		(1)	(2)	(3)	(4)	(5)
Cropland	—acres	1187.5	5711.8	2987.5	764.7	134.3
	percentage	11.0	53.0	27.7	7.1	1.2
Pasture	—acres	245.6	2880.4	3704.2	910.2	393.6
	percentage	3.0	35.4	45.5	11.2	4.8
Woodland	—acres	490.4	4893.9	1092.3	64.1	143.2
	percentage	7.3	73.2	16.4	1.0	2.1
Idle land	—acres	9.0	111.1	402.8	102.1	108.4
	percentage	1.2	15.2	54.9	13.9	14.8
Miscellaneous	—acres	54.7	769.3	78.1	28.1	0.0
	percentage	5.9	82.7	8.4	3.0	0.0
Total	—acres	1987.2	14366.5	8264.9	1869.2	779.5
	percentage	7.3	52.7	30.3	6.9	2.8

rainfall from the steep slopes; (5) impractical pasture management; (6) growing those types of crops on sloping land that furnish a minimum of cover; and (7) damaging natural soil cover of woodland in an exploitative manner.

Owing to the uniformity of soils over a large majority of the area, the variation in intensity of erosion must be attributed to factors other than type of soils. Steep slopes and ill-adapted management practices have been the outstanding contributors to erosion.

Applying the erosion classification outlined in Table 4, it may be seen in Table 5 that practically 93 percent of the area has been damaged by sheet erosion, which has robbed the soil of a portion of its fertility. About 40 percent of the area has lost 50 percent or more of its topsoil; and 53 percent of the area has lost from 25 to 50 percent of its topsoil. More than 28 percent of the area has been damaged by gullying in addition to severe sheet erosion. Landslides and slips have occurred over 16 percent of the area.

More than one-fourth of the land now used for crop production is unsuited for this use because of erosion damage. About 36 percent of the crop land is estimated to have lost more than 50 percent of the topsoil, while an additional 53 percent has lost 25 to 50 percent of the topsoil.

Pasture land occupying the steeper slopes, nearly all of which were once used for crop production, has lost a greater portion of the topsoil than the more level land now cultivated. More than 61 percent of the pasture land has lost at least half of the original topsoil.

Through poor management and general abuse a surprising amount of erosion has occurred on farm woodland. Woodland generally consists of the steepest land and has been burned repeatedly. In addition, grazing livestock have not permitted young trees to grow for protection of the soil. Idle land, which generally exists in connection with abandoned land of a low quality, was found to be damaged most severely by erosion. The implication indicated in these data is that badly eroded land will be difficult to use for any agricultural purpose.

In diverting land from a given use to a more erosion-resistant type of production it is essential that the shift be made before the destructive characteristics of the former have advanced too far. Cropland may be so severely eroded that the establishment of any type of protective cover would be difficult. The conversion should be made while a new use may be established economically. Severely eroded soils often cannot be made to grow any type of desirable cover without expensive and impractical treatment and preparation.

TABLE 6—*Extent of erosion by slope classes in Moundsville project area*

Erosion class	Percentage of all land on slopes:				
	A 0-5%	B 5-15%	BB 15-25%	C 25-40%	D Over 40%
(1) Slight	100.0	36.0	1.5	1.7	4.1
(2) Moderate	____	60.2	69.9	35.2	60.6
(3) Moderate to severe	____	1.0	24.4	48.6	23.6
(4) Severe	____	2.8	3.9	10.9	6.6
(5) Very severe	____	___	.3	3.6	5.1
Total	100.0	100.0	100.0	100.0	100.0

The soil survey of the area reveals that there is practically no erosion on the slopes of less than 5 percent. In general, the severity of erosion increased with the increase in slope except where retarded by an effective type of cover. Slopes of 25 to 40 percent,

TABLE 7—*Extent of erosion on cropland according to slope, Moundsville project area*

Erosion class	Percentage of crop land:				
	A 0-5%	B 5-15%	BB 15-25%	C 25-40%	D Over 40%
(1) Slight	100.0	83.5	1.1	___	___
(2) Moderate	____	14.1	75.4	38.3	35.8
(3) Moderate to severe	____	2.4	19.2	46.0	46.3
(4) Severe	____	___	4.3	12.7	13.1
(5) Very severe	____	___	___	3.0	4.8

which are generally devoted to meadow and pasture, were damaged less than land of lesser slopes being subjected to continuous cultivation. Thus an increase in erosion with a corresponding increase in slope was more generally apparent on cropland.

TABLE 8—*Extent of erosion on various soil types within the Moundsville project area*

Soil type	Percentage of area affected by various classes of erosion:					
	Slight	Moderate	Moderate to severe	Severe	Very severe	Total
	(1)	(2)	(3)	(4)	(5)	
Westmoreland silt loan	1.3	33.1	22.6	5.0	1.2	63.2
Westmoreland gravelly silt loam	.4	13.9	4.0	.7	1.4	20.4
All other types	5.6	5.7	3.7	1.2	.2	16.4
Total all types	7.3	52.7	30.3	6.9	2.8	100.0

Although soils of the various types were eroded to varying degrees, erosion is associated with slope, cover, and farming practices rather than with inherent soil characteristics. However, the rate of erosion is accelerated with advanced stages. The porous topsoil is removed, and the lack of organic matter in the comparatively impervious subsoil does not permit surface water to percolate into the ground. Hence greater run-off is inevitable.

Economic Evaluation of Types, and Organization of Farming in Relation to Soil Conservation

The practicability of a program of soil conservation depends upon how well it fits into or supplants the existing agricultural production program. The application of soil-conserving and fertility-building practices should enhance or at least conserve the economic status of the farmers. The following economic analysis of existing agricultural pursuits is offered in the hope that it may be of value in appraising the effects of a planned program of soil and moisture conservation.

Type and Size of Farm

More than 80 percent of the land included in the survey was operated by resident owners; and about 15 percent was cash rented by owner operators. Only 11 percent of all farms, consisting of the same proportion of the total acreage, was entirely cash or share rented.

Fifty-five percent of all farms were classed as *general*[4] and they comprise 59 percent of all land. *Dairy* farms[5] constituted 31 percent, and only 14 percent of all farms were *self-sufficing* or *part-time*.[6] The operators of the latter type of farms gener-

TABLE 9—*Distribution of farms according to size in Moundsville project area, 1937*

Size of farms	Number	Percentage
(*acres*)		
0-50	16	19.0
51-100	22	26.2
101-150	24	28.6
151-200	7	8.3
201-250	8	9.5
251-300	4	4.8
Over 300	3	3.6
Total	84	100.0

[4]General farms were those deriving less than 40 percent of their total income from any single enterprise.
[5]Dairy farms were those deriving 40 percent or more from the dairy enterprise.
[6]Self-sufficing farms were those on which 50 percent or more of the total farm production was consumed by farm family.

ally did not depend on agriculture as their only source of income. They usually were employed in nearby industrial work at least a portion of the year.

TABLE 10—*Number of farms and acreage by type of farms in Moundsville project area, 1937*

Item	General farms	Dairy farms	Self-sufficing farms	Total all farms
Number farms	46	26	12	84
Total acreage in farms	6335	3331	991	10656
Percentage of all land	59	32	9	100
Acres per farm	138	128	83	127

The average size of all farms was 127 acres. General farms were the largest while those of the dairy type were about the average size for all farms in the area. Self-sufficing farms were considerably smaller than the average for all farms.

The average investment of $10,100 per farm was reasonably high, although not as high as that of beef-cattle pasturing areas. The investment in general farms was about average for the area, while that of dairy farms was about $2500 higher. Self-sufficing farms were valued at less than half that of general farms.

TABLE 11—*Investment in farms of Moundsville project area*

Item	General farms	Dairy farms	Self-sufficing farms	Average all farms
Average total investment	$10,047	$12,633	$4,817	$10,100
Percent land	48.4	46.4	44.3	47.4
Percent dwelling	16.8	15.0	23.4	16.5
Percent farm buildings	16.4	17.2	16.9	16.8
Percent livestock	8.9	8.9	6.8	8.7
Percent machinery	4.1	5.8	4.6	4.8
Percent other	5.4	6.7	4.0	5.8
Investment per acre	$73	$99	$58	$80
Value of land per acre	40	58	46	46

The average investment, including all real estate, was $80 per acre; and the average value of land, excluding buildings, was $46 per acre. Dairy farms were valued at more per acre than the average, while general farms were slightly below. It may be important to note that general farms had a greater proportion of their total investment in land than did dairy farms.

Land Use

The land of Marshall County has been classified according to its value for agricultural purposes (Table 12). About 10 per-

TABLE 12—*Distribution of land in various classes*[1]

	Class and description	Percentage of all land
I	Superior cropland	2.34
II	Good cropland	.60
III	Average cropland	10.59
IV	Below average cropland or good pasture	38.16
V	Inferior cropland or average pasture	17.13
VI	Submarginal land	23.24
VII	Forest land	6.09
VIII	Urban and industrial land	1.85

[1]Pohlman, G. G., Land Classification in West Virginia, Bul. 284, West Virginia Agricultural Experiment Station, 1937.

cent of the total was classified as average cropland, practically all of which consists of ridgetops, or upland soils. The major portion of the county is potentially good to average pasture land, and about one-fifth is submarginal for the prevailing type of agricultural production.

Data in Table 13 indicate that a larger acreage of land was actually devoted to crop production in 1937 than was classed as average-quality cropland. Thus it is apparent that many acres of crops were grown on the hillsides, which were classed as below-average cropland. Open permanent pastures occupied about 45 percent of the total land in farms, consisting of land classified as good pasture, average pasture, and submarginal land. The forest land on most farms has always been included in the pas-

TABLE 13—*Land use on 84 farms in Moundsville project area, 1937*

Land use	General farms		Dairy farms		Self-sufficing farms		All farms	
	Acres per farm	Per-cent-age	Acres per farm	Per-cent-age	Acres per farm	Per-cent-age	Acres per farm	Per-cent-age
Cropland	34	24.6	42	32.8	17	20.5	34	26.8
Open pasture	62	44.9	59	46.1	33	39.8	57	44.9
Woods pasture	11	8.0	8	6.3	8	9.6	10	7.9
Woodland	19	13.8	14	10.9	19	22.9	17	13.4
Other	12	8.7	5	3.9	6	7.2	9	7.0
Total	138	100.0	128	100.0	83	100.0	127	100.0

ture. Such areas supply shade and a water supply for livestock in the narrow ravines between the ridges. Because an appreciable amount of crop and pasture land is very steep, many problems are encountered in connection with erosion and soil depletion. Certain management practices are necessary to protect such land from excessive washing and leaching.

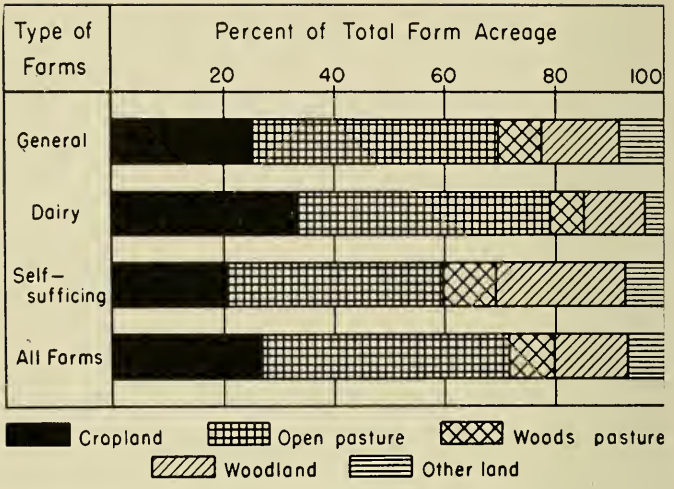

FIG. 2—*Land use on various types of farms in Moundsville area, 1937*

Dairy farms made use of practically all land, and maintained a higher percentage of the land in crops than general and self-sufficing farms. Self-sufficing farms tended to have an unusually large portion of their small area in woods. The data in Table 14 indicate the proportionate use of land for the entire area in 1937. The land-use pattern has been modified considerably during the past two decades. There has been a gradual reduction of cropland and a subsequent increase in pasture and idle land. The lack of good management and fertility-building practices has resulted in areas of badly depleted land that have been aban-

TABLE 14—*Land use in Moundsville project area*[1]

Land use	Acreage	Percentage of total
Cropland	10,785.8	39.6
Pasture land	8,134.0	29.8
Woodland	6,683.9	24.5
Idle land	733.4	2.7
Miscellaneous land	930.2	3.4
Total	27,267.3	100.0

[1]Adapted from unpublished data assembled by E. R. Leadbetter, soil surveyor, Soil Conservation Service.

doned. At present most cropland is confined to the gently-rolling hilltops with the tendency toward complete elimination of grain

crops from the steep hillsides. Pasture will continue to be the major use of the hillside land.

Woodland heretofore has not been recognized in this area as a continuous source of income. Generally only very rough and steep land was allowed to remain in woods, and no new

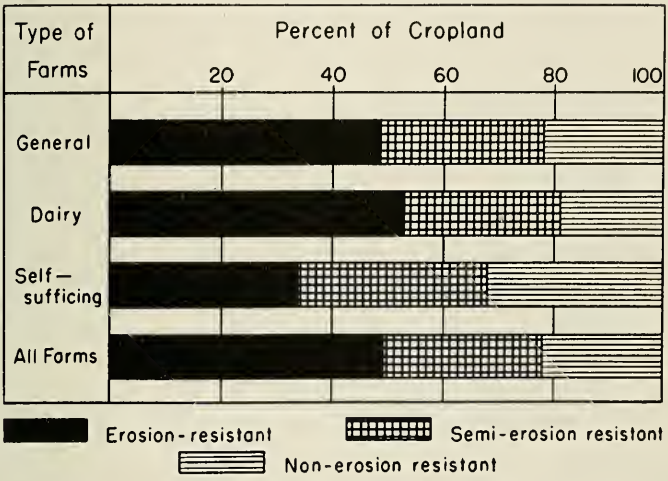

FIG. 3—*Comparative erosion resistance of crops grown on different types of farms in Moundsville area, 1937*

woodland was established except as land was abandoned for all other uses and naturally reverted to brush and low-quality woodland. Much of the present idle pasture and cropland will ultimately grow up in this manner unless plantings are made. It has been estimated that about 30 percent of the area is suitable only for forest production.

Shifts in land use in the past decades have been brought about by changes in demand for certain types of production and by the greater comparative advantage in their production because of competition from other areas. The opening of western

TABLE 15—*Extent of various types of land use on different soils in Moundsville project area*

Soil type	Percentage of land in various land-use classes				
	Cropland	Pasture	Woodland	Idle land	Other
Westmoreland silt loam	46.6	35.0	15.6	2.6	.2
Westmoreland gravelly silt loam	8.8	22.0	66.7	2.3	.2
All other types	50.6	19.7	6.3	3.5	19.9
Total all types	39.6	29.8	24.5	2.7	3.4

grain lands and subsequently the western grazing lands has had a definite effect on the production of this area. Demand created by the World War caused a temporary reversal in land-use trends. New and old land was again devoted to grain production to meet the temporary demand. Consequently, much land has suffered severe erosion that might otherwise have remained in pasture or woods and escaped serious fertility losses.

Crops

Hay, corn, wheat, and oats are the most important crops grown on most farms, while truck and small fruits are important on some farms. All types of farms grew about the same kinds of crops but in greater or lesser proportions. The significant difference in the cropping patterns of different types of farms was the high percentage of erosion-inducing row crops grown on the small self-sufficing farms. A larger proportion of the land was devoted to semi-erosion resistant small grains. Erosion-resistant hay crops having fertility-building qualities were grown to a much less extent on the small farms. Such differences between dairy and general farms were slight, the erosion-resistance features being in favor of dairy farms. It is apparent that a much more intensive type of culture is practiced on farms of small area because they have insufficient land to provide pasture and other feeds to support greater numbers of livestock in a livestock type of economy.

A large percentage of the land is devoted to grain crops which do not fully protect the soil against erosion and which have a comparatively low-yielding capacity when compared to alfalfa and other legumes. Oats and wheat are especially low-yielding crops in this area and, in addition, are conducive to the deterioration of sloping soils. It is possible that alfalfa and other legume hays may take the place of an appreciable acreage of annual

TABLE 16—*Crops grown per farm in Moundsville project area, 1937*

Crop	General farms	Dairy farms	Self-sufficing farms	All farms
Acres of corn	6.0	6.8	4.4	6.0
Acres of wheat	5.1	4.7	2.7	4.6
Acres of oats	3.1	4.4	1.9	3.3
Acres of mixed hay	11.9	14.6	3.7	11.6
Acres of alfalfa	4.8	7.5	2.0	5.2
Acres of soybeans	.0	.4	.2	.2
Acres of other crops	3.7	3.4	1.9	3.3
Acres of all crops	34.6	41.8	16.8	34.2
Percentage of row crops	21.7	19.1	31.6	21.7
Percentage of non-sod crops	29.9	28.0	34.5	29.2
Percentage of perennial hays	48.4	52.9	33.9	49.1

TABLE 17—*Yields of major crops grown in Moundsville project area, 1937*

Crop	Unit	Yields according to type of farm			
		General	Dairy	Self-sufficing	All farms
Corn	bu.	36.4	39.9	30.8	36.8
Wheat	bu.	15.9	16.3	11.1	15.7
Oats	bu.	22.3	25.7	24.5	23.7
Mixed hay	T.	1.3	1.2	1.0	1.2
Alfalfa	T.	1.8	2.1	1.9	1.9
Oat hay	T.	1.0	.8	.6	.8
Soybeans	T.	1.6	1.8	.8	1.6
Crop yield index[1]		106.3	113.1	79.6	107.1

[1]Index for 1937, based on the state average yields from 1923 to 1932 as 100.

grains if dairy and sheep farming continue to dominate production programs. However, some annual grains will and should be grown, under proper cultural practices, for general farm and home use. The average farm cannot afford to purchase all feed for poultry, hogs, and other livestock which are to be used principally for home consumption in competition with the opportunities for raising some of the feed as part of the farming system.

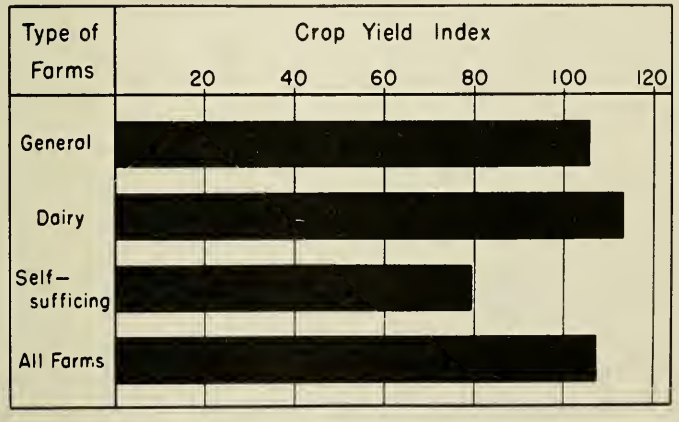

FIG. 4—*Average crop-yield index for farms of different types, Moundsville area, 1937*

Alfalfa and other legume hays have shown their superior yielding ability over mixed and grain hays, when soil and climate are suitable. Comparatively high yields as well as fertility-building and erosion-resisting characteristics make perennial legume hays desirable in a livestock production program. It is clearly evident that self-sufficing farms in particular are in need of crops which will produce higher yields.

Livestock

The average number of animal units on farms was 15.8, ranging from 5.1 on self-sufficing farms to 19.2 on dairy farms. Dairy cows and sheep were the major livestock enterprises on all types

TABLE 18—*Animal units of livestock on farms, Oct. 1, 1936*

Kind	Number of animal units on farms			
	General farms	Dairy farms	Self-sufficing farms	All farms
Dairy cows	4.9	11.7	2.4	6.7
Dairy heifers	.6	1.6	.2	.8
Beef cows and heifers	.1	.3	---	.2
Steers	1.5	---	---	.8
Other cattle	.6	.8	.2	.6
Hogs	.9	1.0	.4	.9
Sheep	4.9	1.0	---	3.0
Poultry	1.2	.6	.4	.9
Horses	1.9	2.2	1.5	1.9
Total	16.6	19.2	5.1	15.8

of farms, while dairy cows alone constituted 60 percent of the livestock on dairy farms. Dairy, sheep, and poultry production were all of importance on general farms. Self-sufficing farms maintained only a small number of cows, hogs, and poultry for farm family use.

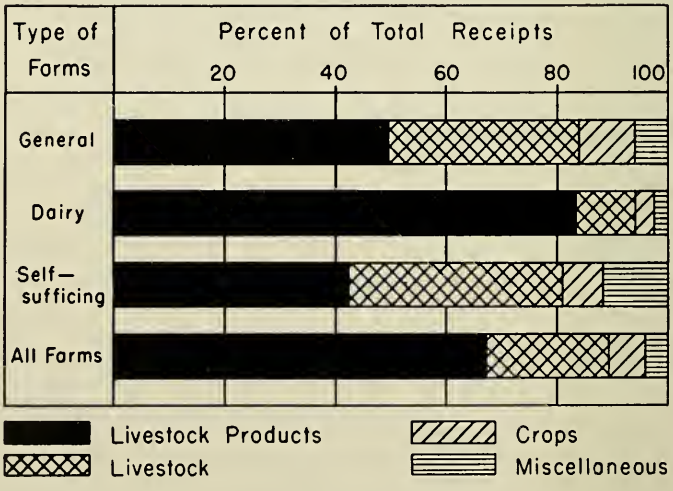

FIG. 5—*Proportion of receipts from various sources by types of farms in Moundsville area, 1937*

Most farms are small in size and maintain a corresponding number of animal units. The livestock program may appear small when compared to that of other areas where beef production is of major importance. The farms in this area are operated in an intensive manner, considering the small area available for crop production. The prevailing livestock production lends itself to further extensification of the supporting crop production. Especially on farms where wheat, corn, and oats have been fed to dairy cattle and sheep, it is possible that a higher-quality roughage may supplant the need for large quantities of grain.

FINANCIAL STRUCTURE OF THE FARM BUSINESS

The manner and extent to which the financial structure of the farm business is affected by a program of conservation are of considerable importance. A practical conservation plan should improve the financial status of farming over a period of years. It is pertinent at this point to describe the financial structure of the farm business in order that a reasonable determination may be made regarding the possible effect of the conservation program on farm income.

Practically 90 percent of all farm receipts was derived from livestock enterprises, the most important of which were dairy cattle and sheep. Poultry contributed a considerable share of the receipts on some farms. Crops and other minor sources made a sizeable contribution on a small number of farms. Truck-crop sales constituted the majority of crop sales.

TABLE 19—*Summary of farm receipts from various sources, 1937*

Sources of receipts	Average value according to type of farm						Average all farms	
	General		Dairy		Self-sufficing			
	Per farm	Per-centage	Per farm	Per-centage	Per farm	Per-centage	Per farm	Per-centage
Livestock	$368	34.7	$245	11.2	$86	38.9	$289	22.5
Livestock products	520	49.2	1812	83.3	93	42.0	859	66.9
Crops	109	10.3	70	3.2	16	7.3	84	6.5
Miscellaneous	61	5.8	48	2.3	26	11.8	52	4.1
Total farm receipts	$1058	100.0	$2175	100.0	$221	100.0	$1284	100.0

In comparing types of farming, dairy farm receipts were practically twice as large as those on general farms and ten times the amount on self-sufficing farms. Thus the relative producing capacity of dairy farms, compared to other types of farming, is much higher in this area.

Subsequent analysis of farming will portray more clearly some of the many factors which affect the profitableness of pro-

duction. In pointing out these factors the association of possible changes will be appraised according to their desirability in controlling erosion and conserving soil fertility.

TABLE 20—*Summary of current farm expenses, 1937*

Item of current expenses	Average value according to type of farm						Average all farms	
	General		Dairy		Self-sufficing			
	Amt.	%	Amt.	%	Amt.	%	Amt.	%
Labor	$208	33.5	$408	31.1	$119	30.5	$257	32.0
Feed	175	28.2	405	30.9	55	14.1	229	28.6
Seed and plants	36	5.8	48	3.7	32	8.2	39	4.9
Fertilizer and lime	26	4.2	43	3.3	10	2.5	29	3.6
Other	175	28.3	406	31.0	174	44.7	247	30.9
Total	$620	100.0	$1310	100.0	$390	100.0	$801	100.0

The major expense items on all types of farms consisted of labor and feed, while seed and fertilizer were of less importance. Both general and dairy farms purchased appreciable quantities of feed, the greater portion of which was concentrates. Although forage of fair quality is produced on the specialized dairy farms, it is quite possible that many farms may find less need for commercial feeds if they can improve the quality of forage.

In establishing conservation and fertility-building practices, certain expenditure is necessary for obtaining legume seed, lime, and fertilizer. These requirements are often looked upon as handicaps by farmers having a minimum of available financial backing. The operators of many small farms find it difficult to contribute as freely to a complete conservation program as may be possible for those having unencumbered cash or sufficient credit.

Financial Recapitulation

The investment in dairy farms was about 25 percent greater than that in general farms, but total receipts were practically twice as much as those of general farms. In the case of self-sufficing farms, an income insufficient to pay expenses was produced. However, these farms are not intended for and generally are not capable of producing more than a subsistence living. Most operators of these small farms depend on non-farm income for cash. However, there are some that have scarcely enough income from any source to support their dependents.

After charging 5 percent on the estimated investment for the use of capital, general and self-sufficing farms returned no labor income to the operator. Dairy farms returned an average operator's labor income of $232. When charges made for family labor were added to operator's labor income, both general and dairy

TABLE 21—*Financial summary of farm operations on 84 farms in Moundsville project area, 1937*

Item	Average for farms by type			Average all farms
	General	Dairy	Self-sufficing	
Total investment	$10,047	$12,633	$4,817	$10,100
Cash receipts	1,058	2,175	221	1,284
Inventory increase	273	367	129	282
Total receipts	1,331	2,542	350	1,566
Current expenses	619	1,310	390	801
Inventory decrease	27	18	8	21
Livestock purchased	93	120	50	95
Depreciation	152	230	88	167
Total expenses	891	1,678	536	1,084
Farm income	440	864	—186	482
Interest on investment (5%)	502	632	241	505
Operator's labor income	—62	232	—427	—23
Value of family labor	121	99	65	107
Family labor income	59	331	—362	84
Non-farm income	182	268	743	289
Perquisites[1]	491	528	375	486
Operator's earnings	611	1,028	691	752

[1]Includes farm produce, and house rent valued at 10 percent of value of dwelling.

farms made a return to family labor. If non-farm income, from industry principally, and the value of perquisites furnished to the farm family are added to labor income, farm operators of self-sufficing farms earned slightly more than those on general farms. Dairy farm operators earned an average total of $1028,

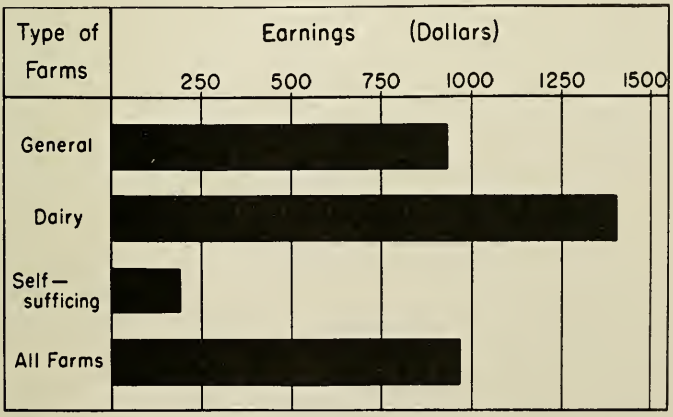

FIG. 6—*Average farm earnings of capital and operator by types of farms in Moundsville area, 1937*

compared to an average of $752 for all farms. General and self-sufficing farmers received operator's earnings of $611 and $691, respectively.

Certain Factors Directly Affecting Farm Profits

A number of factors which affect farm profits have a direct relationship to any program of conservation that is applied. Changes in the size of the current production unit or changes in size and type of enterprises will determine the sources and volume of income. The combination of factors and enterprises in the organization of the farm is important and must be considered in establishing a sound practical conservation program.

The various aspects of the farm business must be understood and recognized, along with the results obtained, in order that recommendations may be made wisely for improvement. The needs must be known before practical changes can be made in the combination and application of the various factors of production.

GENERAL FARMS

Scope of Business

General farms, like all other types of farms in the area, vary widely in relative income-producing capacity, according to size. Large farms permit livestock enterprises of greater volume. Hence more income can be produced if farms are operated to capacity and with a reasonable degree of efficiency. An extremely large investment carries with it the probability of earning a lower percentage of profit than one of medium size which can be worked and managed more efficiently by the average farmer. The important element in considering the size of farm is whether it provides the necessary resources in sufficient amount to make a reasonable return to the operator's labor and capital, in accordance with the type of production employed.

TABLE 22—*Acreage per farm in relation to other size factors and income of general farms*

Size of farms (acres)	Average investment	Average crop acreage	Average pasture acreage	Number animal units	Average farm income	Percentage earned on investment
1-90	$ 6,672	15	23	7.2	$189	2.8
91-180	7,687	38	52	14.5	441	5.7
181-over	17,366	54	127	31.6	766	4.4

In this area, livestock is of major importance on general farms as well as on dairy farms. Hence the amount of pasture and crop-

producing land available to support livestock will largely determine the volume of production. The data in Table 23 illustrate the relative importance of small pasture areas in compar-

TABLE 23—*Relation of pasture acreage and other factors to income on general farms*

Acres of pasture	Average farm area	Average crop acreage	Average number of animal units	Average farm income	Percentage earned on investment
1-30	68	18	6.4	$217	3.6
31-60	116	35	13.2	333	4.6
61-over	226	50	29.7	756	4.5

ison to large pastures in producing farm income. In other words, small pasture acreage is a limiting factor on small farms.

With sufficient land available, the most important need is enough animal units of either dairy cattle, sheep, poultry, or others, to consume efficiently the pasture, forage, and grain produced on the farm. Dairy cattle are the major source of income on general farms, and the volume of income, together with the

TABLE 24—*Relation of number of dairy cows and other factors to income on general farms*

Number dairy cows	Average farm acreage	Average crop acreage	Average pasture acreage	Number animal units	Crop yield index	Acres pasture per A.U.	Average farm income	Percentage earned on investment
1-3	80	17	31	6.5	83	4.8	$164	2.2
4-6	150	40	62	16.5	94	4.0	439	4.5
7-over	211	50	118	34.7	118	3.4	931	5.8

percentage earned on investment, follows directly the number of dairy cows maintained. Data in Table 24 illustrate the important association of large dairy herds with sufficient pasture and cropland of high yielding ability in producing efficiently.

TABLE 25—*Importance of volume of receipts and other factors in relation to income of general farms*

Gross farm receipts (dollars)	Average farm acreage	Average pasture acreage	Number animal units	Acres of pasture per animal unit	Average farm expenses	Average farm income	Percentage earned on investment
1-750	100	38	8.7	4.7	$521	$ 39	0.5
751-1500	107	49	12.3	4.0	726	379	4.9
1501-over	216	105	30.6	3.4	1503	968	5.9

In further emphasis of the importance of size of business, the data shown in Table 25 indicate a constant correlation between volume of production and the percentage earned on investment. It may also be noted that pastures of high carrying capacity were related closely to both volume of cash receipts and income.

Farm Organization

In organizing a farm it is important that effective ratios be maintained between the investment in land, buildings, equipment, and livestock. Too much of one and too little of another may result in an inefficient combination. The most profitable general farms studied exhibited a definite tendency to place more of their investment in productive livestock and good equipment, while less profitable farms consisted of more expensive land and buildings.

On general farms, where a number of livestock enterprises may be kept, it also is important to select the most profitable combination of enterprises. The more profitable general farms showed a tendency to combine larger dairy, sheep, and poultry enterprises, but raised practically no beef cattle. The farm units are entirely too small to raise beef cattle in sufficient numbers to be efficient. The greatest difference between the two groups was within the poultry and swine enterprises. These types of production are outstanding on the more profitable farms, denoting a tendency to vary somewhat from the pasture type of specialized livestock farming, probably because of lack of area. Although the proportions of the various grain and forage crops grown on high- and low-income farms varied only slightly, there was a tendency for all general farms to grow some grain for the support of swine, sheep, and poultry.

TABLE 26—*Comparison of combinations of livestock enterprises on high- and low-income general farms*

Income group	Average number of head on farms				
	Dairy cows	Sheep	Swine	Chickens	Beef cattle
23 farms—highest labor incomes	5.5	38.2	6.2	135	0.7
23 farms—lowest labor incomes	4.4	34.0	3.7	100	2.6

It may be noted from Table 27 that there was a definite tendency for the more profitable farms to depend on livestock products and truck crops for the greater proportion of their income. Dairy products and eggs, along with truck and small fruit, were raised in larger quantities and in greater proportions on the

TABLE 27—*Sources of cash farm receipts on general farms*

Income group	Livestock		Livestock products		Crops		Other sources	
	Amt.	%	Amt.	%	Amt.	%	Amt.	%
23 farms—highest labor incomes	$331	28.1	$665	56.4	$136	11.6	$47	3.9
23 farms—lowest labor incomes	405	43.2	374	40.0	82	8.8	75	8.0

more profitable general farms. Such enterprises furnish a rapid turnover and make possible a larger volume of business than is possible from raising beef cattle and steers on these farms. The practice of raising beef cattle was more prevalent on the less profitable farms.

Efficiency of Production

Since dairy production is exceedingly important on both general and dairy farms, the relative usefulness of pasture and cropland is significant. In Table 28 the 46 farms are grouped according to the number of animal units that were pastured per acre. The farms with the higher-quality pastures and the highest crop-yield index returned the highest percentage profit to labor and capital. This appears to be one of the most essential and fundamental requisites for the dairy and sheep farming of this area. There is general need for pasture and crop-yield improvement. The extent of such improvement is a managerial problem which must be solved by each individual farmer.

TABLE 28—*Importance of carrying capacity of pastures and other factors relative to income on general farms*

Acres of pasture required per animal unit	Crop-yield index	Average pasture acreage required per animal unit	Average farm income	Percentage earned by labor and capital
1.0-3.4	104	2.5	$751	8.6
3.5-6.8	99	4.8	324	2.8
6.9-over	65	8.8	186	2.2

DAIRY FARMS

Scope of Business

As was true of general farms, the size or scope of the dairy farm business was a major determinant of farm income. It is evident that land area is insufficient on many farms to make possible the production of a large volume of income. Hence the operators of many small farms do not produce enough to pay them much, if anything, for their management and labor, and

in many cases insufficient income is produced to pay a reasonable interest on the capital invested.

TABLE 29—*Association of income with various size factors constituting the organization of 26 dairy farms*

Acres in farms	Average investment	Average crop acreage	Average pasture acreage	Number animal units	Total receipts	Total expenses	Average farm income	Percentage earned on investment
1-75	$ 8,300	23	21	11	$ 941	$ 874	$ 67	.8
76-150	12,450	38	59	18	2134	1430	704	5.6
151-over	16,686	65	93	29	4673	2829	1844	11.0

Although the larger farms entailed greater investment, income increased more rapidly than the costs of operating the larger farms. Larger dairy farms provided more pasture and feed for the maintenance of a greater number of livestock. Livestock was the final producer of salable products which returned income. It may be noted that dairy farms of an average investment of $8,300 earned a farm income of eight-tenths of one percent on their investment, while farms averaging twice this investment earned 11 percent. It appears that the smaller farms, following the present production programs, are not capable of earning incomes comparable to the larger farms, but there is the possibility that many small farms might be improved by better organization and management.

The importance of sufficient pasture area has already been pointed out. Table 30 further emphasizes the effect of sufficient pasture acreage in supporting livestock. Since dairy cattle are the most important source of income on dairy farms, high-quality pastures must be maintained for efficient milk production. There is a possibility in improving the available pastures to some extent, thereby furnishing more pasture of higher quality on many small farms where area is scarce.

TABLE 30—*Association of profitableness with acreage of available pasture and other factors on dairy farms*

Acres of pasture	Acreage in farms	Number of animal units	Average receipts	Average expenses	Farm income	Percentage earned on investment
1-40	80	14	$1585	$1247	$ 338	3.9
41-80	129	19	2215	1433	782	6.0
81-over	212	30	5051	3043	2008	10.5

The number of dairy cows that can profitably be maintained per unit of land area is a very important economic factor on both general and dairy farms. Table 31 illustrates the importance

of the size of the dairy herd in producing income. The number of cows that can be maintained efficiently on available pasture and forage will determine the potential volume of farm production. Other factors, too, may determine the number of livestock that can be maintained, aside from pasture and feed available. Labor supply, barn facilities, and capital equipment are some of the items that may be controlling factors on many farms. However, from the standpoint of the present interest in soil conservation and the manner in which land is to be used, it is of special interest to treat in detail the limiting factors which relate directly to a program of conservation.

TABLE 31—*Importance of size of dairy herd relative to income and other factors on dairy farms*

Number of dairy cows	Acreage in farms	Acreage of pasture available	Average total receipts	Average total expenses	Average farm income	Percentage earned on investment
1-8	90	37	$1198	$ 884	$ 314	3.5
9-16	142	63	2631	1736	895	7.4
17-over	186	99	5113	3191	1922	9.1

Farm Organization

The relative proportions of the various constituent items making up the farm investment will, to some extent, determine the earning capacity of any type of farm. As was true of general farms, there was a tendency for the more profitable dairy farms to have a greater proportion of their investment in productive land, livestock, and dairy equipment. The less profitable farms seem to have a larger percentage of their investment in buildings. Good buildings are desirable, but without sufficient land and livestock of good quality such buildings and equipment are not proportionately productive.

TABLE 32—*Organization of investment on more and less profitable dairy farms*

Income class	Percentage of total investment in:				
	Land	Dwelling	Farm buildings	Live-stock	Other
13 farms—highest labor incomes	47.5	10.7	15.6	10.2	16.0
13 farms—lowest labor incomes	45.3	19.3	18.9	7.6	8.9

The more profitable farms earned about 11.5 percent on their investment, while the less profitable earned only 2.0 percent. The more profitable farms received 75 percent of their income from fluid milk, while the less profitable received only

TABLE 33—*Volume of cash receipts derived from various enterprises on dairy farms*

Income class	Amount per farm and percentage of cash receipts from:							
	Livestock		Livestock products		Crops		Other sources	
	Amt.	%	Amt.	%	Amt.	%	Amt.	%
13 farms—highest labor incomes	$311	10.1	$2668	86.7	$52	1.7	$47	1.5
13 farms—lowest labor incomes	179	14.1	956	75.2	88	6.9	49	3.8

56 percent of their receipts from this source. The less profitable dairy farms dealt in cattle to a greater extent, sold more crops off the farm, and depended on other general farm enterprises for a greater share of their income than was true of the more profitable farms. In addition, non-farm sources were depended on for cash income to a greater extent than was true of the operators of the more profitable farms. In summation, it seems that those dairy farmers giving most of their attention to a specialized enterprise, with a possible supplementary enterprise, produced the greatest return on their labor and capital. Specialized dairy production was much more profitable than general farming with dairying as a major enterprise.

Efficiency of Production

The data available do not permit thorough analysis of the efficiency of farm operation and management. However, the profitable production of milk depends on several major items, two of the most important of which are good-quality pastures and forage. The data in Table 34 indicate a definite tendency for farms having pastures of high carrying capacity, requiring only 2.5 acres of pasture per animal unit, to produce a greater percentage return on investment than those farms using 5 acres per animal unit. The high yielding quality of the more profitable pastures was coexistent with a high crop-yield index, as was true of general farms. Thus it seems that a high degree of efficiency in the production of livestock and livestock products was dependent upon high-yielding pasture and cropland.

TABLE 34—*Association of pasture quality with income on dairy farms*

Acres of pasture available per animal unit	Number of animal units	Farm income	Percentage earned on investment	Acres of pasture utilized per animal unit	Crop-yield index
1.0 to 3.4	22	$962	7.3	2.5	120
3.5 and over	16	730	6.0	5.0	103

It was noted that the proportion of total expenses for purchased feed was about 11.0 percent less, or about $4 less per animal unit, on the more profitable farms which had the higher crop and pasture yields than was true of the less profitable, low-yielding farms. Although there may be many limiting factors on the low-income farms which prevent capital improvements, it seems that one positive means of increasing the income would be by increasing the fertility and checking the depletion of the pasture and cropland. The extent to which this is feasible depends upon the resources available and the practicability of each individual case.

SELF-SUFFICING FARMS

Self-sufficing farms of two types are common in the Moundsville area. The *first* is a part-time type by which a small farm is maintained as a homestead and a source of food, while industrial or other non-farm employment is relied on as the major source of cash income. The *second* type resembles the self-sufficing low-income farms in other parts of West Virginia. In these cases the farm, generally of low productive capacity, is the only source of income. Because of small size and low fertility, it cannot be expected to produce more than a subsistence. However, farms of the latter type are not common, except on some of the poor land situated more remotely from the industrial centers.

The livestock maintained on these farms consisted of an average of 2 cows, 3 hogs, 36 chickens, and 1 or 2 horses. Frequently 3 cows were kept. This livestock furnished food to the farm family and some cash income. The major portion of the cash farm income was derived from milk, butter, cream, eggs, truck and small fruits, poultry, and some other livestock. It is quite probable that most farms of this type could increase their production by raising more poultry, small fruits, and truck. The size and character of these farms prohibit expansion in most other enterprises.

The greatest need for most small farms that have been farmed intensively and received a minimum of care is improved soil fertility. Both crop and pasture yields have been exceedingly low. The crop-yield index was 27 points less than the average for all farms, and pasture yields were equally low. Erosion control and fertility-building practices should aid appreciably the future welfare of the small, low-income farmers.

The Recommended Program of Soil Conservation

Variations in soils, slope, and erosion necessitate a complex program of conservation on farms of this area. It appears desirable to set forth more specifically the erosion-control methods

recommended by the Soil Conservation Service for the various slopes: (1) Land with less than 5 percent slope, constituting only small acreages, needs practically no special control measures in this area. (2) Slopes of 5 to 15 percent may generally be used for crops without serious erosion damage if the proper protective measures are used. Crop rotations should be employed on all cropland to build the organic content of the soil. Winter fallowing should be avoided by using cover crops. All crops should be planted and tilled on the contour. Strip cropping may be necessary on slopes of over 5 percent, depending on local field conditions. (3) Slopes of 15 to 25 percent require all of the above suggested practices and controls when used for crop production. Contour strip cropping with alternating sod and grain strips should be used when cultivated crops are grown on this class of sloping land. Land of this steepness has been depleted badly and shows definite need of lime and phosphorus. Where such land must be used for crops on long slopes, diversion terraces and sod waterways may be found necessary to prevent the accumulation of run-off and the subsequent gully forming during heavy rainfall. Fertility-building practices are seriously needed on practically all land having more than 5 percent slope. In all cases where erosion has been "severe," retirement to meadow or pasture is advisable. (4) The general recommendation for use of slopes of 25 to 40 percent is pasture. Their greatest needs include lime, phosphorus, and in many cases reseeding to establish a good stand of desirable pasture grasses. Systematic fertility treatment, rotational grazing, and specific management practices adapted to seasonal requirements are needed on all pastures. Contour furrows, diversion ditches, water spreaders, and other engineering measures have been used on the steeper pastures to prevent excessive run-off and to increase the percolation of water into the soil. It is often necessary to give special treatment to severely eroded pastures. Gullies and steep bluffs require a growth of tap-rooted trees for preventing "slips" and for holding the surface soil in place. (5) Slopes of over 40 percent should generally be used for forestry unless the soil is fertile enough to produce a good protective pasture sod. The same is true for badly-eroded slopes of less than 40 percent that cannot be made to produce good pasture. In places where the soils have been depleted of fertility to the extent that cultivated crops and pasture cannot be grown efficiently, forestry is the last resort. It is essential that an effort be made to separate pastures and forests. Young trees cannot be produced under the trampling and grazing of livestock.

The Moundsville area is not suited to extensive production of intertilled and small-grain crops. Grains can be purchased to a greater advantage than hay. Hence hay should be produced in

sufficient volume to supply all needs. The most suitable land remaining should be devoted to the production of grains for home and farm use. Cash grain production is uneconomical.

EROSION-CONTROL MEASURES

In accordance with the foregoing recommendations, a brief account of the actual application of various practices and control measures is necessary to explain sufficiently the implications thereof. At the close of the fiscal year, June 30, 1938, the Soil Conservation Service had signed cooperative working agreements with 131 farmers, controlling 46 percent of the 27,267 acres in the area. The recommended treatment for erosion control has been completed on approximately 27 percent of the entire area. A complete conservation survey has been completed for the project, including cooperating and non-cooperating farms.[7]

Cropland

The primary objective of the program is a decided reduction of annual cultivated cropland. This program conforms with but speeds up the natural tendency in this area towards a reduction of cultivated cropland. Erosion is becoming so acute that crop production is undesirable and unprofitable on much of the land. Accordingly, the future plans call for a decrease in cropland of 22.7 percent for the farms under agreement. Clean tilled crops are planned to be reduced 39.8 percent, and semi-erosion resistant small grains reduced 14.6 percent. Low-yielding hays are to be replaced where possible with permanent legume forage. All changes anticipate complete compliance with the planned programs.

The land maintained in crops is to be placed under complete rotation management and will be contour-tilled to prevent washing. The acreage planned to be strip cropped is 2,464, compared to 95 acres tilled in this manner prior to the replanning of farms. Field arrangement, removal of obstructions to proper cultivation, diversion ditches and water-outlet structures for removing excess water without damage, and gully control are included in the control measures that are used in critical locations where needed in addition to cropping practices.

The entire cropping program is planned for a period of five years, covering liming and fertilizing, cultivation and seeding, and rotations for each of these demonstration farms. Only the land of sufficiently high yielding capacity was maintained for production of annual crops. Lower-quality cropland was diverted to perennial production, designed to protect and improve

[7]Data adapted from Annual Report of Operations, Soil Conservation Service, Project West Virginia 2, Moundsville, West Virginia, June 30, 1938.

productive capacities. The major crops to be grown include corn and wheat for farm and home use; hay crops to be grown in rotation on cultivated land; and the small area of garden and truck crops desired. Practically all oats will be eliminated from production programs because of its low yielding ability and its non-erosion resistant character. When annual crops are produced, they will be accompanied or followed immediately by erosion-resisting cover crops, which will protect the land from erosion during the fall and winter. An attempt will be made to protect cropland at all times from erosion by growing adequate cover of the proper type.

Permanent Hay Land

Permanent hay land is land on which the principal production will consist of perennial hays. The only time such land will be broken will be for renewal seeding. The more desirable land, not used for crop production, has been planned to produce perennial or permanent hays. This type of production has been increased from 393 to 1,297 acres, or 230 percent. A total of 979 acres of cropland has been diverted to hay land. Permanent meadows have been fertilized, limed, and seeded where necessary to produce desirable yields. Critical portions of such lands are additionally protected by diversion terraces and drainage structures on limited areas. The utilization of sloping cropland for perennial sod crops will serve as a protection against erosion and at the same time strengthen the basis for profitable livestock production.

Permanent Pasture Land

In accordance with the reduction in acreage of cropland and the increase in permanent hay land, the cropping program has been balanced by an increase in pasture. Both area and quality of pastures are planned to be increased. The acreage of permanent pasture has been increased about 12 percent. More than 1,300 acres of low-quality hay and cropland have been properly prepared, fertilized and limed, and seeded to desirable pasture grasses. Lime and fertilizer were applied according to the need of specific areas. In all, more than 5,500 acres of pasture land have been placed under properly planned and managed control. Excessive pasturing, especially during critical seasonal periods, is to be guarded against, and rotation management will be followed where possible.

Contour furrows, and planting of steep bluffs to trees, are included in the erosion-control programs for additional protection of slopes against severe erosion.

FIG. 7—*The neglect of pastures has resulted in reducing both quality and yield. Many acres of once good pasture land have been badly sheet eroded and practically destroyed*

FIG. 8—*Good pasture management together with erosion prevention by contour furrows results in preventing sheet erosion and conserving lime and fertilizer*

Woodland

Most farms of this area include some land that is too steep and too eroded to be suitable for any use except the growing of a desirable type of forest. Consequently, such land has been planted to forest trees which will adequately protect the land and eventually constitute a supplementary income to the farm. A total of 1,800 acres of crop, hay, and pasture land has been converted to woodland. Old and new woodland is protected from grazing by fences for the prevention of erosion and for the protection of seedling trees which are usually destroyed by grazing livestock.

Other Land

Abandoned and idle land, which usually is severely eroded and possesses insufficient cover for protection against erosion, is converted to some desirable use. Generally it is planted to trees because of the serious degree of erosion usually characterizing unused land. If, for other reasons, reasonably good farm land is idle, it is provided with a desirable cover for protection against erosion.

Miscellaneous Operations

With the assistance of labor furnished by the Civilian Conservation Corps, 4,710 tons of limestone have been burned or pulverized; 21,593 rods of fence constructed; 623 permanent and temporary gully dams built; and 84,754 linear feet of diversion ditch constructed. Erosion control has been aided and accomplished by leveling and planting or seeding severely eroded areas. Every individual problem is treated according to specific needs.

The entire conservation program has been designed to give erosion control and water conservation to all land, regardless of its utilization. Thus it includes the entire farm and recognizes the individual needs of every farm business.

PROGRESS OF CONSERVATION TO DATE

A program of soil and water conservation obviously cannot be fully completed within the short period of two years. The nature of the farming business prohibits immediate shifts from one practice to another. Financial and physical handicaps obstruct progress. Depletion and erosion of soil may take place very rapidly under poor management, but fertility building and conservation may take a comparatively long period to become fully effective.

However, after a period of two years following the inauguration of the Moundsville soil and water demonstrational project,

TABLE 35—*Changes in land use on 84 farms in Moundsville project area, 1935 to 1937*

Land use	Acres per farm		Percentage of all land		Percentage of change in acreage
	1935	1937	1935	1937	
Crops	41.4	33.9	32.8	26.7	—18.1
Permanent pasture	60.0	57.2	47.6	45.1	— 4.6
Woods pastured	12.1	9.7	9.6	7.7	—19.8
Woods not pastured	8.9	17.4	7.1	13.7	+95.5
Other land	1.5	6.5	1.2	5.1	_____[1]
Farmstead, roads, etc.	2.2	2.2	1.7	1.7	_____
Total	126.1	126.9	100.0	100.0	_____

[1]The increase in acreage shown for other land is land which is in the process of being changed from one use to another.

the annual farm survey indicated certain tendencies which are of some significance. A definite shift in land use is already in evidence. Low-yielding cropland has been diverted to meadow or pasture, which will protect it from further erosion and enhance its productive ability. With the aid of hay and pasture improvement, more feed of higher quality for livestock may be produced by eliminating comparatively low-yielding grain crops in favor of higher-yielding legume hays.

More interest is being shown in woodland than has been true during past years. Severely eroded meadow and pasture land has been diverted to forest plantings for protection and soil building. Woodlots are being protected from grazing in order that new trees of a desirable nature may be permitted to grow.

TABLE 36—*Character of crops grown with respect to comparative resistance to erosion during the years 1935 to 1937*

Class	Acreage per farm[1]		Percentage of all cropland		Percentage of change in acreage
	1935	1937	1935	1937	
Erosion-resistant	19.0	16.8	45.8	49.1	—11.5
Semi-erosion-resistant	12.1	10.2	29.1	29.8	—15.7
Non-erosion-resistant	10.4	7.2	25.1	21.1	—30.1
Total	41.5	34.2	100.0	100.0	—17.3

[1]Includes acreage double-cropped.

In addition to general land-use diversions, the farmers are gradually deleting from their cropping plans certain types of crops which are conducive to erosion. In their place, erosion-resistant crops have been substituted, according to data shown in Table 36. The acreage of corn was reduced from 9.0 acres

per farm to 6.0, a reduction of one-third. Oats was reduced in about the same proportion, while practically no change was noted in wheat acreage. Mixed-hay acreage was reduced in favor of more alfalfa and pasture on land which was seriously sheet-eroded. The slight increases in grain hays may be attributed to droughty seasons which produced grains of very low quality that were prematurely harvested as forage. This practice is not usually followed in the area.

The above changes appear to be favorable to conservation. Corn is particularly conducive to erosion and soil depletion on the sloping land of this area, and yields are comparatively low on the less fertile land. Spring oats has generally followed corn in the rotation. Thus the land has been allowed to lie fallow during two-thirds of the year. Consequently erosion has been accelerated on cropland. Because of the characteristics of its culture, together with the comparatively low yielding ability of oats, it probably would be well to eliminate this crop completely. Other crops may be grown which produce greater value per acre.

In the case of grain production, the effects of the above changes have been threefold: (1) Land-use diversion has shifted grain production to only the more productive land. (2) Changes in type of grains grown indicate a tendency to devote less land to the comparatively less productive crops, which result in inefficient and deteriorating use of soil. (3) The diversion of grain land to legume-forage land will gradually improve the productive capacity of all cropland, as the rotation of soil-building crops is completed. In this connection there has been an additional benefit in the form of higher-quality hay. Alfalfa and clover hays yield more per acre and have a higher nutritive value than much of the mixed hay grown on these farms during past years.

TABLE 37—*Acreage of crops on 84 farms in Moundsville project area, 1935 and 1937*

Crop	Acres grown per farm		Percentage of all cropland		Number of farms reporting	
	1935	1937	1935	1937	1935	1937
Corn—grain	7.6	5.0	18.3	14.6	77	76
silage	1.4	1.0	3.4	2.9	25	22
Wheat	4.3	4.3	10.4	12.6	42	56
Oats	3.8	2.5	9.2	7.6	42	41
Mixed hay	14.8	11.6	35.7	33.6	76	70
Alfalfa	4.2	5.2	10.1	15.2	45	58
Soybeans	0.6	0.2	1.4	0.6	15	6
Wheat hay	0.1	0.3	0.2	0.9	2	5
Oat hay	0.7	0.8	1.7	2.3	15	18
Truck and orchard	4.0	3.3	9.6	9.7	84	84
Total	41.5	34.2	100.0	100.0	84	84

FARM PLANNING FOR CONSERVATION

The success of the conservation program depends, to a major extent, on the manner and thoroughness of farm planning. Each farm is an individual production unit which must be considered both from the standpoint of immediate and long-time economic production. The application of generalizations to farm planning is possible only in exceptional cases. Many human, economic, and physical factors, which vary greatly from farm to farm, must be considered in developing and completing a plan of conservation on privately-owned, family-size farms. The most important factor in the development of such plans is that of completeness—a well-rounded program including all phases of farm production. Land use must be adjusted to the needs of the farm family, including crop and animal production, in the manner that will produce most economically and efficiently over a long period of time. Local and individual needs will vary production requirements considerably. Erosion should be eliminated to the optimum extent, while production needs are being satisfied. There are instances where it is probably inadvisable to carry conservation to the extreme in favor of an unforeseeable future.

Specifically, one of the most important considerations in "conservation improvement" concerns the balance of *outputs* and *inputs*. Economic farm production depends on the efficient use of inputs in producing desirable outputs. The farmer must utilize the resources at hand, through proper management, to achieve a surplus of outputs. Incidentally, the factor of management, even after a good plan has been developed, will determine the success or failure of a farm enterprise. Hence, if the major need of a farm business is increased volume and efficiency, and the resources are made available for this added production, it is the farmer's responsibility to utilize the resources to the greatest advantage. Conservation alone is not going to increase profits. It is a foundation for the farm business which must be managed and utilized.

With specific reference to the discussion of farm planning as treated in the following examples, it is important that the plan be developed so that it may be carried over an indefinite period of years without inconveniencing the production program of any particular year. In computing five-year programs it is quite possible that suitable rotations may be developed which are entirely satisfactory for a given period. At the expiration of the five years the proper balance between various types of crops may not be maintained, principally because a lack in the continuity of planning has failed to provide land available for all necessary crops when the rotation changes. This error must be guarded against.

The following examples illustrate the type of land use and cropping plans that are being adopted in this area. Table 38 illustrates the cropping plan for a 108-acre self-sufficing general farm. Heretofore, yields of crops have been below average, and not enough livestock was maintained for needed income. The new program plans an increase in pasture and forage acreage which facilitate needed livestock production. In addition, pasture treatment with lime, fertilizer, and seed, protection from excessive grazing, and a higher quality of legume forage will increase the comparative productive efficiency of land that has been devoted to less productive, low-yielding grains. Thus less land will be devoted to corn and wheat, and spring oats will be eliminated from the cropping plan entirely.

TABLE 38—*Cropping plan for 108-acre general farm*

Crops grown	Acreage of production in:					
	1936	1937	1938	1939	1940	1941
Woodland	37.0	38.0	38.0	38.0	38.0	38.0
Pasture	21.0	21.0	27.5	27.5	27.5	27.5
Hay	16.5	19.0	26.5	26.0	27.0	26.5
Winter grain	15.5	10.5	3.0	3.0	3.5	2.0
Spring grain	2.5	6.5	---	---	---	---
Corn	2.0	3.0	3.0	3.5	2.0	4.0
Truck and homestead	13.5	10.0	10.0	10.0	10.0	10.0
Total	108.0	108.0	108.0	108.0	108.0	108.0

However, sufficient corn and wheat is retained on the most productive land for general farm needs. All grains will be grown in a legume rotation, which should build fertility and increase crop yields. Strip cropping of sloping cropland will protect it from excessive erosion during the growing seasons of corn and wheat. In this manner the entire farm has been replanned for better land use in order that the productive efficiency might be increased and livestock production facilitated.

TABLE 39—*Cropping plan for 218-acre general farm*

Crops grown	Acres in various years						
	1935	1936	1937	1938	1939	1940	1941
Woodland	75.0	75.0	75.0	75.0	75.0	75.0	75.0
Pasture	64.0	64.0	92.0	92.0	92.0	92.0	92.0
Hay	47.0	52.0	12.0	31.5	36.0	36.0	35.5
Winter grain	16.0	---	25.0	9.0	5.5	4.5	5.5
Spring grain	---	8.0	---	---	---	---	---
Corn	11.0	3.0	9.0	5.5	4.5	5.5	5.0
Truck and orchard	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Farmstead	1.0	12.0	1.0	1.0	1.0	1.0	1.0
Total	218.0	218.0	218.0	218.0	218.0	218.0	218.0

In Table 39, the plan of a 218-acre general farm is shown. The major changes brought about by the conservation plan include diversion of less productive cropland to forage and pasture for protection against excessive erosion and fertility depletion. Coincident with this benefit the productive efficiency of a larger livestock program, which is needed, will be increased. More pasture and forage acreage of higher quality has been needed. Wheat and corn acreage has been retained in sufficient volume to suffice the general grain needs of the farm poultry, hog, and other livestock enterprises. Management practices including crop and pasture rotations, strip cropping, prevention of excessive grazing, liming, and seeding of cropland diverted to pasture will undoubtedly enhance the production of all crops. Thus the major enterprises, dairy and sheep, may be expanded. Both labor and capital may be utilized more efficiently.

TABLE 40—*Cropping plan for 159-acre dairy farm*

Crops to be grown	Acres during years					
	1937	1938	1939	1940	1941	1942
Woodland	40.5	42.0	42.0	42.0	42.0	42.0
Pasture	48.0	55.5	55.5	55.5	55.5	55.5
Hay	44.0	43.0	44.0	46.5	47.0	46.0
Wheat	13.0	6.0	6.5	5.0	4.0	4.5
Oats	1.5	---	---	---	---	---
Corn	6.0	6.5	5.0	4.0	4.5	5.0
Other crops	3.0	3.0	3.0	3.0	3.0	3.0
Farmstead	3.0	3.0	3.0	3.0	3.0	3.0
Total	159.0	159.0	159.0	159.0	159.0	159.0

The 159-acre dairy farm illustrated in Table 40 has been improved similarly by pasture and forage improvement. Only slight acreage diversions have been planned in favor of more suitable land use. Milk production and the supplemental sheep and poultry enterprises will benefit by more efficient production of basic feed requirements and by virtue of higher-quality

TABLE 41—*Cropping plan for 50-acre self-sufficing farm*

Crop grown	Acres in various years					
	1936	1937	1938	1939	1940	1941
Woodland	3.0	3.0	3.0	3.0	3.0	3.0
Pasture	18.5	18.5	18.5	18.5	18.5	18.5
Hay	13.0	13.5	15.5	17.5	18.5	17.5
Winter grain	3.5	2.5	6.0	4.0	3.0	3.0
Spring grain	1.0	5.5	---	---	---	---
Corn	5.5	3.0	3.0	3.0	3.0	4.0
Other crops	4.5	3.0	3.0	3.0	3.0	3.0
Farmstead	1.0	1.0	1.0	1.0	1.0	1.0
Total	50.0	50.0	50.0	50.0	50.0	50.0

legume forage. All cropland will be strip cropped, and pasture will be limed and managed to increase production and conserve soil fertility. The entire cropping program has been properly balanced according to annual requirements of forage and grains. This organization facilitates a well-rounded production program, which will undoubtedly increase farm income.

The small self-sufficing farm illustrated by the cropping plan in Table 41 is unusually interesting because of the program of conservation that has been developed. Farms of this type need grain for farm and family consumption. Owing to the fact that a very small volume of cash is available, necessary grains cannot be purchased. The fact that such production can be possible in these cases constitutes the possibility of existence for many low-income people. Corn, wheat, hay, and pasture are all as necessary for small farms as they are for larger units, and perhaps more so.

This has been accomplished in a commendable fashion while conservation and erosion control are being attained. Strip cropping to retard excessive run-off constitutes the major conservation measure used on this farm. Practically all land is sloping. Hence, contour cultivation together with improved soil cover should accomplish a reasonable amount of erosion control. Treatment of pasture and forage land with lime and fertilizer will enhance soil cover and efficient crop production as the rotation becomes effective. Oats has been eliminated from the cropping program because of its comparatively low productive ability and lack of ability to prevent erosion. A well-balanced cropping program should make possible more efficient production of both livestock and crop needs of this self-sufficing farm family, and the proper safeguards against erosion and soil depletion will prolong the productive ability of farms of this type.

TABLE 42—*Percentage of change in crop acreage for four farms according to planned programs*

Acres in farms	Percentage of change in acreage		
	Pasture	Hay	Grain
108	+30	+60	—70
218	+40	+25	—60
159	+16	— 5	—53
50	0	+35	—30

It may appear that decided changes in proportion of crops grown such as those shown for the four farms would entail radical changes in farm organization. However, for the majority of this area, the type of farming is well adapted to conserving practices. It has been shown that livestock is the dominant source

of income and that resources for livestock production are the limiting factors on many farms. Further inspection will show that the changes made are, in most cases, in line with greater efficiency in this type of production.

An increase in quantity and quality of pasture and forage undoubtedly will increase the efficiency of livestock production. It also permits the expansion of livestock enterprises where other resources permit. Two of the farms illustrated have found it possible already to add two animal units to their livestock enterprises.

The increases in acreage of hay and pasture necessitate a corresponding decrease in oats, wheat, and corn. Oats has been used as feed for farm horses, but because of its lack of comparative advantage in yields and erosion resistance, this crop has been eliminated from the rotation. Other grains, together with a good quality of legume hay, are entirely satisfactory as a substitute for oats in maintaining draft animals. In fact many farmers in the area feed no oats to horses.

Wheat has been produced as food for the farm family as well as livestock. Wheat raised in excess of domestic consumption has been sold in past years, a practice which is a remnant of a more definite grain type of farming in earlier years. The four farms illustrated sold one-third or less of their wheat production in 1936. Since wheat, as a cash crop, lacks economic advantage compared to forage and livestock production, the reductions in wheat acreage do not appear to be excessive. Enough has been maintained in the cropping plan to satisfy home and farm needs.

Corn has been grown on practically all farms in the area and has been depended on as a feed for all animals. Because of erosion and soil depletion, yields have been low; consequently larger acreages have been devoted to this crop than necessary. Corn has been shown to respond quickly to soil-conserving practices, especially where fertility has been low. Thus conserving practices may safely be expected to result in an appreciable increase in corn yields. Furthermore, less corn will be needed on many farms in lieu of the increase in quality of legume hay, which has been lacking. Corn has been fed as a supplement to poor-quality hay.

The changes involved in rations, in general, are desirable and fit well with the most suitable type of farming. Dairy production in the area is in greater need of higher-quality forage and pasture than it is of grain. Hence the reduction in acreages of certain crops, where properly balanced, will not involve major shifts in sources of income, but will aid in desirable complements to the prevailing sources of income.

Conclusions

CERTAIN ECONOMIC ASPECTS OF SOIL CONSERVATION

A. Some objectives of the soil-conservation program are hereafter evaluated in light of the major factors affecting agricultural production in this area. The relationship and possible effect of conservation on the farm business are important. Practicability is a requirement of all conservation measures. Economic security for the farmer is the ultimate goal.

(1) The determination of the most appropriate use of land is basic and fundamental to conservation. Critical slopes, character of soil, extent of erosion, and past treatment make determinations of future land use essential. The most appropriate use of land will undoubtedly solve many of the present problems of farming: (a) Elimination of misuse and abuse of land will prolong the productive life of farming. (b) Labor and capital, which has in many cases been expended on low-quality land, will return the optimum production if used on the best land. (c) Higher yields of crops and pasture on the most suitable land will return a greater volume of high-quality production. (d) The most appropriate cover for all land will prevent erosion and will aid in retaining soil fertility and moisture for growing crops. (e) Total income from land over a 50- or 75-year period should be greater under a conserving system of management.

(2) Coordination of all land-use enterprises by systematic management and using crops of greater comparative yielding ability will return the most efficient total production. (a) Rotation of various types of suitable crops will improve and conserve soil fertility and result in higher yields and greater economy in production. (b) Comparatively low-yielding crops such as oats will be eliminated with a saving of input per unit of output. (c) Pasture rotation and management will conserve productive ability and increase total production of better-quality pasture. (d) The application of lime and fertilizer to both pasture and cropland will increase quality and quantity of feed necessary for livestock production and also aid in the control of erosion. (e) Care and management of woodland that has generally been ignored will provide farms with needed timber and cash income, aside from usual resources. Growing instead of buying fence posts and lumber will make possible more frequent repairs that have been lacking on many farms because of a scarcity of cash. (d) The use of all land, eliminating idle and waste land, for some productive purpose will aid in maintaining the greatest potential income per acre of farm land while retarding serious accelerated erosion.

(3) Appropriate engineering and cultivation practices will aid in soil and water conservation and in checking soil losses. (a) Contour strip cropping of sloping farm lands will eliminate up- and down-hill cultivation of long slopes, which has heretofore been responsible for the destruction of much agricultural land by accelerated erosion. (b) Engineering structures,[8] including contour furrows and diversion terraces, should eliminate gullies and reduce sheet erosion to a minimum by retaining a maximum portion of rainfall on the slopes for slow percolation into the soil. In addition to improvement of farming conditions these soil- and water-conserving measures undoubtedly will lessen the seriousness of floods and soil deposits on lower-lying lands. The food and raw material supply for the cities as well as rural communities depends on the care and attention given to sloping lands that have been grossly neglected in the past. Thus the entire program is of utmost importance to urban populations as well as to rural people.

B. The economic analysis of organization and business for the three major types of farms pointed out serious handicaps to profitable agricultural production on many farms. Many of them were a result of the lack of conservation and can be partially or entirely overcome by replanning and adopting conservation practices.

(1) The size of business is an important factor of production. Many of the general, dairy, and self-sufficing farms evidenced a definite lack of size, both from the standpoint of area, amount of livestock, and total production. Although area in farms can seldom be altered immediately, there are other ways of increasing production without increasing acreage. The volume of production is the important factor.

Regardless of the type of farm, additional pasture and forage would aid in expanding the dairy and sheep enterprises when needed. These items have been shown to be lacking on low-income farms. It has also been shown that the soil conservation agreements provide for pasture and forage improvement by liming, fertilizing, protection, management, and seeding of comparatively higher-yielding pasture grasses and legume hays. In many instances additional pasture and meadow are provided by diverting land to more appropriate use. Thus it should be possible to increase the number of dairy cows, sheep, or other livestock where the conservation plans are followed. According to statistics gathered from successful farms it is more profitable to produce in medium-to-large units than in small units. Hence greater potential production per unit of input should result.

[8]Furrows and terraces may induce "slips" on steep slopes by retaining excessive amounts of free water in soils underlain by shale or other impervious material.

(2) The next most important factor having a correlation with low income was low crop and pasture yields, which cause inefficiency in the business enterprises. Lime and fertilizer will directly improve the quantity and quality of production of both pasture and forage, while conservation and fertility-building legumes will increase the productivity of all cropland as the rotation becomes effective. Reseeding of pastures where needed and the seeding of high-yielding legume hays rather than timothy will increase the comparative efficiency in the use of all elements of production. More output per unit of input will result.

The growth of the various types of crops on the most suitable land and the elimination of low-yielding oats from the rotation will improve productive efficiency and increase total output. These improvements together with other conservation measures will enable expansion of enterprises that are needed for higher income on all types of farms.

(3) The production of higher-quality legume hay should eliminate the necessity for purchasing large quantities of feeds necessary on many dairy farms heretofore. Less cash outlay will be necessary; at the same time, forage can be produced more efficiently than grains. However, grains for general farm production are planned to be produced on suitable land. The acreage devoted to grain production has been reduced on most farms, but after the rotation and improvements become effective, the increased yields may partially compensate the loss from reduction in acreage.

(4) There are no statistics available which indicate the cost of installing the entire conservation program in comparison to the value of resulting production. However, observation and farmers' opinions indicate that practically the entire program may be applied to the majority of farms at a cost within reach of the average farmer. The cost of building productivity on a badly depleted farm is a serious handicap for the low-income farmers. In such cases it may take longer to establish a complete program. It cannot be expected that a farm subjected to years of depletion will instantly regain a high state of production. From all indications the increase in efficiency and volume of production will equal immediate outlay within a relatively short period of time.

It is apparent that many farmers having a minimum of income will be forced to return a larger proportion of their income to the farm. Farm resources consisting of soil, buildings, fences, and machinery have depreciated rapidly because the production that should have been returned to the farm business for repair and replacement has been spent for relatively nonproductive items. Too many families have lived beyond the sur-

plus production available for luxuries, and have robbed the farm resources. The cost of replacing those resources is expensive. It is entirely possible that many rural families will be forced to develop a keener appreciation of the value of land. More frugality and less prodigality will be necessary in utilizing the agricultural resources by our farm families.