SOIL CONSERVATION IN THE LOESS HILL REGION OF THURSTON COUNTY, NEBRASKA

By

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Bachelor of Science in Agriculture

Oklahoma Agricultural and Mechanical College

Stillwater, Oklahoma

1950

Submitted to the Department of Agronomy

Oklahoma Agricultural and Mechanical College

In Partial Fulfillment of the Requirements

for the Degree of

MASTER OF SCIENCE

1951

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INTRODUCTION

Improper land use, such as farming with the slope of the land (particularly on slopes over 5%), improper cultural practices, over-grazing, lack of systematic crop rotations, failure to apply barnyard manure and to sow and turn under a green manure crop, burning of crop residues, improper maintenance of natural waterways, almost total lack of diversion terrace construction, and generally little thought toward the future productivity of the land, have all contributed materially to accelerated erosion of the brown loess hills of Thurston County, Nebraska.

The producing ability of the soil has declined rapidly because of soil and moisture losses. (53) Approximately 70% of the lands supervised by the Winnebago and the Omaha Indian Agencies have been farmed by tenants under a system not conducive to the maintenance of soil fertility and the prevention of soil and moisture losses. (34) Sheet erosion has removed much of the topsoil. Gullying, a serious menace often leading to permanent abandonment of farm lands, is accepted locally as one of the evils of farming. Flash floods are increasing in frequency and intensity, and this increase is due largely to a reduction in the capacity of the soil to absorb the water when and where it falls.

METHODS OF PROCEDURE AND SOURCES OF DATA

Much of the material for this thesis was obtained from a careful study of actual conditions on 125 representative farms in the area. Questions in the form of a questionnaire concerning soil erosion, cropping systems, crop acreage and yields, and general management of the land were asked of each farmer. This personal interview was supplemented by information from various technical publications. In addition to the above, numerous conferences were held with Soil Conservation men in the Loess Hill region in Iowa and Nebraska.

Surveys were made of each farm used in the study in order to determine general topography, degree of erosion, and other soil conserving practices that have been and are in use at the present time.

Much valuable information was obtained from Mr. H. E. Neilson of the SMCO*, Indian SCS*, Winnebago, Nebraska; and from Mr. George Gregory, SCS, Walthill, Nebraska. Both are soil conservation men for this area.

A careful study of the data secured from the interviews with the 125 farmers and from the survey of their farms has revealed an abundance of information relative to soil conservation practices within the area. A copy of the questionnaire used in this study will be found in the Appendix to this thesis.

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* Soil and Moisture Conservation Office
** Soil Conservation Service

DESCRIPTION OF AREA

Thurston County is located in the northeastern part of Nebraska. The Missouri River is its eastern boundary. It has an area of approximately 249,000 acres. About 90% is farm land, the remainder being timbered tracts along the river. There are about 180,000 acres of crop land, and the 1940 census lists 1,000 farming units in the county. The average size of a farming unit is 176 acres, an increase of 13 acres since the 1935 census. The average altitude above sea level is about 1300 feet. A variation of 400 feet will occur between the tops of the hills and the valley floors. (49) The climate in general is moderate, with a growing season of from 150 to 160 days. The average annual rainfall is about 28 inches. The topography varies from very steep and hilly in the eastern part, with wooded bluffs along the river, to gently rolling in the western part along the Logan Creek bottom. The upland soils have developed mainly on loess and are classified as Marshall and Knox silt loam. These soils cover about two-thirds of the county and are very productive when properly handled, but are subject to erosion on the steeper slopes when not protected by vegetative cover. Wabash silt loam is the third most extensive soil type. It occurs in the bottom lands along the smaller streams.

The principal crops are corn, oats, barley, and alfalfa. Sweet clover is grown as a pasture and soil building crop. Over one-half of the cropland in the county is planted to corn. The total acreage of corn in 1944 was 120,000. Cattle feeding and hog raising are major farm enterprises.

Thurston County has two Indian reservations. The Winnebago Indian Agency is located at Winnebago, Nebraska, and the Omaha Indian Agency at

Macy, Nebraska. About 25% of the land is still owned by Indians (34). This land, as a rule, is not farmed by the Indians, but is rented to white tenants. Pender is the County Seat of the county, but Walthill is more centrally located; hence, it has the office of various state and government agencies such as the Soil Conservation Service, Production and Marketing Administration, and the County Agricultural Agent.

Due to the many steep slopes in the county and to the fact that 25% of the land is Indian owned and leased to white people and little has been done to control erosion, soil conservation remains a very important problem in the county. If the county had not been blessed with an exceptionally deep friable soil underlaid by loess, wind and water erosion would have taken a much larger toll of the natural productivity.

Thurston County, as a whole, is a portion of a large loess plain into which streams have cut and produced minor features of relief. There are three types of topography on the upland; hilly, rolling, and flat. In general the transition zone from the upland to the stream terraces occurs as a moderately gentle slope and from upland to first bottom rather steep and in a few instances along the Missouri River, precipitous.

In general, the roughest topography of the County is in a zone about 5 miles wide along the Missouri River where the slopes are very steep. A large percent of the Omaha and Winnebago Indian land is located in this area.

THE SOILS OF THURSTON COUNTY

The soils of Thurston County have developed principally on loess. The loess varies greatly in thickness both locally and regionally. Local variations are, no doubt, largely the result of erosion on moderate to steep slopes not protected by a vegetative cover. Regional variations are due to the amount and rate of deposition.

The greatest thickness of the loess is always found within a mile from the edge of the bluff, and it thins gradually with increasing distance westward from the edge of the bluff in the east part of the county and bordering on the Missouri River Valley.

The brown loess area throughout the state has a rolling to hilly topography and nowhere are there level areas of any considerable extent. This is due to its geographic position and the geological erosion to which the soft soil material has been subjected since deposition. The dark colored upland soils are high in organic matter and are typical prairie soils. Topsoils of lighter color and lower organic matter content occur on a limited area of forested land and are classified in the Lindley, Knox, and Sarpy series. The textures of different topsoils range from clay through silt loam, loam, sandy loam, and very fine sandy loam to sand. Most of the topsoils are medium textured and the subsoils are relatively friable and permeable. The relative abundance of the dominant soil types in Thurston County are given in the table I.

TABLE I

Acreage of soil series in Thurston County Nebraska
and relative percentage of each soil type

Soil Series	Acres	Percent of County Area
Marshall	155,520	62.8
Wabash	40,896	16.5
Knox	16,064	6.5
Carrington	6,656	2.7
Thurston	6,016	2.4
Waukesha	5,888	2.4
Other	16,820	6.7
	247,860	100.%

Mechnical and Chemical Composition of Loess

The comparisons that have been made of the grain size analysis of Sanborn loess in Kansas, of loess deposits along the lower Mississippi valley, and of Peorian loess in Iowa with the analysis of material known to have been transported and deposited by wind show that there are no important differences. These data seem to demonstrate that wind can sort material to the degree represented by some loess deposits. (40)

The brown loess soils in Missouri (7) are predominately silt loams, that is, the great bulk of the soil particles are intermediate in size between very fine sand and clay. Probably no other extensive soil group is so largely made up of soil particles of about the same size. There are, however variations in texture. (8)

The loess material is always coarsest on the bluffs, and gradually becomes finer with increasing distance from the river. This range in textural change is most pronounced where the belt is wide, and reaches its maximum within 3 to 5 miles from the edge of the deposit. There is also considerable textural range in a vertical section to a depth of about 4 feet. Nearly everywhere the silty surface soil is underlaid by a silty clay subsoil, that contains more of the fine particles than does the surface. This is the result of the normal processes of weathering. The soil particles break down to form clay which is carried down and accumulates in the subsoil through the action of percolating water. The general structure of mechanical composition of the brown loess is especially favorable to the movement of the soil moisture and to the easy penetration of plant roots. The soils are usually porous enough to allow a rapid downward movement of gravitational water. However, they hold a relatively large quantity of moisture and therefore are quite drought resistant.

The chemical analyses of many brown loess soils indicates that they are fairly well supplied with nitrogen and phosphorus and are especially rich in potassium. Organic matter, which includes the nitrogen, has not accumulated in the surface soils under forest cover and on the steeper slopes because of severe erosion. The need of legumes, such as clover to supply nitrogen, is apparent. The loess soils normally are well supplied with lime. The Knox silt loam (7) is better supplied with both nitrogen and phosphorus than the Memphis silt loam.

The dominant color of the loess soils is brown (7). There are, however, many variations in color as might be expected in a group of soils existing under such a wide range of topography. The color variations are always within the range of brown, yellow, or buff.

PRESENT LAND USES IN THURSTON COUNTY

Data in Table II show the uses of land in Thurston County. This information was secured from the census. (52)

TABLE II

Land Uses in Thurston County, Nebraska

Land Use	Acreage and Year			
	1930	1935	1940	1945
1. Cropland Harvested	170,475	142,012	123,925	168,578
2. Crop Failure	1,768	10,366	7,535	3,303
3. Cropland Idle	1,331	18,661	19,053	4,103
4. Plowable Pasture	17,833	22,062	31,527	14,849
5. Woodland	7,769	11,403	4,395	4,471
6. All Other Land	21,386	18,689	18,254	11,489

In the above chart, a number of things are noticeable and interesting. An additional 4,000 acres of woodland was added during the five year period from 1929 through 1934. This increase was probably due to plantings made by the CCC and the WPA. After the dust bowl days and the depression, many acres of eroded cultivated lands were planted to trees or grass.

However, by 1944, much of the idle land and some plowable pasture was put back into cultivation. In 1929 there was less than 26,000 acres of plowable pasture and woodland in Thurston County. By 1944 there was only 19,000 acres of this type of land. Although the cropland harvested stayed about the same in 1930 and in 1945, the crop failure and idle land acreage increased and reached a very high value in 1940. There was 3,000 acres in 1930, as compared with 26,000 acres in 1940.

The land use picture has begun to change, however, as will be noticed later in this report.

LAND USE CAPABILITY CLASSES

Information on land use capability classes in Thurston County is given

in Table III.

TABLE III

A Summary of Land Use Capability Classes in Thurston County, Based On A Reconnaissance Survey of Erosion Susceptibility in 1942

Land Class	Treatment to Control Erosion	Acres	Per Cent of total
I	Requires only good farming methods	48,007	19
II	Simple conservation practices required	6,788	3
III	Intensive conservation required	60,587	24
IV	Limited cultivation with intensive conservation practice	78,840	32
V	No restrictions required (noncultivated)	2,483	1
VI	Moderate restriction in use (noncultivated)	52,891	21
VII	Severe restrictions in use (noncultivated)	none	0
	TOTAL ACREAGE	249,596	100%

It will be observed that over one-half of the total land area is subject to moderate or severe erosion when row crops are planted.

TYPES OF FARMING AND TILLAGE METHODS

The eastern part of the county is devoted largely to the production of cash crops, marketed locally for livestock feeding or sold commercially for use in other distant areas. (24.,34)

The western part of the county is used for the production of crops which are utilized principally for the growing and fattening of livestock, chiefly cattle and hogs.

Row crops are surface planted, or listed. When surface planting occurs, soil is prepared by plowing, disking, and harrowing. The stalk fields are double disked prior to planting small grain with a broadcast seeder or a drill.

Sweet clover is usually planted in the spring with small grain and most of this crop is plowed under as a green manure in early spring just prior to the planting of corn. About 2% of the second year sweet clover is used for pasture.

INDIAN LAND FARMERS COMPARED WITH NON-INDIAN LAND FARMERS

A study of the length of leases held by 70 men on Indian land and 60 men on non-Indian land revealed the following information. Ten men on Indian land had a one year lease, 10 a three year lease and 10 a five year lease. There was 3275 acres of the non-Indian land under a one year lease whereas only 600 acres of the Indian land was under a one year agreement. If length of lease is a facter in the adoption of soil conserving practices, conditions should be more favorable on the Indian land at the present time for the development of cropping systems and the use of other procedures needed to control erosion.

Also, there was 30 of the 70 men with a total of 3455 acres that had a 5 year lease on Indian land, whereas on non-Indian land, only 10 of the 60 men operating a total of 2200 acres had a 5 year lease.

A much higher percentage of the non-Indian land was being farmed by tenants than by owners. A survey of ninety farms indicated that 60 operators were tenants. Only two Indians were farming their land in this area.

A study of 80 farms on non-Indian land showed that 10 were livestock farms, 45 were grain farms and 25 were general farms. Seventy farms on Indian land were classified as follows: 40 were grain farms, 5 were livestock farms and 25 were general farms.

A study of the operations of 80 farmers on Non-Indian land and 70 farmers on Indian land indicates that many farmers live on non-Indian land and lease Indian land to increase their farming operations.

Forty men who farmed Indian land did not farm any white land. There were fifty men who lived on non-Indian farms, who did not farm any additional land.

Farmers on Indian land are farming less non-Indian land than the white

farmers are farming Indian owned land.

Thirty men who had rented Indian land spread 1375 loads of barnyard manure; while eighty men who had rented non-Indian land spread 6350 loads of barnyard manure. Ten of the eighty men who had rented non-Indian land did not return any barnyard manure to the land. The Indian-land farmers hauled an average of only 46 loads per farm; whereas the white land farmers hauled 80 loads per farm.

This supports the fact earlier established that farmers on non-Indian land used more acres for livestock production than farmers on Indian land.

Eighty of the men on non-Indian land were cultivating a total of 8445 acres. Seventy men on Indian land were cultivating a total of 6680 acres. Although the farmers on non-Indian land from which information was obtained outnumbered the Indian land farmers by only 10, they were producing cultivated crops on larger acreage of land than the farmers on Indian land.

TABLE IV

Average Acreages and Yields of Various Crops on Non-Indian and Indian Land

	NON-INDIAN LAND					
	CORN		OATS		LEGUMES	
	When 1st came on farm	In 1950	When 1st came on farm	In 1950	When 1st came on farm	In 1950
Total Acres	4575	3555	1415	2220	1520	3140
Total Yield	2000	2680	1050	1570		
Average Acres	65	51	28	40	28	52
Average Yield	33	41	26	31		

	INDIAN					
	CORN		OATS		LEGUMES	
	When 1st came on farm	In 1950	When 1st came on farm	In 1950	When 1st came on farm	In 1950
Total Acres	3715	3285	1085	1980	995	1805
Total Yield	1775	2660	1025	1445		
Average Acres	57	51	27	39	28	40
Average Yield	29	41	26	28		

The most interesting part of Table IV is that the average corn acreage

on non-Indian land decreased from 65 when the tenants first began to farm their land to 51 acres in 1950.

The average corn acreage on Indian land decreased from 57 when the tenants first moved on to the farm to 51 acres in 1950. The average corn yields increased on Non-Indian land from 33 to 41 bushels per acre during the same period of time and the average corn yield on Indian land increased from 29 to 41 bushels per acre. In other words the farmers on the Indian land have raised their corn production 12 bushels per acre, whereas the operators on non-Indian land have increased their yields only 8 bushels per acre.

Oat yields, according to this survey, are about the same on both Indian and non-Indian land, while legume crops seem to be receiving more attention on the non-Indian farms.

A study of livestock production on 75 Indian land farms and 210 non-Indian land farms showed that farmers on non-Indian land had 3 times as many dairy cattle as those on Indian land. This partly accounts for the greater production of farm manure.

Approximately 1/3 of the total acreage of the Indian land is bottom land.

Eleven of the 70 Indian land farmers were contouring whereas only 40 of the non-Indian land farmers were not farming on a contour. Only 15 of the 70 Indian land farmers sell their corn as grain compared to 65 farmers on non-Indian land that sell their corn as grain. This appears rather odd since the farmers on non-Indian land have more livestock.

The Indian land farmers leave their crop residue on the ground to a greater extent than the non-Indian land farmers. Farmers who have livestock often cut corn for bundle feed or silage.

Also, the study revealed that the Indian land farmers started using fertilizers ahead of their neighbors who were farming non-Indian land.

The Indian land farmers did nearly twice as much weed control work as farmers on non-Indian land because it was required in their leases.

Forty out of the 75 farmers on non-Indian land contour farmed, the other 7 did not.

Slightly over 1/2 of the men that were farming non-Indian land used a lister to plant their row crops. The average acreage planted with a lister was 95 as compared with 92 acres on land where surface planting was used. Some of the men used both methods of planting. The average acreage of row crops on these farms was 85. The acreage of bottom land farmed may have had some influence on method of planting.

Pastures

Brome grass continues to be the best pasture grass for Thurston County. It aids materially in controlling soil erosion and makes a good pasture for all types of livestock as well as providing a good source of income from seed. The 1950 season was excellent for the production of bromegrass seed. The only difficulty with bromegrass is that it becomes sod bound after a few years where no legumes are planted with it or fertilizers applied. An increase in the use of barnyard manure and nitrogen fertilizers on bromegrass has occurred on many farms.

The Wash Brothers of Emerson produced 50 acres of certified Lincoln Bromegrass seed. They were the only certified growers in the County.

At the present time native pastures on Indian land have an estimated 30 percent lower carrying capacity than native pastures on similar areas of non-Indian land. (34) This condition has been caused by excessive overstocking on the part of those who have rented the pastures on the Indian land. Serious overgrazing was the first noticeable effect. This overgrazing weakened the native plants which finally had to give way to the less pala-

table, hence less molested species and now instead of a pasture of palatable grasses, many pastures contain a mixture of annual and perennial weeds. Needless to say, the weeds provide very little suitable forage for livestock consumption.

The objective of a pasture improvement program is to reseed these pastures to desirable native species or to adapted tame grasses, thereby eliminating the undesirable weeds and at the same time providing additional palatable forage which can be utilized by livestock on the farm. Successful reseeding of native pastures is difficult at best. The land is usually quite steep, good seed beds are difficult to prepare, weeds are usually present in abundance, good seed may be limited, considerable expense involved, and several years of restricted use are required to insure the successful re-establishment of native pastures. Legumes could be used to help establish better pasture in a shorter period of time. Since a considerable initial expense is involved and returns are not very great during the first few years following seeding, a renter is unwilling to go to the trouble and expense when tenure is uncertain. The financial plight and lack of physical facilities often make it impossible for many owners to improve their pastures. This can be accomplished, however, through the medium of a long term lease, with the operator bearing the cost. This would eventually make the land more valuable; thus the owner would eventually receive higher rental rates.

The 3,686 idle acres of Thurston County located mostly in the loess hill region, are almost entirely acres which were at one time tilled, but now have become so badly eroded that they remain unprofitable to farm. If these acres are to be efficiently used, they must be put under an intensive soil building program and seeded to grasses and/or legumes along with the native pastures, and be utilized for the production of livestock. Here too,

time and expense will be necessary to bring these misused lands back to profitable production. There has been 6277 acres seeded to permanent pasture up until now. (34) (24)

Evidence seems to indicate that the most desirable and practical methods of conserving these rough lands is to keep them covered with grass. This is possible for rainfall is sufficient to almost always insure abundant yields of palatable forage. However, grasses can survive only if pastures are stocked properly and a plan of pasture rotation is followed which will maintain a vigorous cover of desirable grasses. There are 4943 acres in permanent pasture that are being rotated regularly. Deferred grazing is being practiced on 4748 acres and proper stocking is being applied to 1655 acres at the present time.

Reseeding of weedy native pastures and seeding the now idle acres to pasture mixtures can be accomplished and will result in bringing back into use several thousand acres of now practically worthless Indian land. This program is more closely related to pasture improvement rather than soil conservation. However, such a procedure would increase farm income for the Indians and also these lands would be made relatively safe from the danger of further erosion as an indirect effect of such practice.

The forest and waste lands lie largely on the bluff along the Missouri River or in the lowlands which make up a part of the Missouri River bottom. These are generally heavily covered with vegetation and present no serious soil and moisture problem. Some of the bottom lands might become usuable once the Missouri River is brought under control through work now under way. Just how much area this will affect cannot be determined at this time.

Trends of Principal Crop Acreages (50) In the Loess Hill Region of Thurston County, Nebraska In Relation to Soil Conservation

The acreage of corn in this area increased rapidly until 1930 and remained nearly constant until 1933. A drop of approximately 15,000 acres in corn acreage occured in 1934 and the acreage did not increase again until 1943. When World War II began, the corn acreage jumped to a new high in 1944 and 1945. In the past 2 or 3 years the acreage of corn on Indian land has dropped due to a change in the lease agreement. In 1949 and 1950 lease holders were requested to plant one-third of the Indian cropland to small grain and sweet clover. In 1951 lease holders will be required to plant one-half of the Indian cropland to small grain and sweet clover. Thus, the acreage for corn will be limited by this action and will be decreased another 10 or 15 thousand acres this year.

The acreage of oats has gradually increased during the past five years. Before 1944 anything could and did happen to the acreage of oats. But since the Indian Agency has required 1/3, and is now requiring 1/2 of the cropland to be planted to small grain, the oat acreage has steadily increased and in five years (1944-1949) and the acreage of sweet clover has doubled.

Since the two Indian Reservations make up a large percent of the total land area in Thurston County; naturally, the increased use of soil conserving crops on the Indian will have an important influence on the acreage of soil conserving and soil depleting crops in this area.

The Erosion Problem

Improper Land Use (34,24,53)

Improper land use, farming with the slope of the land (particularly on slopes over 5 percent), improper cultural practices, overgrazing, lack of

systematic crop rotations, failure to apply barnyard manure and to sow and turn under a green manure crop, burning of crop residuss, improper maintenance of natural waterways, almost total lack of diversion terrace construction, and generally little thought toward the future productivity of the land, have all contributed materially to accelerated erosion of the Loess Hill lands.

Soil and moisture losses have rapidly reduced the producing ability of the soil. (53) Sheet erosion has removed much of the topsoil before the very eyes of tenant and owner. Gullying is a serious menace and often leads to permanent abandonment of farm lands. The precipitation has been about the same year after year, however, flash floods are on the increase. (47) More often than not, these flash floods remove the topsoil to plow depth and deposit it and other debris on the lower lands, often destroying crops and severely damaging these highly productive, valuable lowlands. These good lands are not abundant in the area covered by this report. However, their value, based on productive ability, makes them far more important than an acreage comparison might indicate.

Soil erosion is caused by wind and by water acting alone or in unison. Man has accelerated the activity of these forces by improper land use. As the inherent fertility of the brown loess soils goes lower and lower the value of the Indian's equity in the land is greatly decreased. An increasing amount of Indian land is idle because it has been so thoroughly depleted of organic matter through misuse that it will not produce enough crop to pay expenses if it is farmed. Land that has reached this stage of depletion can only be reclaimed by the adoption of intensive soil building practices, together with strict adherence to every possible soil and moisture conserving principle adapted to this region. There was 3,686 idle acres to Thurston County in 1949. This was the condition before the SCMO took a

Figure 1.

Gully system showing main gully and several "feeder" gullies. Nearest branch gully has a "Y" at its head. All gullies and banks are thickly planted to trees.

To be followed with picture on next page.

Figure 2.

Gully control by tree planting. Planted four years ago, trees have completely covered and are controlling the erosion in what was formerly a severely gullied, eroding piece of abandoned land. Vegetation now provides a solid cover on the area and a thorough check showed no evidences of erosion. Some of the cottonwoods have now attained a height of over 20 feet.

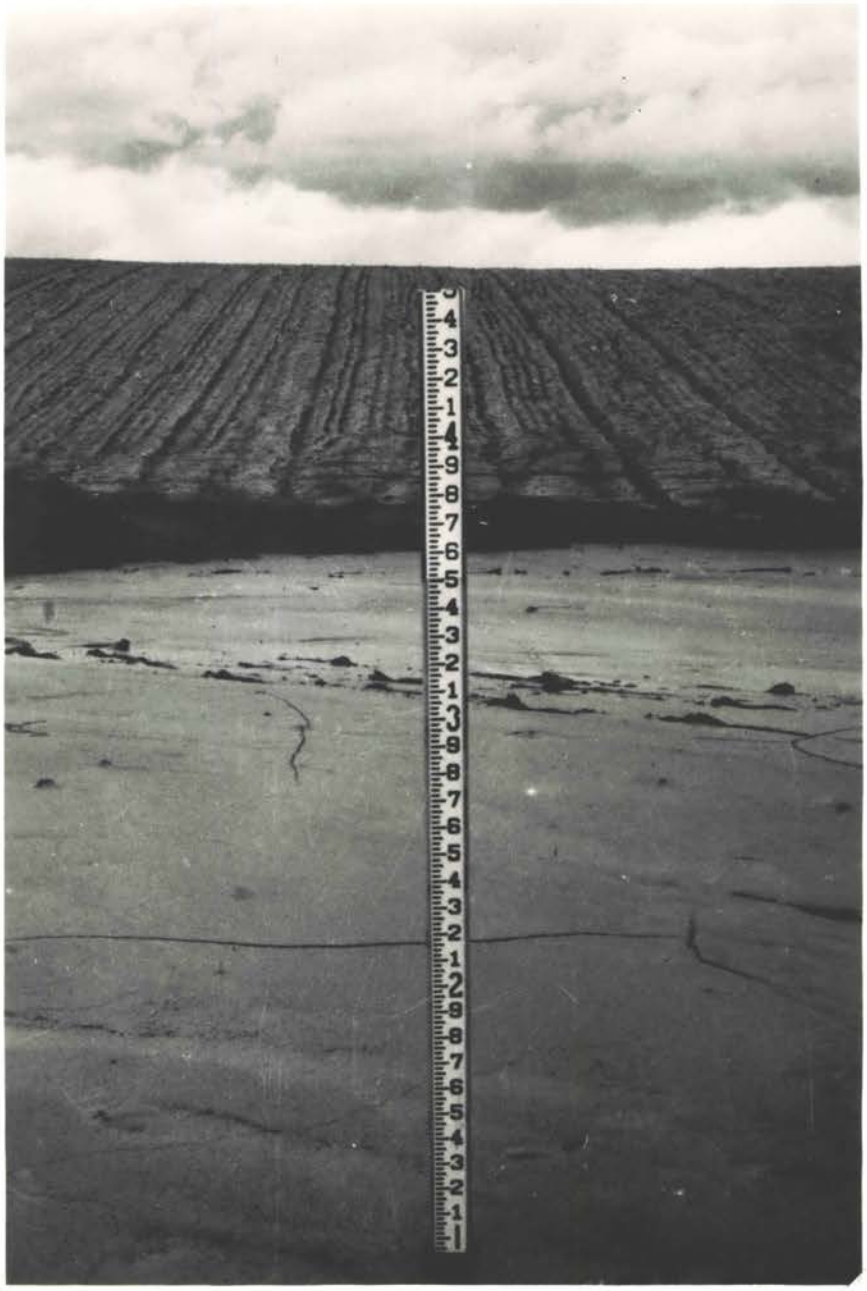


Figure 3. Omaha Reservation, May 1950

A newly planted field of checked corn immediately after a three inch rain showing check rows in the background and a silt deposit at the base of the slope against the roadside fence. The rod was held about three feet above the ground and dropped into the silt deposit. It sank in to the one foot mark.

firm hand in the leasing arrangements. It is a different picture today.

Much effort on the part of the Indian Agency has been put forth in trying to secure long term leases which would be conducive to the adoption of of a desired conservation plan. Lack of personnel, however, has made essential compliance checks difficult. Increased personnel since 1946 has somewhat alleviated this condition.

The following information was obtained from the Winnebago and Omaha Indian reservations on the degree of erosion in those areas.

DEGREE OF EROSION	WINNEBAGO RESERVATION	OMAHA RESERVATION
Slight	26% of Area	32% of Area
Moderate	56%	42%
Severe	18%	26%

It is generally recognized that the Indian lands are for the most part the less desirable in a community. During the time when Indian lands were available for purchase, the white population bought up the more desirable and less sloping land. Also, approximately 70% of Indian land has been farmed more or less on a year to year basis by tenants who gave little thought or effort toward conservation of soil fertility and moisture control. Many of these lease holders lived on their own land and concentrated their efforts toward soil and moisture conservation on that part of the farm unit which they owned. Consequently more erosion occured on the Indian land than on owner-operated non-Indian lands, because of a higher percentage of row crops.

A SPECIAL PROBLEM

Deep gullies are on the move up the slopes and valleys on the Winnebago and Omaha reservations. Each year they chop off several acres of the best land. Diversion ditches can be used to stop the advance of these gullies. Small gullies can be worked in with farm machinery and can be controlled by

planting to grass. The PMA program has provided assistance in the seeding of these areas to a protective grass cover.

Data from the Western Iowa Experimental Farm at Castina, Iowa (53)

The effect of cropping practices on soil and water losses obtained on the Western Iowa Experimental Farm, located near Castina, Iowa in 1950 are presented in Table V. Corn grown in a corn-oats-sweet clover rotation and planted up-and-down hill lost 30.64 tons per acre of soil during 1950. When corn was planted under the same conditions but contoured, the loss was reduced to 9.74 tons per acre. Contour listing of corn further reduced soil losses to the low figure of .39 and .34 tons per acre, respectively, for the corn and oats rotation with sweet clover in the oats and the corn-oats meadow-meadow rotations.

Soil losses from oats planted by broadcasting the seed averaged 4.59 tons per acre in the corn-oats and sweet clover rotation. A cover of brome-alfalfa reduced soil loss to a very low value.

Table V

Effect of Cropping Systems on Soils and Water Losses on Ida Silt Loam on a 14 Percent Slope Western Iowa Experimental Farm, 1948-50*

Cropping System	Soil Loss, Tons per acre			Runoff (inches)		
	1948	1949	1950	1948	1949	1950
	From Corn					
C-Osc surface planted (U and D hill)	38.32	6.01	30.64	3.04	2.51	5.18
C-Osc surface planted (on contour)	7.18	.02	9.74	2.27	1.08	2.34
C-Osc Contour listed	8.11	.08	.39	2.34	1.01	.14
C-O-M-M Contour listed	3.76	.12	.34	1.72	.87	.47
	From Oats					
C-Osc	.23	.90	4.78	1.03	1.95	3.52
C-Osc	.18	.91	3.33	.94	1.98	3.28
C-Osc	.13	.57	5.65	.80	1.13	3.79
C-O-M-M	.37	.52	3.21	.79	1.89	2.94

Table V Cont'd.

Cropping System	Soil Loss, Tons per acre			Runoff (inches)		
	1948	1949	1950	1948	1949	1950
	From Meadow					
C-O-M-M (first year meadow)	.05	.06	1.38	.61	.87	2.15
C-O-M-M (second year meadow)	.17	.04	.03**	.90	1.21	.08**

* Equipment installed May 15, 1948.
** Plot damaged by burrowing of gophers.

Total rainfall was 22.04 inches in 1948, 21.96 inches in 1949, and 28.31 inches in 1950.

Runoff water from corn land was very effectively reduced by contouring and contour listing. In the corn-oats and sweet clover rotation, corn planted up-and-down hill lost 5.18 inches of water by runoff, whereas contoured corn lost 2.34 inches and contour listed corn lost .14 inches.

The runoff from oats varied from 2.94 to 3.79 inches under the different treatments. The runoff from first-year meadow in the corn-oats-meadow-meadow rotation was 2.15 inches. The second-year meadow in this rotation was damaged by gophers and the results are not reliable.

Most of the runoff and soil loss from all treatments occurred in June. For example, in the plot where corn was planted up-and-down hill in the corn-oats-sweet clover rotation, 41 percent of the total annual runoff and 75 percent of the total annual soil loss occurred in June. These losses were the result of 6.38 inches of rain which fell during 6 storms between June 2 and June 19.

Figure 4. OMAHA RESERVATION. October, 1950

The head cut of an advancing gully was at this point in 1940. This picture was taken looking up the gulley at land that has been carried away by runoff water during the last ten years.

SOIL CONSERVATION PRACTICES AND PROGRESS ON 125 FARMS

Data concerning land tenure on 100 farms are given in Table VI.

Table VI

Length of Lease on One Hundred Farms and Average Acreage

	1 Year Lease		2 Year Lease		3 Year Lease	
No. of Men	Total Acreage	Average Acreage	Total Acreage	Average Acreage	Total Acreage	Average Acreage
40	5640	141				
25			2980	114		
35					3330	95

The following information should be noted in regard to the information in Table IV. One man may have a lease on several tracts of land. He may have a one-year lease on one tract, a two-year lease on another, and a four-year lease on another. Fifty-five men were farming a total of 6195 acres of land other than the farm on which they were living. Of the 125 farmers interviewed there were; five full owners, 25 owned a part of the land they farmed and 95 rented all of their farmland. The size of the farms included in this study ranged from a minimum of 40 acres to a maximum of of over 350 acres. The 125 farmers operated a total of 22,500 acres of land, or about 180 acres for each man. There were 120 general type farms and five cash grain farms in this group.

Table VII

Types of Rotations Followed on 125 Farms

Number of men	Total Acreage	Average Acreage	Type of Rotation
95	9395	98	Corn, (oats, sweet clover), Corn
5	300	60	Corn, corn, corn.
5	600	120	Corn, Oats, Wheat, Corn
5	1400	280	Corn, Oats, Corn, Alfalfa, Alfalfa
15	3000	200	Corn, Corn, Oats, Sweet Clover, Alfalfa

Only 40 of the 125 men have planted alfalfa which is normally left on on the land for 4 years.

Table VIII

Soil Improvement Rotations Used on Non-Indian Owned Land (Rented)

Number of men	Total Acreage	Total Acreage	Type of Rotation
5	40	8	Corn, Corn, Corn
5	600	120	Corn, Oats, Sweet Clover, Wheat
10	1400	140	Corn, Corn, Oats, Sweet Clover
20	1950	97	Corn, Oats, Sweet Clover, Corn, Alfalfa

A study of crop acreages and yields indicates that these farmers have reduced their acreage of corn from 75 to 65 acres and have increased their yield from 35 to 43 bushels per acre. The oat acreage has been increased from 37 to 56 and yields have increased from 30 to 34 bushels per acre. Legume acreage also has been increased from 30 to 50 acres per farm.

One hundred men were planting on a contour. Seventy five were listing their corn and 50 were surface planting. Fifty of the 125 men have both bottom land and hill land. Ninety of the 125 men have one or more enormous gullies ranging in size from 10 to 75 feet deep and about the same width.

Table IX

Additional Soil and Crop Improvement Practices

Number of men	Acres Drained Tot.	Aver.	Residue (Crop) Tot.	Aver.	Acres Fert. Tot.	Aver.	Improve. (Crop) Tot.	Aver.	Control (Weed) Tot.	Aver.	Mowing Pasture Tot.	Aver.
15	350	23										
40			3565	89								
25					1350	54						
55							6400	116				
60									5707	95		
40											950	24

Table X

A Tabulation of Gully Control, Tree Planting, Planting Permanent Pasture and Contour Farming Practices on 125 Farms

Number of Farms	Miles of Gullies Controlled		No. of Trees Planted		Acres Planted to Permanent Grass		Acres Contoured	
	Total	Average	Total	Average	Total	Average	Total	Average
25	17.5	.7						
25			5910	237				
85					2270	27		
90							8275	92

All farmers pasture crop residues in the field. Only 15 dams were constructed on these 125 farms for gully control.

Cooperation of Extension Service, PMA, and SCS with SMCO

The relationship between the State Extension Service, the PMA and SCS of the United States Department of Agriculture and SMCO of the Indian Service is becoming closer all the time. There was a tendency for quite some time for other agencies to look upon SMCO as a foreigner in the area, but this year much was accomplished through the cooperation of the above agencies. The PMA has been ready and willing to approve for payment, any conservation project deemed necessary on Indian lands. SMCO has been invited to participate in terracing demonstrations put on by the SCS and thus has had the opportunity to contact large groups of farmers. Many of these farmers operate Indian land, and it has been possible to carry on an educational program involving more farmers than ordinarily would be contacted. (52,34,24)

SCS and the PMA are also very cooperative when it comes to running contour or terrace lines on Indian land. The SMCO has a policy, with the SCS, that when a farmer calls to have lines run, SMCO will not stop at "boundary divisions", but will run all his lines for him at one time. They, in turn, will do the same if they are running lines on white owned land and a tract of Indian land is included in the farm layout. This saves an extra trip by

SMCO or the SCS staff to a farm where the operator is farming both Indian and non-Indian land as one unit.

The County Agent is always ready to work with SMCO on any program involving soil conservation even though the major job deals with Indian owned allotments.

Index for the Determination of Rental Rates

Long term leases are very desirable from a soil and moisture conservation point of view. Many operators desire a long term lease because of the additional security that such a procedure has to offer. However, the present policy of "so much money per year for so many years" tends to discourage some lessees from taking a long term contract, for no provision is made for rentals to vary according to current prices and conditions. It is believed that if an index for the determination of rentals could be devised, more lessees would become interested in a long term lease. (34)

This possibility has been discussed with the superintendents and staff of the Indian agencies and has met with considerable favor. The details are still lacking and it is hoped that something along this line can be worked out in the near future.

Some of the advantages of this plan would be as follows:

1. More equitable rental to the owners of the land in good years and less in poor years.

2. Less work for the already overburdened leasing department.

3. Longer term leases would mean more progressive farming on the part of the operator who would be more apt to use soil and moisture conserving practices to increase crop production.

Leasing and Cooperation (34)

The cooperation between the Lease Department and SMCO and the Winnebago

Agency is very good. All leases come to the SMCO before they are approved. This enables SMCO to check the lease and see if it contains stipulations, get a record of the term of the lease and the name of the lessee. At the same time conservation recommendations can be made.

Leases are generally prepared away from the Indian Agency. Persons who write leases are furnished with a supply of stipulations that are inserted in the lease and also are told what the operator is expected to include in his lease in the nature of permanent conservation improvements which must be included in each lease beginning in 1951.

This method of getting SMCO stipulations and permanent conservation practices included in the leases works out quite satisfactorily.

Compliance Checks (34)

All of the land under stipulations is being checked for compliance. Unless the land is checked for compliance the stipulation part of SMCO program is hampered. Most of the land operators are living up to the stipulations but occasionally one gets out of line. Usually a warning is all that is needed to correct a non-compliance case.

Compliance checking has practically eliminated fall plowing. Fall plowing was a common practice on many farms before the farmers discovered that they were being checked for compliance.

Land Under Stipulation (34)

About two-thirds of the Indian lands under the jurisdiction of this Agency are now being farmed in accordance with soil and moisture conservation stipulations. During the fiscal year of 1950, stipulations were inserted into eighty-seven new leases totalling 7,614 acres of land. At present 691 leases are under stipulation, totalling 46,389 acres. There are 27,000 acres of Indian land that are not under stipulations, but this land will come under

stipulations as fast as the tracts are advertised for lease and a new lease is made. Approximately all the Indian land will be under stipulations in 1952.

The SMCO stipulations to be included in all new leases have been slightly revised. The penalty rate for non-compliance has been increased. Mr. George Gregory, Work Unit Conservationist, and Mr. H. E. Neilson, Indian Service SMCO; seem to think that the best conservation work is being done on farms of 200 acres and over.

Data on the various soil conservation and crop improvement practices occurring on the Omaha and Winnebago Indian lands are given in Table XI. Data on the acreage of virgin soil and the present land class of this acreage are given in Table XII.

Figure 5.

Indian land on the right and white-owned land on the left. No sweet clover was used in the rotation on the white-owned land while sweet clover has been used regularly on the Indian land, Winnebago Reservation, July, 1950.

Table XI

Annual Report of SMCO Activities and Practices, Omaha and Winnebago Indian Reservation (34)

		Unit	Total this year	Total before this year	Total to date	Project SMC	Coop.
Totals						17947	62434
1.	Canals, Ditches	Yd.		20600			
2.	Contouring	Acres	13672	13169	26841	4784	27344
3.	Cover Crop	"	8049	11280	19329	1207	8049
4.	Crop Imp.	"	11482	15843	27325	573	11482
5.	Crop Residue	"	15757	12311	28068	2363	15757
6.	Detention Dams	No.		2	2		
		Cu. Yd.		2500	2500	50	150
7.	Diversion Dams	No.	2	5	7		
		Cu. Yd.	50	4500	7000	50	150
8.	Retention Dams	No.	2		2		
		Cu. Yd.	500		500	50	100
9.	Dikes, Leves	Cu. Yd.	1000		1000	50	100
10.	Drop Turnout	No.		2	2		
11.	Fence, new	Mile		1	1		
12.	Fertilization	Acres	1315	2435	3650	300	6075
13.	Land Classification	Acres	560		560	60	
14.	Land use contract, lease, or permit	No.	127	450	577	1270	8349
	Stipulations	Acres	8349	27476	35825		
	New or first formal plans	No.	3	2	5		
		Acres	80	160	540		
15.	Weed Control	Acre	18465	10509	28974	2308	36930
16.	Mowing Pastures		932	625	1557	93	1864
17.	Upland Waterway	Mile	7.2	41	4820	720	2520
18.	Pastures, Meadows and etc.						
19.	Performance	No.	302	508	810	2114	1058
	Inventory	Acres	18097	31625	49722		
20.	Pest Control	Acres	960	700	1660	480	4800
21.	Soil Surveys	Acres					
	A. Detailed	"	720		720	150	
	B. Recon.	"		5603	5607		
22.	Rotations	"	8049	12877	20926		12073
23.	Rough Tillage	"	580		580	290	1150
24.	Seeding Planting		200	874	1074	220	3000
25.	Terraces	Miles	5.7	7.1	27.2	835	1425

Table XI

Classes of Land and Acreage According to Use Capabilities

Land Class	Virgin Soil	Present Land Use Class I	II	III	IV	V	VI	VII	VIII
I	4240	2545	855	420	420				
II	15529		7840	3805	2297		796	791	
III	15521			6091	7833		800	797	
IV	10735				5333		2701	2701	
V	1905					1905			
VI	6984						3492	3492	
VII	7650							6885	765
Total	62564	2545	8695	10316	15883	1905	7789	14636	765

Data on soil and water conservation practices accomplished by the soil conservation program on non-Indian land are given in Table XIII. A large part of this program has been more closely related to pasture improvement and forage production than with soil conservation.

Table XIII

Major Soil and Water Conservation Practices Planned and Applied During 1950, Non-Indian Soil Conservation Service (USDA)

		Units	Planned This Period	Planned To Date	Applied This Period	Applied To Date
1.	Contour Farming	acres	2588	35344	1412	33105
2.	Stuble Mulch	"	3483	19757	3472	19661
3.	Pasture Improvement	"	1133	6133	628	628
4.	Seeding of Pastures	"	1164	10755	1024	6277
5.	Tree Planting	No	29	171	28	103
6.	Farm Ponds	"	-	12	-	5
7.	Terraces	Miles	126	317	26	120
8.	Flood Diversions	"	-	30	.5	8
9.	Farm Drainage	Acres	114	820	78	648
10.	Stuble Mulch Farming	"	1135	12261	310	1571
11.	Proper Stocking	"	1248	5042	664	1655
12.	Deferred Grazing	"	24	4808	90	4748
13.	Rotation Grazing	"	1239	6133	103	4943
14.	Contour Furrow	"	77	156	77	156
15.	Protection	"	1399	1544	19	43
16.	Harvest Cutting	"	1370	1370	-	-
17.	Outlets and Water Ways	"		939	72	819
18.	Rotation Hay and Past.	"	3910	16277	2532	11168
19.	Seeding Perm. Hay	"	542	4657	302	4323
20.	Land Clearing	"	30	45	-	15
21.	Erosion Control Structures	No.	-	22	-	17
22.	Roadside Erosion Control	Miles	103	103	11.5	27

Conservation Work Accomplished on Indian Land Where Conservation Practices are Required As Compared With Non-Indian Land Where Conservation Is On A Voluntary Basis

Only during the past three years has the SMCO required the lessee of Indian owned land to practice soil conservation on the land he leases. Before these stipulations were set up, the Indian land was very badly abused, but better management is occuring now, and field inspections are made to see that the lessee complies with all stipulations. So one could say that during the last one or two years the Indian land is being managed very well. First, the SMCO has a set of stipulations for soil and moisture conservation which are required of each lessee. Secondly, there is a penalty for failure to comply with each stipulation. Penalty for failure to comply with these stipulations shall be at the rate indicated for each stipulation. If the lessee is unable to comply with any of these stipulations, the SMCO at the Indian Agency should be contacted before-hand. And further, failure to comply with any or all of the stipulations will be sufficient cause for cancellation of the lease. The non-Indian land farmed by white farmers is a different problem. There are over 400 farm plans in progress on the white farms whereas all of the Indian land has farm plans, or will have just as quickly as they can make them out. Any or all conservation work done on white owned land is voluntary, so as you might expect, the white land is being depleted of the fertile top soil where the management is poor. Some farmers are already farming the subsoil. However, there is a distinction between the white farmer who farms his own land, and the white farmer that farms rented land. The farmer that farms his own land has a tendency to take care of it. While the farmer who rents Non-Indian land has a tendency to exploit the fertility of the soil and return nothing to the fields from which the crops were harvested

(24,24).

The annual report of Soil and Moisture Conservation Activities and Practices from both SMCO (Indian) and SCS (White) which follows will verify that the following statement is correct. More soil conservation work is done on the Indian land where it is forced upon them than on non-Indian land.

SOIL AND MOISTURE CONSERVATION PROGRESS

The soil and moisture conservation program is now firmly established on the Indian lands under the jurisdiction of the Indian Agencies. At first many of the farmers and most of the Indians did not realize that erosion was taking place at a rapid pace on these lands. They were reluctant to adopt and put to use soil and moisture conservation recommendations. This land is new in the terms of being farmed, therefore the effects of serious soil and water losses had not been noticed. During the five years which the SMC department has been in operation a lot of progress has been made with the owners and the operators of Indian land. Progress is very noticeable and as one drives over the area field after field will be observed that is farmed on the contour. Grassed waterways, grassed turn rows and terraces can be seen on some fields. Most of the small grain fields contain a good stand of sweet clover. If anyone would stop and ask the land operators what they thought of the recommended SMC practices they have put to use on Indian land, most of them would say, "The recommendations are good. We should have been practicing soil and moisture conservation years ago" (53,24,34).

COOPERATION OF FARMERS

This year the advertisement of lands for lease carried the following provision:

> "In addition to the stipulations, some form of permanent conservation improvement must be included in each lease. The following are recommended as permanent improvements: Grassing of waterways, fence rows and turn rows; seeding permanent pasture to Brome grass or Brome grass

and Alfalfa; construction of terraces; construction of stock water ponds and erosion control dams."

As a rule any change meets with much opposition. Since the farmers have become familiar with conservation work through the stipulations, the response to adding improvements was quite favorable. It was necessary, in many cases, to contact the farmer personally, since he was not sure what should be listed on his particular lease as an improvement. Much of SMCO work was of an educational nature in showing the farmer that in spite of the initial expense involved in any practice he would realize a definite profit over a period of years as a result of the improvement.

The SMCO has found that more farmers are realizing that soil erosion and fertility losses are becoming great enough to endanger their livelihood and are anxious for suggestions which can be used to allay this threat. Even though the farmers of Indian lands felt as if they were being pushed at first on the erosion control program, the majority of them have accepted it and are willing to go a step farther in putting permanent conservation practices on the Indian land.

Another important new requirement in the farm leases is that one-half instead of one-third of the crop land shall be planted to a small grain and sweet clover, or some other legume. The inclusion of soil and moisture conservation stipulations are probably the two greatest factors that have forcibly emphasized to the land operators the need of a SMC program.

SWEET CLOVER

Green manuring in which a good growth of sweet clover is turned under in the spring is one of the recommended SMC practices that is accepted very widely. Since the new lease stipulations call for one-half of the crop land to be planted to a small grain and sweet clover, or some other legume each year, a greater acreage will come under this soil building practice in 1952.

Figure 6.

Contour plowing of sweet clover as a green manure crop on the Winnebago Reservation, May, 1950. A terrace is shown in the background.

Up until the time SMC stipulations entered into the picture, several of the tracts of Indian land had grown corn year after year and yields were decreasing. The practice of including sweet clover in the rotations has increased corn yields. Most of the farmers agree that a sweet clover rotation is profitable and will not continue the practice of planting corn two years in succession. Sweet clover not only increased yields by adding nitrogen to the soil, but creates a better environment for the soil bacteria to work, increases the organic content, improves soil structure and reduces runoff.

Some farmers found that the losses from corn falling to the ground while being picked with a mechanical picker was greater on fields where corn followed corn than on fields where corn was planted every other year following oats and sweet clover. This can probably be attributed to the weakened condition of the stalks as a result of low soil fertility and insect damage resulting from a poor rotation.

CONTOURING

About 6,500 acres of Indian land had contour lines run on them this year. (34) One of the biggest arguments the SMCO hears against contouring is the "ditches" it causes from breakovers during high intensity rains. However the SMC staff talks to the farmer and he usually agrees that he can see where he has not lost as much soil in these "ditches" as he would have lost by adding up all the soil lost out of every row had the corn rows been planted up and down the hill.

The farmers, as a rule, have also realized that although contouring means point rows and short rows, they are saving machinery wear and fuel and increasing the productivity of the land.

It is becoming a widespread practice to divide fields on the contour and thus eliminate many short rows. The final outlook of the more progres-

sive farmers still seems to be that contouring is not practical without terracing.

TERRACES

About six miles of terraces were constructed on fifteen different units in 1950. The main types of equipment used were the motorpatrol, whirlwind terracer, disc tiller, and farm plow. Recently an elevating type of machine has been demonstrated. This machine consists of a large disc which puts the dirt on a rubber conveyor belt which in turn carries the dirt out eight to ten feet from the disc. This attachment is mounted on a farm tractor.

On the steeper slopes of 12-15% the most efficient work can be done with the whirlwind terracer and motor patrol. One whirlwind terracer is owned by a contractor, but he does not furnish a tractor or operator. This has necessitated that SMC personnel supervise terrace construction where the farmer has rented this equipment. Such an arrangement has proven unsatisfactory since it has taken much time of staff members which could be used for other work.

The most efficient type of equipment from the standpoint of cost and type of terrace is the motor patrol. (24, 34) One contractor in Thurston County is doing more terracing all the time and has the cost down this year for the first time to where the farmer can hire the patrol cheaper than he can use his own machinery. The PMA payment this year on terraces was two cents per foot and the patrol can build them for three to four cents per foot depending on the slope and turns involved. Therefore a farmer can have 1,000 feet of terrace built at a cost of ten to twenty dollars.

In order to get more farmers acquainted with terracing the SMCO is interested in having them establish one terrace near the top of each slope as a starter. As they become accustomed to farming with the terrace a terracing system can be completed in the coming years. Many farmers classify terraces

as a form of permanent conservation to be included in new leases being made up this year. Since it is being recognized that contouring without terracing will not prevent torrential rains from overtopping contour furrows the terracing program is gaining momentum rapidly.

Grassed Waterways, Fence and Turn Rows

During the past year approximately fifteen miles of natural waterways were worked in and seeded down to brome grass. Experiences have shown that the big problem is how to handle the surplus water once it is concentrated on the land. All well sodded waterways and outlets should be established on terraced and contoured fields. It is the policy of SMCO to encourage the operators to establish waterways before terraces are constructed.

A great deal of progress is being made in the seeding of fence and turn rows to a permanent type of vegetation. This practice is gaining momentum.

ECONOMIC FACTORS AFFECTING CONSERVATION FARMING

The larger gullies present a problem of high cost for structures needed to control them. The only successful method of controlling the larger gullies is by constructing dams with drop inlets. The metal tubing required for the land operators or the land owners can afford to purchase this size of tubing. As a result, control work on big gullies is progressing slowly. A source of financial aid such as PMA assistance is needed before much progress can be made.

Most of the operators of Indian lands are transient in nature or else they own some land of their own and supplement their units with land rented from Indians. These operators, largely, are trying to get the most out of the land with the least effort and expense to themselves. If they are rushed during the busy season, their own land is taken care of first and if time per-

mits, they then turn to the Indian land. More often than not the average operator tries to farm more land than he is equipped to handle. Very often the equipment is in a poor state of repair or unsuited to the job that is to be done.

FUTURE NEEDS AND RECOMMENDATIONS

The initial step will be to include as a part of the leases a workable conservation plan which will assist greatly in slowing down the excessive losses of topsoil which now occur. A plan applicable to all Indian land will include; (1) tilling and planting all land on the contour when the average slope exceeds five percent (2) a simple crop rotation in which one-half of all crop land is planted in small grain each year, with an intertilled crop never planted more than one year in succession on the same land; sweet clover or other suitable legumes to be planted with all small grain and to be turned under for green manure; (3) all crop resifue to be incorporated into the soil; (4) control of weeds through mowing and clean tillage practices; (5) strip cropping to assist in prevention of erosion caused by both wind and water; (6) stocking of pastures to proper carrying capacity and rotation of pastures to avoid over-grazing; (7) seeding to native or adapted tame grasses that portion of each farm that is not suited for tillage; (8) reseeding of weedy pastures to suitable grasses; (9) construction of diversion terraces to prevent runoff water from damaging lower lying land; (10) leveling and planting of washes caused by uncontrolled runoff to grass; (11) development of suitable drainage and terrace outlets; (12) seeding of waterways to permanent grass; and (13) raising more livestock to utilize the pasture and forage that will be available from the now marginal and sub-marginal areas that will be seeded to grass.

A complete soil and moisture conservation plan will have to be worked

for each unit of Indian land that is farmed by the various operators. This, of course, must be preceded by a detailed soil survey to determine the use capabilities of each unit and the conservation practices required to protect the soil from excessive erosion losses.

The fact that the allotments are so numerous, and are scattered over such a wide area will make the necessary surveys for use capability and inspections for compliance, a difficult and more expensive task than usual.

Administrative expenses will be high in proportion to the total acres of land. Nearly all tracts will have to be treated as separate units when being considered for a conservation plan.

The benefits that can be expected from the application of soil and moisture conserving practices are as follows:

1. The erosion now occuring on all Indian land will be curtailed and the land will eventually be changed to the worthwhile asset that it was under virgin conditions.

2. Instead of more acres becoming so unproductive that tilling them becomes unprofitable, idle lands can be re-built and put back into profitable production.

3. Application of soil and moisture conserving practices will result in higher fertility, more efficient use of moisture, and curtailment of top soil losses which will mean increased production.

4. More livestock will be kept on the farms because of an increase in the acreage of pasture crops. This will make possible a more efficient use of land that is now tilled but should be in grass.

5. Increased production resulting from the control of soil and moisture losses will be an encouragement to the Indians and should result in more of them farming their own land to earn a decent living instead of depending on the meager rent now obtained from the land.

Many of the soil and moisture conserving practices applicable to this area are changes in methods of farming and will involve only technical assistance on the part of the soil and moisture conservation operations staff. These practices can be applied readily on both short and long-term leases. However, construction of dikes and terraces, the re-seeding of pastures, and several other recommended practices will involve expenditures of relatively large amounts of money and can be borne only by operators who will be adequately protected by a long-term lease. It has been the practice in many instances to allow a reduction in rent to compensate for conservation expenditures. Since the per-capita income of the Indians is too low to allow such a reduction in rent, the land operators must bear the major portion of the expenses involved and expect compensation at a later date from increased crop production.

The land in this area as shown by this report is hilly and will require considerable terracing, diversion ditches, and other structures for water control. Once these structures are in place, the responsibility of maintenance can be placed on the man who is farming the land. This initial cost must be borne by the operator since the Indian owner does not have sufficient capital to pay what it will cost to bring this serious erosion condition under control.

SUMMARY

The purpose of this study was to determine the extent and need of soil conservation practices in the Loess Hill region of Thurston County, Nebraska.

The topography varies from very steep and hilly in the eastern part, with wooded bluffs along the Missouri River, to gently rolling in the western part along Logan Creek.

The soil has developed mainly on loess and has been classified mainly as Marshall and Knox silt loam.

Improper land use, improper cultural practices, overgrazing, lack of systematic crop rotations, farming with the slope of the land, failure to apply barnyard manure and to sow and turn under a green manure crop, burning of crop residues, improper maintenance of natural waterways, almost a total lack of diversion terrace construction, and generally little thought toward the future productivity of the land, have all contributed materially to accelerated erosion of the Loess Hill lands.

Deep overfalls at the heads of gullies are on the move up the slopes and valleys in the Loess Hill region. Attempts have been made to combat the action of the gullies. This is a land reclamation job in some instances. The only successful method of controlling the larger gullies is by the construction of dams with drop inlets or diversion terraces. Neither the land operators or land owners can stand the cost of purchasing the pipe needed for the control of large gullies. As a result gully control work is progressing slowly.

More crop residue, more acres fertilized, more crop improvement, more gullies controlled, more trees planted, more permanent pasture planted, more contouring, and more mowing of pastures has be evidenced on the Indian land within the last two years (1948-1950) than on non-Indian land.

The 125 farmers interviewed in this study are farming a total of 22,500 acres of land. There are 120 general type farms and 5 cash grain farms in this group.

There are 3275 acres of land under a one year lease agreement on the non-Indian land, whereas only 600 acres of land were under one year lease agreement on Indian land.

The non-Indian land farmers have more acres in pasture or forage crops and less acres in grain than the Indian land farmers.

The farmers, as a rule, also have realized that although contouring means point rows and short rows, they are saving fuel, wear on machinery and are also increasing the productivity of the land where sweet clover is grown in the oats.

The final outlook of the more progressive farmer still seems to be that contouring is not practical without terracing.

About six miles of terraces were constructed on fifteen different units and approximately 15 miles of waterways were graded and seeded to brome grass in 1950.

About two-thirds of the Indian lands under the jurisdiction of the agency are now being farmed in accordance with SMCO stipulations.

Up until the time the SMC stipulations were included in Indian leases, several tracts of Indian land had grown corn year after year. Corn yields are increasing since lease holders are required to put one-half of the land small grain with sweet clover.

Under similar soil conditions on the Western Iowa Experimental Farm just across the Missouri River from Thurston County, Nebraska, corn grown in a corn-oat and sweet clover rotation and planted up-and-down hill lost 30.64 tons of soil per acre during 1950. When corn was planted under the same conditions

on the contour the loss was reduced to 9.74 tons per acre. Contour listing of corn further reduced soil losses to .39 and .34 tons per acre, respectively, for the corn-oat and sweet clover, and the corn-oat-meadow-meadow rotations. These practices could be applied to the Loess Hill region of Nebraska with similar results.

More soil conservation practices are being used on Indian owned land which is leased to white operators because of the soil conservation stipulations required of all tenants, combined with compliance inspections, fines if the farmers do not comply with these regulations and the threat of cancelling the lease and a forfeit of any future right to obtain another lease if such practices are not followed.

REFERENCES

Albrecht, W. A. and Vanderford, H. B. The Development of Loessial Soils In Central United States as it Relfects Differences in Climate. Mo Agr Exp Sta Bul 345, 1942

Always, F. L. and McDole, G. R. "Loess Soils of the Nebraska Portion of the Transition Region; Humus, Humus-nitrogen and color". Soil Sci 1:239-58 1916

Alway, F. J. and Blesh, M. J. "Loess Soils of the Nebraska Portion of the Transition Region. Hygroscopicity, Nitrogen and Organic Carbon". Soil Sci 1:405-36, 1916

Alway, F. J. and Rost, C. O. "Loess Soil of the Nebraska Portion of the Transition Region, Mechanical Composition and Inorganic Constitutents". Soil Sci 1:405-36, 1916

Alway, F. J. and Islam, R. M. "Loess Soils of Nebraska Portion of the Transition Region; The Water Soluble Constituents". Soil Sci 1:299-316, 1916

Alway, F. J. and McSoel, G. R. "Variations In the Moisture Content of the Surface Foot of a Loess Soil as Related to the Hygroscopic Coefficient". J Ag Res 14:4 53-80, 1918

Alway, F. J. and others. "Loess Soils of the Nebraska Portion of the Transition Region; The Relative Rawness of the Subsoils". Soil Sci 3:9-35, 1917

Ballen, R. E. "Characteristics and Uses of Loess in Highway Construction". Am J Sci 243:283-293

Barbour, F. B. "Loess of China". Smithsonion Rep 1926:279-96

Barbour, G. G. "Recent Observations on the Loess of North China". J Geog. 86:54-64, 1935

Beavers, A. H. and Albrecht, W. A. "Composition of Alluvial Deposits Viewed as Profitable Sources of Loess." Soil Sci Soc Am Proc. 13:468-70, 1949

Bryan, Kirk. "Glacial Versus Desert Origin of Loess". Am Jour Sci . 243:245-8

Condra, G. E. Loess Soils of Nebraska and their Relation to Fruit Raising. Neb. State Hort Soc. Lincoln

Duley, F. L. and Russel, J. C. "Sweet Clover in a Stuble-Mulch System". Soil Sci Soc of Am Proc. 13:1948

Duley, F. L. and Gooding, T. H. and Russel, J. C. "Partridge Pea in a Stubble-Mulch System". Soil Sci Soc of Am Proc. 13:1948

Duley, F. L. and Russel, J. C. Stuble Mulch Farming. 171 Feb 1947

Duley, F. L. "Infiltration Into Loess Soil". Am Jour Sci. 243:278-282

Duley, F. L. and Kelly, L. L. "Effect of Soil Type, Slope, and Surface Conditions on Intake of Water". Nebraska Agr Exp Bul Res 112, 1939

Duley, F. L. and Russel, J. C. Stuble Mulch Farming to Hold Soil and Water. USDA Farmers Bul 1997, 1949

Duley, F. L. and Domingo, C. E. Effect of Grass on Intake of Water. Neb Agr Exp Res Bul 159, 1949

Emerson, F. V. "Loess Deposition, Winds on Louisiana". J Geol. 26:532-41, 1918

Ellas, M. K. "Loess and its Economic Importance". Am Jour of Sci 243:227-230, 1945

Gottschalk, L. C. and Brune, G. M. Sediment Design Criteria for the Missouri Basin Loess Hills. USDA Soil Conservation Service 4400 N. Port Washington Milwaukee 12, Wisconson, 1950

Gregory, George. Work Unit Conservationist Thurston County (White) Nebraska Soil Conservation Service

Hays, O. E. and others. "Increasing Production on an Eroded Loess Derived Soil". J Am Soc Agron 40:1061-9, 1948

Martlock, H. C. and Gruenawalt, R. D. Erosion and Related Land Use Conditions on the Box Elder Creek Project, Nebraska. USDA

Martlock, H. C. Erosion and Related Land Use Conditions in Nebraska. USDA Erosion Survey No 22

Mayer, R. T. Agricultural Soils in a Loess Region of North China. Geog R 26:414-24, 1936

McCalla, T. M. "Influence of Biological Products on Soil Structure and Infiltration". Soil Sci Soc Am Proc. 7:209-214, 1942

McCalla, T. M. "Factors Affecting the Percolation of Water Through a Layer of Loess Soil." Soil Sci Soc Am Proc. 9:12-16, 1945

McCalla, T. M. and Russel, J. C. Nitrate Production as Affected by Grain Crop Residue on the Surface of the Soil. Nebraska Agr Exp Sta Res Bul 131

McCalla T. M. and Russel, J. C. "Nitrate Prod. As Affected by Sweet Clover Residue Left on the Surface of the Soil". Am Soc Agron 40:411-421, 1948

McCalla, T. M. "Water Drop Method of Determining Stability of Soil Structure" Soil Sci 58:117-121, 1944

Nielson, W. Indian Soil and Moisture Conservationist, Indian SCS for Thurston County

Peterson, J. B. "Micromorphology of Some Loessial Soils of Iowa". Soil Sci Am Proc 2:9-13, 1938

Puffeles, N. "Effect of Saline Water on Mediterranean Loess Soils." Soil Sci 47:447-53, 1939

Schultz, B. C. and Stout, T. M. "Pleistocene Loess Deposits of Nebraska." Am Jour Sci 243:231-244, 1945

Smith, G. D. Illinois Loess, Variations in its Properties and Distribution. Ill Agr Exp Sta Bul 490:139-84

Springer, M. E. "Composition of the Silt Fraction as Related to the Development of Soils from Loess". Soil Sci Soc Am Proc 13:461-7, 1949

Swineford, A. and Frye, J. C. "A Mechanical Analysis of Wind-Blown Dust Compared with Analysis of Loess." Am Jour Sci 243:249-255, 1945

Thorp, James. "Significance of Loess in Classification of Soils". Am Jour Sci 243:263-270

Tilton, J. L. "Definition of Loess". Science ns 62:83, 1925

Treasher, R. C. "Origin of the Loess of the Palouse Region, Washington. Science ns 61:469, 1925

Upson, F. W. and others. "Loess Soils of Neb. Portions of the Transition Region; the Water Souble Constituents. Soil Sci 2:377-86, 1916

Watkins, W. I. "Observations on the Properties of Loess in Engineering Structure". Am Jour Sci 243:294-303

Williams, B. H. "Sequence of Soil Profiles in Loess". Am Jour Sci 243:271-277

Winterkorn, H. F. and Eckert, G. W. "Consistency and Physiochemical Data of a Loess Pampanio Soil Physicochemical Properties of Samples from Different Depths of a Profile." Soil Sci 49:72-82, 1940

The Soils of Missouri. Mo Agr Exp Sta Bul 153

Meyer, A. H, Beck, Rockie, W. A. Soil Survey of Thurston County, Nebraska USDA, 1916

Agricultural Census, 1945 Compiled by US Agr Census Bureau, Washington, D. C.

Tekamah Weather Station, Tekamah, Nebraska.

AAA Office at Walthill, Nebraska for Thurston County, Nebraska.

Western Iowa Experimental Farm (1950), Fourth Annual Report, Floyd Andre, Director.

Appendix I

LAND MANAGEMENT

STIPULATIONS FOR SOIL AND MOISTURE CONSERVATION

GENERAL PRACTICES

1. Not less than one-half of the crop land shall be devoted to a small grain each year. (Value $2.00 per acre)

2. Sweet clover or other legume at the rate of 5 lbs. or more per acre, shall be planted in or with all small grain. (Value $2.00 per acre)

3. Sweet clover shall not be pastured after March first the spring following planting and shall be turned under after April first. (Value $5.00 per acre)

4. Row crops shall not be grown more than one year in succession on the same land. (Value $2.50 per acre)

5. All tillage shall be done on the contour on land whose average slope is 5% or more. (Value $5.00 per acre)
   a. Contouring shall not deviate more than 2% from a true level line.
   b. Vertical interval in feet between contour guide lines shall not exceed the maximum percent of slope in the field.

6. It is understood and agreed that the lessee will not pasture on the leased premises a number of cattle or other livestock in excess of the carrying capacity of the lands as determined by the Superintendent or his duly authorized representative and agrees to make promptly such reduction in the number of animals grazed as necessary to prevent overgrazing, soil erosion, or other injury to the land or crops at any time during the term of the lease upon written notice by the Superintendent or his duly authorized representative. (Value $2.50 per acre)

7. Crop residues shall not be burned but shall be incorporated into the soil. Barnyard manure produced on this land shall be spread each year, over the land covered by this lease. (Value $2.50 per acre)

8. The lessee agrees to cultivate, and farm said lands in a husband-like manner; to commit no waste thereon; to keep lands free from weeds, noxious and otherwise and to mow and prevent from seeding such weeds as may grow along the roadside adjacent to the said land and all fence rows thereon. (Value $4.00 per acre)

Note:

Penalty for failure to comply shall be at the rate indicated for each stipulation. Total amount shall be based on the number of acres on which the lessee fails to comply.

If a lessee is unable to comply with any of these stipulations the SMC office at the Winnebago Indian Agency should be contacted beforehand.

Appendix II

Questionnaire

1. Name of farmer_____
2. Location of farm_____
3. Size of farm (acres)_____
4. Type of farming (Dairy etc)_____
5. Owner or tenant _____
6. If rented, kind of lease_____
7. If rented, how long a term lease
8. How long have you lived on farm_____
9. How many yrs since this farm was put under the plow_____
10. Are you farming land in addition to this farm____If so, how many acres
11. Do you farm with tracter or horse_____
12. What kind of crop rotation is followed_____
13. Do you follow the practice of burning stuble, strawpiles etc. _____
14. How many loads of manure are returned to the land each yr._____
15. Do you comply with AAA. Prog. If so, in what year did you enter _____
16. If so, approx. how many acres less of corn is your base than before you entered program_____
17. Number of acres tillable in perm. pasture_____
18. Number of acres tillable in this farm_____
19. No. of acres tillable in perm. Hay___
20. Number of acres tillable in roads, lots, and waterway, wasteland _____
21. Number of acres in corn
    a. when you first came on farm___
    b. in 1950_____
22. Average yields of corn per acre
    a. when you first came on farm___
    b. beginning of AAA prog._____
    c. in 1950_____
23. Number of acres in oats
    a. when you first came on farm_____
    b. in 1950_____
    c. at beginning of AAA prog._____
24. Average yld. of oats per acre
    a. when you first came on farm_____
    b. beginning AAA Prog._____
    c. in 1950_____
25. Number of acres in legumes
    a. when you first came on farm_____
    b. beginning of AAA prog._____
    c. in 1950
26. Do you contour farm_____
27. Do you list or surface plant corn _____
28. Have you limed any fields_____
29. If so, has there been a noticeable change in yield_____
30. Do you sell the corn as a cash crop or feed it to livestock____
31. How many units of livestock
    a. Horse and mules_____
    b. Beef cattle_____ c. hogs_____
    d. Dairy cattle____ sheep_____
    f. Poultry_____
32. Is this more or less than when you came on farm_____
33. What are the soil types_____
34. Is the farm hill-land, bottom, or both
    a. Approx. No. acres of hill-land___
    b. Approx. No. acres of bottom_____
35. How steep are the slopes_____
36. Does the farm have bad gullies___
37. How deep was the virgin soil_____
38. What % of the topsoil has been lost _____
39. How many in. of topsoil remains__

SOIL CONSERVATION PRACTICES

1. Limed (yes or no)_____
2. Drainage (acres)_____
3. Gullies control, (miles)_____
4. Trees and Plants grown, No._____
5. Acres of grass _____
6. Brush control_____
7. Contouring acres_____
8. Cover crops (acres)_____
9. Crop Improvement (acres)_____
10. Crop Residue (acres)_____
11. Dams, No. of_____
12. Deep plowing (acres)_____
13. Fertilization_____
14. Weed control_____
15. Mowing pastures (acres)_____
16. Put others on back of page_____

Glen D. Johnson, Vet. Agr. Instr., Macy, Nebr.

In addition to possible claims as shown above, failure to comply with any or all of the stipulations will be sufficient cause for cancellation of the lease.

Date_____ Signature_____

BASE MAP

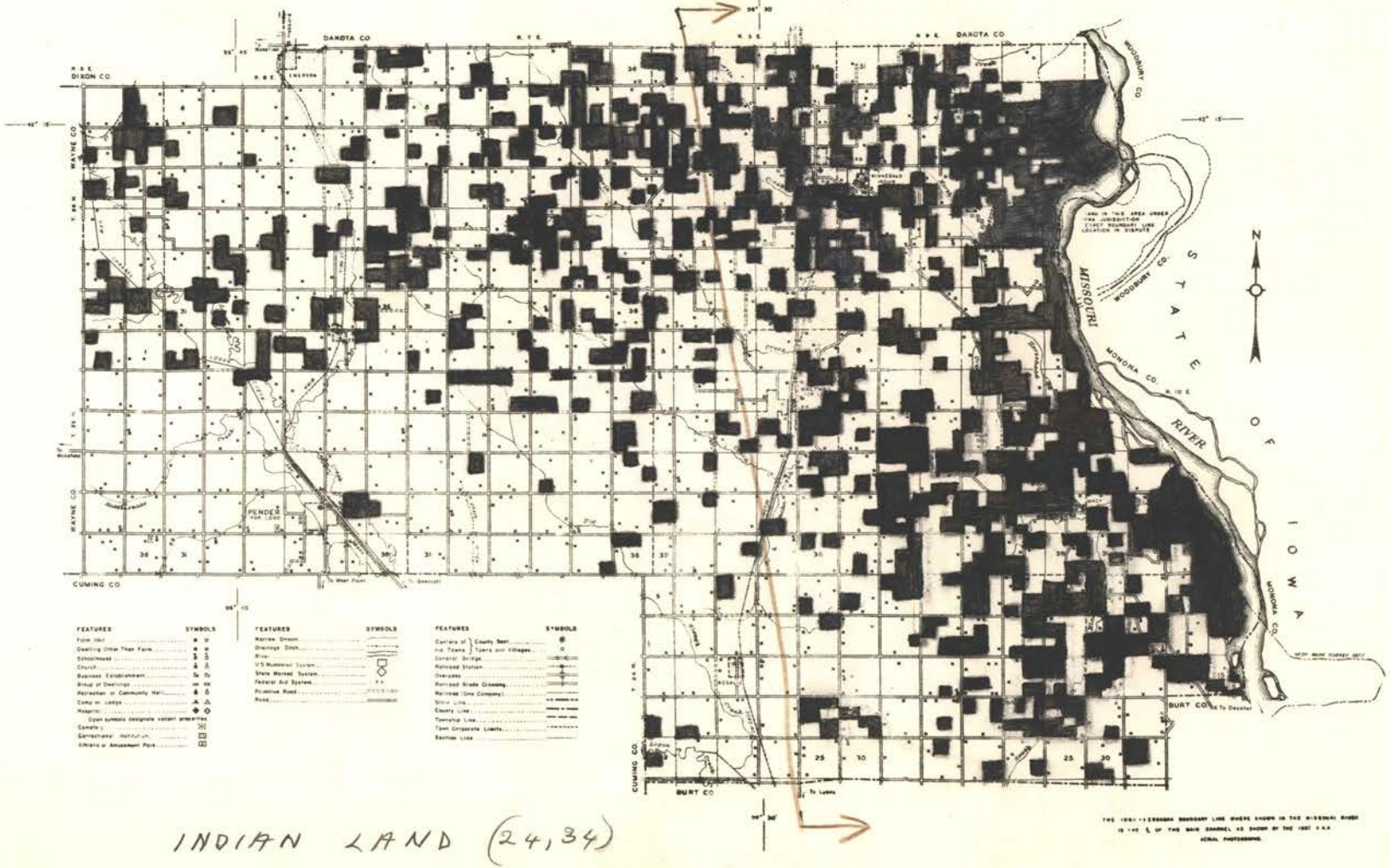
THURSTON COUNTY

NEBRASKA

PREPARED BY THE
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IN COOPERATION WITH THE
U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
DATA OBTAINED FROM
STATE-WIDE HIGHWAY PLANNING SURVEY

SCALE

BROWN LOESS HILL REGION



INDIAN LAND (24,34)

Appendix III

THE WORKS PROGRESS ADMINISTRATION PARTICIPATED IN THIS PROJECT.

LAMBERT CONFORMAL CONIC PROJECTION
NORTH AMERICAN 1927 DATUM
NEBRASKA - NORTH

COPYRIGHT 1938
BY
STATE OF NEBRASKA
DEPARTMENT OF ROADS AND IRRIGATION

LOCATION OF THE 125 MEN USED IN THIS REPORT.

Appendix IV

BASE MAP

THURSTON COUNTY

NEBRASKA

PREPARED BY THE
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IN COOPERATION WITH THE
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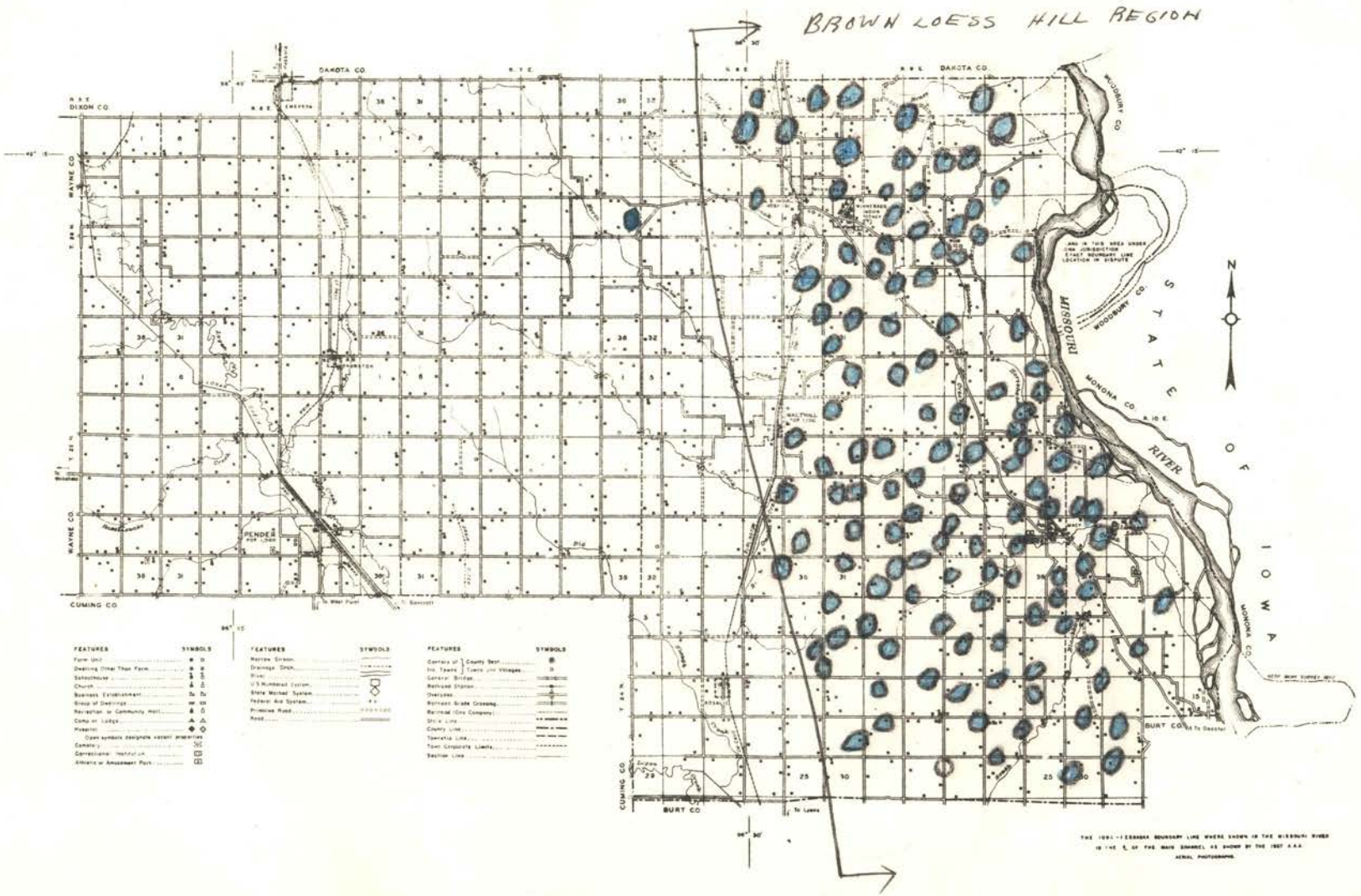

THE IOWA-NEBRASKA BOUNDARY LINE WHERE SHOWN IN THE MISSOURI RIVER IS THE E. OF THE MAIN CHANNEL AS SHOWN BY THE 1937 A.A.A. AERIAL PHOTOGRAPHS.

THE WORKS PROGRESS ADMINISTRATION PARTICIPATED IN THIS PROJECT.

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THESIS TITLE: Soil Conservation in The Loess Hill Region of Thurston County, Nebraska

NAME OF AUTHOR: Glen D. Johnson

THESIS ADVISER: Horace J. Harper

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