CONSERVATION PRACTICES IN CLARK COUNTY, KANSAS

By

EDGAR HAROLD PECHIN

Bachelor of Science

Oklahoma Agricultural and Mechanical College

Stillwater, Oklahoma

1952

Submitted to the faculty of the Graduate School of
the Oklahoma Agricultural and Mechanical College
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
August, 1954

CONSERVATION PRACTICES IN CLARK COUNTY, KANSAS

Thesis Approved:

Ralph E. Bicklard
Thesis Adviser

Edward G. Kelso
Head of the Department

Robert MacVicar
Dean of the Graduate School

PREFACE

The purpose of this study is to show the development and operation of the Soil Conservation Service in Clark County, Kansas. A formal soil conservation program has had only a short history in the county. An acknowledgement of the need for a soil conservation program was not made by the land owners until ten years after the Federal and state governments made it possible in 1937.

This study starts with the legislation creating the organization, the objectives, and the operations of this Soil Conservation District. The physical characteristics that exist in the county are then characterized from interpretation of maps and graphs to bring out the variations in the climatic elements, the vegetation, and the soils and slopes. On the basis of these factors the county has been subdivided into three agricultural resource areas.

The remaining parts of the study center on each of the three areas separately. The specific conservation practices that are commonly used in each area are described. A typical farm unit, with the representative erosional problems, is chosen for each of these three resource areas. The practices used in the control of the problems are those recommended for each region as a whole. Thus, in studying one

small unit, one can see how conservation practices are planned and applied.

The writer, while residing in Clark County, worked for the Soil Conservation Service as an assistant field supervisor. While working in the field in the planning and establishment of conservation measures, he became keenly interested in seeing the basis for the conservation program as an integrated whole for this district.

The historical and factual background material dealing with soils and soil conservation, as well as climatic records, was drawn from books and periodicals. Much of the detailed data for this study was obtained from the official files of the district soil conservation office located at Ashland, Clark County, Kansas. This material includes maps, pamphlets, work unit sheets, and farm plans. Interviews with the County Conservationist and farmers cleared up specific questions for which answers were not found in the other sources.

The writer is especially grateful to Mr. H. Leo Brown, Clark County Soil Conservationist, who gave generously of his time in interviews and literally opened the Conservation District files for the writer's use. Thanks are extended to the members of the library staff of the Oklahoma Agricultural and Mechanical College for their untiring efforts in locating material used in this study.

Help of the staff of the Geography Department of the Oklahoma Agricultural and Mechanical College is appreciated, especially that of Professor Ralph E. Birchard, under whose direction this study was prepared. Dr. Edward E. Keso gave valuable suggestions on the final preparation of the study.

Finally, thanks are due to Lavonne Pechin, wife of the writer, for her constant encouragement and aid during the preparation of this study.

E. H. P.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

DEVELOPMENT OF THE CLARK COUNTY CONSERVATION DISTRICT

Clark County, Kansas, is located in the southwestern part of Kansas (Figure 1). It is the fifth county east from the western border in the southern tier of counties which border Oklahoma. The 100th meridian west passes through the western part of the County, and the 37th parallel north is the southern boundary. The County contains 984 square miles or 629,760 acres and constitutes a Soil Conservation District. Over one-half of the total acreage has active conservation plans (Table I). This table also records the major conservation practices of the district.

Development of the District

This chapter deals with the development of the Soil Conservation Service in Clark County, Kansas. To help in the understanding of the establishment of the Soil Conservation Service in this county, the necessary legislative actions which brought it into being in the United States,

[1]United States Department of Commerce, County and City Data Book 1952 (Washington, D.C., 1953), p. 186.

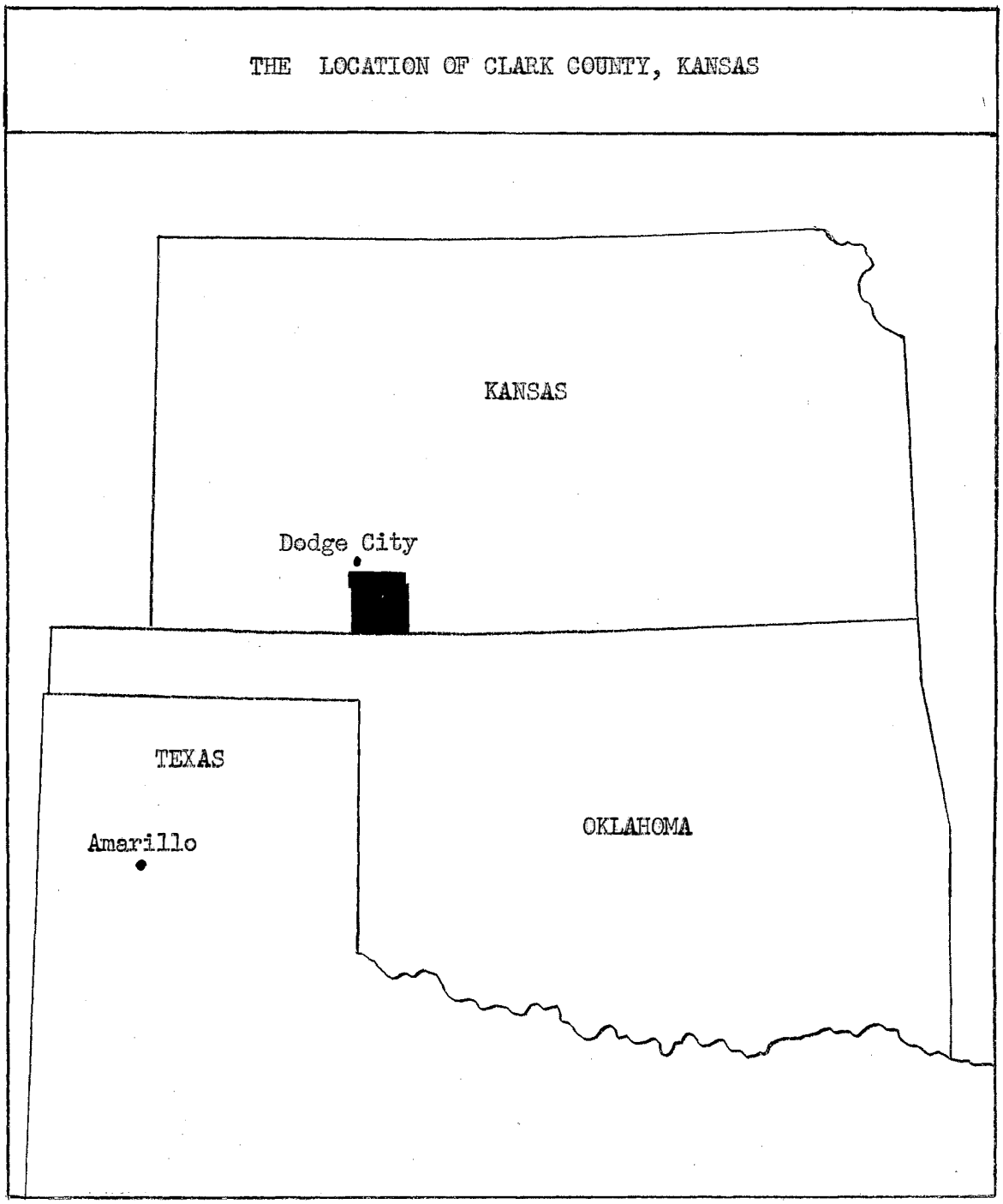


Figure 1. Clark County is the blacked area. The cities located are referred to later in the study.

TABLE I

MAJOR SOIL CONSERVATION PRACTICES
APPLIED THROUGH 1952

	Numbers	Acres	Miles
Conservation Plan			
Applications Received	292	410,459	
Active Conservation Plans	288	326,419	
Practices			
Contour Farming		12,608	
Cover Cropping		11,311	
Stubble Mulching		61,279	
Pasture Improvement		209,201	
Seeding of Pasture		11,851	
Farm and Ranch Ponds	232		
Terraces			398.5
Field Wind Breaks			63.4
Proper Stocking		228,506	
Weed and Brush Control		30,461	
Rotation Grazing		18,293	
Crop Rotation		13,760	

Source: Data for this table were extracted from United States Department of Agriculture, Soil Conservation Service, Work Report of the Clark County, Kansas District, Period ending December 31, 1952.

Kansas, and Clark County will be cited. The erosional problems will be presented.

First of the enactments creating the Soil Conservation Service under the Department of Agriculture was the Soil Conservation Act of 1935 (Public Law, No. 46, 74th Congress). This comprehensive law has been summarized as follows and is

> ...designed to conserve basic soil and water resources by extending sound land-use practices to all land vulnerable to soil erosion. Action in this program involves: (1) research to determine the character, causes, and effects of soil erosion and to develop practical measures for erosion control; (2) surveys to determine the facts needed in planning and prosecuting erosional control and moisture conservation work; (3) demonstrations to illustrate the practical effectiveness of soil-conserving land-use practices and prove techniques of erosion control through actual application on the land; (4) cooperation with local conservation groups formed under the authority of the state law; (5) dissemination of information regarding erosion and its control through the normal media of public communication; (6) cooperation with federal, state, and local agencies in the fields of conservation, land-use, adjustment, and related fields.[2]

The Soil Conservation Act put the responsibility and authority of this program in the local communities, and its operation is voluntary and democratic. In conjunction with the Soil Conservation Act was the Flood Control Act of 1936. This act divided the work of controlling run-off water between the War Department and the Department of Agriculture. To the War Department went the task of planning and building the great engineering works of downstream control. The Department of Agriculture undertook the problem of management

[2]H. H. Bennett, Soil Conservation (New York, 1939), pp. 314-315.

of land to divert excessive run-off from the rivers to underground channels.[3]

During the drought period throughout the Great Plains region in 1934, 1935, and 1936, the situation became very acute, and President Franklin D. Roosevelt appointed the Great Plains Committee.[4] The purpose of this committee was to make a complete study of the land-use problems in this region and to recommend a program that might lead to the promotion of a sound use of the land and at the same time improve the welfare of the people. The Great Plains Committee reported that, in order for this area to survive, some method by which available water supplies could be conserved and used wisely must be adopted. The Committee recommended that Federal aid should be given for the development of small water facilities throughout this region.[5] The resulting program, designed to help the farmers and ranchers in the improvement and development of farm and range water supplies in the arid and semiarid areas, was the Pope-Jones Water Facilities Act of 1937.[6]

The Soil Conservation Service assists farmers and groups of farmers in (1) planning the development of water supplies that will facilitate improvements in land-use; (2) constructing and installing, or assisting farmers to construct

[3]Ayers Brinser and Ward Shepard, Our Use of the Land (New York, 1939), p. 115.

Bennett, p. 329.

[5]Ibid., p. 329.

[6]Ibid., p. 315.

and install, such small water facilities as wells, ponds, small reservoirs, small dams, pumps, springs, stock water tanks, spreading systems for utilizing run-off water, and similar improvements.[7]

Working with the Soil Conservation Service in the development of watershed demonstrations and other projects was the Civilian Conservation Corps.

The major portion of the work in the erosion-control camps, however, involves the installation of soil-conserving measures on farm lands. This work includes such activities as gully control operations, terrace outlets construction and protection, planting of trees and shrubs, running contour lines for furrows and terraces and building structures for stream bank protection.[8]

Although this was before Clark County was a soil conservation district, one Civilian Conservation Corps camp was established in the county. The major part of its work was in the building of the Clark County State Lake in the northeast part of the county on Bluff Creek. The Public Works Administration did most of the erosion control measures on the farm lands and planted some shelterbelts.

In 1937 President Roosevelt sent out letters to the governors of the states suggesting that each state should take up the Soil Conservation Service program and form their own conservation plans. The State of Kansas initiated the soil conservation movement with the approval of Bill Number 606 by the governor on April 2, 1937.[9] This bill declared:

[7]Ibid., p. 316.

[8]Ibid., p. 321.

[9]Proceedin s of the House of Re resentatives of the State of Kansas, irt eth iennial ession opeka, ansas, 1937), p. 874.

...the necessity of creating governmental subdivisions of the state, to be known as 'soil conservation district,' to engage in conserving soil resources and preventing and controlling wind erosion; to establish the state soil conservation committee, and to define its powers and duties; to provide for the creation of soil conservation districts; to define the powers and duties of soil conservation districts, and to provide for the exercise of such powers, including the power to acquire property by purchase, gift, and otherwise; to empower such districts to adopt programs and regulations for the discontinuance of land-use practices contributing to soil wastage and soil erosion, and the adopting and carrying out of soil-conserving land-use practices, and to provide for the enforcement of such programs and regulations; to provide for establishing boards of adjustment in connection with land-use regulations and to define their functions and powers; to provide for financial assistance to such soil conservation districts, and to provide for the discontinuance of such districts.[10]

For an area to become a soil conservation district a petition of 25 land owners must first be filed with the state soil conservation committee.[11] This petition must set forth:

(1) The proposed name of said district; (2) that there is need, in the interest of the public health, safety, and welfare, of a soil conservation district to function in the territory described in the petition; (3) a description of the territory proposed to be organized as a district; which description shall not be required to be given by metes and bounds or by legal subdivisions, but shall be deemed sufficient if generally accurate; (4) a request that the state soil conservation committee duly define the boundaries for such district; that a referendum be held within the territory so defined on the question of the creation of a soil conservation district in such territory; and that the committee determine that such a district be created.[12]

[10] Ibid.

[11] Soil Conservation Districts Law as revised b the 1949 Kansas Legislature (Topeka, ansas, 19 9 , p. .

[12] Ibid., pp. 4-5.

The state committee studies the conditions within this proposed district and decides whether or not this district is necessary. If the answer is in the affirmative, a referendum is held. "All occupiers of lands lying within the boundaries of the territory as determined by the state soil conservation committee, shall be eligible to vote in such referendum."[13] The outcome of the referendum is published and the state committee, after considering this voting and other social and economic factors, makes the final decision whether or not this district should be put into operation. In the organization of the new district the state committee appoints "...two supervisors to act with the three (3) supervisors elected as provided hereinafter, as the governing body of the district."[14] For the nomination of the other supervisors, "...nomination petitions may be filed with the state soil conservation committee to nominate candidates for supervisors of such district."[15] The election for these three supervisors is to be announced, and

> Only...land occupiers shall be eligible to vote. The three candidates who shall receive the largest number, respectively, of the votes cast in such election shall be the elected supervisors of such district.[16]

[13] Ibid., p. 6.

[14] Ibid., p. 7.

[15] Ibid., p. 9.

[16] Ibid.

This group of five supervisors makes up the governing body of the soil conservation district.

After the state of Kansas passed legislation for the establishment of soil conservation districts within the state, Clark County was slow in becoming a district. It was not until March, 1947, that it was accepted.[17] After Clark County became a soil conservation district, a program was designed to provide a basis for the control of and prevention of erosion and the conservation of soil and soil resources of this district.

Soil Conservation Problems and Methods

Officials of the district, with the help of farm owners and operators, would like to solve the problems indicated and accomplish the following:[18]

1. Problem: Shortage of water for crop production.

   Methods: Contour farming, keeping crop residues and clods on the surface, the control of weeds through timely tillage, and the establishing of cropping systems.

2. Problem: Water erosion.

   Methods: Re-grassing of cropland not suitable for cultivation, grassing of draws and "point" rows

[17] Annual Re ort of the Board of Su ervisors Clark County Soil Conservation District Ashland, Kansas, 19 7), p. 1.

[18] Clark County Soil Conservation District Program, Kansas, From the files of this district office located at Ashland, Kansas, pp. 6-8.

in cultivated fields, and by supporting other practices with terraces and diversion ditches when needed.

3. Problem: Wind erosion.

   Methods: Increasing crop growth through water conservation and good soil management, the use of tillage methods to keep stubble on the surface of the land when fields are not in a growing crop, re-grassing cropland that is too steep or sandy, and grazing land management practices.

4. Problem: Soils low in fertility and organic matter.

   Methods: Water conservation, crop residue management, strip cropping, and the use of sweet clover and barnyard manures on the sandy soils and to prevent further decline in organic matter and fertility by preventing erosion.

5. Problem: Wet spots in fields, crops drown out.

   Methods: Keep water where it falls by use of contour farming and management of crop residues, use terraces and diversion ditches to keep water out of low spots, and drain these low spots when feasible.

6. Problem: Feed shortage in dry years.

   Methods: Moisture conservation practices, summer fallowing some land for feed crops, the carrying over of feed, and grass in good years, and growing and harvesting of larger acreages of feed crops, and planting of sudan grass for pasture.

7. Problem: Pasture shortage in early spring and early fall.

   Methods: The planting and setting aside a patch of wheat or rye for harvesting by livestock, planting cool season grasses, and the use of sweet clover for early pasture and soil improvement.

8. Problem: Farmstead and livestock unprotected from wind.

   Method: Encouragement and assistance to farmers in establishing tree windbreaks on favorable sites.

9. Problem: Small odd shaped areas and roadsides unutilized.

   Methods: Plant odd shaped areas to grass and protect road ditches from fire.

For the carrying out of these proposed practices the Soil Conservation Service plans to educate the farm operators in the needs and the fundamentals of these soil conservation practice methods. In order to be eligible for technical assistance in the establishment of soil conservation practices the owner must file an application for assistance with the county committee. However, advice and information can be received without joining the program. A voluntary fee of five dollars is asked from each applicant who joins the program of the soil conservation district. This money goes for supplies and equipment used within the district.

After each application for a farm plan, the County Conservationist goes over the farm unit with the owner and explains to him the conservation practices recommended and why they should be used on this particular farm unit. From this survey a plan of conservation operations is made by the Soil Conservation Service technicians with the aid of aerophotos. This material is organized into the farm plan which basically includes the proposed conservation plan, a land use map, and a land capability map. On these maps, which are aerophotos, are indicated the locations of the conservation practices that are to be applied. A copy of this plan

is given to the owner so that he can get a better insight into the entire soil conservation plan to be used on his farm unit.

For a better understanding of the need of soil conservation in Clark County the existing physical characteristics and the land use in the county need to be considered. In the next chapter the climatic elements, the vegetative cover (natural and man produced), and the soils and slopes will be characterized and analyzed as to their effect in creating soil use problems.

CHAPTER II

PHYSICAL CHARACTERISTICS OF CLARK COUNTY, KANSAS

In this chapter the physical elements--climate, vegetation, soil and slope--will be evaluated as to their influences upon soil conservation. Each one of the physical elements will first be considered separately. The interrelationship of these physical elements will then be correlated to show their combined effect upon soil erosion. It is the action of the exact and varying combination of physical conditions on the land that creates the necessity for varying soil conservation practices throughout an area.

Climate

Clark County, Kansas, lies within a dry subhumid mesothermal climatic region.[1] This region is a rather narrow zone between the moist subhumid mesothermal climatic region on the east and the semiarid mesothermal climatic region on the west. It is frequently by alternate warm moist air masses moving north from the Gulf of Mexico and cold dry air masses moving south from the Polar regions. Sharp changes

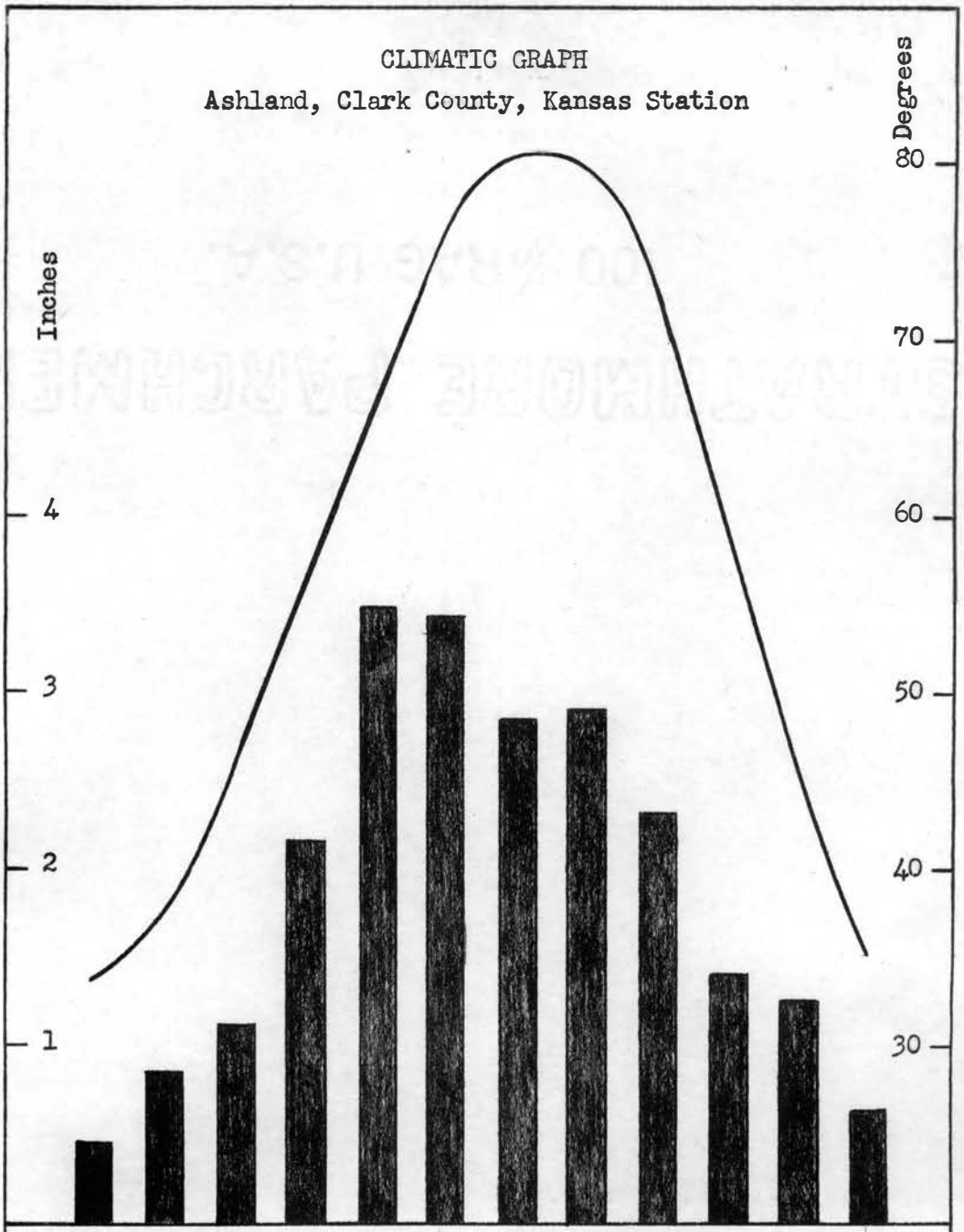
[1]C. W. Thornthwaite, "An Approach Toward a Rational Classification of Climate," Geographical Review, XXXVIII (1948), Plate I facing p. 94.

in the weather occur often and are usually of short duration. Another climatic characteristic of the area is the irregular sequence of wet and dry periods.

The climatic graph (Figure 2) indicates monthly temperature averages and mean monthly precipitation. As far as temperature is concerned, the coldest month is January, having an average of 33.7° F., and the warmest month is July with an average of 80.9° F. Although summer days are generally hot the nights are relatively cool. The periods of high temperatures are accompanied by low relative humidity (Figure 3). It is higher in the winter months but tends to decrease as the temperature increases. July is the month having the lowest relative humidity as well as the highest average monthly temperature.

The precipitation that falls from season to season greatly affects crop growth and also the washing and blowing of the soil. The average annual precipitation for the county is 23.37 inches.[2] The average monthly figures, as indicated by the bars in the climatic graph, show that the winter months have relatively little precipitation; what there is generally comes in the form of snow. Approximately 75 per cent of the total moisture falls in the six most favorable crop growing months of April through September. May and June are the months of maximum precipitation. At

[2]Re ort of the Kansas State Board of Agriculture, Climates of Kansas, LXVII, No. 285 (June, 1948), p. 2.



Source: Report of the Kansas State Board of Agriculture, Climate of Kansas, Vol. LXVII, (June, 1948) No. 285, pp. 103 and 213, 1931 through 1946.
United States Department of Commerce, Weather Bureau, Climatological Data for the United States, Kansas, Vols. XXXVIII through XL, (1947 through 1953).

Figure 2

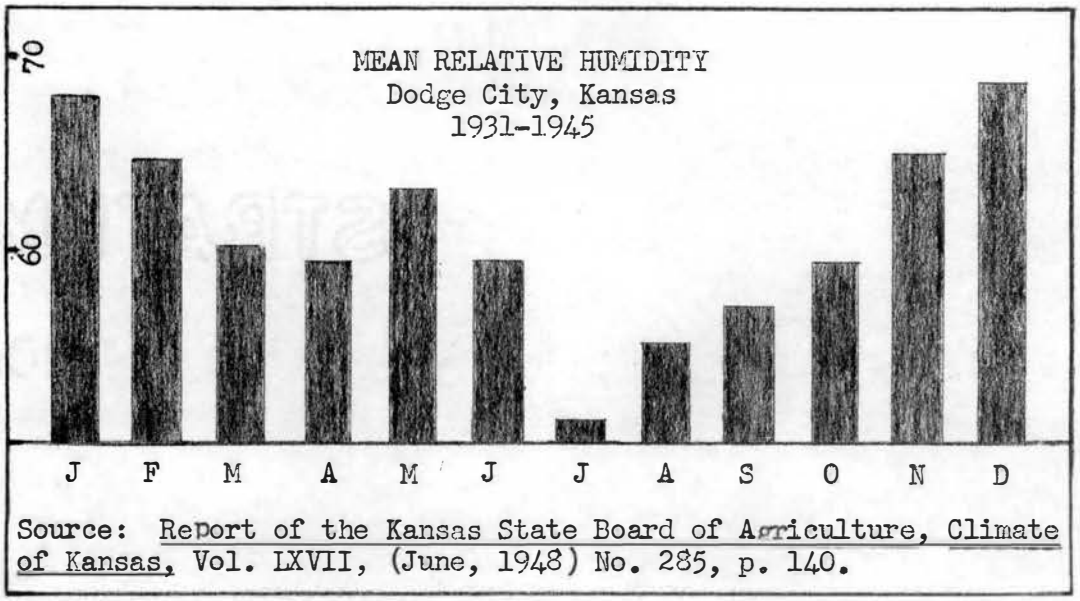
"Amarillo and Dodge City, located in the semiarid Great Plains...because of the high rate of evaporation the rainfall is frequently deficient as far as agriculture is concerned."[3] Clark County lies essentially between these two stations, so the conditions here should be nearly the same. At Dodge City, representative of western Kansas, only 28 per cent of summer rains fall from 6 a.m. to 6 p.m., and there is comparatively little interruption to farm work. Winter and spring precipitation is more evenly distributed.[4] This helps to explain why there are from 160 to 200 days of sunshine and only 60 to 80 days of cloudiness per year.[5] Because of the summer precipitation falling mainly at night and the many cloudless days coupled with high temperatures, evaporation is high, often drying the moisture rapidly and resulting in the low relative humidity. These conditions tend to dry out the surface of the soils.

Other characteristics of the rains are their high intensities and short duration. The number of rains of one inch or more for each month is shown (Figure 4). Heavy rains, even though of short duration, are the great soil

[3]David I. Blumenstock, "Rainfall Characteristics as Related to Soil osion," United States Department of Agriculture, Washington, D.C., Technical Bulletin No. 698 (1939), p. 14.

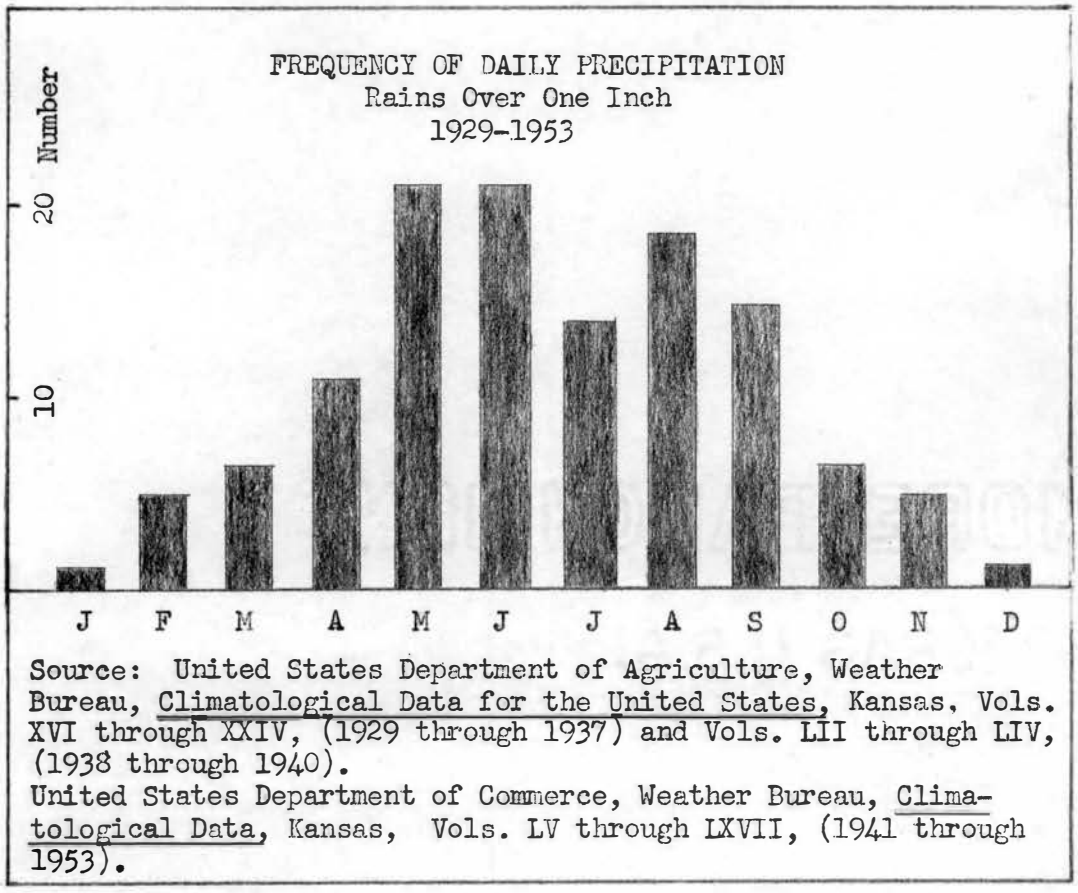
[4]Re ort of the Kansas State Board of A riculture, Climates of Kansas, p. 9.

[5]Ibid., pp. 237-238.



Source: Report of the Kansas State Board of Agriculture, Climate of Kansas, Vol. LXVII, (June, 1948) No. 285, p. 140.

Figure 3. Dodge City, Kansas was nearest station that maintained instruments for this data.



Source: United States Department of Agriculture, Weather Bureau, Climatological Data for the United States, Kansas, Vols. XVI through XXIV, (1929 through 1937) and Vols. LII through LIV, (1938 through 1940).
United States Department of Commerce, Weather Bureau, Climatological Data, Kansas, Vols. LV through LXVII, (1941 through 1953).

Figure 4

eroders. H. Leo Brown, Clark County Soil Conservationist, states that it takes a rain of one inch or more to create erosional problems in this county. The graph of the heavy rains follows the same monthly distribution as the graph of the average monthly precipitation.

The average hourly wind velocities and the prevailing wind directions are shown (Figure 5). The prevailing winds in the winter are from the northwest and are from the south in the summer. The windiest months are in the Spring months of March, April, May, and June. However, in September there is a significant increase in wind velocities. In this month a large part of the cropland is open prior to wheat planting, and serious wind erosion may result without proper conservation measures.

Vegetation

The native vegetation in Clark County is short grass. In 1953 there were 396,540 acres, out of the county total of 629,760 acres, in native grass.[6] The varieties of grass on 286,731 of these acres of the heavier soil, mostly in the northern two-thirds of the county, are blue grama and

[6]United States Department of Agriculture and the Kansas Agricultural Experiment Station cooperating, Physical Land Conditions Affectin Use Conservation and Mana ement of Land Resources, ark 4a attan, Kansas, October, 1953), p. 19.

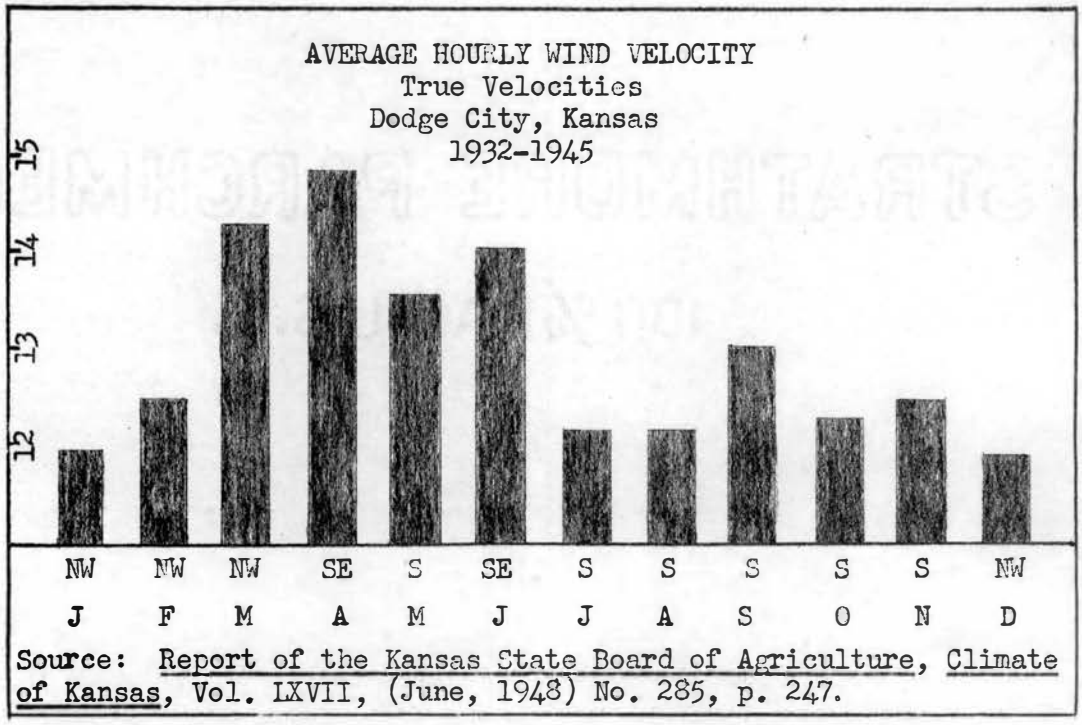


Figure 5. Dodge City, Kansas was nearest station that maintained instruments for this data. Bars indicate wind velocities and letters immediately under bars indicate prevailing wind direction.

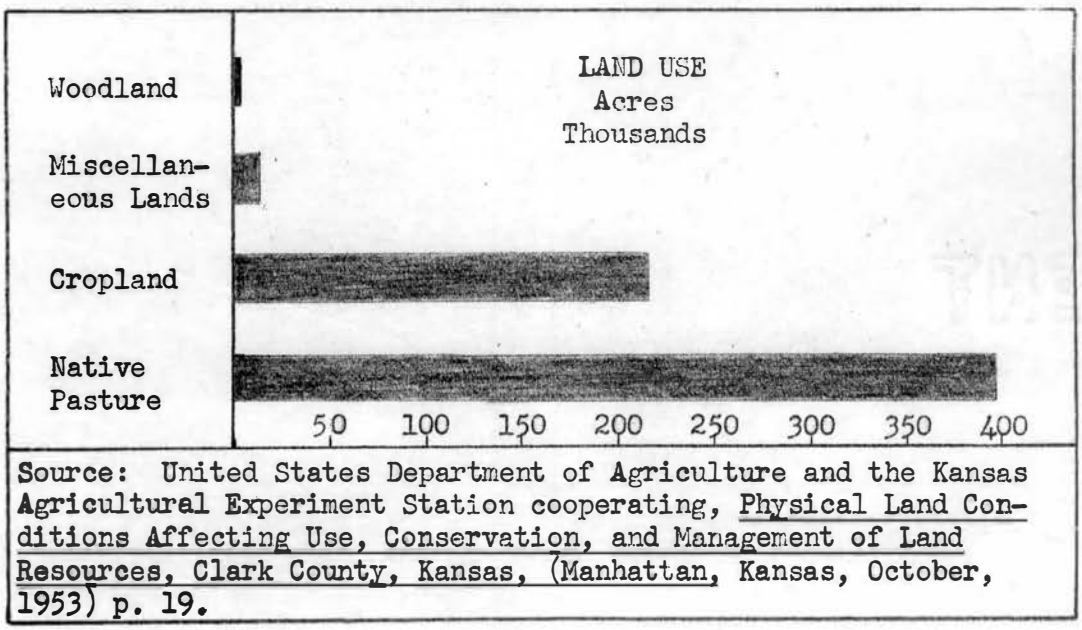


Figure 6. A comparison of the acreage in different land uses.

buffalo.[7] Western wheat grass is found in the valleys, and little bluestem and side oats grama grass are found on the rocky outcrops. Blue grama, bluestem, sand dropseed, and sagebrush are found on the remaining acreage of the pasture land which is sandy and lies in the southern part of the county.

Approximately two-thirds of the area of Clark County is in pasture land (Figure 6). When these grasslands are well managed, erosional hazards are reduced to a minimum. Management is complicated, however, as this county is susceptible to alternate dry and wet periods. During the dry periods, the growth of the grass is stunted, thus reducing the vegetative cover. Then the characteristic hot and dry winds burn the grass and blow the soil. These drought periods are often broken by heavy rains, and serious water erosion frequently results where the soils are thin, unprotected, and highly sloping. Destruction of vegetative cover exposes the soil to beating rainfall which tends to pack closely together the particles making up the surface layer. This prevents the entrance of water into the soil. The result is runoff and erosion.[8]

[7] Ibid., pp. 18-19.

[8] R. I. Throckmorton, "Introduction," Report of the Kansas State Board of A riculture in ansas, o. 2 1 ebruary, 1 , p. 1 .

The grasslands of the more sandy soils in the southern part of the county, when mismanaged, are more susceptible to erosion by wind than by water. Their sandy nature makes them permeable so that they can absorb most of the moisture they receive. When these grasslands are over-grazed, sagebrush increases, which results in a reduced yield of grass. These tendencies show the importance of proper control of grazing land under existing conditions.

The total land under cultivation in the county is 217,009 acres (Figure 6) of which a small part is under irrigation.[9] The major concentration of cropland is in the northern part of the county on the flatter lands. Most of the lands that are under cultivation fall into the better land capability classes. Although they are quite level, they are more subject, than they would be otherwise, to severe erosion by wind and water because they are necessarily open part of the crop growing year. The cropland in the northern and southern parts of the county generally absorb moisture at a moderate rate, thus being less susceptible to erosional hazards than would be the case otherwise. The croplands in the central part have the most varied relief. The soils are tighter also and have a low moisture absorption rate, thus causing more run-off. The degree of water

[9]Physical Land Conditions Affecting Use, Conservation, and Management of Land Resources, Clark County, Kansas, p. 19.

erosion on these soils varies with the slope and the condition of the soils.

Climate is the general controlling factor in the adaptation of crops grown within a region. The crops produced in this county are wheat, forage sorghums, grain sorghums, alfalfa, barley, corn, and oats in the order of the acreage of the cultivated land and is concentrated in the northwest part of the county. The wheat is winter wheat planted in September and harvested in June or early July depending upon weather conditions. After harvest, the land is plowed and left open until planting time in September. The cropping system is generally one year fallow and four years production. During the period that the wheatlands are open, the area often experiences heavy rains, high temperatures, low humidity, and hot winds from the south, as shown by the climatic graphs above. These conditions tend to dry the fields out quickly and set them up for wind erosion. This is especially true in the northern flat lands and the southern sandy lands.

In the southern two-thirds of the county the croplands are generally associated with farming units having some pasture land. Wheat and sorghums are usually produced, with wheat being a cash crop and the sorghums being utilized as grain or forage. The cropland in sorghum production is generally uncovered from October to April. Most of the

acreage is in rows and offers little vegetative cover until summer. It is in the early part of the growing season that the county has the month of maximum rainfall with heavy rains, high winds, increasing temperatures, and decreasing relative humidity. Frequently these crops are washed or blown out. The farming units in the central part of the county, due to the combination of wheat and sorghum production, have some croplands open most of the year, and they are subject to severe water erosion as well as wind erosion.

The native woodlands are restricted to the stream valleys. The native trees are cottonwood, willow, tamarack, hackberry, and elm. Shelterbelts have been planted but are scattered over most of the county. Mr. H. Leo Brown, County Conservationist, recommends that more should be planted to help control wind erosion. The varieties of trees planted in these shelterbelts are Chinese elm, honey locust, Russian o ive, Osage orange, cedar, tamarack, black locust, mulberry, and desert willow. These trees have had a very high survival rate when given the proper protection.

Soils and Slopes

The soil conditions vary considerably in Clark County. The types of soils range from the heavier clayey soils in the north to the loose sands and sandhills in the south. The map and data of a reconnaissance soil conservation survey (see Figure 14, the folded map, page 71) indicate the

generalized classes of land according to use capability for eight general soil groups. A break-down of these soil groups as to their land capability classes and their acreage under cultivation and in native pasture is presented (Table II). An explanation of the land capability classes also is shown (Table III). Since grass protects the soil, erosion is usually more severe on cultivated land. For this reason, only the soil groups making up the bulk of the land under cultivation will be characterized.

It may be seen (Table II) that the bulk of the cultivated land falls into land capability classes II and III (see Table III). The Class II soil groups (Figure 14) are those best suited to cultivation and those which require only simple practices for erosion control, moisture conservation, and fertility maintenance. There is a large concentration of these soils in the northwest part of the county, whereas, in the remaining part of the county these soils are more scattered. In general these soils are fertile, easily tilled, absorb moisture at a moderate rate, and have a high moisture storage capacity. However, the moderately heavy soils have low permeability. The soils in this class occupy areas having generally 0 to 2 per cent slopes. All these areas are subject to wind erosion, and the uplands are subject to slight water erosion where they occur on long slopes of 1 per cent or more.[10]

[10] Ibid., p. 7.

TABLE II

PRESENT USE OF LAND IN EACH SOIL GROUP AND LAND CAPABILITY CLASS IN CLARK COUNTY, KANSAS

Soil Groups	Land Class	Cultivated (Acres)	Native Pasture (Acres)
Moderately heavy clayey soils	II	40,237	2,754
Friable, silty to clayey soils	II	27,526	9,783
	III	82,762	47,631
	VI	3,903	11,981
Moderately sandy soils with friable subsoils	II	17,451	5,845
	III	9,339	3,055
	VI	517	2,675
Sandy soils	II	2,794	1,273
	III	3,587	3,069
Loamy sand soils	III	7,687	4,427
	IV	1,980	4,060
Shallow, gravelly or stoney soils	VI	2,415	9,778
	VII	13,559	187,217
Light colored tight clay and claypan soils	VII	487	11,732
Loose sands and sandhills	VII	2,765	91,260
Total acreages		217,009	396,540
Total acres in Class II and Class III		191,383	77,470
Total acres in other classes		25,626	319,070

Source: United States Department of Agriculture and the Kansas Agricultural Experiment Station cooperating, Physical Land Conditions Affecting Use, Conservation, and Management of Land Resources, Clark County, Kansas (Manhattan, Kansas, October, 1953), pp. 18-19.

TABLE III

LAND CAPABILITY CLASSES

Class	Description
I	Very good land that can be cultivated safely with ordinary farming methods. It is nearly level and easily worked. Some areas need clearing, water management, or fertilization. Usually there is little or no erosion.
II	Good land that can be cultivated safely with easily applied practices. These include such measures as contouring, protective cover crops, and simple water-management operations. Common requirements are rotations and fertilization. Moderate erosion is common under exploitative land use.
III	Moderately good land that can be cultivated safely with such protection as terracing and strip cropping. Common requirements include also crop rotation, cover crops, and fertilization. Usually it is subject to moderate to severe erosion under exploitative methods of using the land.
IV	Fairly good land that is best suited to pasture and hay but can be cultivated occasionally--usually not oftener than one year in six. Even when plowed only occasionally the most intensive erosion pre-practices are required.
V	Suited for grazing or forestry with little or no limitations.
VI	Suited for grazing or forestry with minor limitations; needs protective measures.
VII	Suited for grazing or forestry with major limitations; needs extreme care to prevent land damage.
VIII	Suited only for wildlife or recreation. This land usually is rough, stony, sandy, wet, or highly erodible.

Source: Guy Harold Smith, Conservation of Natural Resources (New York and London, 1950), p. 78.

The Class III soil groups are also suitable for continuous cultivation but require additional and more intensive conservation practices than the Class II soils to control erosion and maintain fertility and productiveness. The slope of these soil groups is generally from 2 to 7 per cent, with rolling topography in the central part of the county and rolling to hummocky in the southern part. In the areas of friable, silty to clayey soils, surface run-off is greater from these areas than any other lands in the county that are suitable for cultivation. Sheet erosion and some gully erosion occur on most cultivated fields.[11] The groups of sandier soils absorb most of the moisture they receive. Water erosion is only slight, but wind erosion can be severe in dry periods.

The remaining soils of the county are generally too rolling, hilly, rough, or sandy for cultivation even though over 23,646 acres of such lands have been plowed, but, in general, the soils are suited for range use.[12] The major part of the land in native pasture is within land capability classes generally not suitable for cultivation. The pasture areas that are in Class II and Class III lands are found on the more sloping lands adjoining the flat lands in the north, and north of the sandy lands in the south. The

[11] Ibid., p. 9.

[12] Ibid., p. 11.

grasslands on lands of poorer classes are located in the central part of the county and in the sandier area in the south.

Regional Division of the Physical Factors Affecting Soil Conservation

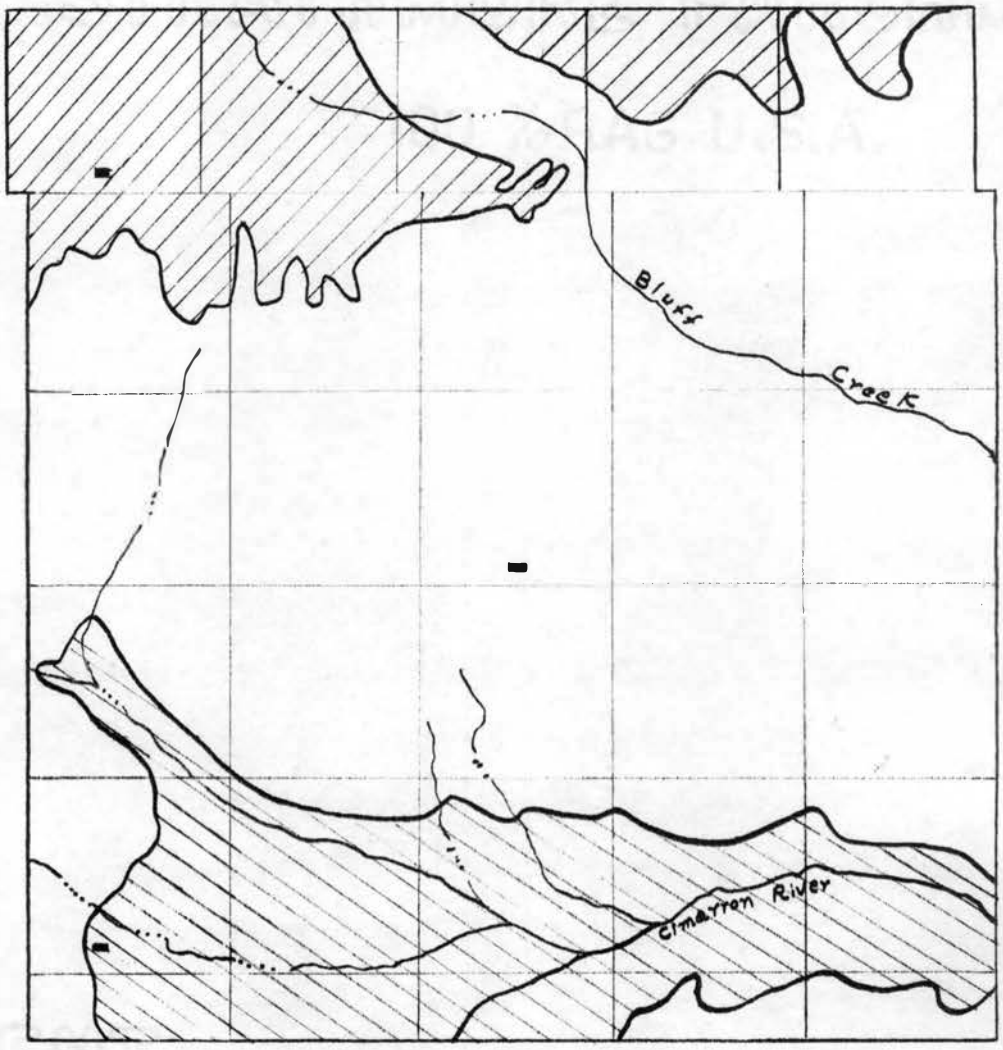
The Kansas State Board of Agriculture has divided the state into 25 agricultural resource regions.[13] This subdivision is based on the physical characteristics--topography, geology, climate, and soils, which, except for geology, have just been analyzed in respect to soil management in Clark County. This county lies within three of these regions which are recognized and utilized by the Soil Conservation Service and will be used as regions with similar soil conservation problems and practices in this study. The county is shown divided into these three resource areas (Figure 7): the dry subhumid hard land region in the northwest and north, the sandy lands and sandhill region in the south, and the remaining part of the county, which is essentially the central part, is part of the South Kansas breaks and canyon region.

Climate applies to the county in general; however, vegetation, soils, and slopes have varying regional

[13]Claude L. Fly, "Natural Agricultural Resource Areas of Kansas," Report of the Kansas State Board of Agriculture, Soil Conservation in Kansas, LXV, No. 271 (February, 1946), p. 127.

NATURAL AGRICULTURAL RESOURCE AREAS

CLARK COUNTY, KANSAS



Legend

Breaks & Canyons Region

Sandy Land Region

Hard Land Region

Approximate Location of Typical Farm Units

Source: Fry, Claude L., Report of the Kansas State Board of Agriculture, Soil Conservation in Kansas, Vol. LXV (February, 1946) No. 271, Map facing page 169.

Figure 7

combinations. As described above, there is a large relatively level area of land in the northwestern and northern part of the county, the hard land region. Most of this upland area of deep, moderately heavy soils is used for wheat production. The major problems of this area are in the control of wind and water erosion on the slightly sloping lands.

In the southern part of the county the area adjoining the Cimarron River is the sandy lands and sandhill region.

> The surface is gently undulating to hummocky with dunes along the river and in small scattered areas. There is little or no surface drainage except on the river breaks, and rainfall sinks quickly into the open sands, or collects for a short time in small depressions...Efficient users of the scanty precipitation they are so subject to wind erosion that they are not suitable for continuous cropping.[14]

Most of this region is in pasture land with small acreages in sorghum, wheat, and alfalfa production.

The remaining part of the county is in the breaks and canyons region. The northern part of this region which has very rough relief is mostly in native pasture. The southern part is in native pasture and cropland intermixed. Wheat and sorghums are the major crops in this region. The major problems in this region are:

> Control of runoff, use of the rainfall to produce crops and grass, revegetation of overused grasslands, and abandoned cultivated fields, and reduction of flood hazards...Where land for cultivation has been chosen unwisely or managed poorly, severe sheet and gully erosion has followed quickly

[14] Ibid., pp. 136-137.

with eventual abandonment of the fields which now support only annual weeds, and grasses of little benefit to livestock.[15]

The next three chapters will deal with each one of these three agricultural resource areas, separately. Each area will be described in general including the conservation practices generally applied in it. A typical farm unit has been chosen to represent each of these three resource areas. Each of these units will be discussed in detail concerning the conservation plan and practices being used.

---

[15] Ibid., pp. 155-156.

CHAPTER III

THE HARD LAND REGION

All the land in this relatively level upland region generally is suited to continuous cultivation. The lands in this region are "...well drained, have deep soils and need only simple practices to control erosion."[1] As stated earlier, winter wheat production consumes most of the acreage in this region. The nature of the climate when these lands are open has a tendency to subject these soils to more erosion by wind than by water, except in the more sloping areas adjoining the breaks and canyons region. Conservation practices are mainly centered on the control of wind erosion and upon moisture conservation.

Major Soil Conservation Practices

One of the major methods of soil conservation is the proper management of crop residues. Crop residues may be defined as "...those parts of crops left in fields after

[1]United States Department of Agriculture and the Kansas Agricultural Experiment Station cooperating, Physical Land Conditions Affecting Use, Conservation and Management of Land Resources, Clark County, Kansas (Manhattan, Kansas, October, 1953), p. 3.

harvest."[2] The eroding force of either wind or water depends upon velocity, and any material protruding above the surface of the soil tends to reduce the velocity and, therefore, slow down erosion. This is illustrated by the fact that

> Very little movement can be observed in the lower four inches of a thin stand of wheat stubble seven inches high when the wind is blowing about twenty miles per hour eighteen inches above the ground surface...movement of water over the surface is slowed by crop residue.[3]

The slowing down of the water movement by the presence of crop residues tends to keep the moisture received on the land longer, thus, aiding moisture absorption. The presence of crop residues, also, aids the rate of moisture absorption. It is claimed that "...a soil may take water more than twice as fast where it is protected by combine stubble as where the stubble is removed."[4]

Thus, the management of crop residues, while adding organic material to the soils, also helps to conserve the moisture received for future crop production. A type of crop residue management which is called stubble mulch farming is used in this region. In stubble mulch farming, residues are generally plowed under to a degree that part of

[2]H. H. Bennett, Soil Conservation (New York, 1939), p. 376.

[3]J. C. Hide, "Rotations, Crop Residues, Manure, and Lime," Re ort of the Kansas State Board of A riculture, Soil Conservation in o. 2 1 February, 19 , p. 2[illegible].

[4]Ibid., p. 28.

the material is buried and part is left protruding above the surface. This practice is recommended for all cropland in this region when lands are not in use and especially on cropland left fallow. Fallowing, which is primarily used to build up the moisture content and nitrates in the soils, gives the soils time to receive and store more moisture and, also, allows a longer period for the decomposition of crop residues, a source of nitrates. Fallowing "...is recommended for one-third to one-fourth of the hard land in the county each season."[5] With proper residue management, wind erosion can be reduced on these fallow lands. The recommended cropping system for this region is fallow one year and wheat production three years with the interjection of a legume in the system. Crops are rotated in order that soils productivity may be preserved and crop yields maintained.[6]

In the farming of these croplands the timely killing of weeds and leaving clods on the surface helps in the conserving of moisture and controlling of wind erosion. Timely tillage to prevent wind erosion is carried out as part of the regular operations in crop production and soil moisture conservation. The use of emergency tillage methods that clod or roughen the surface may be of value in the temporary checking of wind erosion.

[5]Physical Land Conditions Affecting Use, Conservation and Management of Land Resources, Clark County, Kansas, p. 5.

[6]Bennett, p. 340.

Emergency tillage operations are of little value in checking wind erosion unless they are performed when the ground is wet, owing to the fact that the topsoils are usually deep and loose and it is often difficult to get tillage implements deep enough to bring clods to the surface when the soil is dry.[7]

Another major method of soil conservation in this region is contour farming. This simply means the planting of crops on the level across the slope. This type of farming is recommended only for lands having very little slope. In contour farming, small retainers for moisture are built by the marks made by the implements used in the farming operations. In this area of low rainfall, these small retainers tend to hold the moisture received when it falls. Thus, the moisture is given more time to soak into the soil.

On the croplands of less than 2 per cent slope, the establishment of absorptive type or level terraces is recommended.

A terrace is a combined earth ridge and channel built across slope to intercept runoff water...Gentle slopes are terraced with absorptive-type terraces for the purpose of retaining runoff waters and permitting them to percolate into the soil for increased production.[8]

Usually the ends on this type of terrace are closed to hold the water on the field until it soaks away or evaporates.

[7]Tom Dale, Conservation Farming for the Sandy Lands of the Southern Great Plains, United States Department of Agriculture, Soil Conservation Service (Washington, D.C., February, 1941), p. 18.

[8]V. B. Fredenhagen, "Terracing," Report of the Kansas State Board of Agriculture, Soil Conservation in Kansas, LXV, No. 271 (February, 1946), pp. 51-53.

On lands of greater slope, where run-off velocities increase, a graded type terrace is recommended. This type of terrace is designed primarily to intercept and divert run-off at nonerosive velocities.[9]

The outlets of these terraces are on grasslands or established sod waterways so that run-off can be spread out and not cause erosion. The spacing of terraces is based upon the vertical interval which is the amount of drop per linear foot down slope. "A rule of thumb formula for this interval is S/2 + 2 where S = slope in per cent."[10] This results in the terraces being closer together as the slope increases.

Associated with contour farming and terracing is the retention of run-off water from intermittent lakes which sometimes can be drained by the construction of a drainage channel. Where drainage channels are not practical the practices of contour farming and terracing of the slopes above these lakes has been very effective.

Another practice generally recommended in this region is that of strip cropping. This is done by planting

> ...two or more alternate strips of fallow or summer-tilled land protected by two or more alternate strips of close-grown crops or intertilled sorghums...The width of the strips must not be less than 2 rods nor in excess of 20 rods.[11]

[9]Bennett, p. 444.

[10]Fredenhagen, p. 56.

[11]1951 Soil Conservation Program for Clark County, p. 45.

Strip cropping is usually done at right angles to the prevailing winds or on the contour if contour farming is practiced. Establishing strip crops is a method used as a protection against washing or blowing of soil and to reduce run-off, thus conserving soil and water.

The use of windbreaks for farmstead and livestock protection is recommended for this region, as well as for the county as a whole. Around farmsteads poultry and livestock keep the vegetation killed, and this leaves the area open for wind erosion. The windbreaks are planted on the north and west sides of the farmsteads. Studies recently completed show that the saving in fuel alone will amply repay the farmer for establishing a farmstead windbreak.[12] These windbreaks also offer protection to the livestock during the winter months. Cattle wintered in the protection of windbreaks do better and fatten faster on less feed.[13] Associated with windbreaks are shelterbelts.

Long strips of trees are called shelterbelts because they shelter adjoining fields from hot winds in the summer, and the gales which occur in winter and spring when field are most subject to the destructive effects of wind erosion.[14] This type of structure is very effective in its use. The length of the shelterbelt has an important bearing upon its

[12]Ross A. Williams, "Forestry," Report of the Kansas State Board of Agriculture, LXV, No. 271 (February, 1946), p. 119.

[13]Ibid.

[14]Ibid., pp. 119-120.

effectiveness. This may be seen from the fact that, when the length of a shelterbelt is doubled, for example, the area protected is increased three times. A shelterbelt 35 feet in height has a slowing down effect upon a wind velocity of 30 miles per hour to an extent of approximately 175 feet on the windward side and 1500 feet on the leeward side.[15] These, for their best effectiveness, should consist of five or more rows of trees and with the main shelterbelts being spaced not over one-half mile apart.[16]

The soil conservation practices emphasized above are the major practices used in the hard land region of the county. There are other minor practices used, however, but they are fitted to localized needs. To show how these general practices are representative of this region and how they are planned and put to use, a typical farm conservation plan will be used.

The Soil Conservation Program of a Typical Farm

Land Capability

This typical farm unit is operated by Donald S. Wyatt and is a cash crop farm.[17] The land capability map of this

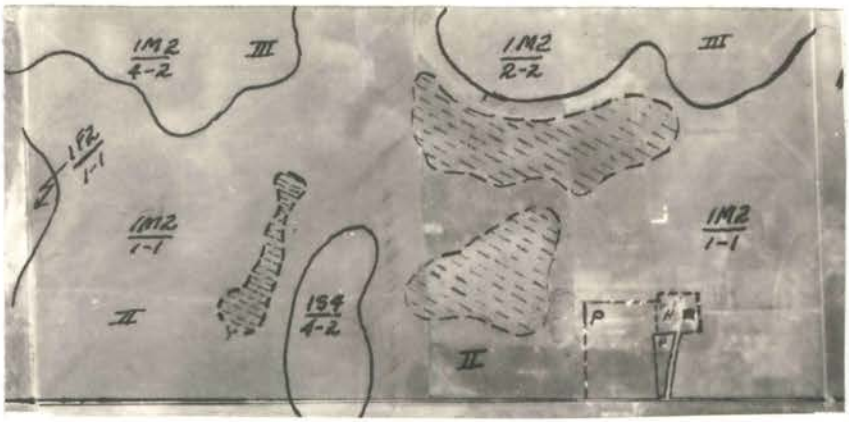
[15] Ibid., p. 121.

[16] Ibid., p. 123.

[17] Information concerning this typical farm unit comes from Farm Plan No. 190, from the files of the Soil Conservation Service located at Ashland, Clark County, Kansas.

320 acre farm is shown (Figure 8). The Roman numerals on this map indicate the land capability classes which are described in Table III. It may be seen that most of the land of this farm unit is in Class II with two small areas of Class III lands in the northern part.

The other symbols on this map designate the characteristics of the soils. These soils are silty, and they seal over and are subject to wind and water erosion when left unprotected. The most prevalent type is the 1M2 soils. The number 1 indicates that these soils are deep and have a medium textured, M, topsoil. The permeability of the subsoil is shown by the number 2, a slow rate of permeability. The small area of 1F2 soil in the western part of the farm unit is a deep, 1, and the topsoil has a moderately heavy texture, M. The 1S4 soils are also deep, but have a lighter textured, S, topsoil, and the permeability of the subsoil is 4, a moderately rapid rate of permeability. The lower range of numbers shows the average per cent of slope and the degree of erosion, respectively. From this it may be seen that most of this farm unit has slopes of 1 percent or less. Two small areas in the northwest and the south central have average slopes of 4 per cent. Another area in the northeast has slopes of 2 per cent. The degree of erosion, 1 and 2, has been slight or moderate on this farm. The areas enclosed by the dotted lines are intermittent lakes.



LAND CAPABILITY MAP

Survey by the U. S. Department of Agriculture
Soil Conservation Service

Legend

Roman numerals symbolize Land Capability Classes

Symbols above lines		Symbols below lines	
1	Soil depth very deep 60 inches or more	1	Average slope one percent
M	Medium textured topsoil	2	Average slope two percent
F	Moderately heavy textured topsoil	4	Average slope four percent
S	Moderately light textured topsoil	1	No apparent or slight erosion
2	Slow permeability of subsoil	2	Moderate erosion
4	Moderate permeability of subsoil		

Source: Farm Plan No. 190 from the files of the Clark County Soil Conservation District, Ashland, Kansas.

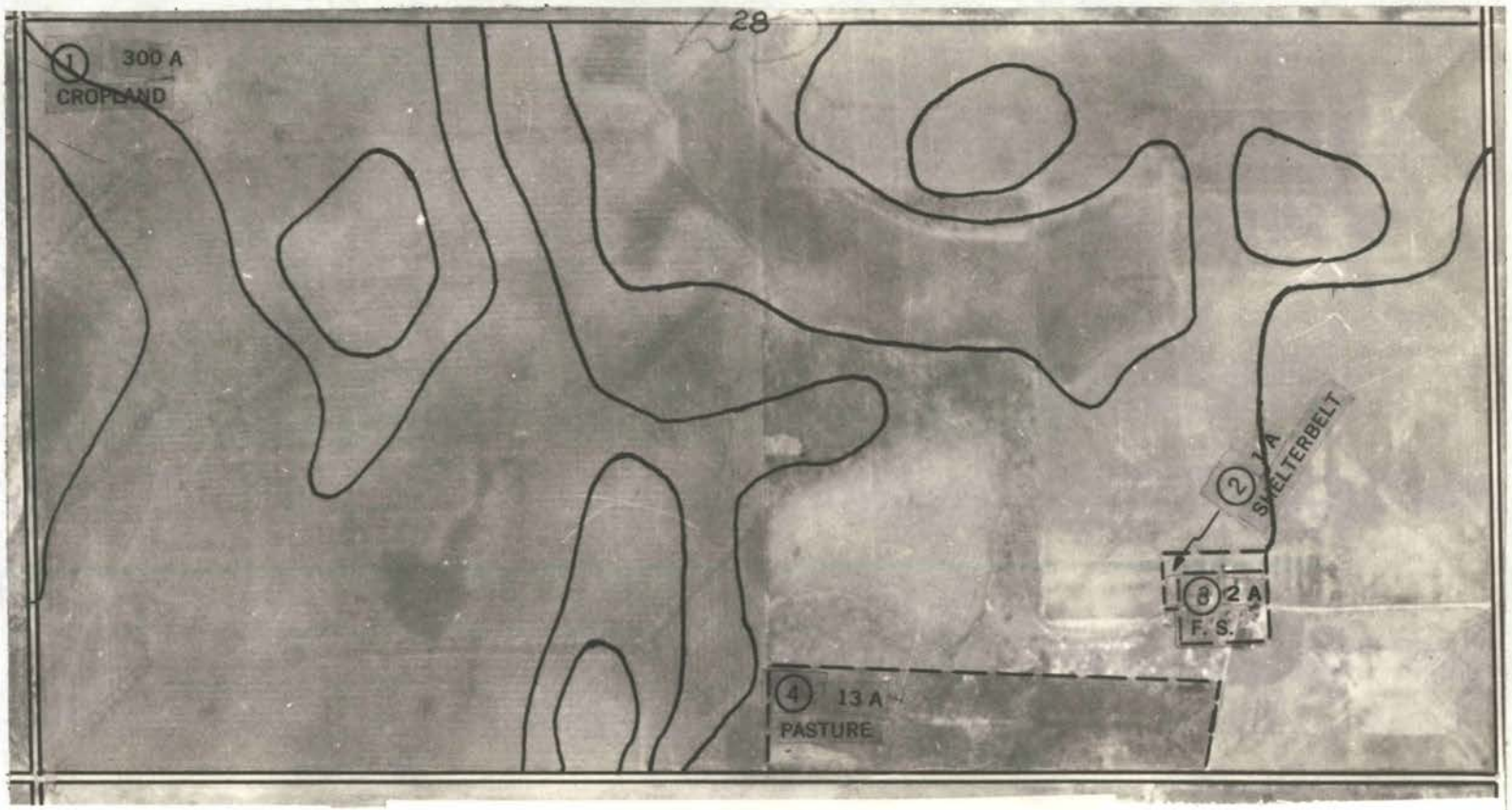
Figure 8

Conservation Plan

The break-down of the farm according to land use is shown (Figure 9). Fields are coded by the encircled numbers. Field 1 contains 300 acres of cropland. One of the proposed practices of this field was that a level terrace system be established. The heavy lines (Figure 9) show this terrace system as it is now. Mr. Wyatt does not have any foreign drainage entering his farm, and these terraces have kept the intermittent lakes free of excessive run-off. Associated with terraces is the practice of contour farming which is to be used at all times. Crop residues are to be utilized also in this field, and stubble mulching may be done by the use of a chisel or shovel type implement so as to keep the stubble at or near the surface as long as possible. The planned cropping system is sorghums one year, sweet clover two years, and wheat production three years.

Field 2 is a one acre windbreak to be established on the north and west sides of the farmstead (Field 3). These trees are to be cultivated and to be protected from damage by fire, livestock, rodents, and insects.

Field 4 contains thirteen acres which, according to the plan, will be put back into native grass. The establishment of sorghum stubble takes place first so as to protect and catch moisture for the new grass. The grass will be planted in the spring and is to be a native mixture consisting of



LAND USE MAP
United States
Department of Agriculture
SOIL CONSERVATION SERVICE

This Conservation Plan developed by the Operator and U. S. Soil Conservation Service, co-operating with the Soil Conservation District. Acreage figures and location of practices are approximate, and boundary lines are used for conservation planning only.

Figure 9

buffalo, blue grama, big and little bluestem, sandlove and switch grass.

As may be seen, the soil conservation practices recommended in the hard land region are relatively few and simple. They are basically for checking wind erosion and for moisture conservation.

CHAPTER IV

THE SANDY LAND AND SANDHILL REGION

The soil conservation practices used in the southern region of Clark County will be characterized in this chapter. As described in Chapter II, this sandy region of low hummocky to sand dune relief generally does not have water erosional problems except along the streams during flood periods. These sandy soils absorb moisture quite readily. However, the sandier soils are highly susceptible to wind erosion, and the moderately sandy soils become very susceptible once erosion has progressed to the stage where organic matter of the topsoil has been removed.[1] The blowing of these sandy soils creates the soil conservation problems of the section.

Major Soil Conservation Practices

Most of this area is in native pasture which ordinarily could protect the soils from wind erosion if proper range conservation is provided.

[1]Tom Dale, Conservation Farming for the Sandy Lands of the Southern Great Plains, United States Department of Agriculture (Washington, D.C., February, 1941), p. 6.

By conservation of range land is meant not merely the maintenance of good grass cover, the prevention of erosion, and the control of weeds, but includes, also, the factors of efficient and profitable utilization of the forage through livestock production.[2]

For the purpose of range conservation the soil conservation practice of grazing management is recommended. The importance of proper grazing for the maintenance of good grass cover is shown by the fact that

...native pasture grasses are perennials and must, therefore, be permitted to produce and store sufficient food reserves in their roots each growing season to carry the plant through the winter and to start growth the following spring. As new growth starts each year, there is a severe depletion of this stored food to supply energy for the growth processes. The stored foods are carbohydrates produced in the leaves by photosynthesis. They can be replaced only after the plant has made sufficient top growth to manufacture foods faster than they are utilized by the growth processes. If the plant is kept closely clipped or grazed from the beginning of its growth period, it may never attain sufficient size to do this, and must then starve until it dies and is replaced by some worthless species which has not been grazed and which is, therefore, not reduced in vigor.[3]

To give these grasses an early start before being grazed, it is recommended to defer grazing three or four weeks after growth starts in the spring.[4] Since the surface soil is subject to blowing when left without an adequate

[2]Kling L. Anderson, "Range and Pasture," Report of the Kansas State Board of A riculture in Kansas, LXV, No. 271 February, 19[illegible], p. 94.

[3]Ibid.

[4]United States Department of Agriculture and the Kansas Agricultural Experiment Station cooperating, Physical Land Conditions Affectin Use Conservation and Management of Land Resources, ark ounty, ansas, Manhattan, Kansas, October, 1953), p. 11.

cover, it is necessary to graze these pastures in such a manner as

> ...to maintain a cover of desirable forage plants and litter (in general, such a condition can be maintained by leaving from one to two inches of short grasses and from four to six inches of mid-grasses and tall grasses at the end of the grazing season.[5]

In this sandy land region over-grazing, drought, and silt from adjacent blowing lands have severely damaged many pasture tracts during recent years.[6] Most of the pastures in this region have dense growths of sagebrush which have spread due to these conditions. Eradication of the sagebrush, and other undesirable plants, in conjunction with reseeding to better varieties of grasses is recommended. In the re-grassing of these thinly vegetated areas, some sort of cover, such as sudan grass or sorghum should be planted. This cover crop should be mowed during the growing season to prevent it from seeding, thus reducing the amount of competition to the young grass. After the cover crop has been established, an appropriate mixture of bluestems, sand reed, and love, and side oats grama grasses should be seeded.[7]

In the true sand dune area, where there is very little vegetative cover, the blowing sands have caused severe damage to the adjoining areas. Numerous "blowouts" and dunes

[5] Ibid., pp. 11-12.

[6] Dale, p. 23.

[7] Ibid., p. 15.

emphasize the hazards in the use of this land. In the control of these active dunes and "blowouts" there is a need for the scattering of the cover crop seed with straw or hay. Some type of farm equipment, such as a tractor, should be used to compress the hay or straw and seed into the soil. After the cover crop is established, the grass can be planted. By keeping all crop residues on the land, preventing burning, fencing to prevent grazing until grass is well established, and by adding all available manures, these areas can be converted into usable grasslands. Other practices of range management include the following:

> Rotate grazing on native grasslands using three pastures in the rotation if possible in order to secure maximum use, and allow periodic recovery; distribute water, salt, and supplemental feed throughout pastures as a means of securing uniform use of the forage; prevent burning; interseed with more desirable grasses where needed and practical to do so; maintain one to three years' reserve food supply; provide summer grazing crops where needed in pasture rotation.[8]

The small amount of cropland in this region, if kept in cultivation, must be very carefully used.

> It is highly essential that most of the sandy croplands, especially those that are subject to wind erosion, be protected with a cover of stubble, crop residues, or growing crops during the winter and spring months.[9]

The practices of crop rotation and strip cropping are recommended in this region. Strip cropping can be used on cropland that has not been severely eroded.

[8] Ibid., p. 11.

[9] Dale, p. 11.

When erosion has progressed to an advanced stage and most of the organic matter has been blown away, strip cropping is not recommended. Solid plantings of erosion-resistant sorghums or retirement to permanent vegetation seem to be the only feasible treatment for such lands.[10]

Terracing, as a general practice, is not recommended for sandy soils. As emphasize above, these sandy soils can absorb most of the moisture they receive and do not have water erosional problems, except during heavy rains. Where the land is not too hummocky, the use of contour farming is recommended.

In this sandy land section the use of windbreaks and shelterbelts is highly recommended for the control of wind erosion. When these trees are first planted they need protection from drifting sands. Sandy soils, however, absorb most of the rainfall, and, if this is sufficient and trees are properly cared for, they may make satisfactory growth.[11]

The Soil Conservation Program of a Typical Farm

Land Capability

The typical farm unit chosen to represent this resource area is a 320 acre livestock unit farm operated by J. M. Graves.[12] This unit was accepted by the Soil Conservation

[10] Ibid., p. 11.

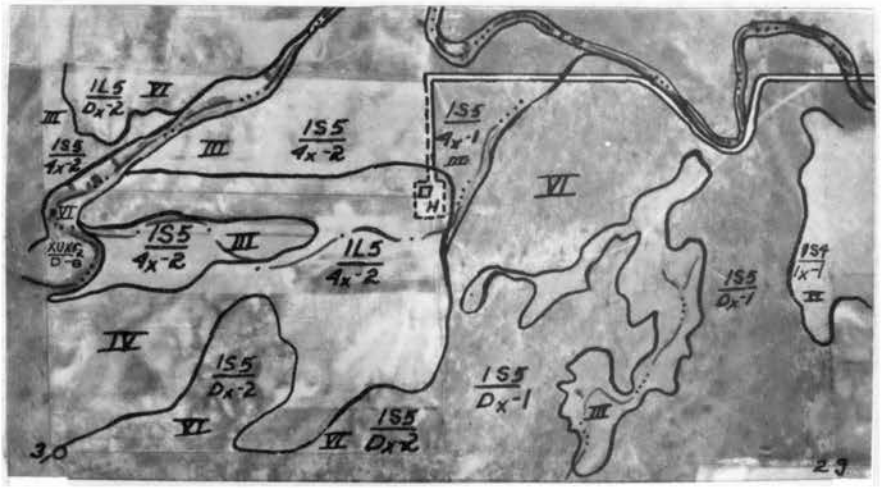
[11] Ibid., p. 12.

[12] Information concerning this typical farm comes from Farm Plan No. 180 from the files of the Soil Conservation Service located at Ashland, Clark County, Kansas.

Service in 1950. At that time this farm unit was divided equally into cropland and pasture land. Since 1950 the proposed soil conservation plan for this unit has been completed.

The soils on this farm unit are all basically sandy and are subject to wind erosion when left open. From the land capability map (Figure 10), it may be seen that most of this unit is in land capability Class VI with small amounts in Classes II, III, and IV (See Table III). The most common soil is the 1S5. This soil is classed as a very deep, 1, sandy soil with a moderately light textured, S, topsoil and will absorb moisture at a moderately rapid rate, 5. In the eastern part of this unit is a small area of $\frac{1S4}{1x-1}$ soil. This soil is, also, a very deep sandy soil with a moderately light topsoil, but it takes moisture at a less rapid rate. The relief is nearly level, 1x, and there has been only slight erosion on the land. The 1L5 soil differs from the 1S5 soil only in the respect that the sands are a little coarser with a light textured, L, topsoil. The XUXf2 designates mixed bottomlands along the intermittent stream.

The symbols Dx, 4x, -1 or 2, indicates the slope and erosional characteristics. The Dx characterizes a strongly sloping relief, but it can be traversed in an automobile. A low hummocky relief is indicated by the symbol, 4x. The erosion symbol, 1, designates there has been only slight erosion on the cropland and pasture lands. Slight erosion



LAND CAPABILITY MAP

Survey by the U. S. Department of Agriculture
Soil Conservation Service

Legend

Roman numerals symbolize Land Capability Classes

Symbols above lines		Symbols below lines	
1	Soil depth very deep 60 inches or more	D_x	Strongly sloping and hummocky
L	Light textured topsoil	4_x	Hummocky with average slope of four percent
S	Moderately light textured topsoil	1_x	Slightly hummocky with average slope of one percent
4	Moderate permeability of subsoil	1	No apparent or slight erosion
5	Moderately rapid permeability of subsoil	2	Moderate erosion

Source: Farm Plan No. 180 from the files of the Clark County Soil Conservation District, Ashland, Kansas.

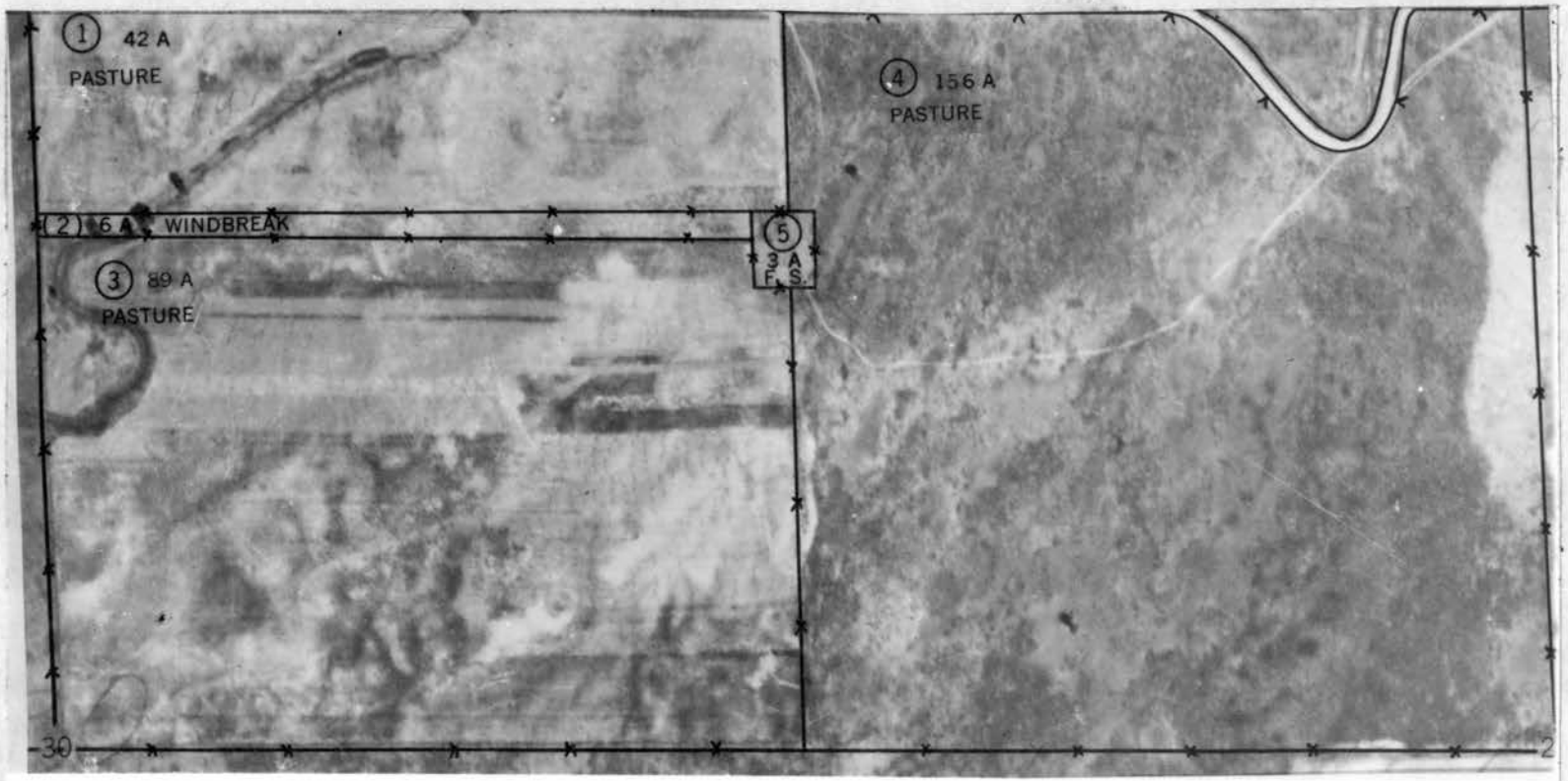
Figure 10

on the grasslands and moderate erosion on croplands is shown by the symbol 2.

Conservation Plan

The proposed conservation plan for this farm unit was to plant Fields 1 and 3 back to grass as shown on the land use map (Figure 11). The grass which was planted in the required sorghum stubble was a mixture of sand bluestem, sandlove, Indian grass, blue grama, and little bluestem grasses. Weed and brush control was planned on these re-grassed fields. The predominant brush is sagebrush, and it is to be controlled by either mowing or spraying in the spring. Pasture improvement is to be practiced on all this unit and consists of proper stocking, rodent control, and weed control. The stocking rate is to be 15 acres per animal unit. Field 2 is the established shelterbelt, and all the trees are to be cultivated and protected from fire, livestock, rodents, and insects. Field 4 will be left in pasture.

From above it may be seen that the basis for the soil conservation program is centered on the control of wind erosion. The character of these sandy soils to moisture absorption reduces the factor of water erosion.



LAND USE MAP
United States
Department of Agriculture
SOIL CONSERVATION SERVICE

This Conservation Plan developed by the Operator and U. S. Soil Conservation Service, co-operating with the Soil Conservation District. Acreage figures and location of practices are approximate, and boundary lines are used for conservation planning only.

Figure 11

CHAPTER V

THE BREAKS AND CANYONS REGION

The largest agricultural resource area in Clark County is the Breaks and Canyons Region. The rough central part of the county is a part of the "red hills." It is so-called because of the escarpments of Permian red beds along the breaks and streams. Here most of the soils have a reddish-brown color in the lower part. The hills are capped with sand and gravel and, in places, a thin mantle of loess.[1] In traversing this section one can see that the northern part is extremely rough and eroded into a series of small canyons and narrow divides. Southward, the relief smooths out somewhat and blends into the low hummocky relief of the sandy land region. In the rough area to the north, native pasture is predominant, while in the southern part native pasture is used in conjunction with croplands.

Major Soil Conservation Practices

The soil conservation practices prescribed for the native pasture lands of this region are, as in the sandy

[1]United States Department of Agriculture and the Kansas Agricultural Experiment Station cooperating, Physical Land Conditions Affecting Use, Conservation, and Management of Land Resources, Clark County, Kansas (Manhattan, Kansas, October, 1953), p. 1.

land region, based on proper range land management. Although wind erosion is not too serious in this region, mismanaged pasture lands are more subject to water erosion than in the sandier soils to the south.

One of the soil conservation practices commonly used on native pasture is that of contour furrowing. The primary purpose of contour furrows on pasture and range land is to conserve soil and water and thereby maintain forage production at a high level. These furrows catch and store run-off, and, when the run-off exceeds the storage capacity, water is spread over the area lying below.

> Contour furrows and ridges have been generally effective on range lands of gentle to moderate slope where soil productivity is sufficient to support the additional grass growth that the increased moisture supply encourages; and where soil blowing from adjacent lands is not severe.[3]

In the areas where vegetative cover is relatively sparse these furrows will be filled with silt by both wind and water, thus reducing their effectiveness in trapping run-off. In the sandy areas practices for moisture conservation and checking of run-off are generally not necessary because of the ability of these sandy soils to absorb most of the

[2]J. H. Stallings, Review of Data on Contour Furrowing Pasture and Range Land, United States Department of Agriculture, Soil Conservation Service (Washington, D.C., December, 1945), p. 1.

[3]J. S. McCorkle and Tom Dale, Conservation Practices for the Range Lands of the Southern Great Plains, United States Department of Agriculture, Soil Conservation Service (Washington, D.C., February, 1941), p. 18.

moisture that they receive. It is on pasture lands of heavier soils which have a lower permeability that the use of these contour furrows gives best results. These furrows are made on the contour by different types of farm implements, such as cultivators, listers, chisels, and plows. The spacing of the furrows is generally between four and eight feet.

Another conservation practice common in this region is that of building stockwater dams. These are small, earthen dams used to help control run-off as well as to provide a source of drinking water for livestock. In the selection of a site for a dam, consideration should be given to its location in respect to good grazing land and other sources of water. The type and size of the drainage area also must be considered. A native pasture watershed is the most desirable. The vegetative cover causes run-off waters to dump a considerable amount of silt before reaching the dam, thus reducing the amount of silt entering the pond. When croplands are included within this drainage area, terracing of these croplands or the use of a diversion ditch is recommended. These structures are used either to divert the cropland drainage away from the watershed when possible, or to spread the run-off over a grassed area to aid in filtering of silt. These practices have been effective in reducing the volume of silt reaching the pond. The feasibility of locating a dam on a particular site is determined

largely by the size of the drainage area. If the drainage area is too large, the dam may be destroyed by excessive run-off from heavy rains. If the drainage area is too small, the pond probably will be dry during droughts when water is most needed.

In the choosing of a site for a stockwater dam, conservationists look for a grassed gently sloping area above the bottom of the main channel that can be used for a spillway. The width of the spillway increases with the size of the drainage area. Usually there is a necessity for cutting and shaping-up of these spillways. The spillway must have a suitable place to empty. Turning water loose from a spillway near a rough or broken area may cause serious gullying and may result in the loss of the dam.

Another factor influencing the location of a dam is the possible storage capacity. The most desirable reservoir is one that has good depth with a minimum surface area. The depth of a pond in this area is important because of the high rate of evaporation.

A minimum depth of 10 feet is recommended. Surface evaporation in the Southern Great Plains is approximately 60 inches a year, most of which occurs during the spring and summer months. A pond that has a potential water supply of less than 5 feet below the spillway level will normally lose most of its water through evaporation during the summer months of dry years.[4]

The type of foundation of underlying material is very important in the control of seepage from under the dam. A

[4]Ibid., p. 24.

good compactible soil near the site is needed in the construction of the dam. In the sandy areas stockwater dams are not practical because of the high degree of seepage.

In the building of these dams, a freeboard must be provided. The freeboard is that part of the dam extending above the level of the spillway. Its purpose is to keep water from over-topping the dam after the dam is filled and to force excess water out through the spillway. After a dam is built, the dam and areas that have been cut for a spillway are planted to grass and fenced off from livestock.

These stockwater dams, while serving as a control of run-off water, provide a source of drinking water for livestock and aid in the distribution of grazing when it is possible to locate them strategically. Where dams have been built in pasture lands to intercept run-off from croplands, they have helped considerably in the control of erosion on these croplands. The use of small earthen dams, commonly called silt dams, on croplands is not generally recommended. Because of the lack of good year around vegetative cover on the drainage area, these dams fill rapidly with silt and lose their effectiveness. Also, during periods of heavy rains, these dams are often washed-out and cause serious damage to the croplands below.

In this area of concentrated pasture lands serious prairie fires some times occur. Aiding in the control of these fires, narrow strips are commonly plowed is pastures

adjoining roadways. These fireguards are approximately eight feet wide and are generally plowed on the south sides of pastures because summer winds are predominately from the south.

Although most of this section is in native pasture, the occurrence of some sloping croplands encourages water erosion which

> ...is a problem on all lands with more than 2 per cent slope. Even in years that are considered dry, 3 or 4 inches of rain will sometimes fall in 24 hours and it will do a great amount of damage to sloping lands.[5]

In response to the greater per cent of slope in this region, graded terraces are commonly used to help control run-off water. When using this type of terrace, the outlets must be on relatively low sloping grassed areas in order to spread the excess water at non-erosive velocities. Usually grasslands are adjacent to these croplands. When grass areas are not handy, sod waterways must be established for terrace outlets. The natural drainageways in the fields are used for this purpose. In some cases, where a large amount of foreign drainage enters a cultivated field, the use of a diversion ditch or a dam is recommended for the control of this run-off. A diversion ditch is a large graded terrace. It is essential that diversion ditches be made large enough

[5]Physical Land Conditions Affecting Use, Conservation, and Management of Land Resources, Clark County, Kansas, p. 2.

to carry all the run-off from the contributing drainage area during periods of maximum rainfall.[6] Along with terracing, contour farming is practiced to aid in the control of run-off and increase the absorption of soil moisture. When highly sloping fields are to be re-grassed, terraces are built and sorghum stubble established before the grass is planted.

Other soil conservation practices recommended for the cropland in this region are proper crop residue management, crop rotation, and strip cropping. On terraced fields the terraces are not normally parallel to each other because of the variety of slopes. The farming operations follow the terraces and small odd shaped areas called point rows result from this irregularity of terrace spacings. These point rows are clumsy to farm and are often re-grassed. The planting of shelterbelts has aided in the control of blowing croplands.

The Soil Conservation Program of a Typical Farm

The farm unit representing this region is the 240 acre wheat and livestock farm unit operated by Kenneth Salyer. Mr. Salyer joined the Soil Conservation Program in 1948.[7]

[6]H. H. Bennett, Elements of Soil Conservation (New York, 1947), p. 240.

[7]Information concerning this typical farm unit comes from the Farm Plan No. 87, from the files of the Soil Conservation Service located at Ashland, Clark County, Kansas.

Some of the major problems on this farm unit were as follows: areas being cultivated that should have been in grass; large ditches in the fields which made farming difficult; and a need for a farmstead and livestock windbreak.

Land Capability

The land capability classes found on this farm unit are the Class VI in the western which is mostly pasture, and in the eastern part the lands smooth out somewhat into Class IV. There are two small areas of Class III lands (See Table III).

The soil characteristics are shown (Figure 12). As may be seen, these silty soils are very deep, 1, and have topsoils of medium, M, texture. All of the soils except the very rough area in the southwest part of this unit have moderate, 4, permeability. The small areas of 3M4 soils are different from the other soils by being moderately, 3, deep. The small circles found over the soil texture symbol M indicate that there is a large amount of lime in the topsoils. When the circle is over the permeability symbol, 4, lime is present in the subsoils. The relief of this farm unit ranges from rough and broken, D, in the west and the southeast corner to moderate slopes in the eastern part. The erosion varies from very slight, 1, on cropland and pasture land to 3, slight erosion on grasslands to severe erosion on the croplands. The XF1 soils are classed as mixed redbed soils on steep slopes.

LAND CAPABILITY MAP
Survey by the U. S. Department of Agriculture
Soil Conservation Service

Legend

Roman numerals symbolize Land Capability Classes

Symbols above lines		Symbols below lines	
1	Soil depth very deep 60 inches or more	D	Strongly sloping average slope ten percent
3	Soil moderately deep 20 to 36 inches	4	Average slope four percent
M	Medium textured topsoil	1	No apparent or slight erosion
		2	Moderate erosion
		3	Severe erosion

Source: Farm Plan No. 87 from the files of the Clark County Soil Conservation District, Ashland, Kansas.

Figure 12

Conservation Plan

From a land use map (Figure 13), the proposed program for this farm unit is outlined. Also, the lands that were being used for cropland can be seen. In Field 1 all the area left in cultivation is to be terraced where needed. Areas to be re-grassed will have sorghum stubble established first. Only entire fields 2 and 4 are to be kept in cultivation. Because of the limited amount of adjacent pasture-land, and, due to the fact that most of the drainage is toward the east and north, sod waterways, 1a, 1b, and 1c, will be established first to serve as outlets for the remaining planned graded terraces.

Some conservation practices have been completed. The terrace system for Field 2 and the cropland in the southeast are shown by black lines (Figure 13). These terraces are spaced much closer together due to the greater percentages of slope than are on the terraces of the typical farm in the hard land region (Figure 9). A few of the upper terraces were built first where outlets on native pasture were available to help control some of the run-off. The lower terraces were built after the sod waterways were established. These waterways, located on natural drainageways, were seeded with a mixture of brome and intermediate and western wheat grasses. The average width for waterways 1a and 1c is 100 feet and the average width of 1b is 75 feet. A permit from the Kansas State Highway Commission was granted to Mr.

LAND USE MAP
United States
Department of Agriculture
SOIL CONSERVATION SERVICE

This Conservation Plan developed by the Operator and U. S. Soil Conservation Service, co-operating with the Soil Conservation District. Acreage figures and location of practices are approximate, and boundary lines are used for conservation planning only.

Figure 13

Salyer to dump excess run-off from the south terraces into the roadside ditch.

The conservation practices recommended for the remaining cropland are contour farming and crop residue management. Stubble is to be kept on the surface and protected from fire and from over-grazing by livestock. The cropping system is wheat, wheat, sorghum, and sweet clover.

The pasture land is in good condition. The proper stocking rate will be 8-10 acres per animal unit. The cattle may be turned in on the grass around May 1st and taken off October 1st. A farmstead and livestock windbreak has been planted on the north and west sides of the farmstead, Field 3.

As may be seen the soil conservation practices recommended for this typical farm unit of the breaks and canyons region are more varied than the practices used in the other agricultural resource areas.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purposes of this study have been to show the development and the operations of the Soil Conservation Service in Clark County which is located in the southwestern part of the state of Kansas. As of December 31, 1952, approximately two-thirds, 410,459 acres, of the total land area of 629,760 acres has been organized in the district soil conservation program.

The major legislative actions passed by the Federal, State, and County organizations that are responsible for creating the organization, the objectives, and the operations for the Soil Conservation Service have been considered. The physical characteristics that exist in this county have been characterized to reveal the variations in the climatic elements; the vegetation, natural and man produced; and the soils and slopes. On the basis of these physical characteristics, the county was subdivided into three agricultural resource areas.

The remaining part of this study centers on each of these three areas separately and the specific soil conservation practices that are commonly used for the control of erosion in each of these areas. A typical farm unit is used

to show the representative erosional problems and to show how these soil conservation practices are planned and applied in the control of erosion.

The soil conservation problems which exist in Clark County as a whole are as follows: shortage of water for crop production; water erosion; wind erosion; soils low in fertility and organic matter; wet spots in fields, and crops drown out; feed shortages in dry years; pasture shortage in early spring and early fall; farmstead and livestock unprotected from winds; and, small odd shaped areas and roadsides not utilized. Among the major methods used for alleviating these soil conservation problems are the following: contour farming; keeping crop residues and clods on the surface; control of weeds through timely tillage; establishing cropping systems; re-grassing cropland that is too steep and sandy; grazing land management practices; strip cropping; the use of sweet clover and barnyard manures on the sandy soils to prevent further decline in organic matter and fertility by preventing erosion; the use of terraces and diversion ditches; draimage of low spots when feasible; summer fallowing land for feed crops; the carrying over of feed, and grass in good years; growing and harvesting larger acreages of feed crops; planting sudan grass for pasture; planting small areas to wheat or rye for harvesting by livestock; planting cool season grasses and sweet clover; establishment of tree windbreaks; and re-grassing.

The topography in Clark County is quite varied. The hard land region which is relatively flat is somewhat comparable to the sandy land region which is low and hummocky. While the relief of these two areas may be classed as roughly similar, their soils are different. The hard land region has deep heavy soils derived from weathering of loess, whereas, the soils of the sandy land region are mostly derived from aeolian sands and stream deposits. In conjunction with the differing soils there is a different land usage. The northern region which is mostly in cropland with a limited amount of native pasture is used for the production of wheat. The sandy region, however, is mostly in native pasture with a limited amount of cropland that is used for the production of sorghums and alfalfa. Water erosion is not a serious problem in either region because of the permeability of the soils and their gentle slopes. Wind erosion is common to both regions, as it is to the county as a whole.

Because of the difference of land use in these two regions the general soil conservation programs vary. The vulnerability of these two regions to wind erosion is due to differing factors. The hard land region is mostly in cropland which is open part of the year, whereas, the sandy region has loose sands which are easily blown. Although the soil conservation programs differ, they are both basically for the control of wind erosion.

For the croplands in the northern region, and the small amount in the southern region, crop residue mana ement, strip cropping, cover cropping, and crop rotation are common. In the northern region contour farming and level terraces can be used for better water conservation. The major practices in the sandy land region are based upon proper range management of this large area of grasslands.

The largest agricultural resource area in the county and the one with the most varied relief is the breaks and canyons region. The northern part of this region is extremely rough, but it gradually levels out southward. The relief of the southern part of this region resembles the sandy land region.

Also found in this region is a wide variety of soils. The soils in the north are derived from the outwash of loess of the hard land region and from different sedimentary sources outcropping in this region. In the southern part the soils are more sandy which may be due to the blowing of the sands from the sandy lands region by winds from the south. Land use in this region also is varied. Most of the region, as in the sandy region, is in native pasture which is concentrated in the western, northern, and eastern parts. The southern part is a combination of pasture land and cropland. The crops produced are mainly wheat and sorghums. The croplands in this region are more sloping than in the other two regions. There are small areas, however, that are fairly level.

The varied relief and land uses in this region bring about a great variety of soil conservation practices. The conservation practices used on the grasslands are the same as in the sandy region for proper range management. However, run-off is greater here and contour furrowing is helpful in checking and conserving moisture on the grasslands. The soil will hold water so stockwater dams can be built in this region for aiding in grazing distribution and run-off control. The sloping croplands are subject to water erosion as well as wind erosion in this region. The conservation practices used to control wind erosion are the same as in the hard land and sandy land region and are crop residue management, strip cropping, cover cropping, and crop rotation. Added practices in the control of run-off, such as diversion ditches, sod waterways, and graded terraces are common except in the more sandy areas.

The general soil conservation practices common to the three agricultural resource areas are proper stocking, deferred grazing, rotated grazing, distribution of grazing, and re-vegetation. The practices common to the croplands are crop residue management, crop rotation, cover cropping, strip cropping, and re-vegetation. The establishment of shelterbelts is a common practice being carried out in all parts of the county.

The Clark County Soil Conservation District has had only a short history, but in this short period a considerable

amount of work has been accomplished under the competent leadership of Mr. H. Leo Brown. In the beginning the development was slow, but, as the farmers and ranchers became more familiar with the benefits received from soil conservation, interest grew. In the few years since the establishment of the conservation district, over one-half of the total area of the county has active conservation plans. Today the majority of the farmers and ranchers are conscious of the need of practical soil-saving practices to help them in maintaining and improving the productivity of their land. They realize that in a region of such erratic climatic conditions and diversified landscape that theirs is a complex problem of utilizing available rainfall as well as maintaining a coverage for their lands during periods most like to have wind erosion. The soil conservation program has proved to be one of the most effective ways to bring about increased performance of approved soil and water conservation measures.

There also has been increasing recognition that it is not the responsibility of farmers and ranchers alone to conserve agricultural resources. The problem is so vital to the welfare of the people in general that such a program merits the support of the entire Nation.

BIBLIOGRAPHY

Personal Interviews

Brown, H. Leo. Clark County District Soil Conservationist, Ashland, Kansas. Personal Interview, April 17, 1954.

_____. Personal Interview, June 3, 1954.

Government Publications

Blumenstock, David I. "Rainfall Characteristics As Related to Soil Erosion." Technical Bulletin No. 698. United States Department of Agriculture. Washington, D.C.: United States Government Printing Office, 1939.

Dale, Tom. Conservation Farming for the Hard Lands of the Southern Great Plains. United States Department of Agriculture, Soil Conservation Service. Washington, D.C.: United States Government Printing Office, February, 1941.

_____. Conservation Farming for the Sandy Lands of the Southern Great Plains. United States Department of Agriculture, Soil Conservation Service. Washington, D.C.: United States Government Printing Office, February, 1941.

McCorkle, J. S. and Tom Dale. Conservation Practices for the Range Lands of the Southern Great Plains. United States Department of Agriculture, Soil Conservation Service. Washington, D.C.: United States Government Printing Office, February, 1941.

Stallings, J. H. Review of Data on Contour Furrowing, Pasture, and Range Land. United States Department of Agriculture, Soil Conservation Service. Washington, D.C.: United States Government Printing Office, December, 1945.

United States Department of Agriculture and the Kansas Agricultural Experiment Station cooperating. Physical Land Conditions Affecting Use, Conservation, and Management of Land Resources, Clark County, Kansas. Manhattan, Kansas, October, 1953.

United States Department of Agriculture, Weather Bureau. Climatological Data for the United States, Kansas. Washington, D.C.: United States Government Printing Office, Vols. 16-24, 1929-1937.

United States Department of Agriculture, Weather Bureau. Climatological Data, Kansas. Washington, D.C.: United States Government Printing Office, Vols. 52-54, 1938-1940.

United States Department of Commerce. County and City Data Book, 1952. Washington D.C.: United States Government Printing Office, 1953.

United States Department of Commerce, Weather Bureau. Climatological Data, Kansas. Washington, D.C.: United States Government Printing Office, Vols. 55-67, 1941-1953.

State Publications

Anderson, Kling L. "Range and Pasture." Report of the Kansas State Board of Agriculture, Soil Conservation in Kansas. Topeka, Kansas: Ferd Voiland, Jr., State Printer, Vol. 65, No. 271, 1946.

Fly, Claude L., "Natural Agricultural Resource Areas of Kansas." Report of the Kansas State Board of Agriculture, Soil Conservation in Kansas. Topeka, Kansas: Ferd Voiland, Jr., State Printer, Vol. 65, No. 271, 1946.

Fredenhagen, V. B. "Terracing." Report of the Kansas State Board of riculture Soil Conservation in Kansas. Topeka, Kansas: Ferd oiland, tate Printer, Vol. 65, No. 271, 1946.

Hide, J. C. "Rotations, Crop Residues, Manure and Line." Report of the Kansas State Board of Agriculture, Soil Conservation in Kansas. Topeka, Kansas: Ferd Voiland, Jr., State Printer, Vol. 65, No. 271, 1946.

Proceedings of the House of Re resentatives of the State of Kansas, rtieth Biennial ession. Topeka, ansas: Kansas State Printing Office, 1937.

Report of the Kansas State Board of Agriculture, Climate of Kansas. Topeka, Kansas: Ferd Voiland, Jr., State Printer, Vol. 67, No. 285, June, 1948.

Soil Conservation Districts Laws as Revised by the 1949 Kansas Legislature. Topeka, Kansas: State Printing Office, 1949.

Throckmorton, R. I. "Introduction." Report of the Kansas State Board of Agriculture, Soil Conservation in Kansas. Topeka, Kansas: Ferd Voiland, Jr., State Printer, Vol. 65, No. 271, 1946.

Williams, Ross A. "Forestry." Report of the Kansas Board of Agriculture, Soil Conservation in Kansas. Topeka, Kansas: Ferd Voilland, Jr., State Printer, Vol. 65, No. 271, 1946.

County Publications

1 1 Soil Conservation Program for Clark Count . Ashland, Kansas: Clark County Clipper Office, 19 .

Books

Ayres, Quincy Claude. Soil Erosion and Its Control. New York: McGraw-Hill Book Company, Inc., 1936.

Bennett, H. H. Soil Conservation. New York: McGraw-Hill Book Company, Inc., 1939.

_____. Elements of Soil Conservation. New York: McGraw-Hill Book Company, Inc., 1947.

Brinser, Ayers and Ward Shepard. Our Use of the Land. New York: Harper and Brothers Publishers, 1939.

Evans, Harold C., chief ed. Kansas, A Guide to the Sunflower State. New York: The Viking Press, 1939.

Gustafson, A. F., et al. Conservation in the United States. Cornell Heights, Ithaca, New York: Comstock Publishing Company, Inc., 1939.

Lyon, T. Littleton and Harry O. Buckman. The Nature and Properties of Soils. New York: The Macmillan Company, 1943.

Mickey, Karl B. Man and the Soil. Chicago, Illinois: International Harvester Co., 1945.

Millar, C. E. and L. M. Turk. Fundamentals of Soil Science. New York: John Wiley and Sons, Inc., 1951.

Parks, W. Robert. Soil Conservation Districts in Action. Ames, Iowa: The Iowa State College Press, 1952.

Smith, Guy-Harold. Conservation of Natural Resources. New York: John Wiley and Sons, Inc., 1950.

Periodicals

Thornthwaite, C. W. "An Approach Toward a Rational Classification of Climate." Geographical Review, Vol. 38, 1948.

Unpublished Materials

Annual Report of the Board of Supervisors, Clark County Soil Conservation District. From the files of the Clark County Soil Conservation District, Ashland, Kansas.

Clark County Soil Conservation District Program Kansas. From the files of the Clark County Soil Conservat on District, Ashland, Kansas.

Farm Plan No. 87. From the files of the Clark County Soil Conservation District, Ashland, Kansas.

Farm Plan No. 180. From the files of the Clark County Soil Conservation District, Ashland, Kansas.

Farm Plan No. 190. From the files of the Clark County Soil Conservation District, Ashland, Kansas.

Work Re ort of the Clark Count Kansas District Period End ng ecember 31 1 2. From the files o the Clark County Soil Conservation District, Ashland, Kansas.

VITA

Edgar Harold Pechin
candidate for the degree of
Master of Science

Thesis: CONSERVATION PRACTICES IN CLARK COUNTY, KANSAS

Major: Geography

Biographical and Other Items:

Born: October 29, 1925, at Ashland, Kansas.

Undergraduate Study: Oklahoma Agricultural and Mechanical College, Okmulgee Branch, 1946-1947; Oklahoma Agricultural and Mechanical College, 1949-1952.

Graduate Study: Oklahoma Agricultural and Mechanical College, 1953-1954.

Experiences: United States Army Air Corps, 1944-1945. Soil Conservation Service, Summers of 1948 and 1950. The Home Lumber and Supply Company, 1952-1953.

Member of Gamma Theta Upsilon, Sigma Gamma Epsilon, and Lambda Chi Alpha.

Date of Final Examination: July 21, 1954

THESIS TITLE: CONSERVATION PRACTICES IN CLARK COUNTY, KANSAS

AUTHOR: Edgar Harold Pechin

THESIS ADVISER: Dr. Ralph E. Birchard

The content and form have been checked and approved by the author and thesis adviser. The Graduate School Office assumes no responsibility for errors either in form or content. The copies are sent to the bindery just as they are approved by the author and faculty adviser.

TYPIST: Elizabeth J. Kerby
KERBY TYPING SERVICE