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TYPE OF FARMING AND RANCHING AREAS IN NEW MEXICO

PART II

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FOREWORD

The results of the study of types of farming and ranching in New Mexico conducted cooperatively by the New Mexico Agricultural Experiment Station and the Bureau of Agricultural Economics of the United States Department of Agriculture have been published in two separate bulletins: Part I and Part II. Part I, Bulletin No. 261, sketches the agricultural development of New Mexico and presents the reasons for making the study, the basis for classifying the farms into types, and the major types of land tenure. It presents, further, a discussion of the physical, biological, and economic factors which have influenced and largely determined the kinds of farming and ranching to be found in different parts of New Mexico. Lastly, it includes a series of figures which show approximately where the principal crops are grown, where the different kinds of livestock are produced, and where the more important types of farming are carried on.

Part II, Bulletin No. 267, presents a somewhat detailed description of each of the type-of-farming areas and also of the subareas. Both Parts I and II should be read in order to obtain a comprehensive understanding of the agriculture of the State.

TYPE OF FARMING AND RANCHING AREAS IN NEW MEXICO

PART II

INTRODUCTION

In the first part of this study New Mexico was differentiated into 25 type-of-farming and -ranching areas and 33 subareas (fig. 1 and table 1). In delimiting the State into type-of-farming areas and subareas, a wide range of information was used. The distribution of the crops, livestock, and types of farms over New Mexico is largely the result (1) of such physical factors as topography, altitude, type of soil, rainfall, and natural vegetation, and (2) of such economic factors as distance to market, available transportation facilities, and relative profitableness of the enterprises adapted to the State. All these factors, as well as current farm and ranch practices, were given due consideration in locating the boundary lines of the type-of-farming areas and subareas.

In general, the degree of similarity between the combination of crop and livestock enterprises and production practices from farm to farm depends largely upon the uniformity of the controlling factors enumerated above. Because of the large variation in one or more of these factors within relatively short distances in some parts of the State, considerable variation exists in the type of farming carried on within some areas and subareas.

The boundary lines separating the different areas and subareas are not to be considered fixed and definite. In nonirrigated and ranching districts the areas and subareas generally grade imperceptibly into each other, while in the case of irrigated areas the boundary lines are more stable and definite. Likewise, the types of farms to be found in any area should not be considered as static. Gradual changes in farm organization take place over a period of years in response to certain long-time shifts in price relationships of the products produced or to permanent changes in production costs occasioned by the introduction of new varieties of crops, power machinery, or other technological developments. More or less abrupt or short-time changes are caused by changes in business conditions, as brought about by war and other unusual occurrences or by production difficulties, such as those caused by drouth.

The discussion in this bulletin (Part II) describes in considerable detail the type-of-farming and -ranching areas into which the State has been divided, portrays the nature of the agriculture in each area and subarea, and enumerates the more pressing problems and needed adjustments.

TABLE 1.—DESIGNATIONS AND CHARACTERISTICS OF TYPE-OF-FARMING AND -RANCHING AREAS.

Area No.	Designation	Use characteristic
1	Western and south central New Mexico range livestock area	Range cattle and sheep, some goats. Mostly yearlong grazing, very little crop farming.
	Subarea 1-A	Mostly range cattle. Some herded sheep and goats. Mostly semidesert vegetation. Yearlong grazing except in mountains. Very little supplementary feeding.
	Subarea 1-B	Range cattle and sheep, mostly in fenced pastures. Short-grass vegetation. Yearlong grazing. Supplementary feeding quite common.
	Subarea 1-C	Cattle and sheep more or less intermingled. Mostly short-grass vegetation. Some woodland. Mostly yearlong grazing. Some supplementary feeding.
	Subarea 1-D	Cattle strongly predominate. A few herds of sheep and goats. Mountain areas summer grazed. Valleys and mesas winter grazed. Very little supplementary feeding.
	Subarea 1-E	Sheep predominate. Some cattle. Sheep all herded. High mountain areas summer grazed. Mesas and valleys winter grazed. Very little supplementary feeding.
	Subarea 1-F	Sheep predominate. Some cattle. Both cattle and sheep summer in Colorado and winter in Subarea 1-F. Marketable lambs and cattle delivered in fall while yet in Colorado.
2	Northeastern New Mexico range livestock and nonirrigation farming	Range cattle and sheep. Nonirrigation cash-crop farming. Some irrigation. Short grass, woodland, and forest vegetative types. Farm crop supplementary feeding.
	Subarea 2-A	Range cattle. A considerable number of sheep. Cash crops (corn, beans, grain sorghum, hay, wheat). Some part-time and self-sufficing. Some winter feeding of bundle forage.
	Subarea 2-B	Range sheep. A good many cattle. Increase in crop-specialty (beans), part-time, and self-sufficing farms and a decrease in general and cash-grain farms, as compared with Subarea 2-A. More irrigation than in 2-A.
	Subarea 2-C	Mostly a rough, mountainous, summer cattle-grazing area. Cattle winter at lower altitudes. Considerable feeding of hay during winter.
3	Southeastern New Mexico range livestock and nonirrigation farming area	Range cattle and sheep in fenced pastures. Some general, dairy, self-sufficing, and part-time farms.
	Subarea 3-A	Range cattle predominate. Many sheep. Some general, dairy, self-sufficing, part-time, and cotton farming. Some irrigation by pumping from wells.
	Subarea 3-B	More general, dairy, and cash-grain farming and less cattle, sheep, part-time, and self-sufficing than in Subarea 3-A.
4	Eastern New Mexico nonirrigation farming area	Cash-grain, crop-specialty, stock farms, stock ranches with some dairy, cotton, and poultry.
	Subarea 4-A	Mixed types: Cash-grain, general, crop-specialty (broomcorn), cotton, stock farms and ranches, dairy, poultry.
	Subarea 4-B	Cash-grain (wheat, some sorghum and corn). Some range livestock (mostly cattle) and dairying.
	Subarea 4-C	Cash-grain (mostly wheat and corn; some sorghum), dry beans. Some range livestock (mostly cattle).

TABLE 1.—(Continued)

	Subarea 4-D	Mixed types: General, cash-grain (sorghum and corn), crop-specialty (broomcorn, beans, hay), and range livestock, mostly cattle.
	Subarea 4-E	Mixed types: General, crop-specialty (broomcorn), cash-grain (sorghum, corn), with some cotton and range livestock.
5	Estancia Valley nonirrigated bean area	Crop-specialty (dry beans) predominates. Some stock farm, stock ranch, general, and part-time.
6	North central New Mexico area of mixed types	Mixed types: Self-sufficing, part-time, general, crop-specialty (beans, hay), stock farms, stock ranches (mostly sheep). Some truck and cash-grain (wheat and corn). Both irrigation and nonirrigation farming.
7	South central Colfax County irrigated areas	Crop-specialty (hay, beans), general, cash-grain, with some dairy, stock farm, and part-time.
	Subarea 7-A Springer Irrigation Project	Crop-specialty (dry beans, hay), general, cash-grain (small grain and corn). Some dairy, part-time, and stock farms.
	Subarea 7-B Antelope Valley Irrigation Project	Crop-specialty (beans, hay), cash-grain (oats, barley, corn, wheat), general, part-time.
	Subarea 7-C Maxwell Irrigation Project	Crop-specialty (alfalfa, beans), general, cash-grain (barley, oats, wheat), dairy, self-sufficing. Some poultry and stock farms.
	Subarea 7-D Cimarron Irrigated District	This subarea is occupied largely by a few large farms which are operated in connection with range cattle production. Hay crops predominate.
	Subarea 7-E Miami Irrigation Project	Crop-specialty (alfalfa beans), cash-grain (small grains, corn), general, poultry, fruit (apples), part-time, and stock farms.
	Subarea 7-F Moreno Valley	Cash-grain (barley, oats, wheat), stock farms (mostly cattle), crop-specialty (hay, potatoes), truck (peas and lettuce). Wintering area for livestock summer grazed on national forest. Both irrigated and nonirrigated.
8	Fort Sumner Irrigation Project	Crop-specialty (sweet potatoes, hay), general, cash-grain, dairy, fruit, poultry, self-sufficing, part-time.
9	Portales Pump Irrigation District	Crop-specialty (sweet potatoes, peanuts, hay), general, cotton, stock farms, part-time, dairy, and poultry.
10	Pecos Valley irrigated cotton area	Cotton strongly predominates. Some general, fruit, dairy, crop-specialty (alfalfa), part-time, truck.
	Subarea 10-A Roswell-Artesia irrigated area	Cotton, crop-specialty (alfalfa), general, fruit, part-time, dairy, truck. Irrigated from artesian wells and by pumping from shallow wells and weak artesian wells.
	Subarea 10-B Carlsbad Reclamation Project	Cotton strongly predominates. Some general, crop-specialty (alfalfa), part-time, dairy.
11	Hope irrigated district	Fruit, general, crop-specialty (hay), dairy, and part-time.
12	Sacramento Mountain area; irrigated and nonirrigated	Stock ranch (mostly cattle), general, crop-specialty (hay), part-time, self-sufficing, cash-grain, fruit, truck.
13	Tularosa-Alamogordo irrigated area	General, cotton, crop-specialty (hay), part-time, dairy, self-sufficing, truck, poultry.
14	Ruidoso-Bonito-Hondo valleys irrigated area	Mixed types: Fruit, part-time, truck, self-sufficing, crop-specialty (hay), general, stock farms.

TABLE 1.—(Continued)

15	Mesilla Valley-Rincon irrigated area	Cotton predominates. Some general, crop-specialty (alfalfa), dairy, truck, part-time, self-sufficing.
	Subarea 15-A Mesilla Valley	Cotton strongly predominates. Some general, dairy, truck, crop-specialty (alfalfa), part-time.
	Subarea 15-B Rincon area	Similar to Subarea 15-A but with less cotton and more general, crop-specialty (alfalfa), self-sufficing, part-time, dairy, truck.
16	Deming pump irrigated area	Crop-specialty (beans, hay), cotton, poultry, general, dairy, with some truck, part-time, self-sufficing.
17	Upper Mimbres Valley irrigated area	General, crop-specialty (alfalfa, beans), cash-grain, fruit, truck, self-sufficing, part-time.
18	Virden Valley irrigated area	Cotton, crop-specialty (potatoes, alfalfa), general, poultry, part-time, self-sufficing.
19	Cliff-Gila irrigated area	Cash-grain (wheat, corn, oats, barley), crop-specialty (hay, potatoes), truck, general.
20	Middle Rio Grande Valley irrigated district	Mixed types: Part-time, general, crop-specialty (mostly hay), truck, cash-grain, self-sufficing, fruit, dairy.
	Subarea 20-A Sandoval County irrigated area	Cash-grain (corn, wheat), general, self-sufficing, crop-specialty (mostly hay), some fruit, part-time.
	Subarea 20-B Bernalillo-Valencia Counties irrigated area	Part-time, general, crop-specialty (mostly hay), truck, cash-grain (corn, wheat), self-sufficing, fruit, dairy.
	Subarea 20-C Socorro County irrigated area	Self-sufficing, cash-grain (wheat, corn), crop-specialty (hay), general, part-time.
21	Laguna Indian Reservation	Stock ranches (sheep and cattle), part-time, crop-specialty (hay, beans), self-sufficing, cash-grain, general. Considerable irrigation.
22	Zuñi Indian Reservation	Self-sufficing, stock ranch, stock farm, some general, cash-grain, part-time. Considerable irrigation.
23	Bluewater-Toltec irrigated area	Crop-specialty (dry beans, hay, some potatoes), dairy, part-time, truck, cash-grain (corn, oats, wheat).
24	Navajo Indian Reservation	Stock-ranch (mostly sheep), part-time, some general, self-sufficing, crop-specialty, fruit, cash-grain, truck. Considerable irrigation.
25	San Juan irrigated area	General, fruit, part-time, crop-specialty (hay, potatoes, beans), stock farm, cash-grain, self-sufficing, poultry.
	Subarea 25-A Farmington-Aztec irrigated area	General, fruit, stock farm, part-time, crop-specialty (hay, potatoes), cash-grain, poultry, self-sufficing, truck, dairy.
	Subarea 25-B Fruitland irrigated area	Part-time, general, crop-specialty (hay), self-sufficing, cash-grain (corn), stock farm, fruit.
	Subarea 25-C La Plata irrigated area	General, cash-grain (corn), stock farm, self-sufficing, dairy, poultry, part-time.
	Subarea 25-D Bloomfield irrigated area	Crop-specialty (dry beans, hay), self-sufficing, stock farm, cash-grain (corn), general, part-time, poultry.

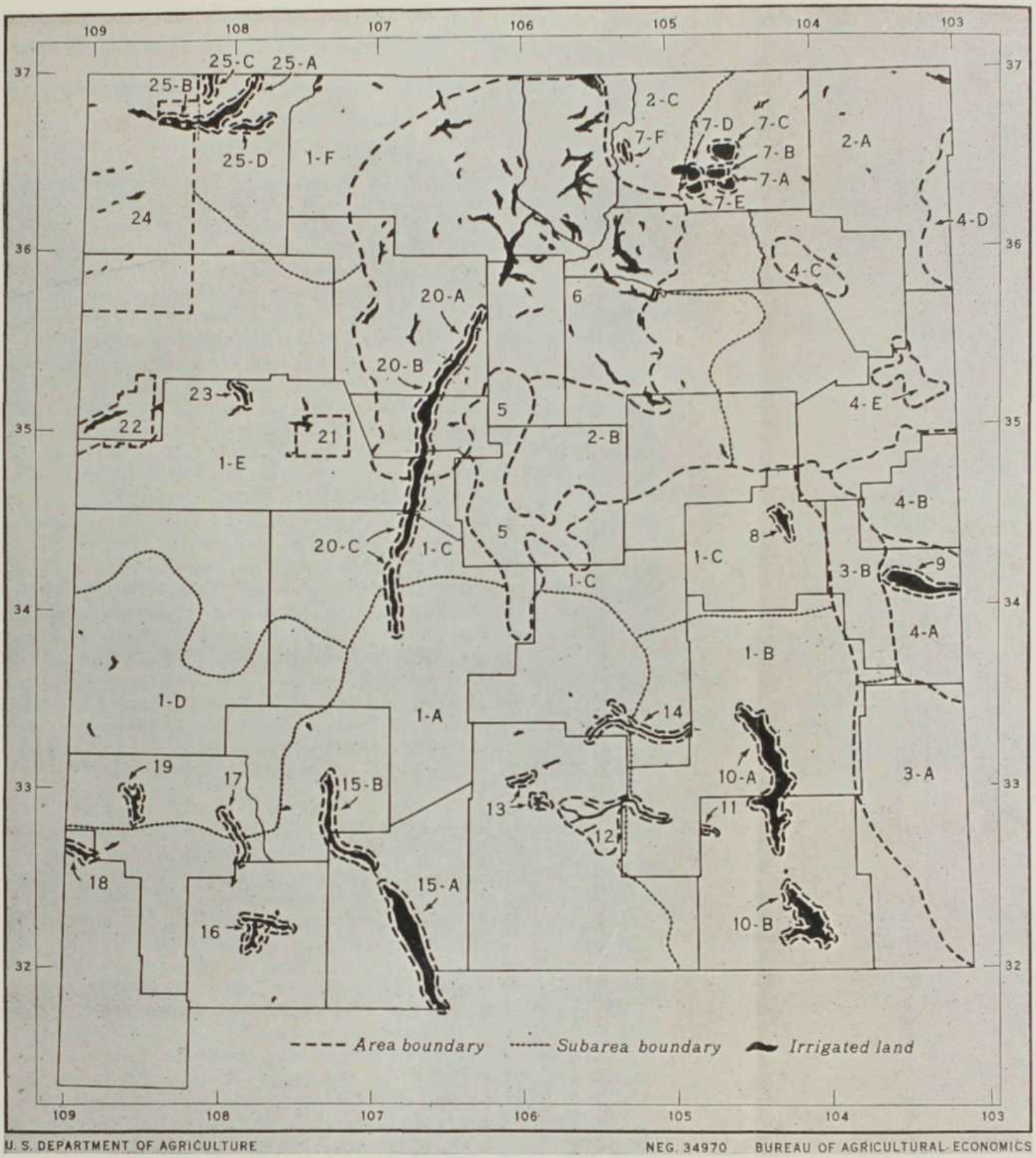

Fig. 1.—Type-of-farming and -ranching areas, New Mexico (irrigated land in black).

AREA 1. WESTERN AND SOUTH CENTRAL NEW MEXICO RANGE LIVESTOCK AREA

GENERAL DESCRIPTION

Type-of-farming Area 1 is situated in the western and south central parts of New Mexico (figure 1). It includes approximately three-fifths of the total area of the State and embraces within its borders either all or parts of 21 of the 31 counties of the State. It likewise includes either all or part of 12 of the 14 major drainage basins.

The topographical features of the area include sharp precipitous mountain ranges, rough mountainous areas, rolling hills, high plateaus, mesas, gently sloping plains, stream valleys, and wide flat-bottomed basins, some of which have no surface drainage outlets.

Area 1 is traversed from north to south by the Continental Divide, by the Rio Grande, and by the Pecos River. While the bulk of the area drains to the south into the Gulf of Mexico, the surface runoff of the western part finally reaches the Gulf of Lower California. The elevation varies from 2850 feet, where the Pecos River crosses the State line into Texas, to approximately 11,000 or 12,000 feet on the summits of some of the peaks of the higher mountain ranges. Thus, the area has a range in altitude of about 9,100 feet. Its greatest length from north to south is 369 miles. The influence of that distance on temperature is equal to approximately that of 1400 feet in elevation. These two factors—variation in elevation and distance from north to south—have a marked influence on temperature, length of growing season, precipitation, and the proportions of the precipitation that fall as snow and rain.

Because Area 1 is so extensive (see figure 1) and so variable in topographical features, in climate, in vegetative cover, in the kind of livestock that predominates in different parts of the area, and in the methods used in handling the livestock, it has been divided into six subareas in order to facilitate the discussion of it.

CLIMATE

An abundance of sunshine, very little cloudy weather, a rather wide range between day and night temperatures, low relative humidity, a scant and variable annual precipitation, and very rapid evaporation of moisture from the surface of the ground are some of the chief climatic characteristics of the area. The prevailing winds are generally from the south and west, but owing to the influence of sharp mountain ranges, in some localities they are from the south and southeast.

The mean annual precipitation varies from less than 10 inches in some of the low-lying basins to 30 inches or more on a few of the highest mountain peaks (figure 8). The annual precipitation in any given locality varies widely in amount from year to year and may be expected to be either above or below the long-time average during two, three, or even four years in succession. The precipitation is also unevenly distributed throughout the year, approximately 50 percent falling during July, August, and September. The summer rains frequently are torrential and this results in considerable soil erosion and loss of moisture by surface

runoff. In most of the area, especially at the lower elevations, the period from late fall to late spring is usually one of low rainfall. The mean annual snowfall varies from about two inches in the southern part of the area to approximately 130 inches at some of the higher elevations in the northern portion. Over most of the area snow generally melts soon after falling and interferes but little with winter grazing, except during severe snowstorms, which are usually of short duration.

SOILS

The soils of Area 1 are extremely variable, ranging from gravelly, stony soils in some parts to stiff clays in others. They also vary widely in depth. In some localities the topsoils are deep and well drained, while in others only a thin layer of soil covers the underlying parent rock or caliche. Variations in soil and climatic conditions are largely responsible for much variation in the natural vegetative cover and in the carrying capacity of the range land.

NATURAL VEGETATION

Since Area 1 has a range in elevation of approximately 9100 feet, in rainfall of about 20 inches or more, and also in soil types from sand and gravel to clay, a striking variation in its natural vegetation is to be expected. Thus, it presents all of the six types into which the vegetative cover of the State has been differentiated in this study; namely, short grass, semidesert shrub, semidesert grass, oak brush, woodland, and forest. The approximate location of each of these six types is shown in figure 4. The plant association of each of these types has been described in some detail in Part I of this report. Figure 4 also shows, in black, the location of the principal irrigated lands within the borders of the area.

Short grass.—The blue, black, hairy, and side-oats gramas and (in the eastern part of the area) buffalo grass are the more important grazing forage plants of the short-grass type. Other less important plants are ringgrass, galleta grass, red three-awn, hairy triodia, alkali sacaton, and annual weeds and other flowering plants. The yearlong grazing capacity of this type varies from about 10 to 30 animal units per section of land.

Semidesert shrub.—The semidesert shrub type covers the river valleys, mesas, and lower plains. It consists mostly of creosote bush, blackbrush, mesquite, soapweed, and chamiza. The grazing capacity is high where chamiza is plentiful, when compared with that of the remainder of the semidesert shrub type, which, on the average, will carry about four animal units per section on the basis of yearlong grazing. Black grama, dropseed, and bush muhly are the principal grasses. Sometimes annual weeds are abundant in the spring. The soils occupied by this type are usually shallow or stony and very low in productivity. The annual rainfall averages about 9 inches.

Semidesert grass.—The semidesert grass type is to be found in Area 1 in San Juan, Valencia, Socorro, Sierra, Grant, Hidalgo, Luna, Dona Ana, and Otero Counties. Black grama, the dropseeds, and bush muhly are the principal grasses on the higher, drier mesas and plains. The yearlong grazing capacity varies from about 8 to 13 animal units per

section. On the flood flats and catchment basins, tobosa grass, alkali sacaton, vine-mesquite, and burro grass are important summer-fall grazing species. The browse plants mentioned above under semidesert shrub may occasionally predominate in places or may be scattered in the semidesert grass type.

Oak brush.—The oak-brush type is confined mostly to the southeastern part of the area and consists principally of a low shrubby growth of shin oak. This type generally occupies loose sand and sand hills. The grasses associated with the shin oak are of the tall group: big bluestem, little bluestem, prairie beardgrass, and the three-awn grasses. Other plants to be found in this association are small soapweed, threadleaf sage, and annual weeds. The grazing capacity of this mixed type is about half that of the short-grass type, i. e., about 5 to 15 animal units per section.

Woodland.—The woodland type usually occupies the foothills below the forested areas and is composed chiefly of piñon, juniper, and several species of evergreen oak. The blue, black, side-oats, and hairy gramas and also galleta, Texas timothy, muhly, the saltbushes, beargrass, and willows make up the principal grazing and browse plants. While grazing is generally yearlong, heavy death losses sometimes occur because of severe winter weather conditions. The average yearlong grazing capacity is about 9 animal units per section.

Forest.—The forest type occupies virtually all land above 7500 feet elevation. From this altitude up to about 9000 feet, yellow pine is the common timber species. Between 9000 and 10,500 feet, the pine gives way to Douglas fir, white fir, and quaking aspen. Above 10,500 feet Engelmann spruce is generally the dominant timber tree. The timber line is usually located at about 11,000 feet.

In the lower altitudinal limits of the forested areas, blue grama is the principal range forage species. As the elevation increases the grama gives way quickly to such grasses as Arizona fescue or pinegrass, mountain muhly, and beardless pinegrass; also to various weeds and annual flowering plants. The common browse species are mountain mahogany, wild currants, antelope brush, thimbleberry, willow, sedges, and rushes. The last three mentioned species occur generally on the highest mountain peaks, the willow in stunted form.

The mean annual precipitation ranges from about 15 to 25 or 30 inches, the upper limit being unknown. The frost-free growing season is short and decreases markedly as the altitude increases. The forest type of vegetation is used mostly for summer and early fall grazing. On a yearlong basis a section of land will carry an average of about 7 animal units.

CROPS

Little or no crop production is incorporated in range livestock ranching, which strongly predominates in Area 1. However, within its boundaries numerous small irrigated areas are to be found where crops are produced with but little relation to the surrounding livestock industry. Most of these irrigated areas are too small to be shown in figure 1. A

number of the larger ones have been set apart and described as separate type-of-farming areas. Alfalfa, corn, sorghum, vegetables, and fruit are the crops commonly grown under irrigation. The larger percentage of these crops is consumed locally. Limited amounts of corn, wheat, and sorghum also are produced without irrigation in some of the more favorable localities.

LIVESTOCK

The livestock enterprises associated with Area 1 are chiefly range beef cattle and sheep. Cattle predominate in some parts of the area and sheep in others. Soil types, vegetative cover, and topography are of primary importance in influencing the distribution of livestock in this area. Sheep are generally found on fine-textured soils, where short grass grows in combination with perennial browse plants and annual weeds, and not, commonly, on sandy soils or in densely forested mountain areas with dense underbrush. Cattle are more generally distributed over the area on all types of soil and vegetation; however, they are more concentrated in high rough mountainous and sandy areas and in localities with short-grass vegetation where few or no browse plants are found. The cattle are chiefly of Hereford breeding and the sheep consist almost entirely of Rambouillets. Considerable progress has been made in this and other areas in developing an ideal range type of Rambouillet; that is, a type which has a fleece not below 64's in fineness and of good combing length, and which produces lambs that are excellent feeders. Goats are important only in localized areas. They are kept for meat, milk, and mohair. Poultry, swine, and dairy cattle are of very minor importance. Only a sufficient number of horses—mostly of the saddle type—are produced for local needs.

TYPES OF FARMING AND RANCHING

Range livestock ranching, in which little or no crop production is incorporated, represents the characteristic agriculture of Area 1. That the grazing of livestock strongly predominates is shown by the fact that the stock ranches make up approximately 70 percent of the total number of farms and ranches within the area. The other 30 percent is constituted of part-time farms (11 percent), self-sufficing farms (7 percent), general farms (4 percent), special-crop farms (3 percent), and other types (5 percent). A portion of the farms of the types enumerated above is dry-farming homesteads, while others are small irrigated farms located along the comparatively minor streams of the foothill country. Although the commercial importance of these small irrigated areas and dry-farming homesteads is not great, they affect the range livestock industry in three ways: First, the dry-farming homesteaders generally occupy and plow some of the best grazing land; second, through the development of irrigated farms and the fencing of these lands, the supply of water for livestock is sometimes seriously curtailed; and third, the farmer and members of his family of these scattered farms furnish a source of labor needed on the surrounding ranches.

Yearlong grazing is practiced in most of Area 1 and it is only on the high-altitude land, which constitutes but a small part of the total range area, that the winters are too severe for year-round grazing. The carrying capacity[1] of the range in Area 1 varies from about 4 to 30 animal units per section. The proper stocking of the range under yearlong grazing should provide for the conservation of sufficient forage produced in the summer months to carry the stock during the normally dry winter and spring period.

In the past there has been a tendency to stock the range above its actual carrying capacity. The continuance of this practice has resulted in an overgrazed condition which varies in severity in different parts of the area. The depletion of the plant cover is most advanced in those parts of the area having comparatively low rainfall. The carrying capacity of the range under low-rainfall conditions was very low even before the advent of the range industry in this area. The drouth periods are long and recuperation of the plant cover through reseeding is a slow process, especially when the stand of the more desirable species of vegetation has been seriously depleted. It has been estimated that during the severe drouth of 1933 and 1934, 20 to 70 percent of the black grama grass in southern New Mexico died on account of lack of water. The depletion of the vegetative cover may be brought about by any one or a combination of the following practices or conditions: overstocking, that is, grazing more stock than the range will carry year after year, which was encouraged by the free-competitive use of much of the grazing land; improper seasonal use, such as grazing summer range too early in the spring or using winter range in the summer; and faulty distribution of stock, which in many cases is caused by improper rotation-grazing methods or insufficient watering places; prolonged drouths, through which vegetation cannot survive; and damage by rodents.

The condition of range forage has great influence on breeding practices in Area 1. In most parts of this area the rainfall is so scant and uncertain and forage so scarce that it is the general practice to allow the bulls to run with the cow herd throughout most of the year. By yearlong breeding, ranch operators maintain that a larger percentage of calf crop is obtained than under seasonal breeding. Seasonal breeding may be more desirable on small ranches for the purpose of producing more uniform calves; in locations where extreme weather conditions are experienced in winter; or where an abundance of feed is available. A majority of ranch operators segregate and feed at least some of their bulls in late winter or early spring. Under such a system of year-round breeding the larger proportion of the calves comes in two seasons: in the spring and during the fall months. Most of the cattle run together regardless of class or sex, which results in many heifers calving at two years of age.

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[1]Carrying capacity on a yearlong basis is expressed in animal units that can be grazed for a 12-month period on a section of land. Correct carrying capacity allows sufficient forage for normal production and growth of livestock during a 12-month period and, at the same time, provides for the maintenance of a permanent vegetative cover.

In the past, cattle have been left on the same range throughout the year where climatic and vegetative conditions permitted. The majority of ranchmen still follow this practice; however, there are increasing numbers of stockmen who are grazing less heavily throughout the year, for the purpose of allowing the plant cover to strengthen and possibly reseed in favorable years. The practice of deferred or rotation grazing, however, is being adopted to some extent. Under this system the ranch is divided into several pastures and each year one of these pastures is protected from grazing until the plants have had an opportunity to produce seed. This grazing practice has given excellent results when moisture conditions have been such as to allow the seed of the better forage species to mature, thereby revegetating naturally. To be successful, this practice must also prevent the overloading of the unreserved portion of the ranch. Such a system, together with fenced pastures, permits controlled breeding. This, in turn, results in a more uniform crop of calves, and makes it possible to prevent the calving of two-year-old heifers. The general practice on cattle ranches in Area 1, as in other grazing areas, is to market the production as calves rather than as one- or two-year-old steers. There are many exceptions to this general rule, as will be pointed out in the discussions of the subareas.

The more successful sheep-ranch operators reserve some of their comparatively level grazing land that is near water for use during the breeding season; provide supplementary feed for the ewes previous to lambing; run the ewes in small bands for a month to six weeks after lambing; and stock their ranges very conservatively. These operators secure a higher-percentage lamb crop, produce heavier lambs, and experience a lower death loss than the average from poisonous and other injurious weeds, much of the death loss being avoided because of a greater abundance of palatable forage.

SUBAREA 1-A

Subarea 1-A is located in the southwestern part of New Mexico, as shown on the type-of-farming map on page 10. Its boundaries embrace all of the grazing land in the counties of Hidalgo, Luna, and Dona Ana; also the southern part of Grant, eastern Sierra, southern Socorro, and western Lincoln Counties, and all except the extreme eastern part of Otero County.

The low-lying parts of subarea 1-A (the major portion) have a mean annual precipitation that varies in different localities from 8 to 10 inches; in the foothills near the mountains, where the elevation is higher, it increases to about 15 inches; in the Coronado National Forest in Hidalgo County and in the Organ and San Andres Mountains in Dona Ana and Socorro Counties, it ranges up to around 25 inches; and in the Lincoln National Forest in Lincoln and Otero Counties, where the elevations are highest, it reaches as much as 30 inches.

From 50 to 60 percent of the yearly precipitation falls during the months of July, August, and September, and the period from December to May, inclusive, is one of low rainfall. Only in the higher altitudes of this subarea is the average annual snowfall more than a few inches. What little snow falls in the lower altitudes generally melts quickly.

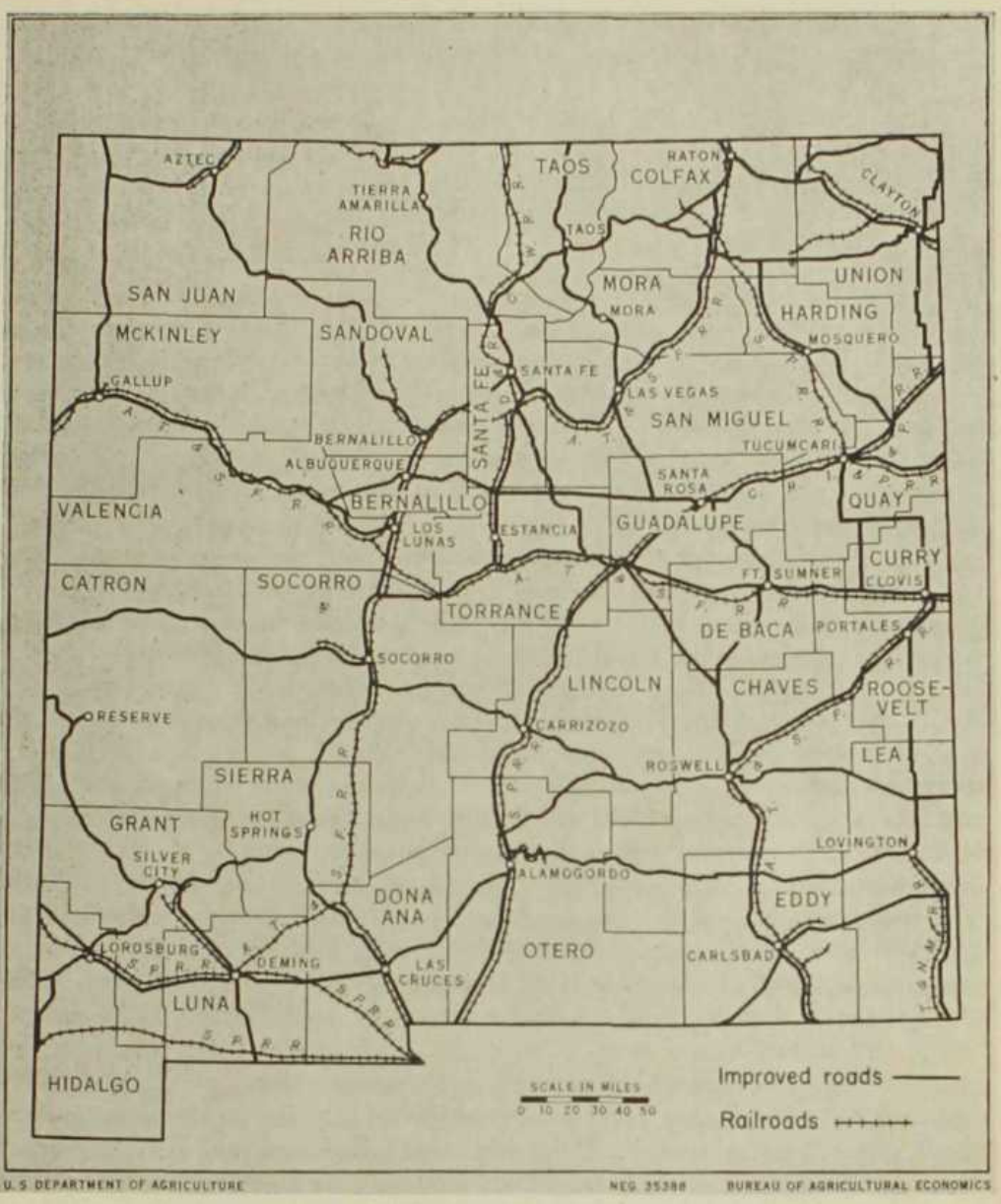

Fig. 2.—Counties, improved highways, and railroads of New Mexico.

Sandy and gravelly soils predominate in subarea 1-A, although small areas of those of heavier types are to be found. Because of the low and variable rainfall and the comparatively light soil texture, the natural vegetation over most of subarea 1-A consists largely of the semidesert shrub and semidesert grass types. The only woodland and forest types of vegetation of any importance in this subarea are found in the Lincoln National Forest in Lincoln and Otero Counties. The Lincoln National Forest is not typical of subarea 1-A, so far as vegetation is concerned, but it was included in this area because the management of livestock there is

very similar to that in the remainder of the area. Cattle production also predominates there as in most other portions of subarea 1-A.

In general, the ranges of subarea 1-A have a comparatively low carrying capacity, which is also quite variable, due to variations in precipitation and in the vegetative types. The carrying capacity ranges from not more than four animal units per section on the lower-lying sandy areas to approximately twenty in the more favorable locations with heavier rainfall, at higher elevations. In a large part of this subarea the grazing capacity averages about eight animal units per section.

Types of Ranching and Farming.—Cattle ranching predominates in subarea 1-A, relatively few sheep and goats being raised. The sheep and goats are concentrated mainly in central Hidalgo, eastern Otero, and southern Sierra Counties. The semidesert vegetation covering most of the area contains many plants with burs and thorns, which, together with the occurrence of sandy soil over much of the area, results in conditions unfavorable to sheep production.

Yearlong grazing is common in this area, with the grazing so managed as to take advantage of the seasonal growth of grass and weeds. Yearlong breeding is also generally practiced, which results in the calves' coming throughout the year, the larger proportion, however, being dropped during the spring months. Most of the calves born before July 1 are sold in the fall, while those dropped after that date are sold as yearlings either the next spring or fall. As a result of the climatic conditions and ranch practices, particularly in the portion of the area covered by desert-shrub vegetation, the average weight of cows, percentage of calf crop, and weight of calves when weaned and sold are comparatively low.

A comparison of the results obtained on the ranches in this subarea with those obtained on the ranch of the New Mexico College of Agriculture and Mechanic Arts, located on vegetative types typical of this subarea, sheds much light on the causes of low production in this subarea. The College ranch was originally a part of severely overgrazed public domain in the semidesert shrub area. Since the College took possession, it has been lightly grazed for eleven years, a sufficiently long period to permit development of a denser grass cover, which now has a productive capacity about twice that of nearby privately controlled range. By year-round grazing at the rate of about eight animal units per section, cows on this ranch have been developed regularly, without supplementary feeding, to weights of 900 to 1000 pounds. These cows have averaged 85 percent calf crops from 1931 to 1938, inclusive, the calves weighing approximately 413 pounds each at the age of 7 months. In addition to maintaining the vegetative cover on the ranch, in certain pastures it is estimated that approximately twice as much beef is being produced per section as on neighboring ranches. Furthermore, the College ranch product brings a higher price when marketed, because of superior quality. On typical ranches in the vicinity of the one controlled by the College, cow weights average about 700 pounds, with calf crops averaging around 50 percent and calves weighing approximately 325 pounds each at 8 or 9 months of age.

SUBAREA 1-B

Subarea 1-B lies immediately east of subarea 1-A in the southeastern part of New Mexico. While most of it lies in Chaves and Eddy Counties, it also includes the southeastern part of Lincoln County and the southeastern and the southwestern corners, respectively, of Otero and Lea Counties (figure 1). It is traversed from north to south near the center by the Pecos River. In the Pecos Valley within this subarea is found one of the more important irrigated areas in the State; namely, Area 10.

In this subarea the grazing land west of the Pecos River includes the adjacent mesa. This slopes gently upward from the River and becomes more rough and broken as it rises to the west and merges into the foothills adjacent to the eastern boundary of the Lincoln National Forest and the Mescalero Indian Reservation, which are the approximate western boundaries of this subarea. The elevation of this portion of the subarea varies from an average of about 3500 feet on the mesas adjacent to the River to approximately 5000 feet at its western boundary. The elevation of the southern part of the area, where the Pecos River crosses the New Mexico-Texas state line, is 2850 feet. On the east side of the Pecos River the surface features are those of a gently rolling plain, which extends eastward to the approximate western boundary of the Staked Plains. This portion of 1-B has an average altitude of approximately 4000 feet.

The mean annual precipitation over the larger part of subarea 1-B—the central and eastern portions—varies from 10 to 15 inches. As one proceeds westward from the Pecos River, the precipitation gradually increases, reaching about 20 inches at the higher elevations near the western border of the area. Approximately three-fourths of the precipitation falls during the six-month period, May to October, inclusive; and July, August, and September are the heaviest rainfall months. From January to April, inclusive, is the period of least rainfall and it is during this period that the larger part of the supplementary feeding is carried on. Snow is more common than in subarea 1-A and minimum temperatures average somewhat lower.

Four types of natural vegetation are found in this subarea, namely, short grass, shin-oak brush, semidesert shrub, and woodland (figure 4). The short-grass type occurs largely west of the Pecos River and furnishes most of the range feed produced. The land which is covered more or less intermittently with oak brush is second in extent and is located in the eastern part. In the southern part the desert-shrub type predominates, and the woodland type is found in the western portion at higher elevations. The short-grass and woodland types are located mainly on comparatively heavy soil types, while the soil in the semidesert shrub and oak-brush sections is of sandy texture.

Types of Ranching and Farming.—Both sheep and cattle ranches are important in this subarea, but goat ranches are rather limited in number. The sheep are concentrated largely in the western part. Two reasons may be assigned for this distribution: First, the soil in this territory, for the most part, is heavy and is stony in the foothill section; second, the vegetation is relatively free from burs and brush but contains many browse

plants at the higher elevations. Much of the eastern part of the area is sandy and is better adapted to cattle, though cattle are rather evenly distributed over the whole area. There is a small goat population concentrated in the rougher sections of the subarea in southwestern Chaves and Eddy Counties.

The characteristics which set this subarea apart from others of Area 1 are, in the main, concerned with the practices followed by ranch operators. First, most of the ranges are fenced and cross-fenced. This is true particularly of the sheep ranches, the majority of which have been divided into pastures with woven- and barbed-wire fences, which eliminate the necessity of herding and tend to reduce losses from predatory animals, chiefly coyotes.

Another advantage of fencing pastures, as given by ranch operators, is that sheep, when free from the restraints of herders and their dogs, spread out and do not tramp the surface of the ground so severely nor graze the grasses so closely. The result is a marked increase in the productivity of the ranges and a decrease in the amount of labor required. The sheep are under the care of a man called a "fence rider" or a "pasture rider," whose duties are to keep the fences in repair, watch carefully for holes where coyotes have gained entrance to the pasture by digging under the fence, hunt the coyotes and kill them when their entrance to the pasture has been discovered, and to look after the sheep in general. One pasture rider usually looks after two or three pastures. The elimination of a portion of the labor cost is of importance. It appears to be increasingly difficult to obtain reliable sheepherders who are willing to live in the isolation required in this work. These advantages are in a measure offset by the added investment in fences, which amounts to approximately $300 to $325 a mile. The fences are generally constructed of woven wire 42 inches in height, with two barbed wires above.

The second practice characteristic of this area is the operation of combination sheep and cattle ranches. In portions of this subarea both shortgrass and browse types of vegetation are available, which are more completely utilized by this method of grazing than by running sheep or cattle alone.

A third distinguishing feature is the widespread and regular use of cottonseed cake as a supplementary feed. It is a general practice during the winter and spring months, from December to April or May, to feed cake not only to the bulls but also to the cow herd and to the two-year-old heifers which are to calve in the spring. Cake is also fed by some operators to calves held over winter to be marketed the next spring or fall. Cottonseed cake is fed to sheep on the range for approximately a month prior to lambing.

Yearlong breeding is generally practiced in the area, with most of the calves being born before July 1 and with the next largest number in the early fall. Practically all of the calves born before July 1 are marketed in the fall, mainly in November.

All the ranges in this subarea except the oak-brush type may be grazed during the entire year, but the general practice is to reserve a portion of

each range for winter grazing during the drier months. The oak-brush vegetation is grazed mainly by cattle in the summer, fall, and winter, for it is necessary to remove the stock sometime during the spring; i. e., from the time the buds begin to swell until the leaves are well developed. Ranch operators who use this type of range need to have available short-grass range for spring grazing or roughage, such as sorghum fodder or alfalfa hay.

SUBAREA 1-C

This subarea is bordered on the south by subareas 1-A and 1-B and on the north by subareas 2-A and 2-B. It extends from the eastern boundary of De Baca County on the east to the Rio Grande on the west. The physiography is much like that of subarea 1-B, the relief features ranging from a comparatively level plain in the eastern part to rolling uplands in the west central portion and to a high, rugged range, the Manzano Mountains, in the western section. The elevations vary from about 3700 feet at the lowest point on the Pecos River to approximately 10,000 feet on the higher peaks of the Manzano Mountains.

The soils of the grazing lands vary from loose sand and sandy loams, found in the eastern part of the area along the Pecos River, to the so-called "tight" lands, composed mostly of sandy loams and clays, in the central and west central parts. Stony mountain soils are to be found in the mountainous portion of the subarea.

The short-grass type of vegetation predominates. It covers about 86 percent[1] of De Baca County and is also important in eastern Lincoln County (figure 4). In the extreme southeastern corner of this subarea there is a good deal of shin oak, while in the extreme western part and on the higher ridges and rough breaks in the northern section the woodland type, made up of piñon and juniper with blue, hairy, and black gramas, yucca, and beargrass, predominates. The grazing capacity of the shin-oak and woodland types is much lower than that of the short grass.

The mean annual rainfall within this subarea varies from 14 to 20 inches. The spring precipitation is generally sufficient to produce some growth of forage, particularly on sandy soils; but the principal growth occurs during July, August, and September, the months of heaviest rainfall. Because of the low and uncertain precipitation, very little crop production is carried on in this subarea under natural rainfall. A considerable acreage of range land in the northeastern and also in the central parts of the area has been plowed in past years for the purpose of crop production, but many of these fields have been abandoned and at present support only a thin cover of vegetation. These old fields and many of the fields now cultivated serve as points of origin of wind erosion.

Types of Ranching and Farming.—This subarea is used predominantly for grazing, as shown by the fact that approximately 72 percent of the farms and ranches are stock ranches. The remaining 22 percent consist largely of general, cash-crop, and part-time farms and are insignificant in the agricultural economy of the area. The ranges are stocked with

[1]Report and recommendations on range conditions and range conservation in De Baca County, New Mexico, based on the Western Range Survey.

both sheep and cattle, very few goats being raised. Cattle are fairly evenly distributed, but the sheep are concentrated mainly west of the Pecos River.

The winters in this subarea are usually not severe, except in the northern part, and yearlong grazing is the common practice. The system of allowing a portion of the range to rest each year is not so common as it is in subarea 1-B. One reason for this difference is the fact, especially in De Baca County, that a larger percentage of the land is privately owned, which results in a larger proportion of smaller ranches. Approximately 73 percent of the range land is deeded and one percent is public domain, in De Baca County, while the combined average percentages for Chaves and Eddy Counties are 42 percent deeded land and 30 percent public domain. In general, continuous grazing is practiced on small ranches and overgrazing is more common than on large ones.

In this subarea a larger proportion of the sheep is grazed under the herder system, rather than in fenced pastures, as is common in subarea 1-B. However, at present ranch operators are erecting woven-wire fences, as funds are available.

SUBAREA 1-D

Subarea 1-D is located in the rough mountainous parts of Grant, Catron, Socorro, and Sierra Counties in western New Mexico. A large percentage of it is included within the boundaries of the Apache, Gila, and Cibola National Forests. It is set apart from other subareas of Area 1 because of its rough topography, its dense forests, and its almost exclusive use as a cattle range.

Within the area are several mountain ranges which are separated by numerous streams. In some places these streams have cut deep canyons and in others they have formed small valleys with adjoining mesas. The elevations vary from about 4200 to somewhat over 10,000 feet. A portion of the subarea at extreme elevations is rather inaccessible and is adapted only for summer range.

The precipitation varies from 10 inches in some of the lower valleys to slightly over 30 inches at very high elevations on the mountain peaks. Over a large portion of the subarea the variation is between 20 and 30 inches. Heavy snowfall occurs at the higher altitudes and the melting snows are a source of stream flow throughout the relatively dry spring months. The rainfall occurs largely in July, August, and September and is often torrential in character during this period.

In the valleys and on the mesas at the lower elevations the grassland type of vegetation is most common. At intermediate elevations the woodland or piñon-juniper type occurs, while at higher elevations the forest types are found. These include the yellow pine association and the spruce-fir-alpine type. The forest types are used largely for summer grazing, while the woodland and grassland types are reserved mainly for winter range. Some exceptions to this general rule, however, occur at various locations.

Types of Ranching and Farming.—Although crop farming is of minor importance in this subarea, there is some forage produced for livestock in

the various small irrigated mountain valleys and on a number of widely scattered nonirrigated farms. Such forage, however, is relatively unimportant, since cottonseed cake is the principal supplementary feed used. While irrigated type-of-farming areas Nos. 17 and 19 lie within the borders of this subarea, they are not to be considered a part of it, for they have both been set apart and described as separate areas (figure 1).

Livestock ranching (mostly cattle, with a few sheep and goats) strongly predominates. Cattle are better adapted to most of this subarea than sheep, because of its extremely rough topography, dense brush, and the danger of losses from predatory animals. Of the total number of farms and ranches, approximately 57 percent are stock farms and ranches, a high percentage being ranches. The ranches are relatively large, as compared with other types of farms, and are far more important than they appear to be when judged numerically. Of the total number of farms, self-sufficing make up about 15 percent; part-time, 11; general, 8; and crop-specialty, 4 percent. The remainder consists chiefly of fruit, cash-grain, dairy, and forest-products farms. Most of the farms making up this group of miscellaneous types are small, have low incomes, and contribute very little to the livestock industry.

The carrying capacity of this subarea varies widely from place to place; however, the majority of the ranches range in carrying capacity from 12 to 20 head per section. On relatively level mesas or gentle mountain slopes, vegetation grows profusely, whereas many mountain sides are so steep as to be practically devoid of vegetation, other than forest trees and brush.

The higher mountains are grazed during the summer and the lower valleys and mesas during the winter. It is the general practice to rely on grass to carry the livestock through the winter and very little supplementary feeding is done, except in case of severe drouth. The fact that comparatively small amounts of cottonseed cake are fed in this subarea is at least in part attributable to the long hauls over the rough terrain.

Year-round breeding is practiced in most of the subarea; however, some ranch operators segregate the bulls during the two or three severe winter months. Where extremely rough topography prevails, year-round breeding is thought to be necessary for the production of maximum calf crops.

Because of the rough surface features, ranches are operated with a minimum of cross fencing, but in spite of this attempt at economy, the fence cost per animal unit is the highest of all grazing areas in New Mexico. Packing fence materials on the backs of burros or mules is not uncommon and in many cases blasting is necessary before posts can be set.

SUBAREA 1-E

This subarea is located north of subarea 1-D and includes most of McKinley and Valencia Counties and the northern part of the counties of Catron and Socorro. It is a region in which sheep production predominates and in which definite areas are used for summer and winter grazing, many of which are widely separated.

Fig. 3.—The income from the sheep industry in New Mexico amounts to approximately 6 million dollars yearly.

The topography is characterized by its broad mesas and plateaus, interspersed with foothills and mountains. The mesas and plateaus vary from about 6000 to 7000 feet in elevation and increase to 8000 or 10,000 feet in the mountainous portions. The average annual precipitation varies with the altitude, ranging from 10 to 14 inches in the plateau country to slightly more than 20 inches in the mountainous parts.

This subarea has a much greater proportion of its acreage in unbroken plains than subarea 1-D, and consequently has more of the grass type of vegetation. Adjacent to the grassland, the woodland types occur on the foothills which surround the higher mountainous areas. These types consist mainly of juniper-piñon and associated plants. Scattered through the subarea are forested sections at the higher elevations.

The mountain soils are rather gravelly, while those of the mesa are usually a very heavy clay loam, varying in color from red or yellow to dark gray. These soils erode easily, forming deep vertical-walled arroyos.

Types of Ranching and Farming.—A considerable amount of crop production is carried on within the boundaries of this grazing subarea. The more important farming areas, such as the Bluewater Irrigation District and the Zuñi and Laguna Indian Reservations, are set apart as separate areas in figure 1. Stock ranches, however, make up approximately 70 percent of all farms and ranches in the subarea. The next most numerous type consists of part-time farms, which form 17 percent of the total number. Self-sufficing and general farms then follow, with 4 percent

each; crop-specialty, with 2 percent; and cash-grain, with 1 percent. No other type constitutes as much as 1 percent. The majority of farms other than stock ranches carry on dry-land crop production, and they are scattered. These other farms contribute practically no feed for the range livestock.

Previous to the closing of the public domain to the filing of homesteads in 1935, and to some extent since that date, there was an influx of settlers into this subarea, especially in northern Catron County and to some extent in western Valencia County. These homesteads are widely distributed, due to the fact that soil suitable for farming is not concentrated in one body but is to be found only in relatively small tracts. The settlers have plowed a portion of their acreage and are producing crops more or less regularly. The principal crops are corn and pinto beans. During recent years, fairly satisfactory yields have been obtained. However, in considering the permanence of this phase of agriculture in this subarea, it must be kept in mind that so far as cultivation is concerned, the land is relatively new and is producing at its best. The history of other areas similarly situated has been that after being cropped for a period of years the organic matter has become depleted, soil blowing has been accelerated, and the water-holding capacity of the soil has been reduced to a considerable extent.

Sheep are the predominant type of livestock produced in this subarea, with cattle second in importance. In general, the sheepmen use different areas for summer and winter grazing. Some, however, use the same area throughout the year. The severe winter weather and absence of browse on most of the higher mountain ranges cause them to be unsuitable for winter grazing; while the grass type of vegetation and in some places the lack of water in summer cause the lower ranges to be adapted to winter grazing. On some ranches the summer and winter range may lie adjacent; in others, they may be separated by distances as great as 100 miles. Designated trails have been established, which are used both for the purpose of traveling to and fro between summer and winter ranges and for driving lambs and cattle to market. Movement out of higher elevations usually takes place in October and November and the return is made in May and June. The sheep in this area are kept under the care of herders during the entire year and virtually no sheep-proof fences are to be found. During the winter the ewes are kept in bands ranging from 1500 to 2200 each. After lambing, the number of ewes per band generally ranges from 800 to 1500. There are usually two men with each band, one being a herder who cares for the sheep. The other is a camp tender or "campero." His duties include preparing meals for the herder, moving camp, and packing water and supplies for use in the camp. These men make their camp with tepee tents the year round. The camps are moved with burros, there being from 4 to 8 with each band of sheep.

Cattle production in this subarea is confined largely to the lower altitudes, where yearlong grazing is practiced. Very little supplemental feeding is done, except when made necessary by drouth. Selling of calves

is the most common marketing practice, although in some parts of the subarea which are a considerable distance from shipping stations, yearling and two-year-old steers are sold.

SUBAREA 1-F

This subarea is located in eastern San Juan County and western Rio Arriba County. Small portions of northern McKinley and Sandoval Counties are also included.

Physical conditions—climate, topography, and elevation—in subarea 1-F are much the same as in subarea 1-E. The rainfall averages slightly below 10 inches in the western part adjacent to the Navajo Indian Reservation and increases to 24 inches a year over a limited territory where the elevations are highest.

Types of Ranching and Farming.—This subarea is grazed by sheep to a larger extent than subarea 1-E; however, there are a few cattle ranches along the San Juan River.

The feature which sets this subarea apart from the others is the fact that it is practically all used for late fall, winter, and early spring grazing. During May and the first part of June the bands of sheep are moved to higher elevations in Colorado for lambing and later into the mountains for summer grazing. Shearing is done in July en route from the winter grazing lands in subarea 1-F to the mountain ranges in Colorado. Virtually all the feeder lambs are marketed in Colorado before returning the breeding bands to New Mexico in the fall. A considerable number of Navajo Indians outside of the reservation have been allotted land within this subarea, on which they run bands of sheep the year round and practice yearlong grazing.

PROBLEMS AND ADJUSTMENTS IN AREA 1

Overgrazing.—Overgrazing, which has resulted in killing out desirable species of grass, encouraged the growth of undesirable weeds and shrubs, and increased the rate of erosion, is the most serious problem in Area 1. The gravity of this problem is increased by the fact that it is difficult to rehabilitate depleted vegetative cover under the physical conditions found in the area. This overgrazing was brought about by the practice of stocking the ranches on the basis of vegetative growth in years of above-normal rainfall, by failure to reduce the grazing load quickly enough in times of severe drouths, and by a lack of systematic supplemental feeding during the low-rainfall months in late winter and spring. Convincing evidence points to the fact that low calf crops and lightweight cows and calves are the result largely of a low level of nutrition.

A large proportion of the public domain of New Mexico is located in Area 1. In the past these lands have been among the most severely overgrazed portions of the range area. Because of the fact that no allotments on these lands were made to individual stockmen, except to Indians, no incentive was offered to ranch operators using the public domain to reserve grass to be used during periods of drouth. The Taylor Grazing Act as amended June 26, 1936, provides for the correction of this evil. Specifically, the purposes of the Act are twofold; first, to

rehabilitate the range through preventing overgrazing, by means of regulations providing for orderly use, improvement, and development; second, to stabilize the livestock industry by administering the use of the public range in such a manner that it will be possible for the stock grower to plan his annual operations over a period of years, with assurance against invasion by others. Taylor grazing allotments not only limit the grazing load but tend to increase the stockman's interest in the welfare of the plant cover on land allotted to him. Seven Taylor grazing districts have been set up in New Mexico, most of the area of which is included within Area 1, under discussion.

A considerable degree of overgrazing is found also on State-owned land. Land classification of State lands and a more permanent system of tenure would go far toward solving this problem.

Overgrazing, where it occurs on privately owned land, is most severe on relatively small ranches whose operators do not have an opportunity to lease additional land or to secure Taylor grazing permits. It is especially common in parts of Area 1-B. The financial situation on such ranches is largely responsible for overstocking. The high indebtedness, the low level of income, and lack of capital prompt operators to attempt to increase their current income by carrying too much livestock, even at the expense of the vegetative cover. The recommended measures for remedying such deteriorated ranges are stocking to proper grazing capacity and the use of deferred and rotation grazing practices. How to adapt such practices to ranches which are of uneconomic size is difficult of solution. That is, it is not only difficult to get small operators to realize that in the long run overstocked ranges will produce more meat per section if livestock numbers are properly reduced, but in some cases it is impossible for operators to forego immediate returns, even though greater returns could reasonably be expected at no very distant date in the future as a result of such reduction.

In the mountainous parts of Area 1 the unequal division of grazing lands as between summer and winter range may be a cause of overgrazing. This is notably true in subareas 1-D and 1-E. For example, overgrazing on a particular ranch may not be common to the entire ranch but possibly only to that portion which must be used for winter grazing, due to the unequal division of summer and winter range. Solutions in such cases may not be under the control of the ranch operator. They may involve shifts in forest permits, purchasing or leasing of additional seasonal range, or, as a last resort, actual reduction of grazing load.

Water Development.—Even though ranch operators are protected in their tenure and limited in rate of stocking, the matter of water development is a difficult problem. For example, in using public lands under the Taylor Act, the ranch operator may own or lease "key tracts" of land lying adjacent to his allotted land. These so-called "key tracts" are of great importance, because it is upon them that watering places have been maintained or developed in the past as a result of drilling wells, building surface tanks, or by the utilization of springs and small streams. In order to graze the public domain efficiently in the future, additional

water facilities should be developed on it. In some parts of the area, as in subarea 1-B west of the Pecos River, the cost of water development is a serious problem. In places it is necessary to drill a thousand feet or more to obtain water. Because of these excessive costs, there has been a poor distribution of stock water and watering places. In recent years, however, large numbers of surface tanks have been constructed to supplement the wells. Considerable labor is necessary to keep these tanks in repair, especially after heavy, torrential rains. Surface tanks are unreliable sources of water in periods of drouth, and in certain locations ranch operators have installed pipe lines and storage tanks to distribute water from the deep wells.

Rodents and Predatory Animals.—In all parts of the area damage by rabbits and by rodents, such as kangaroo rats, prairie dogs, and ground squirrels, is an important factor, not only in range depletion but in the prevention of revegetation. Rabbits are by far the most serious pest in this respect. Observation indicates that rabbits injure and destroy more vegetation than they consume. The results of a plot test on the New Mexico State College cattle ranch indicate the effect of rodents on revegetation. The fenced plot is located in a pasture that formerly was overgrazed but which has not carried stock for five years. The plot is fenced rodent-proof. At the end of two years the vegetation inside the fenced plot was 3.67 times as dense as that on the adjacent unprotected plot. Neither plot was grazed by livestock.

Coyotes are troublesome on fenced sheep ranches, as well as on the unfenced ranges, for they frequently gain entrance to the sheep pastures by digging under the fence or by other means, and on certain large ranches from two to four men are employed to hunt coyotes in pastures in which there is evidence that they have gained entrance. At times in higher altitudes mountain lions cause serious losses of livestock.

Poisonous Plants.—Death loss of livestock caused by poisonous plants is rather common in this area. Poisonous plants frequently found include pingue, rayless goldenrod, whorled milkweed, cocklebur, and jimsonweed. The eradication of such plants is so expensive as to be impracticable; however, death loss of livestock can be materially reduced by conservative grazing. Throughout the western part of Area 1, especially in subarea 1-E and in the northern part of subarea 1-D, large losses of sheep are encountered from pingue poisoning. More or less of this plant is to be found on many of the ranges of northern and northwestern New Mexico. It has wide adaptations but thrives best in open grasslands. Death losses from pingue poisoning may occur at any time during the year, but the most dangerous times for the grazing of areas infested with this plant are in the spring and late fall, when palatable forage is likely to be scarcer than during the summer. Stockmen usually remove their sheep from a pingue area when there is a frost and hold them off until the spring growth of grass is well advanced.

Investigation by the Animal Husbandry Department of the New Mexico Agricultural Experiment Station indicates that pingue invades most rapidly ranges which have been overgrazed, and that losses are least

when sheep are in good physical condition after lambing. A deficiency of the necessary mineral nutrients in the feed may cause livestock to consume pingue and other poisonous plants. To alleviate this condition some ranchmen feed minerals containing phosphorus.

Erosion.—Water and wind erosion, which has increased because of overgrazing and the breaking of the range land for cropping, is an important problem in parts of Area 1. Gully erosion has developed on the steeper slopes on account of the depletion of vegetation, especially along the minor roads and trails. This condition leads to the formation of large arroyos and washes, which conduct the water off the range land rapidly, leading to further plant-cover depletion. Earthen dikes, contour furrows, and ditches should be used to direct runoff water onto areas where the water will irrigate the vegetation and not cause erosion. For the more gradual slopes where sheet erosion is taking place, contour furrows are effective on heavy soils and will greatly reduce erosion and runoff if combined with light stocking and deferred and rotation grazing.

Nonirrigated crop production is hazardous in this area, because of the scant and erratic rainfall. Crop failure is common. When failure occurs, serious wind erosion generally takes place. On this land only erosion-resistant crops should be planted and approved practices adopted, even though other cash crops may offer a promise of more immediate returns. Land that has been plowed and is not suited to crop production should be returned to native forage plants by keeping stock off and protecting it from erosion, or, where practicable, by seeding it to adapted range grasses or browse shrubs.

Distance to Shipping Points.—The transferring of livestock over long distances to shipping points is a rather important problem in some isolated localities, particularly in subarea 1-D. It has been the practice to drive stock to Magdalena from points considerably over 100 miles distant. Common driveways, which have become overgrazed and infested with worthless weeds and poisonous plants, have been used for this purpose. The enlarging of these driveways and the construction of additional fencing would make restricted grazing possible and would tend to revegetate this portion of the range and save it for the fall drives.

AREA 2. NORTHEASTERN NEW MEXICO RANGE LIVESTOCK AND DRY-FARMING AREA

This is located in the northeastern part of New Mexico. It is the second largest of the 25 type-of-farming areas into which the State has been differentiated in this study. It includes the major portion of eight counties and a small part of two additional counties. While the area is used largely for livestock grazing, a good many nonirrigated cash-crop farms and numerous small irrigated areas are interspersed among the stock farms and ranches. The three largest and most important dry-farming sections within the area have been set apart and described as subareas of Area 4. In like manner, the 7 most important irrigated areas have also been segregated and described as subareas of Area 7 (figure 1). Since there is an appreciable amount of variation in the kinds of farming

done and also in the conditions which obtain in the eastern, northwestern, and southwestern parts of Area 2, it has been divided into three subareas, which are shown in figure 1 as subareas 2-A, 2-B, and 2-C. A brief discussion of Area 2, as a whole, precedes the discussions of the three subareas.

The surface features of Area 2 are varied, ranging from practically level and gently rolling plains in the eastern part to rough mountainous and broken foothill lands in the western and northwestern portions. Throughout most of the western half of the area the streams leading down from the lofty Sangre de Cristo Range, as well as many other lesser intermittent streams, have cut rather deep channels. The slopes bordering these watercourses are generally steep and the areas lying between them are usually more or less rolling and rough. The elevation varies from a minimum of about 3,900 feet, on the eastern border of the area where the Canadian River crosses the New Mexico-Texas state line, to approximately 12,000 feet at the summits of some of the peaks of the Sangre de Cristo Range. Much of the intervening grazing land has elevations ranging from 4,000 to 7,000 feet.

CLIMATE

Area 2 presents a rather wide range in climate. This is largely because of a variation in elevation within the area of approximately 8,000 feet. At the lower elevations along the eastern border the average length of the frost-free period is around 190 days. For altitudes ranging from 4,000 to 5,000 feet, the average is approximately 190 days; from 5,000 to 6,000 feet, 165 days; from 6,000 to 7,000 feet, 150 days; and from 8,000 to 9,000 feet, 85 days. Killing frosts may be expected almost any time during the summer months on the summit of the Sangre de Cristo Range in the northwestern part of the area.

The mean annual precipitation varies between 15 and 20 inches over most of the eastern and northern portions of the area and between 12 and 15 inches in the southern part in Torrance and Guadalupe Counties. There is also a small area in south central Colfax County that has between 12 and 15 inches. At high altitudes in the extreme western part the mean annual precipitation is 30 inches or more. The average annual snowfall varies from about 12 inches in the southeastern and southern parts of the area to over 100 inches on the summits of the highest mountains. Snow, especially in the northern and northwestern portions, makes it necessary to feed in order to carry livestock through the winter.

SOILS

The soils of Area 2 vary widely as to texture and depth, the range in texture being from coarse sand and gravel to heavy clay. Those used for crop production generally vary from sandy loam to clay loam. While most of the cropland is medium in depth, some of it is too shallow for successful crop production except during the most favorable seasons. Virtually all soils of the area are low in organic matter and most of them are more or less subject to both wind and water erosion if left bare and exposed after the vegetative cover has been weakened or destroyed.

NATURAL VEGETATIVE COVER

Three general types of vegetation occur in Area 2 (figure 4). The short-grass type predominates over practically all of the plains portion; forests that are typical of north central New Mexico cover the rough mountainous parts, particularly those of subarea 2-C; and the woodland type lies between the other two just mentioned. The woodland type consists of piñon and juniper, together with their associated shrubs and grasses. The woodlands generally occupy the relatively high rolling to rough foothill sections.

CROPS

Crops are produced in Area 2 both with and without irrigation. The principal ones raised under dry-farming methods are dry beans, corn, and the grain sorghums, together with smaller acreages of wheat, oats, barley, and broomcorn. Beans are the chief cash crop. They are grown on farms which contain only relatively small amounts of grazing or range land. Wheat and broomcorn are also cash crops, but are of secondary importance. The crops grown under irrigation consist largely of alfalfa and limited amounts of wild or native grasses, oats, wheat, and barley. Alfalfa, wild grasses, and to a considerable extent the small grains also are used for making hay. The irrigated crops are grown mostly on small tracts at relatively high elevations in the north and northwestern parts of the area. The hay raised is generally fed on the farms and ranches where produced or it may be sold locally to neighboring ranchmen.

LIVESTOCK

The production of range cattle and sheep is by far the most important phase of the agriculture of Area 2. Cattle, on the whole, are more important than sheep. They are distributed fairly evenly over the entire area, whereas the sheep are concentrated considerably in Mora, southeastern Colfax, and western Guadalupe Counties. Sheep are also produced in limited numbers in the eastern or plains section of the area, especially where heavy soils predominate. They are better adapted than cattle to graze hilly areas where both grass and browse forage are available. Dairy farming has not been extensively developed in this area and is confined mostly to supplying the needs of the town, farm, and ranch population. The poultry consists mainly of small farm and ranch flocks. Swine production is restricted largely to local farm and ranch needs. Horses are used chiefly to provide farm and ranch power and as saddle horses. The number has been decreasing during recent years.

TYPES OF FARMING

From the standpoint of land use, Area 2 may be considered predominantly a livestock-ranching area. This is because a very high proportion of the total land area is used for grazing purposes. However, the stock ranches do not appear so important when compared, numerically, with the other types of farms. Thus, in 1929, the stock farms and ranches together made up 36 percent of the total number of all farms and ranches; crop-specialty formed 21 percent; general, 15; part-time, 8; self-sufficing, 8; cash-grain, 6; and dairy, 3 percent. The remaining 3 percent

(82 farms) were distributed among seven different types, none of which constituted as much as one percent of the total number. Since the stock farms and ranches made up 15 percent more of the total number of farms than did any other type; since they included the major portion of the total land area; and since they produced 60 percent or more of the total gross income of all farms and ranches of the area, they may be considered the dominant type.

The Dominant Type.—The dominant type of farm consists of both stock farms and stock ranches. The stock farms are of minor importance. They form approximately 15 percent of the total number of operating units in this type group, are relatively small in size, have less than ten acres of grazing land to each acre in crops, are usually located in districts where either dry farming or irrigation is practiced, and generally receive a considerable amount of income from sources other than livestock and livestock products. The stock ranches, on the other hand, make up about 85 percent of the operating units in the group, have 10 acres or more (usually a great deal more) of grazing land to each acre in crops, are very large in size as compared with the stock farms, and receive the bulk of their income from livestock and livestock products, chiefly wool. The discussion that follows pertains mainly to the stock ranches.

The stock ranches of this area may carry either cattle or sheep, or both cattle and sheep. It is now generally recognized that where the range forage consists of a variety of such plants as the grasses, wild flowers, weeds, and shrubs, it may be utilized more effectively and completely by grazing both cattle and sheep on the same area, though not necessarily at the same time. This is because the sheep feed on many plants that the cattle will not consume if the feed is plentiful and the range is not overstocked.

It is usually necessary for ranchmen in this area to own or lease virtually all of the land they use. This is because from 60 to 85 percent of all land in different parts of the area is privately owned. That which is not privately owned, named in the order of importance, consists of State land, national forests, and a very little public domain. Only in the extreme northwestern part of the area is it possible for ranchmen to obtain permits to graze their flocks and herds on the national forests. Because so much of the grazing land is privately owned, practically all ranches are well fenced for cattle. But few sheep fences, however, have been constructed and nearly all the sheep are kept under the care of herders.

The stock ranches vary widely in size. About 18 percent of them contain less than 500 acres; 16 percent range from 500 to 999 acres; 47 percent from 1,000 to 4,999 acres; 9 percent from 5,000 to 9,999 acres; and 10 percent contain 10,000 acres or more. Their average size is approximately 6,300 acres. A few of them are very large. About 42 percent of all stock ranches are operated by full owners, 44 percent by part owners, 11 percent by tenants, and 3 percent by managers. These percentages vary considerably in different parts of the area.

Yearlong grazing is practiced in almost all parts of the area, the chief exception being the rough, mountainous northwestern portion. It is necessary to feed in this part of Area 2 during the winter and early spring, especially during periods when snow covers the ground. In the plains portion, sorghum fodder and corn fodder are the chief feeds used, while in the western part alfalfa hay, native grass hay, corn fodder, and sorghum fodder are the important feeds. Cottonseed cake is also used as a supplementary feed throughout the whole area, especially during drouthy seasons when the range forage is scarce. As a rule, the supplementary feeding of cattle is more common than in the case of sheep. There is quite a wide variation in the area of crops harvested per ranch, the average being from approximately 15 acres in Torrance and Guadalupe Counties, in the southwest, to over 100 acres in Union County.

Nearly all the lambs are sold as feeders, very few of them going as "grass fat." Many of the lambs are shipped to the irrigated districts of Colorado to be fattened. The cattle are generally marketed as calves, a few being sold as yearlings. When calves are carried over to be sold as yearlings or long yearlings, it is usually because of good range conditions, extremely low cattle prices in the fall, or a belief that future prices will be better.

Other types.—A dozen other types of farming are carried on in Area 2 in addition to the dominant type discussed above, seven of them being of very minor importance. The remaining five types are discussed below in the order of their importance from the standpoint of numbers.

The crop-specialty farms are second in importance and make up approximately one-fifth of the total number of all farms and ranches. As a rule, they are nonirrigated, average about 420 acres in size, and harvest about 100 acres of crops per farm. Dry pinto beans are the chief source of income on most of the crop-specialty farms. Broomcorn is also an important cash crop on some farms in the east central part of the area. In 1929, approximately 78 percent of the gross income was derived from crops and 6 percent each from livestock and livestock products. The value of the farm products consumed by the operator's family made up the remaining 10 percent.

The general farms average approximately 500 acres in size, harvest an average of about 75 acres of crops per farm, and have a more even distribution of their source of income. In 1929, approximately 41 percent of the gross income came from crops, 20 percent from livestock, 20 percent from livestock products such as eggs and dairy products, and 2 percent from forest products. The farm products consumed by the operator's family constituted the remaining 17 percent of the gross income. The forest products of the general farms were produced chiefly in Mora and San Miguel Counties.

The part-time farms averaged about 360 acres in size and harvested an average of about 16 acres per farm, ranging from as low as 9 acres in Guadalupe County to 23 acres in Quay County. The operators of the farms of this type generally find work away from home for 150 days or more, i.e., on other farms and ranches, in the mines, on the highways

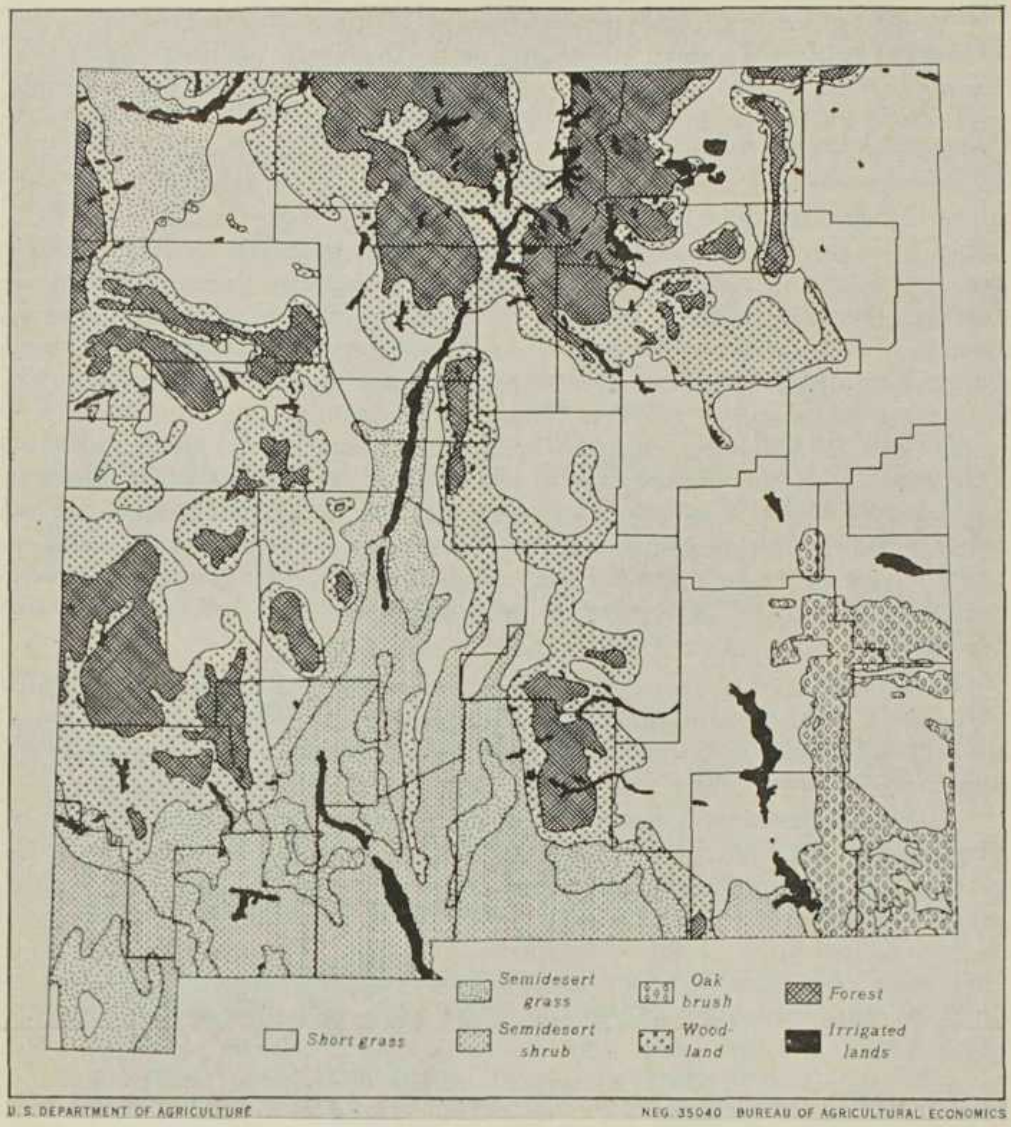

Fig. 4.—Types of natural vegetation, New Mexico.

and railroads, and in the towns. Outside labor is the chief source of income on these farms.

The self-sufficing farms are small in size, averaging less than 300 acres. In 1929 their harvested crop acreage was about 11 acres per farm and their gross income about $270. The gross income varied from an average of about $210 in Mora County to $330 in Union County. Approximately 64 percent of the gross income consisted of the value of the farm products consumed by the operator's family and about 14 percent came from crops, 11 percent from livestock, 9 percent from livestock products, and 1 percent from forest products. Most of the self-sufficing farms are located in the west central part of the area and many of them contain a small acreage of irrigated land. Thus, it is evident that the

farms of this type are little more than subsistence homesteads; that is, ones on which the living is very meager.

The cash-grain farms are located mostly in the eastern part of Colfax and in Union Counties. Very few of them contain irrigated land and their income is received mainly from the sale of wheat and grain sorghums. The cash-grain farms vary in size from an average of 869 acres in Colfax County to 123 acres in Mora County. The average crop acreage harvested in 1929 varied from 119 acres in Colfax to 29 acres in Mora County. This type of farming is hazardous in this area, because of the high percentage of years in which little or no grain is produced on account of moisture deficiency and wind damage.

SUBAREA 2-A

Subarea 2-A occupies the major or eastern portion of Area 2 and is larger than the other two subareas combined (figure 1). Livestock production predominates, cattle being more important than sheep, except in Mora County and in the south central part of Colfax County. Cash-crop, general, and dairy farming are considerably more important in this subarea than in either of the other two. This is evident from the distribution of the total number of farms among the several types in each subarea. The stock farms and ranches, in 1929, made up nearly 40 percent of the total number in this subarea; crop-specialty formed 18 percent; general, 16; cash-grain, 8; part-time, 6; self-sufficing, 6; and dairy, a little more than 3 percent. There is more supplemental feeding of cattle in this subarea than in 2-B and less than in 2-C. Grain sorghum, corn, dry beans, wheat, hay, and broomcorn are the principal cash crops grown.

The agriculture of this subarea is in need of more drastic readjustment than is that of the other two subareas. The problems of both wind and water erosion and of obtaining satisfactory incomes on the many small cash-crop, general, and stock farms are pressing.

SUBAREA 2-B

Subarea 2-B, compared with 2-A, is characterized by a relatively low rainfall (figure 8); by a higher proportion of part-time, self-sufficing, and crop-specialty farms; and by a lower proportion of general, cash-grain, and stock farms and ranches. The part-time and self-sufficing farms make up about 26 percent of all the farms and ranches in this subarea. The farms of these two types are small and, in the main, are farmed by Spanish-speaking operators, whereas, most of the farm operators of subarea 2-A have come in from the East and Central West. The bean farms (crop-specialty) make up about 31 percent of all farms. They are relatively small, also, and may be considered the fringe of the bean farms in Area 5. The general and cash-grain farms are of relatively minor importance, making up 10 percent and 3 percent, respectively, of all farms and ranches. The stock farms and ranches constitute 26 percent of the total number, a larger percentage of them being sheep ranches than in subarea 2-A.

SUBAREA 2-C

This subarea consists of foothills and forested mountains. The topog-

raphy is rough and the elevation high. Most of the area is grazed only during the summer and the remainder of it during the spring and fall. The cattle, which strongly predominate in numbers, are moved to the lower valleys or into subarea 2-A, where they winter.

PROBLEMS AND ADJUSTMENTS

The problems of Area 2 are concerned chiefly with three phases of agriculture; namely, range livestock production, dry farming, and irrigation farming. Only the more important of these problems are here considered.

Adjustment of Livestock Numbers to Feed Resources.—The carrying capacity of the grazing lands of Area 2 varies widely from ranch to ranch, even in the same neighborhood. This may be attributed, in large part, to variations in the rate of stocking with respect to the carrying capacity of the grazing land of the individual ranches. On many ranches, especially the smaller ones, overstocking has been practiced so continuously that the natural vegetative cover has been seriously weakened, thus subjecting the soil to both wind and water erosion. Especially have the grazing land of the small stock rancher and the farms of other types been overstocked. The problem is to reduce livestock numbers to such an extent that the vegetative cover will gradually improve and re-establish itself and thereby increase the productive capacity.

Land-use Adjustments.—Land-use adjustments in Area 2 pertain very largely to localities in which attempts have been made to produce crops by dry-farming methods. The rainfall is scant for crop production, much of the soil is shallow or of poor texture, and experience has shown that a great deal of land that is best adapted to grazing has been brought under cultivation. Since the individual farms are too small to be converted into stock ranches, the problem involves the consolidation of farms and of diverting cropland to grazing. It also involves the problem of providing a means by which the people living on the farms to be consolidated may earn a living.

Low Incomes.—There are many farms and ranches in Area 2 that are too small to be operated economically or to produce sufficient income to give the operators and their families a satisfactory living. On such farms and ranches there is a tendency to attempt to obtain greater incomes by increasing the rate of stocking the available grazing land. This, in turn, tends to weaken the vegetative cover.

Conservation of Moisture.—Because of the limited annual precipitation of Area 2 and the relatively high proportion of the rainfall that is lost by surface runoff, the conservation of moisture is of prime importance. Much may be accomplished along this line on the grazing lands by re-establishing and maintaining an effective vegetative cover and by contour furrowing. Contour listing and farming and in some cases the building of terraces are effective means of conserving moisture on the cropland. The building of storage reservoirs to impound floodwater and the flow of the streams during the nonirrigation season would do much toward stabilizing the limited amount of irrigation farming done within Area 2.

AREA 3. SOUTHEASTERN NEW MEXICO LIVESTOCK AND DRY-FARMING AREA

GENERAL DESCRIPTION

Area 3 is located in southeastern New Mexico and includes parts of five counties; namely, Quay, De Baca, Curry, Roosevelt, Chaves, and Lea (figure 1). It covers the major portion of Lea County and approximately the western third of Roosevelt County, but only very small parts of the other three counties. Its length from north to south is approximately 195 miles and its greatest width from east to west about 45 miles. The area is a level to rolling plain that slopes from north to south. It has no perennial streams. Its elevation varies from about 2950 feet in southern Lea County to 4900 in Quay County.

This area is distinguished from adjoining areas in that, while it is used principally for the grazing of livestock, there is also a good deal of cash-crop and general farming. Because much more cash-crop and general farming is to be found in the northern part of the area than in the southern, it has been divided into two subareas, 3-A and 3-B. These subareas are shown in figure 1 and will be discussed separately.

CLIMATE

Climatic conditions in Area 3 are intermediate between those of subareas 1-B and 1-C, on the one hand, and those of subareas 4-A and 4-B on the other. The northern part of the area receives an average annual precipitation of about 16 inches, as compared with 12 inches at its southern extremity. In general, the precipitation decreases gradually from east to west and from north to south. As in other parts of the Southern Great Plains, about three-fourths of the yearly precipitation falls between April and September, inclusive. July, August, and September are the heavy-rainfall months. The average length of the frost-free growing season varies from about 190 days in the northern part in Quay County to approximately 216 days at the southern extremity in Lea County.

SOILS

Six groups of soils cover the surface of Area 3 as a whole. Since the relative importance of these soil groups differs materially as between the northern and southern parts of the area, the soils will be discussed by subareas.

Soils of Subarea 3-A.—Five of the six soil groups are to be found in 3-A, two of which are of major importance when measured by the area covered.

1. The topsoils of the major portion of the southern part of subarea 3-A and also of a small portion of the northern part consist of loose sands and sand hills. Because of their susceptibility to blowing when the vegetative cover is disturbed, these sandy soils are adapted only to grazing. However, some crop farming has been done on these soils, under the most favorable conditions.

2. A group of shallow to very shallow soils covers the north central part of this subarea in north central Lea County. While loams and clay

loams predominate, the texture of this group varies from heavy to sandy. Because of the smooth, level topography, the runoff is light. The topsoils are all very shallow, friable, and calcareous to the surface. On account of their shallowness and the nearness of a layer of caliche to the surface, the land covered by this group of soils is generally rated as being adapted only to grazing. Both wind and water erosion are severe where the vegetative cover is inadequate. Some land covered by this soil group has been placed under cultivation.

3. Situated along the eastern border of subarea 3-A, seven separate and relatively small tracts of land are to be found which are covered with deep sandy soils. Loamy fine sands and sandy loams are the principal textural grades. The subsoils usually contain sufficient clay and loamy sand to provide fairly good moisture storage. These soils are very susceptible to wind erosion when the crop residue or vegetative cover is scant and inadequate. Aside from grazing, this group of soils is best adapted to the production of cotton and sorghums. The growing of cotton in alternate strips with wind-resistant sorghums on the contour has been recommended to control wind erosion. The planting of small grains as pasture and cover crops after cotton is harvested is also recommended.

4. In the east central part of this subarea are some eight or ten very irregularly shaped bodies of land which have a group of clay loam soils of medium depth. The depth to free carbonates ranges from 8 to 14 inches. The surface soils absorb moisture slowly but hold it fairly well. However, this group is rated as grazing and feed-crop soils because of the nearness of free lime to the surface.

5. In the extreme northwestern part of subarea 3-A a limited amount of rough, broken, and stony land is to be found that is adapted only to grazing.

Soils of Subarea 3-B.—Subarea 3-B contains all of the five soil groups described above under the caption "Soils of Subarea 3-A." Of the five groups, the deep sandy row-crop land described in paragraph 3 predominates in subarea 3-B. This accounts for there being more crop farming in subarea 3-B than in 3-A.

The medium-depth, grazing-feed crop soils described above in paragraph 4 are perhaps the second most important group in subarea 3-B. They cover three areas near the center of this subarea.

The other three groups discussed above—the loose sand and sand dunes, the shallow grazing soils, and the rough, broken, and stony soils—are of minor importance.

In addition to the five soil groups discussed above, subarea 3-B also contains in its northern portion a limited amount of deep soils which range in texture from loams to clay loams and which have deep subsoils of high moisture-holding capacity. These are the so-called "tight" or "hard" wheat soils, which also predominate in subarea 4-B. The surface soil, when not covered with plant residue or a natural vegetative cover, is subject to wind erosion.

VEGETATIVE COVER

The vegetative cover in this area varies considerably with type of soil. Where loose sand and sand hills predominate, the oak-brush type of vegetation is to be found. It is made up largely of shin oak, bunch grass, yucca, and threadleaf sage, and is a part of the oak-brush area described under Area 1. The short-grass type of vegetation is to be found on the medium- and fine-textured soils, the dominant vegetation consisting of buffalo grass and grama grass.

CROPS

Crop production in this area bears a very close relationship to the livestock industry. Most of the dry-land crop acreage consists of feed crops which are fed on the farms or stock ranches where produced, or sold to near-by ranches for supplemental feeding. The sorghums, consisting of grain sorghums, sweet sorghums, and Sudan grass, rank first, and are followed by corn and cotton, which are of comparatively minor importance. In the east central part of subarea 3-A, a variety of crops are grown under irrigation from water supplied by pumps, a description of which is given under subarea 3-A.

LIVESTOCK

Range cattle and sheep are the most important classes of livestock in this area, although in some parts dairy cattle are of considerable importance on the general farms. Beef cattle are distributed rather uniformly

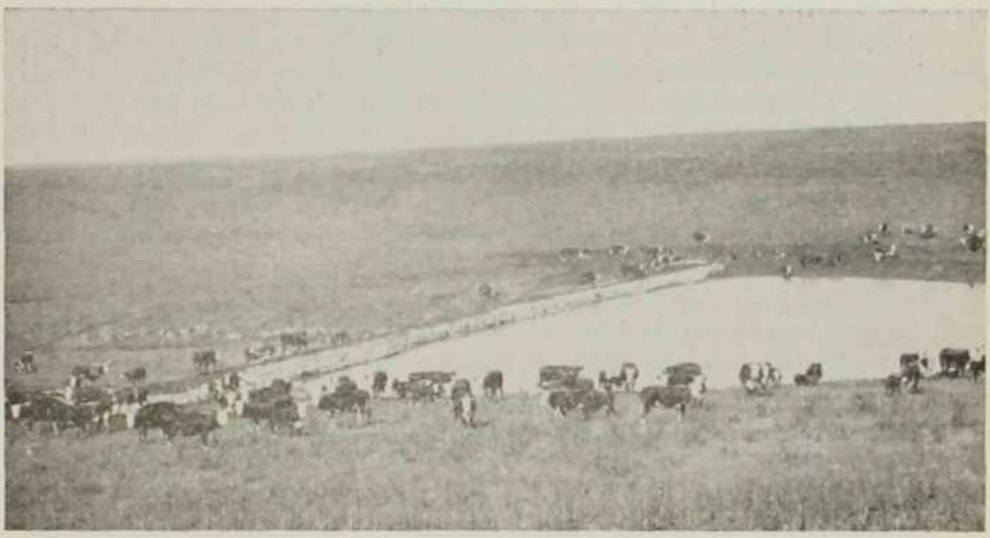

Fig. 5.—Proper distribution of stock water on the range is an important conservation practice.

throughout the area. The sheep, however, are found largely in those parts where the soil is of medium or fine texture, practically none being on sandy land. The fine-textured soils are referred to locally as "hard land." Such land has a higher carrying capacity than the sandy land.

TYPES OF FARMING

Stock farms and ranches are the most important type of farm organization, accounting for approximately 47 percent of the total number. General farms are next in importance, making up 18 percent; crop-specialty, 7 percent; dairy, 7 percent; cash-grain, 6 percent; self-sufficing, 6 percent; part-time, 5 percent; cotton farms, 2 percent; and miscellaneous types, 2 percent.

Because of the differences in the relative importance of these types in various parts of the area, the description of each follows under the discussion of the subareas.

SUBAREA 3-A

Subarea 3-A covers Lea County, with the exception of its southwest and northeast corners. It differs from subarea 1-B in that stock ranches strongly predominate in 1-B, whereas in 3-A, general and other types of farming are of considerable importance.

The production of range livestock is dominant in this subarea, as evidenced by the fact that stock farms and ranches make up 66 percent of the total number of farms and ranches. Practically all of the shallow, fine-textured soils in the area are located in this subarea. The facts that these soils have a relatively high grazing capacity and that water for stock can be developed easily because they are located in the shallow-water belt make them well adapted for grazing purposes. An advantage is also gained through there being on a great many of the ranches two types of vegetation; i. e., short-grass and oak-brush. This allows the operators to make full use of both types by seasonal grazing.

A slightly larger number of cattle than sheep are grazed in this subarea; however, in recent years the number of sheep has been gradually increasing. Most of the ranches are fenced and cross-fenced and a limited amount of wolfproof sheep fence has been constructed. A majority of the ranches are grazed conservatively and it is estimated that in general there is a smaller degree of overgrazing in this subarea than in most of the other type-of-farming areas of the State. Deferred and rotation grazing are rather common practices.

In this subarea calves are born largely from February to April; are sold in October and November at the age of 8 or 9 months; and weigh from 375 to 425 pounds. As a rule, only cut-back calves are held over and sold as yearlings, and very few calves or lambs are fattened. Lambs are usually born in April or early May and sold as feeders in November. One of the distinguishing features of this subarea is that sheep are generally lambed in sheds.

Supplemental feeding of cottonseed cake and sorghum bundles is a common practice, especially on the smaller ranches. In the east central part of 3-A, some ranch operators also irrigate a relatively small acreage on which feed crops are produced for supplemental feeding, while others have a considerable acreage of dry-land feed crops for the same purpose.

General farms are the second most important type and account for 11 percent of the total, followed by self-sufficing, 8 percent; part-time, 7 percent; dairy, 3 percent; cotton, 2 percent; and miscellaneous types, 3

percent. The crops on these various types of farms are produced on both irrigated and nonirrigated land. Irrigated crop production, however, is of greater importance than that on the dry land and is tending to increase in extent, while farming by dry-land methods is decreasing in importance.

Water for irrigation is furnished from wells by pumping with turbine pumps operated by gasoline or natural-gas engines. The wells vary in depth from about 60 to 70 feet. After drilling to the second stratum of water, the water rises to within 30 to 50 feet of the surface, the average being about 40 feet. It is estimated that there are about 1300 square miles of land in this subarea underlain by water within 50 feet of the surface. Although further development of irrigation from this source of water can be made, the ultimate development is very definitely limited by the fact that only a small percentage of the soils is of sufficient depth to be suitable for cultivation.

Most of the irrigated land is occupied by general farms. However, as previously stated, some ranches utilize the available water for feed-crop production. The irrigated crops, in order of importance, are grain sorghums, corn, cotton, truck crops, peanuts, and alfalfa.

The extensive development of oil fields in the southern part of this subarea has increased the outlet for truck crops, dairy products, and fresh meats. This demand has resulted in increased numbers of truck and dairy farms, while in order to supply the demand for fresh meat, the raising and fattening of hogs has increased appreciably on all types of farms.

The self-sufficing and part-time farms are generally small in size. They may be either irrigated or unirrigated and most of them are located in the vicinity of either Lovington or Hobbs.

The cash-grain type of farming by dry-farming methods underwent moderate development between 1915 and 1925, but has not proved successful and during recent years has declined to some extent. Much of the land that was placed under cultivation has been abandoned and is again being used for grazing purposes.

SUBAREA 3-B

Subarea 3-B is a comparatively narrow strip of land lying immediately west of the principal dry-farming section of the State (subareas 4-A and 4-B) and east of subarea 1-B, which is used almost exclusively for livestock grazing. The agriculture in subarea 3-B consists of both dry-land crop farming and range livestock ranching.

Because of its intermediate location between the dry-farming area and that used strictly for grazing, a rather mixed type of agriculture is carried on. From the standpoint of numbers, general farms predominate, and from that of acreage used, livestock ranches are most important.

Of the total agricultural operating units in the subarea, only 25 percent are classified as stock farms and ranches. These data may be rather misleading from the standpoint of showing the relative importance of stock raising, in that many of the farms of other types also have grazing land upon which beef cattle or sheep are grazed. This situation is true especially on the general farms, which constitute the leading type of farming, numerically, in the subarea, making up 26 percent of the total farms

and ranches. The sorghums, which are the chief group of crops on these farms, and the range grass are partially utilized on the general farms by both dairy cattle and beef cattle.

Crop-specialty farms make up 15 percent of the total. The income on this type of farm is derived largely from the sale of broomcorn. This crop grows well on rather sandy soils and is classed as a wind-erosion-resistant crop.

On approximately 12 percent of the total number of farms and ranches, a larger percentage of the total gross income is derived from the sale of grain than from any other source. These are classed as cash-grain farms. Grain sorghums are the principal source of this income, although some wheat is produced. However, because of the relatively low rainfall and the prevalence of soil blowing, this subarea is not well adapted to cash-grain farming and there is a tendency toward a decrease in this type.

About 12 percent of the farms in this subarea receive sufficient income from the sale of dairy cattle and dairy products to be classified as dairy farms. The principal source of income is the sale of butterfat. In most cases these farms have part of their acreage in range grass but are too small to be operated successfully as beef-cattle ranches.

The remaining 10 percent of the farms are made up of four types: The self-sufficing farms constitute 4 percent of the total number; part-time, 3 percent; cotton, 2 percent; and poultry, 1 percent.

Stock ranches, together with stock farms, constitute approximately 25 percent of the total number and are second only to general farms from the standpoint of numbers. Most of the land used for grazing purposes is privately owned and the ranches are comparatively small, averaging in size about 5000 acres and keeping an average of approximately 140 breeding cows. The majority of the ranches produce feed crops which are used for supplemental winter feeding.

AREA 4. EASTERN NEW MEXICO DRY-FARMING AREA

Area 4 is situated in the eastern part of New Mexico and forms part of the Canadian-Cimarron High Plains. It includes parts of 5 counties (Roosevelt, Curry, Quay, Harding, and Union) and is made up of 5 subareas: 4-A, 4-B, 4-C, 4-D, and 4-E (figure 1). Subareas 4-A and 4-B lie adjacent to each other, but 4-C, 4-D, and 4-E are separated by the intervening grazing lands of Area 2, previously described.

In general, each of the 5 subareas may be described as a comparatively level to undulating plain that is cut here and there by drainage channels of intermittent streams. Each of the subareas slopes to the east and the southeast. Their elevations vary from about 5600 feet in subarea 4-C to approximately 4100 feet in 4-A. Subareas 4-C, 4-D, and 4-E are drained by the Canadian River and 4-A and 4-B by the intermittent tributaries of the Brazos River of Texas.

Area 4 was used almost exclusively for the grazing of livestock until early in the present century, when there was an influx of settlers. The filing of homesteads reached its peak about 1910 and then continued at decreasing and fluctuating rates until about 1930. The maximum area

that could be homesteaded by an individual prior to 1909 was 160 acres; from 1909 to 1916, 320 acres; and after 1916, 640 acres. The sizes of the homestead units under which the area was settled are very largely responsible for the small-sized-farm and -ranch problem of the present time.

Each of the 5 subareas was settled chiefly with crop farming in view, and the breaking of the prairies progressed rapidly. The high prices of grain which obtained during and immediately following the World War greatly stimulated the bringing of the grasslands under cultivation. This, however, was interrupted now and then by recurring drouths. In addition to interrupting the transformation of the grasslands into grainfields, the severe drouths which occurred from time to time also caused many of the settlers to move out of the area.

CLIMATE

The climate of Area 4 is typical of that of the Southern Great Plains. There is an abundance of sunshine and a wide variation in both seasonal and daily temperatures. Nineteen degrees below zero in subarea 4-C is the lowest temperature on record and 109 degrees in subareas 4-A and 4-B, the highest. The average temperature for the coldest month (January) varies from about 32 to 35 degrees in the different subareas, as compared with about 73 to 77 degrees for the warmest month (July).

The growing season is relatively long. The average frost-free period varies in length from 169 days in subarea 4-C to 195 days in 4-A and 4-B. The growing season is of sufficient length in subareas 4-A, 4-B, and 4-E to mature cotton, provided the crop can be planted in due season. But when the planting or the germination of the seed is delayed for want of moisture, the crop may be damaged by autumn frosts before it matures.

The annual, seasonal, and monthly precipitations are subject to wide variations. The mean annual precipitation ranges from approximately 16 inches in subarea 4-C to between 18 and 19 inches in parts of 4-A and 4-B. The annual precipitation may be either above or below the average for as much as three years in succession. In like manner wide variations in the monthly precipitation, also, are to be expected.

Since torrential showers often occur during the summer months, much of the seasonal precipitation may be lost as surface runoff, especially if the topsoil is heavy and there is much slope to the surface. The scantiness and erratic variability of the rainfall render dry farming uncertain in each of the five subareas. Practically all of the production and adjustment problems of the area are concerned in the reduction of the runoff and the retention of the moisture where it falls for the use of crops and range vegetation.

SOILS

Depth and texture of soil, surface slope, and amount and distribution of the annual precipitation are the principal factors that determine how the lands of each of the five subareas are used, what crops are grown, and what cultural methods and practices are adopted. In texture the soils range from clay at one extreme to sand at the other, and in depth from very shallow to fairly deep. The heavy, fine-textured soils absorb mois-

ture slowly but have a high moisture-holding capacity. They are the most productive soils of the area, provided (1) the annual precipitation is normal or above, (2) the precipitation is fairly well distributed throughout the growing season, and (3) that it falls as gentle to moderately hard showers. But during seasons of scant precipitation and when much of the summer rain falls as torrential showers, the sandy soils are the most productive. This is because of their ability to absorb moisture rapidly. Thus, a much higher proportion of the water that falls as violent showers becomes available for the use of plants on the sandy soils than on the heavy, tight lands.

Crops are being produced most successfully on soils that are deep and underlain with subsoils which are also deep and of high moisture-holding capacity. Attempts have been made, however, to produce crops on soils that are too shallow to have the necessary moisture-holding capacity for successful crop production; that is, on land which should have been allowed to remain in the native grasses. In general, wheat is produced on the loams, silt loams, and clay loams, and the sorghums and other row crops on the sandy loams and very fine sandy loams. Since the farming carried on in the five subareas varies considerably from area to area and since this variation is caused mainly by differences in texture and depth of soil, it seems advisable to give further consideration to soils in the discussions of each of the five subareas.

VEGETATIVE COVER

The five subareas making up Area 4 are all situated in the short-grass vegetative zone of the Southern Great Plains. Blue grama grass furnishes the principal grazing forage. Buffalo grass, black grama, hairy grama, side-oats grama, ringgrass, galleta grass, red three-awn, hairy triodia, alkali sacaton, small soapweed, and annual weeds and other flowering plants (all occurring in varying amounts) are other common constituents of the vegetative cover. While much of the comparatively level grassland has been put under cultivation, the steeper slopes and broken lands have been left largely in the native vegetation and are now being used for the grazing of livestock. The tall-grass type of vegetation is common on the loose sandy soils. This type is composed largely of big bluestem, little bluestem, side-oats grama, lovegrass, three-awn grass, threadleaf sage, and annual weeds and other flowering plants. The vegetative cover of most of the grazing lands has been seriously damaged by overstocking. The desirable, palatable plants have been weakened and decreased in numbers, while the undesirable ones, such as the snakeweeds, have increased numerically.

SUBAREA 4-A

Subarea 4-A includes the eastern two-thirds of Roosevelt County and also small parts of both Lea and Curry Counties. For the most part, it is a gently rolling to undulating plain having an average elevation of about 4100 feet. Its mean annual precipitation ranges from about 16 inches on its western border to between 18 and 19 inches on the eastern.

Fig. 6.—Grain sorghums are well adapted to eastern New Mexico.

The frost-free growing season averages about 195 days, but varies considerably from year to year. It is generally long enough to mature cotton if seeding is not delayed beyond the normal planting season.

Soils.—Subarea 4-A presents four groups of soils. Their chief characteristics are as follows:

1. The first group covers more than half of 4-A and consists of deep sandy soils (mostly sandy loams, fine sandy loams, and loamy sands) that are generally underlain by sandy clay loam subsoils. These soils absorb moisture rapidly but retain it only moderately well. They are best adapted to the production of row crops and are very susceptible to wind erosion.

2. The second group is located in the east central part of 4-A and consists principally of clay loams that absorb moisture slowly, with free carbonates ranging from 8 to 14 inches below the surface. A limited portion of the area occupied by this group has sufficient depth to permit of the production of wheat. In general, however, these soils are considered best adapted to grazing and feed-crop production. Much of the cultivated land occupied by this group has been severely damaged by wind erosion.

3. Within the borders of subarea 4-A are to be found some 8 or 10 tracts of land having shallow soils of variable texture, with clay loams and loams predominating. Because of their shallow depth and the rough or broken surface features of the areas they often occupy, the soils of this group are usually rated as best adapted to grazing.

4. The fourth group consists of loose sands and sand hills. Three different areas of this group are to be found in 4-A. While a limited amount of these loose sandy areas has been cultivated, they should be used only for grazing.

Crops.—Because of the comparatively light type of soil in this subarea, row crops, rather than wheat, predominate. Slightly over 50 percent of the cropland is normally planted to sorghums, mostly grain sorghums, followed in order of acreage by corn, broomcorn, cotton, and wheat. Broomcorn, cotton, grain sorghums, and wheat are the chief cash crops in the area; however, considerable amounts of sorghums and corn are fed to livestock on the farms.

Livestock.—This subarea is characterized by dairying carried on as a supplementary farm enterprise. The production of butterfat is larger than in any other of the subareas of Area 4. Almost all of the production is separated on the farm and sold as butterfat. Poultry production is also of considerable importance. Relatively small numbers of beef cattle are kept, owing to the scarcity of native grass pasture.

On farms having sufficient native pasture, the dairy stock is pastured from about May 15 to November 1. Approximately 18 acres are necessary to carry a cow and accompanying young stock for that period. Farms which have insufficient native pasture use Sudan grass pasture. Enough native grass pasture, however, should be provided to carry the stock in the spring until July 1, at which time the Sudan grass has ordinarily attained sufficient growth for pasturing. With this system, approximately 5 acres of native pasture and 2.5 to 3 acres of Sudan grass, with normal rainfall, will carry a cow and accompanying young stock from May 15 to November 1. Farmers usually find it necessary to feed cows from November 1 to May 15, a period of 196 days. Kafir, hegari, or milo chops, or ground heads and cottonseed meal with cane roughage, are the most common feeds used during this period.

Types of Farming.—Subarea 4-A presents 10 or more types of farming. The cash-grain farms in 1929 formed 28 percent of the total number of all farms and ranches; general farms made up 26 percent; crop-specialty, 12; cotton, 11; dairy, 6; stock ranches, 6; stock farms (animal-specialty), 4; self-sufficing, 3; and poultry and part-time, 2 percent each. During recent years, doubtless, slight changes have taken place in the classification of the farms of this subarea. These changes have resulted mainly from increases in the production of feed crops and in the livestock enterprises and also from decreases in the production of wheat, corn, and dry beans. Such changes in crop and livestock production tend toward an increase in the number of general farms and a decrease in cash-grain farms.

The cash-grain farms average approximately 590 acres in size and harvest an average of about 175 acres of crops to the farm per year. This, however, varies considerably from year to year, owing chiefly to recurring drouths. The grain sorghums and small acreages of wheat are the chief sources of income. Most of the cash-grain farms carry livestock, 10 percent or more of the gross income being derived from the sale of livestock products and a similar amount also from the sale of livestock.

As indicated above, the sorghums are the leading crop enterprise on the cash-grain farms. The sorghums are planted from May 15 to July

15, the time depending largely on soil-moisture conditions. From two to three cultivations are given during the summer. Harvest takes place from September to November, but mostly in October. Forage sorghum, Sudan grass, and some of the grain sorghum are cut with a binder. Some of the grain sorghum is hand-headed, placed in piles to dry, and threshed later; some is allowed to ripen thoroughly and is then harvested with a combine; and some is cut with a header and then threshed after it is thoroughly dry. Because of the great amount of labor required to head grain sorghum by hand and the difficulty in getting the necessary labor when needed, the trend during recent years has been toward combining and machine heading. As a rule, the sorghums, as well as all other row crops, consume such a high proportion of the soil moisture that wheat planted on the same land in the fall after the row crops are harvested will not produce satisfactory yields the following year. This is the chief reason that wheat seldom follows any of the row crops.

The general farms differ from the cash-grain farms in several respects. They are about one-fifth smaller in size, have a higher proportion of the total land area in crops, and receive a much higher proportion of the total gross income from livestock and livestock products and a smaller proportion from the sale of crops. Dairying and, in some cases, poultry are also quite important enterprises on the general farms. Broomcorn, and dry beans in some instances, are the special crops that characterize the crop-specialty farms. Since more or less production of dairy products takes place on virtually all types of farms in this subarea, except the stock ranches, dairying is of far more importance than the number of dairy farms would indicate. During recent years dairying has made a steady and material growth in this subarea.

SUBAREA 4-B

This subarea lies immediately north of subarea 4-A and includes the major portion of Curry County and the south central part of Quay County. Its surface, for the most part, is a level to slightly undulating plain that slopes to the east and the southeast. It is drained by the channels of intermittent streams, which are generally flanked on each side by narrow strips of steep grazing land. The grazing of livestock is confined largely either to areas of steep and broken land or to localities where the soils are shallow or light in texture. When compared with other parts of eastern New Mexico, it may be said that a relatively high proportion of the total land area of 4-B is in farms and also that a high proportion of the land in farms is cropland.

Soils.—Approximately the northern two-thirds of subarea 4-B is covered by deep, fairly heavy soils (mostly loams, clay loams, and clays) that are underlain by deep subsoils. These soils are rated relatively high in productivity, absorb moisture slowly, and have a high water-holding capacity and a medium rate of runoff. They are known locally as "tight" or "hard" soils and are especially adapted to the production of wheat. The surface soils are dark in color and are very susceptible to wind erosion when left bare and unprotected. Under high wind pressure the fine

particles of these dark-colored soils rise and virtually fill the atmosphere, forming dark-appearing clouds; hence the term "black dust storms."

The southern third of 4-B is occupied mostly by fine sandy loams, sandy loams, and loamy sands that are usually underlain by sandy loam and sandy clay loam subsoils. While these soils are devoted largely to the production of row crops, some wheat is also raised. The row crops grown are the grain and feed sorghums, broomcorn, cotton, and both corn and beans in limited quantities. These soils are easily eroded by the wind when the crop-residue cover is scant and inadequate.

In addition to the two groups of soils described above, this area includes a considerable percentage of land that is either shallow, steep,

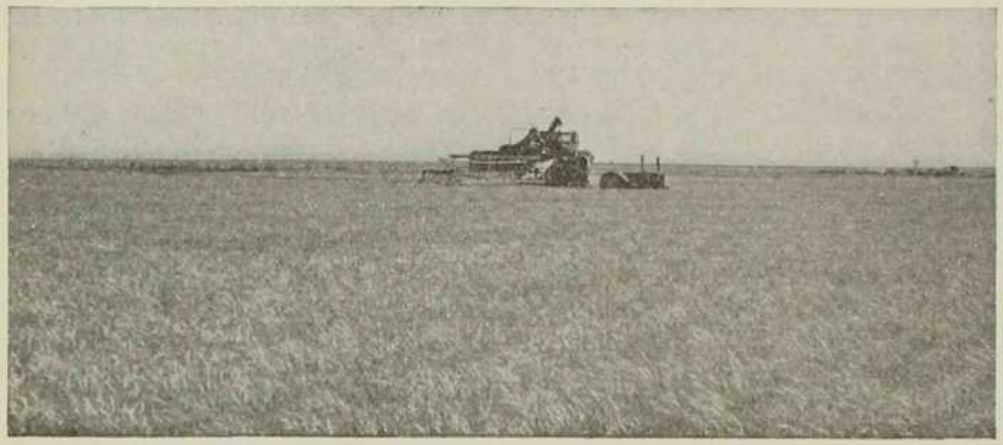

Fig. 7.—Wheat in subarea 4-B being harvested with a combine.

or stony and which is adapted only to grazing purposes. Because of the presence of this grazing land, subarea 4-B contains a number of stock farms and ranches.

Crops.—This subarea is the most important wheat-growing section of New Mexico. Because of the adaptability of the soil to this grain, there has been a greater tendency toward one-crop farming than in other parts of Area 4. In 1937, approximately 50 percent of the cropland in Curry County was devoted to wheat.

Grain sorghums rank second among the crops grown. The disposition of grain sorghums includes selling as cash grain and feeding to livestock, principally dairy cattle. Other crops grown, in order of the harvested acreage, are corn, broomcorn, cotton, and beans. A moderate increase in the broomcorn acreage has taken place in recent years.

Livestock.—Beef and dairy cattle are the most important types of livestock in this subarea. Beef cattle are found largely on the farms which have native grass pasture. Where this pasture is not available, dairy cattle are more important. The dairy enterprise has developed in this area with increases in grain sorghums. The method of handling livestock in this subarea is very similar to that of subarea 4-A, previously described.

Types of Farming.—The cash-grain farms strongly predominate in this

subarea and make up from 75 to 80 percent of the total number. General, crop-specialty, dairy, stock farm and ranch, part-time, self-sufficing, and poultry then follow, being named in the order of their numerical importance.

The cash-grain farms (the dominant type) average about 500 acres in size. During years when rainfall conditions are normal or above normal, an average of approximately 290 acres of crops is harvested on these farms. Owing to recurring drouths, however, the area harvested per farm from year to year varies widely. The income of the cash-grain farms on the "tight" soils in the northern two-thirds of 4-B comes very largely from the sale of wheat and to a much less degree from the sale of grain sorghum. In the southern part of 4-B, on the other hand, where the soils are sandy in texture, the grain sorghums rank first as the source of income, with wheat second. Because of the adaptation of the soils of the major portion of subarea 4-B to wheat, it leads all other parts of eastern New Mexico in one-crop dry farming.

Wheat, on these cash-grain farms, generally follows wheat, the aim being to produce a crop every year. Wheat is usually planted in the fall (from September to November), provided the subsoil is well supplied with moisture and the surface soil contains enough moisture to germinate the seed and get the stand of wheat established. If the stand does not become established in the fall, there are two alternatives for the use of the land the following year: One is to prepare the seedbed and plant a row crop during June or early July. The other is to summer-fallow the land and plant winter wheat again the following autumn. During years of exceptionally heavy summer rainfall, there may be sufficient moisture in the subsoil to permit of the planting of winter wheat after harvesting a row crop. However, that is the rare exception.

Dairying is of far more importance in this subarea than the number of farms which are classified as dairy farms indicates. This is because dairying is carried on as a minor or supplementary enterprise on so many farms of other types, especially on the general farms. On those having native grass pasture, the dairy stock is pastured from about May 15 to November 1. Where there is not sufficient native grass available, it is supplemented with Sudan grass pasture. When winter wheat makes enough growth, it is pastured three or four months during the winter. There has been a material increase in the production of dairy products in this subarea during the past decade.

SUBAREA 4-C

Subarea 4-C is located in the west central part of Harding County. Most of it is situated on a mesa that is higher than the surrounding country. While the topography of the major portion of this subarea is relatively level to rolling, portions of it are hilly, rough, and broken. The elevation ranges from about 5400 to 5900 feet. The length of the frost-free growing season averages about 169 days, about 26 days less than that of subareas 4-A, 4-B, and 4-E. The average annual precipitation is about 16 inches, or about 2 inches less than that of subareas 4-A and 4-B. Part of this subarea is drained by the Canadian River, part

by Carrizo and Ute Creeks, and part by intermittent streams that flow into several landlocked lakes.

Soils.—The central and major portion of this subarea is occupied by deep, moderately heavy soils consisting mostly of loams, clay loams, and clays. These soils cover very irregularly shaped areas, are very similar to the soils occupying the northern portion of subarea 4-B, and are considered best adapted to the production of wheat and sorghums. In certain localized areas, severe wind and water erosion has occurred.

A limited part of the extreme western portion of subarea 4-C has deep sandy loam and fine sandy loam row-crop soils, with sandy clay loam and sandy clay subsoils. These soils are subject to severe wind erosion after having been brought under cultivation, unless protected by an adequate crop-residue cover. The sorghums and corn are the most dependable crops grown on these soils.

Limited areas of clay loam ranging in depth from about 8 to 14 inches are to be found in the south central part of this subarea. The areas having these soils are rated as best suited to grazing and the production of feed crops. Where under cultivation, land of this sort is subject to both wind and water erosion.

Another group of shallow soils of variable texture occurs mainly on the north side of 4-C. The topography of the areas covered by these shallow soils varies from fairly level and undulating to rolling and hilly. While some of the land occupied by this group has been placed under cultivation, it is fit only for grazing purposes, owing to its shallowness and low water-holding capacity. Lastly, 4-C includes a good deal of shallow, stony, rough, broken land that can be used only for grazing. These rough, broken lands have a high rate of runoff and are the source of floods.

Crops.—Approximately one-third of the land in subarea 4-C is in cultivation, the remainder being in native grass. Wheat, the leading crop, occupied in 1936 about 57 percent of the cropland. That year grain sorghums occupied about 13 percent of the cropland; corn, 13 percent; beans, 6 percent; and millet, 2 percent. Ordinarily, about 9 percent of the cultivated land is idle or fallow. The proportion of wheat to other crops in any one season depends considerably upon the moisture conditions during the preceding fall, winter, and spring.

Livestock.—The kind of livestock kept varies with the size of the farm. The principal kind on farms of 880 acres or less is dairy cattle, whereas the larger farms are stocked chiefly with beef cattle. Farms containing fewer than 880 acres, and averaging approximately 400 acres, keep an average of about 10 head of cattle, mostly dairy; 4 horses; 3 hogs; and 90 chickens, according to studies made in the subarea in 1936 by the Resettlement Administration. A great deal of variation exists with reference to livestock kept. Some farmers scarcely supply the needs of their families for dairy and poultry products, while others sell butterfat and eggs in Roy and Mosquero, the two principal towns of this subarea. A few bands of sheep are run in 4-C, but this class of livestock is not common to many farms or ranches.

Types of Farming.—Of the total number of farms and ranches in subarea 4-C, approximately 64 percent were of the cash-grain type. The general farms made up 11 percent; crop-specialty, 10; stock ranch, 5; and stock farm, 3 percent. Five other types, all of very minor importance, constituted the other 7 percent. Not much change has taken place in the classification of these farms during the last decade.

The cash-grain farms, as shown above, strongly predominate. They averaged about 730 acres in size and harvested an average of 192 acres, each, of crops in 1929. About two-thirds of the land in farms was grazing land. As would be expected from the proportion of the farm area that is grazing land, some livestock is handled on most of the grain farms. Of the total gross receipts, about 81 percent came from the sale of crops, 7 percent from livestock products (chiefly wool and dairy products), and 6 percent from livestock, while 6 percent represents the value of the farm products consumed by the farm operator's family.

The general farms, as compared with the cash-grain, average 112 acres smaller in size, harvest but a trifle over half as many crop acres, have a much higher proportion of the farm in grazing land, and derive a much higher proportion of their gross receipts from livestock and livestock products. The special crop that characterizes the crop-specialty farms is dry beans.

SUBAREA 4-D

This subarea lies in the eastern and southeastern parts of Union County. It is the only large body of land in Union County where crop production under dry-farming methods predominates. The farm land of this subarea is relatively level to undulating and is broken here and there by drainage channels of intermittent streams. The slopes adjacent to these watercourses are steep, have been left in the native vegetation, and are used for grazing purposes in connection with crop production. This subarea suffered more severely and continuously from the recurring drouths of the early and middle thirties than any other part of Area 4. A high percentage of crop failures occurred during that period, wind erosion was intense, and a considerable percentage of the farm land was abandoned.

Soils.—Subarea 4-D is occupied mostly by three groups of soils, the texture and depth of which very largely determine what crops are grown.

The first group consists of deep, moderately heavy topsoils which range in texture from loams to clays and which are underlain by deep subsoils. This group occupies only a limited portion of 4-D and represents the tight or hard wheatland described under 4-B and 4-C. Very little wheat has been produced on these soils of late years.

The second group occupies the major portion of 4-D and consists of deep sandy loams, fine sandy loams, and loamy sands that are underlain by sandy clay loam and sandy clay subsoils. In general, these are feed-crop soils, since their moisture-holding capacity usually is not sufficient to carry crops of wheat through the dry winter and early spring months successfully. Wheat may be grown only on limited areas of above average moisture-holding capacity and where wind erosion is well under con-

trol. Such erosion has been severe on much of the cultivated land occupied by this group of soils.

The third group consists of shallow soils of variable texture. While some of the lands occupied by these shallow soils have been put under cultivation, they are clearly adapted only to grazing purposes. Wind erosion is generally severe where the vegetative or crop-residue cover is inadequate.

Crops.—In the postwar period previous to 1932, corn was the leading crop in this subarea, followed by beans, grain sorghums, and wheat. In fact, Union County, as a whole, ranked second among the counties of the State in bean production. As a result of the experiences during the prolonged drouth from 1931 to 1937, farmers made drastic reductions in both corn and bean acreages. These acreages have been partially replaced by sorghums. The beans that are raised at present are planted, in the main, in alternating strips with grain sorghums. Wheat has occupied in the past, and will no doubt continue to do so, but a small portion of this area, because of the limited area of soil to which the crop is adapted. Much of the sorghum grain is sold at present; however, some is fed to a limited number of livestock.

Livestock.—Normally, under average moisture conditions, sufficient livestock is kept on the farms of this subarea to stock the pastures and consume the roughages produced. Since 1934, livestock has been drastically reduced, but at present is being increased somewhat as feed supplies and the finances of the farmers permit. While beef cattle ordinarily predominate, the trend in dairy cattle was upward previous to the reduction in 1934. That trend is being resumed at the present time. If the reduction in bean acreage is permanent and if sorghum acreage continues to increase, the upward trend in numbers of dairy cattle may continue for several years. Convenient markets for butterfat exist in Clayton, where it is assembled and shipped to Amarillo, Texas. It must be recognized that crop production here is subject to greater risks than in the southern part of Area 4, that the farms must be stocked more conservatively, and that larger feed reserves should be kept on hand at all times. The situation with reference to poultry and swine is much the same as in other subareas.

Types of farming.—No one type of farm in subarea 4-D in 1929 dominated the agriculture of the area. Of the total number of farms and ranches, the general farms constituted 25 percent; cash-grain, 23; crop-specialty, 21; stock ranches, 15; stock farms, 8; and dairy, 4 percent. Self-sufficing, part-time, horse or feed-lot, and poultry made up the other 4 percent. Since no one type predominated, this subarea has been termed an area of mixed types. The proportion of the total number of farms that is classified as dairy farms gives a very poor picture of the relative importance of the dairy enterprise, for dairy cows are carried on a high percentage of all farms. Especially is the dairy enterprise important on the general farms. A study made by the Resettlement Administration in this subarea in 1936 indicates that there has been a material increase

in the number of general and stock farms and a decrease in the cash-grain farms since 1929.

SUBAREA 4-E

This subarea is located in north central Quay and southeastern Harding Counties. Its topography varies from virtually level to rolling; its size is limited by surrounding grazing lands that are either shallow, broken, or rough; it is served by the C. R. I. & P. Railroad and U. S. Highway No. 24; and it is drained by the Canadian River, which flows across the northern part of the area from west to east. The elevation of 4-E averages about 4000 feet; its mean annual precipitation is about 17 inches; and its frost-free growing season is very similar to that of subareas 4-A and 4-B, averaging about 195 days.

Soils.—The major portion of this subarea is occupied by a group of sandy soils (mostly sandy loams and loamy fine sands) that are usually underlain by sandy clay loam subsoils. These soils absorb moisture rapidly but have only a medium moisture-holding capacity. They, therefore, are best adapted to the production of row crops; i.e., crops that make their growth during the summer months and mature in early autumn. Ordinarily, the moisture stored in these soils at the end of the growing season is not sufficient to carry a crop of wheat through the long winter and spring low-rainfall period.

A limited area of moderately heavy soils (mostly clay loams) of medium depth is located in the eastern part of 4-E. These soils absorb moisture slowly but have a high moisture-holding capacity. Because of depth of soil, this small area is rated as best adapted to grazing and feed-crop production.

Within the borders of 4-E, chiefly in its western part, are to be found limited areas of shallow, broken, rough, and stony lands which are suitable only for grazing. Where the vegetative cover has been weakened or destroyed, these areas are subject to severe wind erosion, and also to water erosion where the surface is steep and the topsoil is of heavy texture.

Crops.—Subarea 4-E differs from 4-D in that cotton can be grown, and that broomcorn occupies a larger proportion of the cropland. It is estimated that in 1938, 50 percent of the harvested acreage consisted of grain sorghums, 30 percent broomcorn, 10 percent corn, and 10 percent cotton. A portion of the corn and grain sorghums is fed to the beef and dairy cattle and work stock and the remainder is marketed as cash grain. In recent years the acreage of broomcorn has increased and the bean and cotton acreages have decreased.

Livestock.—Beef cattle are more important than other types of livestock. Many of the farms have range land on which a small herd of cattle is run and the pasture is supplemented by sorghum bundles during the winter. A few farmers keep enough dairy cows to make possible the selling of butterfat during part of the year. These farmers also generally keep sufficient poultry to enable them to sell limited quantities of eggs. Neither the dairy nor the poultry enterprise is of any great

importance. Many of the tenants operating cash-crop farms keep practically no livestock other than work stock.

Types of Farming.—The farms and ranches of subarea 4-E vary widely in size and in the proportions of the total farm area that are used for cropland and grazing land. Thus, an analysis of 230 farm-survey records taken in 1936 by the Resettlement Administration in the central part of Quay County, where subarea 4-E is located, shows: (1) that 45 of the 230 farms averaged 169 acres in size; 64 farms averaged 339 acres; 54, 573 acres; 28, 893 acres; 24, 1428 acres; 14, 2619 acres; and 1 farm contained 5320 acres; (2) that the 230 farms averaged 702 acres in size and had 193 acres of cropland and 509 acres of other land, mostly grazing land; (3) that the 45 farms in the smallest-sized group had an average of 56 percent of the total farm area under cultivation; and (4) that the percentage of cropland decreases as the farms increase in size, reaching 6 percent in the group of larger farms.

The general farms in 1929 accounted for 38 percent of all farms and ranches in this subarea. Crop-specialty farms that year included 21 percent; stock ranches, 10; cash-grain, 8; cotton, part-time, and self-sufficing, 5 each; and dairy and poultry, 2 percent each. Since no one type dominates the agriculture of this subarea, it may be designated as one of mixed types. However, the general farms made up 38 percent of the total number and were almost twice as numerous as any other type. Hence, the agriculture of 4-E tended strongly toward general farming. It is probable that since 1929 there has been an increase in the number of crop-specialty (broomcorn) farms and cotton farms and a decrease in general farms.

The general farms average about 625 acres in size and vary from less than 50 acres to over 1000. Of the 625 acres (the average size), about 165 acres are cropland and the remainder (460 acres) consists of grazing land, wasteland, and the farmstead. A very high percentage of the cropland on the general farms is used mainly for row-crop production; i.e., sorghums, broomcorn, cotton, corn, and beans.

The crop-specialty farms average about 100 acres smaller than the general farms and range in size from less than 50 acres to nearly 1000 acres; broomcorn and dry beans are the special crops characterizing the crop-specialty farms.

PROBLEMS AND ADJUSTMENTS IN AREA 4

The problems and needs of adjustments facing each of the five subareas of Area 4 are very similar in most respects, their chief differences being due mainly to variations in texture and depth of soil and in the amount of the annual rainfall. Therefore, the discussions which follow will be general, except where a problem pertains to a specific subarea only. It should be understood that opinions vary considerably as to what and how adjustments should be made. Furthermore, it should be understood that, owing to variations in surface slope, in depth and texture of soil, and in previous use and treatment of soil, individual farms and fields call for variations in the application of the corrective measures.

Only general principles can be presented here and only the more important problems are considered.

Soil and Moisture Conservation.—Both from the standpoint of profitable crop production and the control of both wind and water erosion, maximum water penetration and conservation in the soil are basic necessities. The problem of runoff control and the storage of water in the soil, however, must be dealt with according to conditions which prevail on specific fields. Contour listing and the planting of row crops on the contour are generally effective means of preventing runoff on the lighter types of soils of medium slopes. On some of the steeper slopes and on some of the heavier types of soil, terracing may be advisable. When inadequately protected by a vegetative cover, certain heavy soils may require chiseling to open up the soil sufficiently to promote water penetration and to bring clods to the surface and lessen wind erosion. In summer fallowing, it is considered advisable to use implements which leave the surface rough and cloddy. A very effective preventive of wind erosion is the maintenance of a vegetative cover on the surface of the ground. A substantial cover of the residue of crops and weeds tends (1) to hold the moisture where it falls, (2) to promote soil-moisture absorption, and (3) to reduce both wind and water erosion. The fibrous root system of the grasses holds the soil together and the dense cover protects the surface soil from the wind and reduces runoff.

The grain and sweet sorghums, Sudan grass, and broomcorn are the most effective crops grown in Area 4 for protecting the soil while the crops are growing and also for providing a crop-residue cover after harvest. The residue cover may consist mostly of tall fibrous-rooted stalks, the heading being done high, in order to give surface protection from the wind. Where there is danger of the soil's blowing, there should be little or no grazing of livestock on row-crop fields during the winter and spring. The consuming of the crop residue and the tramping of the soil by livestock cause serious wind-erosion hazards.

Winter wheat and other winter cereals generally provide satisfactory winter and spring protection, provided the supply of soil moisture is ample at planting time in the fall to enable the crop to make a substantial growth before winter. Land in winter wheat is generally very susceptible to wind erosion if only a very light growth is made before winter. In this case chiseling the field is generally recommended, the furrows being about three feet apart. Beans and cotton are the least effective of the crops grown in abating soil erosion, while corn is intermediate in this respect. The growing of these crops in alternate strips with erosion-resistant crops has been widely advocated and practiced.

Reserve Feed and Livestock.—The reduction of soil erosion and surface runoff generally necessitates the production of a considerable acreage of wind-resistant (grain and/or feed) sorghums. In order to utilize these crops properly and to obtain satisfactory returns therefrom, beef cattle, sheep, or dairy cattle are a necessary part of the farm setup. On the larger farms containing a relatively high proportion of native-grass pasture land, beef cattle, and, in some instances, sheep are generally pre-

ferred. On the smaller and medium-sized farms, where the pasture land is limited and where the farm income is relatively low, dairy cattle generally fit into the situation most satisfactorily. In this case, Sudan-grass pasture is an excellent supplement to the native grasses as a source of summer forage. In a few instances feeder lambs or feeder cattle have been used to utilize surplus feeds. Hogs and poultry have proved satisfactory as complementary enterprises on farms where much skim milk is available for feed.

Owing to the severe drouths and crop failures which occur from time to time in Area 4, the carrying over of reserve feed from the "fat" years for use during the "lean" ones is very necessary where livestock enterprises are included in the farm economy. This may be done in the form of grain, fodder, or silage. It appears that the use of the trench silo should be greatly extended in this area. Only by carrying feed over from one year to another can the liquidation of livestock be avoided during seasons of drouth when feed supplies become exhausted.

Small-Farm Low-Income Problem.—The acquisition of farms by homesteading (chiefly in tracts of 160 and 320 acres) has resulted in many farms being too small (1) to be operated economically, and (2) to provide sufficient income to support a family properly. While the minimum economic size of farms will vary in different parts of Area 4, experience has proved farms of 160 and 320 acres to be inadequate in size in each of the five subareas. The adjustment of this problem involves (1) the enlargement of farms and ranches by consolidation in order to form units that will support a family, and (2) providing means by which the people to be removed from the land may earn a living.

Land-Use Adjustments.—Owing to low income and lack of suitable land for crop production, a great deal of land has been brought under cultivation that is too shallow, too steep, too fine or coarse in texture, or otherwise unfit for successful crop production. The problem in this case is to divert the use of these misused lands from the growing of cash crops to the production of grazing forage. This involves either the establishment of a new plant cover that is satisfactory for grazing purposes or the restoration of the original native grasses. There is a possibility that in certain situations, Johnson grass may serve as a forage plant on such land.

Deteriorated Grazing Land.—The carrying capacity of the native pasture lands of Area 4 has been reduced materially by overstocking year after year. In order to correct this situation, it is necessary to give the pastures sufficient rest to permit the native grasses to recuperate and re-establish the vegetative cover.

Low Production per Dairy Cow and per Hen.—The average production of milk cows in Area 4 is low, being slightly in excess of 175 pounds a year of butterfat per cow milked. Improvement in this respect is one of the outstanding opportunities for increasing net incomes. To maintain high production, cows must be well fed at all times, which involves carrying over an ample supply of feed each year (silage, fodder, and grain) as a reserve against drouth. It also involves efficient herd improvement; i. e., the use of proven sires, severe culling, and good care.

AREA 5. ESTANCIA VALLEY DRY-BEAN AREA

GENERAL DESCRIPTION

This type-of-farming area, which specializes in the production of pinto beans, is located mainly in the eastern and southern parts of Torrance County. It includes, also, the western end of Bernalillo County, the southeastern corner of Santa Fe County and the eastern portion of Socorro County. The outline of the area is very irregular, because bean production is confined largely to the intermediate foothill country, the extent of which is limited by the mountains on one side and the lower-lying plains on the other. The elevation of Area 5 ranges approximately from 6200 to 6900 feet. A portion of the land in farms is level to gently sloping, while in other parts of the area land with comparatively steep slopes is used for crop production.

CLIMATE

Because of the comparatively high altitude, the frost-free growing season is rather short, varying from approximately 140 to 160 days in different parts of the area. Owing mainly to changes in elevation and proximity to the mountains, the average annual precipitation within the area varies from approximately 14 to 20 inches. The precipitation is highly seasonal, 65 to 70 percent usually coming in the period between April and September, inclusive; much of it is also rather torrential in character, especially during July and August. Winter precipitation is principally in the form of snow.

SOILS AND CROPS

Extreme variations occur in the texture of the soils of Area 5 and crops are produced on soils ranging from sandy loams to clay loams. Thus the soil-texture problems vary greatly from farm to farm. Crops are produced almost entirely without the aid of irrigation and the precipitation of the area undergoes erratic variations from season to season. This situation, coupled with the fact that the growing season is rather cool and comparatively short, tends to limit the number of crops which may be grown successfully. Because of the adaptability of pinto beans to these conditions, this crop is produced to the exclusion of most others. It is estimated that in 1936, 83 percent of the harvested crop acreage was devoted to the production of dry beans. The relative success of this crop may be attributed to the fact that it may be planted rather late in the spring, thus making its growth during the season of greatest rainfall and ordinarily maturing before the first killing frost. Corn ranks second, constituting about 10 percent of the harvested acreage. The sorghums occupy about 6 percent of the harvested acreage, and wheat 0.5 percent. The cool, short growing season causes grain production from corn or sorghums to be somewhat uncertain. Although beans yield, on the average, only about 275 pounds to the acre, this is the most profitable cash crop of the area. The production of feed crops is limited to the farm needs.

LIVESTOCK

Livestock is a minor farm enterprise in this area. Most farms, however, have some acreage of native grazing land, averaging between 200 and 300 acres per farm, which is used to graze a few beef cows and two or three milk cows. There is a tendency to overgraze farm pastures, however, and in dry years a feed shortage often develops.

TYPES OF FARMING

Farms specializing in pinto-bean production and coming under the crop-specialty classification make up approximately 78 percent of the total number of farms and ranches in the area. General farms are the next most important type, accounting for 10 percent. Then follow stock ranches, with 6 percent; part-time, 4 percent; and miscellaneous types, 2 percent.

The crop-specialty farms average about 440 acres in size, with approximately 26 percent of the farms of this type ranging in size from 260 to 500 acres and 20 percent from 500 to 1000 acres. Most of the remainder are less than 260 acres in size. On farms of approximately average size, about one-half of the land is cropland and one-half is used for grazing. On farms smaller than average size a larger proportion of the acreage is devoted to crop production. A considerable percentage of the cropland frequently is idle temporarily, because of the lack of moisture at planting time.

This area is one of the best examples in the State of a situation in which physical conditions have reduced the alternatives available to farmers to the point where a single cash-crop type of farming strongly predominates.

The farms in this area classed as general farms, as a rule, also raise beans as a cash crop, and in addition keep dairy or beef cattle, from which considerable income is received. A very few of them produce wheat as an additional farm enterprise.

PROBLEMS AND ADJUSTMENTS

The important agricultural problems of Area 5 are concerned with (1) crop production on land adapted only to range use, (2) continuous cropping to beans, (3) wind and water erosion, and (4) deficiency of feed for livestock production.

No one of the above problems is separate and distinct, but all are more or less interrelated. Attempts to produce crops on land that is too sandy or that is too steeply sloping may serve to accelerate wind or water erosion. Hence, a portion of the land used at present for crop production is better adapted to range use.

While continuous cropping to beans in many instances apparently has not resulted in reduced yields per acre, such land is more subject to blowing than if fibrous-rooted crops had been alternated with beans. County planning committees in 1936 recommended a reduction in bean acreage from 73 percent to 63 percent of the total cropland.

Contour farming and strip cropping with feed crops, especially sorghums, have proved effective in reducing both wind and water erosion in this area, and terraces are proving beneficial in certain situations.

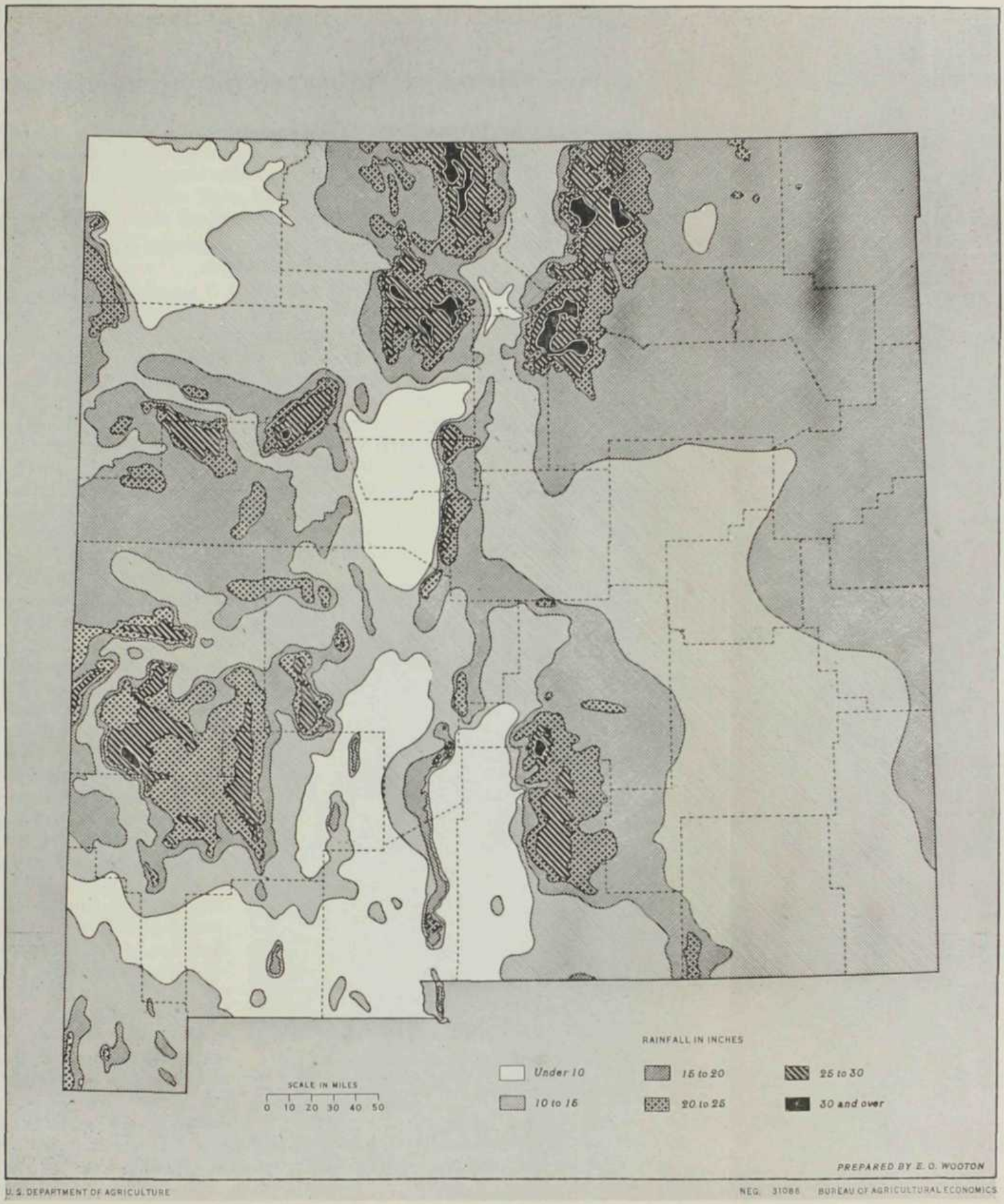

Fig. 8.—Mean annual precipitation zones, New Mexico.

County planning committees have also recommended an increase in dairying as the most profitable utilization of the feed crops grown in connection with soil-conservation practices on crop-specialty farms. Data from the records of the State Dairy Commissioner show an increase in butterfat production in the area during the period 1936 to 1938, inclusive.

AREA 6. NORTH CENTRAL NEW MEXICO AREA OF MIXED TYPES

GENERAL DESCRIPTION

Type-of-farming Area 6 is situated in the north central part of New Mexico. It includes parts of 8 counties and is the third largest of the 25 type-of-farming areas into which the State has been divided in this study. The area, in general, is rough and rugged, being largely occupied by the southern portion of the Rocky Mountain system and its associated intermountain valleys, benchlands, mesas, plateaus, and foothills. The central part of the area is traversed from north to south by the Rio Grande, the eastern portion by the Sangre de Cristo Range, and the northwestern part by the Continental Divide. The altitude varies from a minimum of approximately 4,750 feet at the southern extremity of the area in the Rio Grande Valley to a maximum of 13,303 feet at the summit of Truchas Peak, which lies northeast of the city of Santa Fe in the Sangre de Cristo Range. Thus, Area 6 has a range in altitude of about 8,550 feet.

The flow of most of the large streams (the Rio Grande, Rio Chama, Jemez Creek, and the Red, Mora, and Pecos Rivers) is perennial. Though they generally flow continuously, the supply of water furnished by some of these streams for irrigation purposes is not very dependable, because of the variability of the flow during the irrigation season. Many of the smaller streams which have their origin in the mountains are also perennial. Their flow, however, is generally limited and their waters are either diverted for irrigation or sink into the ground when they reach the lowlands. A few streams which drain extensive areas of plains and valley lands, such as the Rio Puerco and Rio Galisteo, flow continuously only for relatively short distances below their headwaters, the major portion of their channels being dry most of the time except after heavy rains.

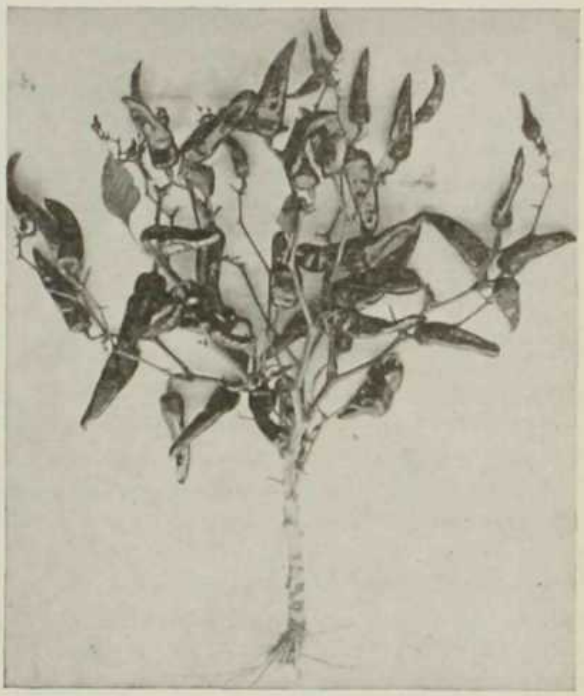

Fig. 9.—Chili is an important crop, especially in northern New Mexico. In this illustration the leaves have been removed to show the pods as they are produced on the plant.

Irrigation farming has been carried on within Area 6 for considerably over 300 years. Coronado, in 1540, found the Indians living in villages along the Rio Grande and its tributaries and practicing a simple form of irrigation farming. The communal irrigating ditches and the methods which were being used by the natives at that time clearly indicated that they had been producing crops under irrigation for many years.

The first Spanish settlement in Area 6 was made in 1598, near the junction of the Rio Grande and Rio Chama. As further colonization efforts were undertaken and as the Spanish-speaking population increased, other settlements were established, chiefly in the narrow valleys of the tributaries of the Rio Grande where both water and irrigable lands were available. For their mutual protection the colonists lived in compact villages. A grant of land was generally made to each colony by the Spanish Government and each grant usually embraced a limited amount of irrigable land and extensive areas of range or grazing land. Out of these grants relatively small tracts of irrigable land were allotted to the individual families for the production of food crops. The villagers were also permitted to own livestock—sheep or cattle—which pastured on the grazing lands surrounding the villages. However, the range land that could be grazed with comparative safety was greatly restricted for many years because of the depredations committed by bands of marauding Apache and Navajo Indians. Grants of land were also made to the Indian villages (pueblos) and to influential individuals, the latter grants generally being very extensive. These land grants embrace a large part of the area. From the establishment of the first settlement in 1598, it has been the custom to divide the land equally among all the children upon the death of a property owner. This procedure has reduced the landholding of the individual families to very small units, which, as a rule, are insufficient to provide adequate subsistence.

With the passing of time the pressure of the Spanish-speaking population on the irrigable lands of the central part of the area became sufficiently great to cause a spreading out or overflow, chiefly to the south along the Rio Grande and to the eastern slope of the Sangre de Cristo Range, where settlements were made in the western parts of Mora, San Miguel, Guadalupe, and Colfax Counties.

Following the annexation of New Mexico by the United States in 1848, and especially after the marauding Indians had been subjugated, practically all of the grazing lands within Area 6 could be used with safety. While competition for the use of the range lands soon became intense, the expansion of the livestock industry benefited but few of the Spanish-speaking villagers. Year by year they saw their right to use the open range gradually disappear. The passing, by one means or another, of the title of the range lands included in the village grants into the hands of a few enterprising individuals; the confirmation of the Spanish land grants by the United States; the establishment of the Indian reservations and the national forest reserves; the coming of the Anglo-American homesteaders; the Government purchases of lands for the use of the Indians and the administration of the Taylor Grazing Act have virtually eliminat-

ed the non-Indian village population from using the range lands of the area.

From the foregoing discussion it will be noted that for more than two centuries the village population of Area 6 has been largely dependent for its sustenance upon the limited areas of irrigable lands adjacent to the villages and upon the near-by grazing lands. At the outset this was due mainly to extreme isolation, to great distances to outside markets, to inadequate transportation facilities, and to lack of opportunity to market surplus labor. Conditions changed materially, however, with the coming of the railroads during the early 80's. At that time the area took on new life, there was an influx of settlers from States to the east, mines were developed, the lumber industry soon got under way, sheep and cattle could be shipped to distant markets, and the opportunity to market farm produce and surplus labor was greatly improved. During the intervening period and up until 1930 the income from full or part-time employment in such industries as mining, lumbering, stock ranching and the beet fields in Colorado served to supplement the farm and ranch incomes in supporting an ever-increasing population in the area. The unfavorable economic conditions existing from 1930 to date (1939) have caused a decreased demand for laborers in these industries and have forced the population to depend upon the inadequate incomes of their farms for an existence. Coincident with this situation, a large relief load is being carried by Federal agencies.

CLIMATE

Area 6 presents a wide range in climatic conditions. This is due chiefly to its rough and irregular surface features and to a variation within its borders of approximately 8,550 feet in altitude. The frost-free period varies from about 100 days in some of the high irrigated mountain valleys to 185 days or thereabouts in the southern part of the area in the Rio Grande Valley. Frosts may be expected at almost any time during the summer in the higher mountainous areas. The extensive mountain masses of the area, and especially the Sangre de Cristo Range, have a marked influence in determining the variations in the climatic conditions to be found.

The mean annual precipitation is lowest in the floor of the valley of the Rio Grande, where it ranges from approximately 8 inches, to about 13. In the high mountainous areas and on the crest of the Sangre de Cristo Range the maximum probably reaches 30 to 40 inches, but cannot be stated definitely for lack of weather records. About 65 to 78 percent of the annual precipitation falls between April and September, inclusive. As a rule, July, August, and September are the heavy-rainfall months, at which time brisk showers are to expected. When moisture falls as violent showers, much of the water is generally lost as surface runoff. In the southern part of Area 6, the annual snowfall is light and that which does fall usually disappears quickly. In the mountainous portions, on the other hand, there is generally a great deal of snow during the winter and early spring. The total snowfall in the mountain areas varies widely from year to year. A heavy accumulation of snow in the mountains is

very desirable from an irrigated crop-production standpoint. The deep snow becomes packed, melts slowly, and tends to stabilize the flow of the streams during the irrigating season. Where the water is diverted directly from the streams, a shortage of irrigation water generally develops during June and again late in September.

LAND USE AND VEGETATIVE TYPES

From the standpoint of use, the land included in Area 6 may be divided into four classes; namely, irrigated, dry-farming, grazing, and forested. The irrigated land makes up less than five percent of the total area and consists very largely of noncontiguous strips of alluvial land located in comparatively narrow stream valleys. It is upon this irrigated acreage that the majority of the very small farms of the area are located.

The dry-farming lands are rather widely scattered. Settlers have attempted to produce crops under natural rainfall conditions. In general, their efforts have been successful only during very favorable seasons. Attempts have been made by governmental agencies to purchase the homesteaded lands in certain districts, divert the land back to grazing, and locate the settlers elsewhere under more favorable conditions for earning a livelihood. Much of the homesteaded land which has not been purchased has been abandoned and the cropland which it contained is now covered with undesirable weeds.

The grazing lands are occupied by three general vegetative types. In the order of the elevations that they occupy, named from low to high, they are as follows: semidesert grass, short grass, and woodland.

The semidesert grass type occupies the lower elevations on each side of the Rio Grande in the southern part of the area, where the rainfall is less than 10 inches. Because of excessive grazing, this type of vegetation has deteriorated greatly and soil erosion is in an advanced stage.

The short-grass type lies at elevations just above the semidesert grass type. In general, it shows less deterioration than the semidesert type. However, in some of the lower-lying areas and on rather steep slopes, several of the most palatable species of grasses have disappeared because of overgrazing. The short-grass type is used for both summer and winter grazing, which is another cause of its deterioration. Most of the homesteads referred to above were located on lands having this type of vegetation.

The woodland type is situated just above the short-grass type, at elevations of about 5000 to 7500 feet. It consists chiefly of piñon pine, juniper, and evergreen oak, which are interspersed with various species of grasses and browse shrubs. Grazing is yearlong but heavy death losses sometimes occur from severe winter conditions. Some dry farming has been done on the better soils of the woodland type. Water erosion is severe on the cropland and soil conservation practices are necessary to prevent deterioration. The woodland ranges are in better condition, generally speaking, than those of the semidesert grass or the short-grass type.

The forested parts of Area 6 lie, for the most part, at elevations above 7,500 feet. They constitute important timber and grazing resources. The forested areas are also important, in that they are used for grazing during the late spring, summer, and fall; which makes it possible to practice

deferred grazing on the lower-lying winter-grazing areas. The forested areas receive a larger amount of rainfall than any of the other three types discussed above. They are also the most densely vegetated. Most of the forested lands are within the borders of the national forests, which have been put under conservative use. Because of the relatively high precipitation received and also because of their steep slopes, it is important that an adequate vegetative cover be maintained on the forested areas, in order to prevent soil erosion and to regulate, in a measure at least, the flow of streams that furnish water for irrigating the lower-lying areas.

CROPS

The crops grown within Area 6 may be placed in three groups: grain crops, hay and forage crops, and other crops. The proportion of the total cropland that is devoted to each of these groups varies considerably in different parts of the area and from year to year. Crops are grown both under and without irrigation, the major portion being irrigated. The harvested acreage, especially that of the nonirrigated crops, may be materially reduced by severe drouths such as occurred during 1934.

The grain crops and the grass and forage crops are about equal in importance when measured in terms of harvested acres. These two groups generally make up from 85 to 95 percent of the total harvested acreage. Corn and wheat are the leading grain crops, oats, barley, rye, and the grain sorghums being of minor importance. Alfalfa is by far the most important of the hay and forage crops. The tame and wild grasses, clover, and the small grains are the other most important hay and forage crops. The remaining cultivated acreage in the area is devoted largely to the production of fruits (principally apples), vegetables, potatoes, and dry beans.

LIVESTOCK

The livestock enterprises associated with Area 6 are range sheep and beef cattle, dairy cattle, goats, hogs, poultry, and horses. The sheep are of first importance and the beef cattle second. Most of the sheep are owned by a few large-scale operators who also control the use of much of the grazing land. The goats, dairy cattle, poultry, hogs, and horses are kept mainly for local use.

TYPES OF FARMING AND RANCHING

Type-of-farming Area 6 has been designated "an area of mixed types." That is, no one type strongly predominates numerically. Of 6,969 classified farms and ranches within the area in 1929, self-sufficing farms made up approximately 31 percent of the total number. Part-time farms constituted 21 percent; general, 13; crop-specialty, 12; stock farms and ranches together, 12; and truck and cash-grain, 4 percent each. The remaining 3 percent was made up of seven types, none of which included as much as one percent of the total number.

It will be noted from the data presented above that the self-sufficing farms constituted 10 percent more of the total number of farms than any other type. These farms, however, are not so important as they appear numerically. By and large they are very small in size and their con-

tribution to the family living is meager indeed. Their average size in 1929 was about 99 acres, 9 acres being harvested cropland and the remaining 90 acres mostly grazing land. That year their gross income averaged approximately $253.00. Thus, it is evident that instead of being "self-sufficing," they provide only a very meager sort of subsistence.

The part-time farms in 1929 were second in importance, numerically. That year they constituted approximately one-fifth of the total number of farms and ranches, harvested an average of about 8 acres of crops per farm, and averaged about 50 acres in size. Although smaller in size, their gross income averaged about three times as much as that of the self-sufficing farms. This increase was due in large measure to the earnings of the part-time farm operators at labor away from their farms. It is highly probable that many of the part-time farms of 1929 shifted in classification to self-sufficing (subsistence) with the coming of the depression during the early 30's, when many of the operators lost their employment away from their farms.

The general farms were the third most numerous type. As the name implies, they usually produce a greater variety of products than do the farms of other types. The general farms harvested an average of about 16 acres of crops per farm and had average gross incomes of approximately $660 per farm.

The crop-specialty farms, while not quite so numerous, were of greater importance from the standpoint of total area than the general farms. They averaged about 170 acres in size, harvested approximately 24 acres of crops per farm, and had average gross incomes of around $930. Hay, dry beans, and potatoes are the special crops grown, the beans and potatoes being of minor importance. Most of the nonirrigated farms of the area are of this type.

The stock farms and ranches in 1929 made up approximately one-eighth of all the farms in the area, one-third of them being classified as stock farms (animal-specialty) and two-thirds as stock ranches. While there are a few very large ranches, the stock farms and ranches together average much smaller in size in Area 6 than in most other parts of the State—ranging from less than 20 acres to over 10,000. Some of the stock farms and ranches carry only sheep, others only beef cattle, while still others produce both sheep and cattle. On a few ranches goats are of considerable importance.

Sheep are the dominant kind of livestock and their ownership tends to be concentrated in the hands of a relatively few persons. In many cases sheep are leased out by the owners to individuals under what is known as the *partido* system. In some parts of the area as many as 70 percent of the sheep are handled by this method, in relatively small bands. Under this system, the *partidario* (lessee) receives a band of ewes from the *dueño* (owner or lessor), together with the required number of rams, and agrees to pay a rental of so many lambs per 100 ewes in the fall of each year to the *dueño*. A rental of 20 lambs per 100 ewes is typical under these lease agreements. In some cases the *dueño* requires that the lambs paid back as rental be ewes. All the wool goes to the *partidario*.

The *partidario* agrees at the termination of the lease to return the same number of ewes and rams of the same ages and quality as he originally received. The *partidario* agrees to provide all feed and, of course, bears all the risk. Grazing permits on the national forests are in some cases held in the name of the *dueño*, or owner of the sheep, and in others the *partidarios* have individual permits.

PROBLEMS AND ADJUSTMENTS

Area 6 is beset with numerous economic, sociological, and agricultural problems, among which the following stand out as of prime importance:

Overpopulation.—The pressure of the rural population on the available irrigable land in Area 6 has become intense. In some communities there is only nine-tenths of an acre of irrigated land per person, whereas from 4 to 5 acres are considered necessary to provide even a minimum standard of living.

Conservation of Available Water.—In general, there is a shortage of water for the production of both irrigated crops and range forage. Water for irrigation purposes may be conserved (1) by the construction of numerous relatively small reservoirs for the storage of floodwaters during the irrigating season and also to impound the flow of streams during the nonirrigating season, where water rights will permit, and (2) by a more efficient application of what irrigation water is available. Permanent diversion dams are necessary in order to utilize all water that is available and to deliver the water when needed. The water available for the production of range forage may be utilized more efficiently, in many instances, (1) by the establishment of a more adequate vegetative cover through controlled and deferred grazing, and (2) by the use of small dams, spreader ditches, and contour furrows.

Rearrangement of the Irrigated Land Pattern.—The custom of dividing the family landholdings equally among the children upon the death of the parents has resulted in a very unsatisfactory land pattern, in which the individual holdings generally lie in long narrow strips. These strips usually include both irrigated and nonirrigated land, cross the irrigation canal at approximately right angles, and extend down the slope to the floor of the valley or across the valley. Thus, it is usually necessary to irrigate by running the water down the slope lengthwise the strips of land. In many instances the slope is sufficient to cause an appreciable amount of erosion, and the length of the strips results in a very uneven penetration of the irrigation water. By a consolidation and redistribution of all irrigable lands, it should be possible to reduce materially the washing of the soil, improve the methods of applying the irrigation water, and increase crop production.

Increasing Crop Production.—Although the rural population of Area 6 is at times hard pressed for food, the agriculture of the area, in general, is at a very low ebb. This condition is due, in large part, to the lack of efficient modern farm implements and machinery; to inferior and obsolete methods and practices used in crop production; to the uneven surface condition of the irrigated fields; to inadequate supplies of irrigation

water; and, in some cases, at least, to the farm work being done by women and children while the men are working away from their farms. These conditions, it is evident, offer abundant opportunity for improvement.

Improvement of Range Vegetative Cover.—The preservation of the grazing land resources of the area depends upon maintaining an adequate protective cover of vegetation. In order to do this, a downward adjustment in range livestock numbers, in addition to proper seasonal grazing and other range conservation practices, will be necessary. The following quotation from Technical Bulletin 567, issued by the United States Department of Agriculture, refers to this area and shows the importance of this problem: "Past lack of land control and of unified effort for any constructive land-utilization policy have been largely responsible for the damage to vegetation and lands of this watershed . . . ."

In addition to the problems discussed above, the following are also very important: (1) equitable distribution of grazing lands among range livestock operators, (2) adjustment of agricultural lands to proper uses, (3) biological pest control, and (4) soil conservation.

AREA 7. SOUTH CENTRAL COLFAX COUNTY IRRIGATED AREA

The land included in Area 7 lies in six separate irrigated tracts, the general characteristics of which are similar in many respects. However, enough difference exists, in relative importance of various types of farms and kinds of crops produced, in the methods of utilization of crops, and in the source and reliability of the water supply, to justify the formation of six subareas. Approximately 33,000 acres of land are irrigated in this area as a whole, the total amount varying from year to year according to the availability of irrigation water.

The subareas also vary considerably in topography. Some are rather level, while others have considerable slope. These subareas also lie at elevations ranging from 5900 to 8850 feet, subarea 7-F in the Moreno Valley having the highest elevation.

CLIMATE

Because of the relatively high elevation, a comparatively cool climate prevails. The temperature rarely is higher than 95 degrees in the summer but at times reaches 20 to 25 degrees below zero during the winter in subareas 7-A to 7-E, inclusive, and is considerably colder in 7-F. The frost-free growing season is approximately 150 days over most of the area. At Springer, the principal town, the average date of the last killing frost in the spring is May 9 and the average date of the first killing frost in the fall is October 4.

The average yearly precipitation ranges from approximately 14 inches to about 16.5 inches in the different subareas. A good deal of snow falls during the winter, amounting to an average of 25 to 35 inches, according to location.

SOILS

No detailed soils information is available for this area. In general, however, the soils are of a rather heavy nature, clay loam being common throughout.

SOURCE OF IRRIGATION WATER

The irrigation water is derived from streams originating in the Sangre de Cristo mountain range, which is located approximately on the western boundary of Colfax County. These streams have a variable flow throughout the year; therefore, adequate storage facilities are necessary for successful irrigation agriculture. Each subarea has made separate provisions for its water supply, which facilities will be described separately under the subarea descriptions.

CROPS

The income to farmers comes largely from the sale of crops. In general, a rather extensive type of production is carried on, as shown by the fact that crops such as alfalfa, pinto beans, small grains, and corn occupy a large percentage of the cultivated land. Most of the feed crops produced in the area are sold to stock ranches in the vicinity or trucked into the mountainous areas where there is a deficiency of such feeds.

LIVESTOCK

A rather limited amount of livestock is produced on the irrigated farms. In some portions of the area a considerable quantity of feed is fed to beef cattle during the winter, while in others dairy production is of some importance.

TYPES OF FARMING

For the area as a whole, crop-specialty farms are of greatest importance, making up approximately half of the total number of farms. Pinto beans are the chief source of income on the majority of these, although a few farms in this group specialize in alfalfa as the chief source of income. General farms ranked second, numerically, in 1939, and constituted 16 percent of the total number. That year, cash-grain farms made up 13 percent of all farms; dairy, poultry, and part-time farms, 4 percent each; and miscellaneous, 7 percent. The miscellaneous types include truck, self-sufficing, and stock farms, all of which are approximately equal in importance from the standpoint of numbers.

General farms in this area practice crop diversification to an appreciable extent, and in addition, some carry dairy and poultry enterprises which furnish income from butterfat and eggs.

The cash-grain farms produce wheat, oats, barley, and corn as the chief sources of income and, in general, livestock on these farms is of minor importance.

PROBLEMS AND ADJUSTMENTS

Adjustment of Crop Acreage to Supplies of Irrigation Water.—The past history of this area records periodical shortages of irrigation water in the various subareas. At present the kind of crops grown and the cropping systems practiced are determined largely by the seasonal water supply. In some parts of the area, storage facilities are inadequate and downward adjustments in cropland should be made to provide a more economic use of water.

Problem of Erosion.—The slope of a portion of the irrigated land is

sufficient to cause severe soil erosion when irrigation water is applied. Such land should be retired from crop production or terraced so as to prevent erosion.

Farm Organization.—It is the view of many farm operators in the area that the use of more feed on the farms by livestock and a reduction of cash-crop farming would increase both farm incomes and soil productivity.

SUBAREA 7-A. SPRINGER IRRIGATION PROJECT

This subarea is located about six miles northwest of the town of Springer. It has water rights on the Cimarron River from the Eagle Nest reservoir. Supplemental storage is provided by the Springer reservoir for use as needed. Because of the water rights and storage facilities, a comparatively reliable supply of water is available.

Approximately 5660 acres of cropland are irrigated in this subarea, most of which are devoted to the production of cash crops. The crops, in the order of planted acreage, are: alfalfa, pinto beans, corn, wheat, oats, and barley. Most of the alfalfa is sold locally, while the beans are sold to buyers who move the bulk of the crop out of the area.

A relatively small amount of livestock is kept within this subarea. A comparatively few of the farmers have small dairy enterprises, but in general only sufficient numbers of livestock to supply home needs are kept.

The importance of cash-crop farming is shown by the fact that on slightly over one-half of the farms 40 percent or more of the income is derived from the sale of pinto beans and/or alfalfa, while 9 percent of the farms specialize in the production and sale of grain. Only 13 percent of the farms are sufficiently diversified to be classed as general farms, while dairy production is dominant on 6 percent of them.

SUBAREA 7-B. ANTELOPE VALLEY IRRIGATION DISTRICT

Subarea 7-B has approximately 5600 acres of cropland which can be irrigated. However, in 1938 only about 3000 acres were irrigated, because of an inadequate water supply. This subarea obtains its irrigation water from floodwater and from water furnished by intermittent streams for which storage is provided. However, in years of below-normal precipitation or in those with less-than-average seasonal rainfall, the supply is insufficient. Additional irrigation water may be purchased from Eagle Nest Lake, but the cost makes its use uneconomic.

The selection of crops grown in this subarea is determined largely by their water requirements. In 1938, approximately 40 percent of the cropped land was in pinto beans, 20 percent in oats, 10 percent each in corn and barley, 5 percent each in alfalfa and wheat, and the remainder in cane, sugar beets, millet, and apples. Most of the major crops grown have relatively low water requirements. Water shortage has seriously affected the production of apples, a considerable acreage of which was planted and brought into production. Later the trees were either pulled out or are, at present, uncared for.

Three types of farming account for 88 percent of the farms in this

subarea. Crop-specialty farms constituted 59 percent of the total number; general, 19 percent; and cash-grain, 10 percent. Virtually all of the farm income of all types of farms is derived from the sale of crops, as very little livestock is kept in addition to that necessary to supply home needs.

SUBAREA 7-C. MAXWELL IRRIGATION PROJECT

Subarea 7-C is located adjacent to the town of Maxwell, which is 14 miles north of Springer. This subarea obtains its supply of irrigation water from the headwaters of Red River and other small streams. The water supply is highly seasonal, being increased with melting of the mountain snows in the spring and by the summer rains. For this reason, adequate storage capacity is necessary for efficient crop production. In previous years this supply was insufficient for maximum production, but with the reorganization of the Maxwell Irrigation Project and the completion of the reservoir under construction, some 20 or more reservoirs of varying sizes will be available for storage purposes. These will care more adequately for the needs of the district.

In 1938, approximately 13,500 acres of crops were produced in this subarea, consisting of alfalfa, 6500 acres; barley and oats, 3500 acres; beans, 1500 acres; wheat, 1000 acres; and corn and miscellaneous crops, including millet and sweet clover, 1000 acres.

A very large percentage of the alfalfa is sold to near-by ranchmen and in the larger towns, such as Las Vegas and Raton, being hauled entirely by means of trucks. Only sufficient hay to feed work stock and a relatively few dairy cows is consumed in the subarea. The pinto beans are shipped out in carlot quantities, while a large percentage of the grain crops is fed on the farms.

The distribution of the types of farming in 7-C is very similar to that of subarea 7-A. The principal difference lies in the fact that a greater proportion of the crop-specialty farms specializes in the production of alfalfa rather than in the raising of pinto beans. This is due largely to a water supply which is more nearly adequate.

SUBAREA 7-D. CIMARRON DISTRICT

Approximately 6000 acres are irrigated in subarea 7-D. Most of the land is controlled by a relatively few livestock producers who winter stock in the area. The crops consist largely of alfalfa and small grains, which, for the most part, are fed in the subarea. This subarea has an excellent water supply, which is stored in Eagle Nest Lake and taken from the Cimarron River.

SUBAREA 7-E. MIAMI IRRIGATION DISTRICT

Subarea 7-E, known as the Miami Irrigation District, is located 12 miles west of the town of Springer. The farm land in this subarea varies from level to rolling and most of the soils are of relatively fine texture. Provisions have been made for the storage of irrigation water in a reservoir located west of the District, into which floodwater and the water of mountain streams drain. During years of average precipitation suf-

ficient irrigation water is available, and only in a relatively few years have serious seasonal shortages occurred. The reliability of the water supply is reflected by the fact that this subarea has a larger acreage of apple orchards than any of the other six subareas.

The principal crops include alfalfa, small grains, apples, beans, and corn. Beans are of less importance and fruit is of greater importance, than in the Springer, Maxwell, or Antelope Valley district. Most of the crops are marketed as cash crops. Some dairying and considerable poultry raising are carried on. In general, however, livestock does not form an important farm enterprise.

From the standpoint of type of farming, this subarea differs from the other subareas of Area 7 in that a smaller proportion of the farms is classed as crop-specialty, and a larger percentage as part-time, truck, and poultry.

SUBAREA 7-F. MORENO VALLEY

This subarea is a high-altitude (8500 feet) mountain valley, the farm land of which is located on the benchland to the west of Eagle Nest Lake. Most of the land is quite sloping and is irrigated from small streams coming from the near-by Sangre de Cristo Mountains, located west of the Valley. Only a portion of most of the farms is irrigated, while on the remaining farm lands the crops are produced under natural rainfall. Many of the streams are more or less intermittent, depending upon the seasonal precipitation. In some parts of the subarea, floodwaters are used to supplement the moisture which falls during the growing season. In general, the water supply for crop production is rather erratic, from the standpoint of a steady supply during the irrigating season.

The relatively high elevation results in a rather short growing season, severe winters, and a heavy snowfall. Because of the short growing season, certain adapted crops must be selected. The relative importance of the crops grown in 1938, the crops being named in the order of their acreages, is as follows: barley, oats, wheat, peas, head lettuce, potatoes, native hay, and alfalfa. The small grains, because of their adaptation to cool weather and their low water requirements, are successfully grown under natural rainfall, but all the other crops named are produced under irrigation. Peas and head lettuce of excellent quality are produced. However, the acreage is limited by the uncertain market outlets and because of the large labor requirements of these crops. In recent years the pea crop has been produced under contract, by the provisions of which the wholesale distributor has furnished the seed, picked and packed the crop, and shipped it out in carlot quantities.

Practically all farms in this subarea have beef cattle that are grazed on the national forest in the summer and wintered on the farms. The majority of the farms, however, obtain the larger part of their income from the sale of grain. Stock farms are second in importance. On these the crops, consisting mainly of barley and oats, are consumed on the farms.

AREA 8. FORT SUMNER IRRIGATED AREA

GENERAL DESCRIPTION

The Fort Sumner irrigated area is located in the valley of the Pecos River in east central De Baca County. The irrigated land extends from the town of Fort Sumner along the Pecos River in a southeasterly direction for approximately eight miles. In 1937, about 6650 acres were under irrigation and additional land was being brought under irrigation by the construction of ditches to lead water onto land lying somewhat above the floor of the Pecos River valley. The southern half of the area is rather flat with poor natural drainage. Before artificial drainage was provided this part of the area became seeped and some of it became sufficiently impregnated with saline material to be detrimental to crop production. A drainage system has been constructed which has largely corrected this condition. Area 8 lies at an average elevation of about 3960 feet and is surrounded by grazing lands varying from 4500 to 5000 feet above sea level.

The irrigated land is well leveled in the valley proper but many farms near the edge of the valley, and especially those brought into production recently as a result of the construction of a high-line irrigation ditch, are poorly leveled and are irrigated on a slope. The soils of this part of the area are lighter in texture and have a tendency to be less productive than those lying in the floor of the valley.

CLIMATE

The climate of the area is fairly warm, with comparatively low rainfall. The average length of the frost-free growing season is 194 days, the average date of the first killing frost in the fall being October 25 and that of the last killing frost in the spring, April 14. The area has an average annual precipitation of approximately 16 inches, 70 percent falling from April to September, inclusive. During the period from 1913 to 1928 the yearly precipitation varied from a low of 10.45 inches in 1916 to a high of 30.51 inches in 1919. Such variations are typical of most of New Mexico. Snow may fall almost any time from November to March, inclusive, the total averaging 11 inches a year. The yearly temperatures average about 57 degrees, with a maximum of approximately 100 degrees at times each summer and a minimum of a few degrees below zero each winter during brief cold periods. Brisk southwesterly winds prevail during the spring months.

SOILS

The soils consist largely of fine sandy loams. However, scattered throughout the area are small bodies of clay and clay-loam soils. Fine sand and loamy fine sand are found adjacent to the River and near the outer margins of the Valley. Most of the soils are underlain by comparatively heavy subsoils. The characteristics of the soils and subsoils thus favor both a rapid absorption and efficient retention of irrigation water. Some difficulty is encountered with soil blowing, on the fine sands and loamy fine sands.

In general, the soils are very well adapted to a large variety of crops. Their depth is favorable to the growing of tree fruits and alfalfa and their friable nature makes them well adapted to all kinds of truck crops. However, additions of fertilizer, especially phosphates, result in marked increases in yields.

SOURCE AND SUPPLY OF IRRIGATION WATER

The water for irrigation comes from the Pecos River, impounded above the Alamogordo Dam, located about 15 miles northwest of Fort Sumner. This dam was constructed for purposes of giving flood protection to communities along the Pecos River and to furnish an adequate supply of irrigation water, particularly for the Carlsbad irrigated area. The building of the dam (completed in 1937) enables this area to obtain an adequate supply of water for irrigation, which it did not have when the seasonal flow of the River was depended upon.

CROPS

The long, warm, frost-free growing season, combined with deep fertile soil and a plentiful supply of irrigation water, explains the large variety of crops produced in the area. Four classes of crops—feed grains, legumes, fruit, and truck crops—are important in the farm setups of the area.

Alfalfa occupies 35 percent of the cropland and yields of from 4 to 5 tons to the acre are secured. This crop is fed to farm livestock and is marketed by truck to livestock ranches and farms in the surrounding non-irrigated areas and to dairymen in Clovis and other population centers. Alfalfa is very important in the organization of the farms of the area. It is complementary to the production of the feed grains and truck crops, by aiding in the maintenance of yields on relatively light-textured soils.

Feed grains and alfalfa are of approximately equal importance from the standpoint of the harvested acreage. They occupy approximately 72 percent of the total cropland. The acreage devoted to the feed grains is about equally divided between sorghums and corn. Corn does well, and yields of from 40 to 60 bushels an acre are commonly obtained. Much of the grain is fed on the farms to work stock, hogs, and dairy cattle. Some of it is used on a limited number of farms for the fattening of cattle and some is sold in the surrounding ranching country.

Fruit, consisting principally of apples, occupies 19 percent of the irrigated cropland. Over a period of years apples do not have a comparative advantage over feed grains, truck crops, and alfalfa for the use of the land. As evidence of this fact, very few new plantings of apple trees have been made in recent years. Two serious difficulties are encountered in apple production: First, late frosts make for uncertain yields, which vary from zero to approximately 500 bushels an acre, the average being about 200 bushels; and second, the infestation of codling moth is rather severe. Most producers consider that 6 to 8 sprayings are necessary to control effectively the insects of this area, compared with 2 to 4 sprayings in areas of higher altitude.

Grapes are second in importance among the fruit crops. The grapes

are of excellent quality. Peaches and pears are also of some importance. These crops are marketed mostly in the surrounding ranching and dry-farming area. However, some of the products of this area are transported by trucks as far as some of the Texas markets.

Truck crops and vegetables occupy approximately 7.5 percent of the irrigated cropland. Of the truck crops, sweet potatoes are the most important. The sweet potatoes, cured and stored in the area, are sold both cooperatively and independently. A portion of the crop is trucked to other points in New Mexico, such as Las Vegas, Santa Fe, and Albuquerque, while most of the remainder is shipped in carload lots to the central markets. Tomatoes, onions, and Irish potatoes are also of some importance.

LIVESTOCK

Livestock production is of rather minor importance on a majority of the farms of this area, hogs being raised more extensively than any other kind of livestock. The rather abundant yields of corn and sorghums, together with alfalfa pasture, are favorable to their production. Dairying for butterfat production and poultry raising for commercial egg production are carried on in limited volume. In some years turkey raising is an important farm enterprise and carload shipments of dressed turkeys have been made from Fort Sumner. A few individuals carry on livestock-feeding enterprises.

The factor limiting the amount of livestock in the area is not scarcity of feed, but rather the alternative opportunity of marketing feed in the surrounding range and dry-farming areas. A fairly constant demand for feed exists from these sources and this is increased during years of below-normal rainfall.

TYPES OF FARMING

Cash-crop farming is characteristic of Area 8. The production of special crops predominates on approximately 46 percent of the farms. The majority of the crop-specialty farms specialize in the production of sweet potatoes, and a limited number in alfalfa. Those specializing in sweet potatoes normally produce alfalfa, feed crops for farm animals, fruit, and some other truck crop, such as tomatoes or onions. The average farm in the area contains approximately 30 crop acres, but those which come under the crop-specialty classification usually range below this average. The general practice is to rotate sweet potatoes with alfalfa and corn, in order to maintain yields and quality of the potatoes. Several of the growers have their own storage houses in which the crop is cured. A farmers' cooperative stores and cures the remainder of the crop.

About 20 percent of the farms have a diversity of crops, combined with livestock enterprises to the extent that they are classed as general farms. Cash-grain production, consisting principally of corn, is the predominating enterprise carried on by 10 percent of the farmers of the area. The types of farms which are of minor importance and their per-

centages of the total number of farms are as follows: Dairy farms make up 7 percent of the total number; self-sufficing, 7; fruit, 6; poultry and part-time, 2 percent each. The part-time farms consist of small acreages adjacent to Fort Sumner and play only a small part in the economy of the agriculture of the area.

PROBLEMS

Several problems confront the farmers of this area. Many of the farms are too small for efficient operation, or for organization on the basis of field-crop production, and for this reason the operators have turned more strongly to truck crops and vegetables. This, in turn, has resulted in a marketing problem.

On many of the new farms, as well as on some of the older ones located on levels above the valley floor, a considerable percentage of the land needs leveling, in order to make better use of irrigation water, prevent washing, and increase yields. Drainage is also a problem in limited sections of the area.

AREA 9. PORTALES PUMP-IRRIGATED AREA

GENERAL DESCRIPTION

The Portales pump-irrigated area is located in the Portales Valley. This Valley, in turn, is located in the north central part of Roosevelt County, in eastern New Mexico. The city of Portales, located near the center of Area 9, is the trade center not only for this area but also for the nonirrigated districts surrounding Area 9. It offers excellent marketing facilities, which include grain elevators, sweet-potato curing and storage houses, creameries, a cheese factory, a canning factory, and several produce stations which buy eggs and cream on a butterfat basis.

Geologically, the Portales Valley is thought to have been the channel of an old river which flowed into the Brazos River; however, there is no stream flowing through the Valley and no stream channel of any considerable length. In general, the surface of the area is smooth, with a gentle slope of 12 to 25 feet to the mile toward the southeast. Surface depressions, or *playas*, are found throughout the area. They are thought to have been the result of underground basic rock from which gypsum and limestone have been dissolved, permitting the collapse of the surface.

A comparatively large amount of development has taken place in this area in recent years. Drouth conditions in the Great Plains region stimulated interest in the production of crops by irrigation. A survey made by the New Mexico State Engineer shows that in 1931 there were 325 pumping plants in the area, with 8850 acres irrigated. While the Portales area is primarily an irrigated one, many of the larger farms and those situated on the edge of the shallow-water belt devote part of their acreage to nonirrigated crops.

CLIMATE

The average annual precipitation at Portales is approximately 18 inches, only a small percentage of which falls during the winter and early spring months. The average between November 1 and April 1 is

but 2.8 inches. The small amount of moisture falling during the winter and early spring months, in conjunction with high westerly winds, is the principal climatic drawback of the area. The heaviest precipitation falls during June, July, and August, averaging 8.2 inches for the three months. A considerable percentage of the rains which occur during these months may be torrential in character. However, there is very little runoff, because of the level nature of the land and the sandy character of the soil. The rain that falls in summer materially reduces pumping costs during a period of high water requirements.

The elevation is 4000 feet above sea level, which fact makes for rather pleasant summer temperatures, in spite of its southern location. With the exception of a relatively few days during the year, the temperature range is between 10 and 100 degrees, the winters being so mild that little protection is needed for livestock.

SOILS

The soils are of eolian origin and consist largely of sandy loams interspersed with areas of silt loam. The surface soil is underlain by a layer of consolidated calcium carbonate, known as caliche. This layer is found at depths below the surface varying from several feet in some parts of the area to actual outcroppings in others. The value of the soils for cropping purposes is affected considerably by the depth of this calcareous layer. Because of the sandy character of the soils, they are easily worked, absorb water readily, warm up quickly in the spring, and thus are well adapted to the production of truck crops. For the same reason, however, the soils lose organic matter rather rapidly under irrigation and have a tendency to blow when left unprotected in winter and spring.

SOURCE AND SUPPLY OF IRRIGATION WATER

The irrigation water is supplied exclusively from wells by pumping. The principal source of the water is apparently precipitation that falls over a territory of approximately 850 square miles lying to the west and northwest of the area. That this is its source is evident from the fact that the water level in the wells rises and falls with the amount of rainfall in the contributing territory. Engineering studies of the ground water in Roosevelt County indicate that the underground water supply is being pumped as rapidly, if not more rapidly, than the rate of recharge.[1] These studies indicate, also, that, with the continuation of the present policy of bringing more land under irrigation, there is a possibility of a water shortage in this area.

The irrigation water is pumped from an average depth of approximately 40 feet. Nearly all of the pumps are operated with engines using fuel oil or gasoline. A few of them use natural gas. According to studies made in the area by the New Mexico Agricultural Experiment Station in 1933-34, the average total cost of pumping water for crop production amounted to $7.14 an acre. The cost of fuel and lubricat-

[1]Tenth and Eleventh Biennial Reports of the New Mexico State Engineer.

ing oil was $2.73, while the overhead costs, including interest on investment, and depreciation and repairs of pumping equipment, amounted to $4.41. The fuel and oil expense varied from $0.96 an acre for hegari to $7.02 an acre for alfalfa. Pumping costs vary considerably from year to year, largely because of fluctuation in seasonal rainfall.

CROPS

The medium texture of the soil, the reliability of the water supply, the long and favorable growing season, and the availability of markets are factors favorable to the production of a wide variety of crops in Area 9.

The soils, as a rule, are light and friable, which makes them adapted to the production of vegetables and truck crops. This fact, together with favorable temperature conditions and a water supply that is available for immediate use when needed, makes this an area which is well suited to vegetable production. The dry-land farming areas of the plains of eastern New Mexico and western Texas provide an outlet for many of the crops grown under irrigation.

Sweet potatoes are the leading crop, providing about one-third of the gross farm receipts; the soil and climatic conditions being favorable for the production of roots of high quality. The yield averages approximately 200 bushels to the acre. Through cooperative endeavor of the growers, a special market has been developed for sweet potatoes in Los Angeles, California. At present (1939), a large percentage of the crop is shipped in carlot quantities and by trucks to that market, after having been cured in storage houses located in and near Portales.

Cotton is second in importance in acreage. This is grown to the greatest extent on the larger farms and on the heavier types of soils. The length of the growing season is sufficient to mature the crop, and yields range from 350 to 500 pounds to the acre, the yield depending largely on the amount of irrigation water applied.

Average acre yields of peanuts, which rank third, of approximately 50 bushels have been obtained in recent years. This crop is hauled by trucks into Texas and other market areas to the east.

Tomatoes rank fourth from the standpoint of total value. This crop is sold to a local cannery and also to market centers in Texas. The proportion sent into Texas depends upon the condition of the intermediate crop in that State, which varies according to rainfall conditions.

String beans are the next most important vegetable crop, most of which is transported by trucks to Texas and Oklahoma markets.

Other miscellaneous truck crops include onions, melons, peppers, potatoes, cabbage, and carrots, most of which are hauled to market by trucks.

Corn and sorghums are the principal feed crops. These are raised only for the feeding of farm livestock, as except in dry years there is an abundance of such feeds produced on surrounding nonirrigated land. Because of its high water requirements, alfalfa production is of less importance than in areas where irrigation costs are lower. It occupies about 10 percent of the irrigated land. From the standpoint of soil pro-

ductivity, it would be desirable to increase alfalfa production in rotation with sweet potatoes. Two other crops grown in the area are broomcorn and wheat. The acreages of these fluctuate as prices for them shift in relation to prices of other crops in the area. In years of above-normal seasonal rainfall these two crops, together with cotton, are matured on a portion of the area without the aid of irrigation water.

LIVESTOCK

Livestock is produced most commonly on the larger farms. These usually include native pasture which is used to supplement the feed raised on irrigated land. Both dairy and beef cattle are raised but the former are of the greater importance. The milk produced is separated on the farm, the butterfat is sold to creameries, and the skim milk is fed to hogs and chickens. A study of 40 farms in the area carried on by the New Mexico Experiment Station from 1932 to 1934 showed annual sales of dairy products amounting to $98 and sales of eggs, $26, per farm. Hog production is limited mainly to the production of pork for family use. The factors tending to limit livestock production are the small size of the farms, 55 percent being less than 50 acres in area; lack of native grass pasture; and a relatively small production of alfalfa.

TYPES OF FARMING

Crop-specialty farms are the most important type, accounting for approximately 59 percent of the total number. Practically all of this type specialize in the production of sweet potatoes. These farms, in general, represent the medium-sized farms of the area and vary from about 20 to 60 acres in size. On farms of this type, ordinarily a part of the land is devoted to a limited acreage of peanuts, cotton, alfalfa, feed crops, or vegetables. Only a limited number produce livestock above that necessary to supply the needs of the farm family.

The general and cotton farms, together, make up about 19 percent of the total and ordinarily are larger than the crop-specialty farms, the bulk of them varying from approximately 60 to 175 acres. They have larger numbers of livestock, consisting mostly of dairy cattle. In recent years there has been an increase of cotton farms and a decrease of general farms, until in 1939 they are estimated to be of approximately equal importance. There has been a tendency during the last few years for dairy production to increase on both the general and cotton farms. As a result, feed grains, principally corn and hegari, are rather important commodities, while broomcorn, wheat, peanuts, and truck crops are produced on only relatively few of these farms.

Truck farms make up about 11 percent of the total. They are usually small in size, ranging under 20 acres. In addition to sweet potatoes, these farms produce a rather large variety of vegetable crops, including melons, onions, peppers, carrots, string beans, and tomatoes. In the past, little livestock and not much in the way of feed crops have been produced on the truck farms. However, in recent years, feed crops have been increased somewhat, in an effort to eradicate nematode infestation resulting from constant truck cropping.

Other types of farms, such as cash-grain, dairy, and poultry, are of minor importance, making up fractions of the total varying from 1 to 3 percent each.

PROBLEMS AND ADJUSTMENTS

Soil Fertility and Nematode Infestation.—Owing to their light texture, the soils of this area lose organic matter rapidly under constant cropping with sweet potatoes and other truck crops. Sweet-potato yields tend to decrease where no crop rotation is practiced and at present the highest yields generally are obtained on newly broken land.

A series of difficulties with diseases and insects results from constant cropping with soil-depleting crops. The nematode infestation is more serious than that of any other pest. It is soil borne and attacks the roots of most crops, other than those belonging to the grass family, such as corn, hegari, and Sudan grass. However, it is reduced to a great extent by the growing of alfalfa on the infested land. A rotation with alfalfa and other feed crops is the only practical method of controlling nematodes. Increased acreage of these crops would create a marketing problem which would tend to encourage the introduction of more livestock, preferably dairy cattle, into the farming systems. These two adjustments probably would have a tendency to alleviate both the soil-fertility and the soil-pest problems.

Small-Farm Problem.—Operators of small farms have attempted to increase their net incomes by intensive cropping of all of their land to vegetable and truck crops. These operators have very limited opportunities to practice rotations with soil-conserving crops or to incorporate livestock enterprises in their farming systems, and thus are handicapped in attempting to maintain high yields and good quality over a period of years.

The pumping costs are greater on small than on large farms. The operating costs are practically the same in both cases, but the investment per acre in pumping equipment on small farms exceeds that on the large farms.

AREA 10. THE PECOS VALLEY IRRIGATED DISTRICT

GENERAL DESCRIPTION

Area 10 lies in the valley of the Pecos River in Chaves and Eddy Counties. It consists of two separate irrigated areas, known locally as the Roswell-Artesia irrigated district and the Carlsbad Reclamation Project. Owing to differences in the source of the irrigation water used in these two areas, in the crops grown, and in the types of farming carried on, they are discussed separately, the Roswell-Artesia district being designated as subarea 10-A and the Carlsbad Reclamation Project as subarea 10-B (figure 1).

Subarea 10-A extends from a point 2 miles north of the city of Roswell in a southerly direction for approximately 50 miles along the Pecos River. The rolling character of the land below this point and inability to secure irrigation water from the Pecos River preclude any extensive development of irrigation farming. The valley again widens out a few

miles above Carlsbad and extends south for approximately 25 miles. It is in this second valley that subarea 10-B is located.

Area 10 as a whole has a range in altitude of about 700 feet, i.e., from approximately 3,600 feet above sea level at the northern extremity of subarea 10-A to about 2,900 feet at the southern end of subarea 10-B. Most of the irrigated land lies well for irrigation, although the slope of a portion of it is so great that irrigation is difficult. In general, the surface of both subareas slopes gently to the south.

CLIMATE

The average frost-free growing season varies from 198 days in the northern part of the area to 216 days at its southern extremity. The length of the growing season is sufficient for the production of cotton and other crops of similar climatic requirements. Over a period of 34 years the average date of the first killing frost in the autumn at Roswell in subarea 10-A was October 26, and November 1 at Carlsbad in subarea 10-B. The average date of the last killing frost in the spring varies from March 30 to April 11. The temperature averages about 60 degrees, with a maximum slightly above 100 degrees practically every summer and a minimum occasionally below zero in winter. The average annual precipitation of approximately 13 inches is not sufficient for successful crop production and must be supplemented by the application of irrigation water. The seasonal rainfall (May to October, inclusive) is approximately 9 inches and has varied from as little as 3.5 inches to 16 inches during a period of 16 years. Snow is not uncommon from November to April. However, due to the relatively mild temperatures, it remains on the ground only a day or two and, consequently, livestock requires very little shelter. As in most other sections of the Southwest, the rainfall is sometimes torrential in character, hail occurs occasionally, and evaporation is rapid.

SOILS

The soils of this area consist mainly of alluvial deposits. They have originated from limestone, gypsum, and sandstone and therefore have a rather high gypsum content. Most of the soils have been developed on smooth-surfaced, gently sloping alluvial fans, are comparatively deep and friable, and are adapted to a variety of crops. The principal soil types vary in texture from clay loam to fine sandy loam. In some sections of the area, especially in parts of subarea 10-A, the land has poor natural drainage and consequently has a high degree of soil salinity. Most of the poorly drained acreage has been reclaimed by means of both open and covered drains. In general, the soils of the area are rather deficient in phosphorus, the addition of which results in considerable increases in the acre yields of crops, especially of alfalfa.

SOURCES AND SUPPLY OF IRRIGATION WATER

The irrigation water for subarea 10-A is obtained from three sources: flowing artesian wells, pumped shallow wells, and streams. Artesian water was discovered in subarea 10-A in 1891 but it was not until 1903 that drilling artesian wells for irrigation assumed proportions of conse-

quence. The development was rapid from then on and by 1910 there were approximately 1080 flowing wells. Overdevelopment occurred and many wells ceased to flow. In order to initiate control over the development of underground water, a law was passed by the New Mexico legislature in 1931, wherein certain underground waters were declared to be public property and to be subject to appropriation for beneficial use. Since drilling of artesian wells has been controlled, abandoned wells plugged, and wasteful leaks stopped, the supply of water has been more effectually stabilized.

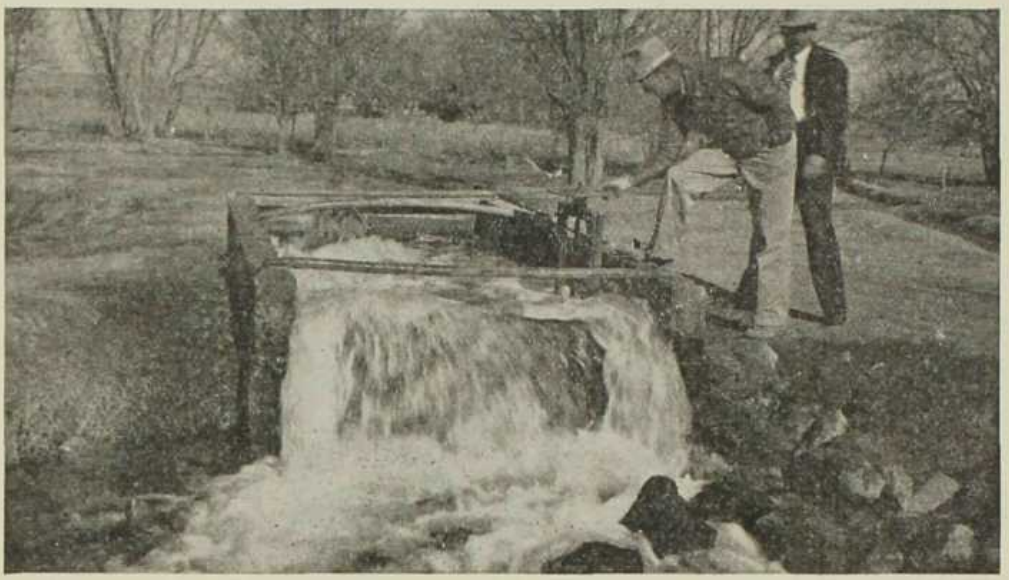

Fig. 10. Irrigation water from an artesian well in the Pecos River Valley.

While irrigation by pumping from shallow wells has been practiced for many years, recently there has been a rapid expansion. Some doubt has been expressed by engineers as to the reliability of the supply of the water pumped from the shallow wells. In the Roswell-Artesia subarea water is obtained also by diversion from small streams. The water in these streams is derived from springs and the flow is limited.

The irrigation water for subarea 10-B, the Carlsbad Reclamation Project, comes chiefly from the Pecos River. To stabilize the supply, provision was made in developing the project for impounding water in two reservoirs, Lake McMillan and Lake Avalon. Time has shown that the combined capacity of these two reservoirs is entirely too small to insure an adequate supply of water during seasons of severe drouth. To stabilize the supply of water further, a third reservoir was provided in 1937 by the construction of the Alamogordo Dam on the Pecos River, approximately 150 miles north of the city of Carlsbad and 15 miles above Fort Sumner. In addition to irrigation water taken from the Pecos River, a limited amount is also obtained by pumping from comparatively shallow wells.

CROPS

The cropping systems of the area, in the main, are built around cotton. Because of soil and climatic conditions, this crop has been more profitable than other cash crops. The fact that during the period from 1928 to 1934 approximately 48 percent of the harvested acreage in this area was in cotton indicates the importance of this crop. However, by 1938, as a result of adjustment programs and low prices, the cotton acreage was reduced to about 36 percent of the total crop acreage. The advantage of cotton over competing crops is brought about partially by reason of the relatively high yields obtained. During the period from 1928 to 1932, inclusive, when cotton occupied approximately 48 percent of the cropland, average yields of about 340 pounds of lint to the acre were obtained. In reducing the cotton acreage, there has been a tendency to concentrate cotton production on the more productive land and to use the less productive areas for other crops. As a result of this adjustment, in combination with better cultural practices and improved varieties, the average yield of cotton per acre was increased to 450 pounds during the period 1933 to 1937.

Alfalfa ranks second in importance and occupied approximately 17 percent of the land during the period 1928 to 1934. The increase in alfalfa from 1934 to 1938 was very moderate, most of the displaced cotton acreage having been planted to other feed crops. Alfalfa is grown in rotation with cotton, a practice which is necessary for the maintenance of satisfactory cotton yields. The alfalfa is fed in the valley, sold to surrounding stock ranches, trucked to the dry-farming area in eastern New Mexico, and a limited amount is shipped to markets in southeastern Texas and Louisiana.

The grain crops, principally corn and grain sorghums, rank third with respect to acreage. Virtually all of the production of these crops is used in the area for farm livestock and for fattening range sheep and cattle.

Vegetable and fruit production in the area is of rather minor importance from the standpoint of acreage, but makes a considerable contribution to the income of the area. Vegetable production has been increased in recent years. This has come about mainly through new opportunities for marketing in Texas by means of trucks. Further increases in production are in prospect. The principal vegetable crops grown include onions, tomatoes, carrots, and cantaloups.

Fruit production is confined largely to apples, though there is, in addition, a small acreage of peaches. The trend in this enterprise is toward a lower production. This is shown by the fact that many of the orchards have been taken out and very few replacements are being made. The combination of severe frost damage, increased difficulty experienced in controlling the codling moth, and the relatively low prices received for apples during recent years accounts for the declining importance of this enterprise.

LIVESTOCK

The principal livestock enterprise in the area is that of fattening range cattle and sheep. The combination of alfalfa, grain, and cottonseed meal, which are available in the area, is almost ideal for the feeding of livestock. Both lamb and cattle feeding are increasing in importance. The livestock is purchased from surrounding ranches or, in some cases, it is fed on contract or in cooperation with a near-by livestock producer.

The other livestock enterprises are of minor importance and the products are used largely for local consumption in the area.

TYPES OF FARMING

Cotton farming predominates in this area, as evidenced by the fact that 72 percent of the farms are classified as cotton farms. Alfalfa predominates on most of the crop-specialty farms, which make up 7 percent of the total number. The other types, with their percentages of all farms and ranches, are: general, 5 percent; part-time, 4; fruit, 3; dairy, 3; self-sufficing, 2; truck, 2; and poultry, 2. As a rule, general farms also have a considerable acreage of cotton and alfalfa, and in addition commonly carry on a feeding enterprise. The proportion of this type of farming is increasing.

Previous to the introduction of cotton into the Pecos Valley, alfalfa occupied a high percentage of the farm land. Most of this alfalfa was shipped to the cotton-producing areas of Texas and Louisiana. Later a shortage of irrigation water caused a reduction of alfalfa acreage. Therefore, when it was demonstrated that cotton could be grown successfully, the farmers, having found that it filled a need in three ways, adopted this crop rapidly. It provided a suitable crop to rotate with alfalfa, gave a greater return per acre, and resulted in greater diversity in their farming operations. Many farm operators went too far in cotton growing; i.e., to the exclusion of sufficient acreage of alfalfa to provide a satisfactory rotation. It was found that at least 25 to 30 percent of the farm land should be in alfalfa to maintain satisfactory cotton yields. The cotton-alfalfa rotation system was successful until the demand for alfalfa in the southern markets began to decline, a situation which increased the difficulty of disposing of all the alfalfa at a satisfactory price. As the alfalfa price was lowered, more grain sorghums were raised. This train of developments resulted in operators' being encouraged to feed lambs and later cattle, both of which were available on near-by ranches. The availability of feed; i.e., alfalfa, grain sorghum, and cottonseed meal; the mild winter climate; the fact that total freight charges are reduced by shipping fattened livestock rather than alfalfa; and the increased yields of cotton following applications of manure are factors having a stimulating effect on the feeding operations at present. This enterprise also provides profitable winter labor and aids in giving a balance to the farm organization.

COMPARISON OF THE ROSWELL-ARTESIA SUBAREA 10-A WITH THE CARLSBAD SUBAREA 10-B

In general, the farming systems of the two subareas (10-A and 10-B)

are similar, in that cotton is the principal product. However, certain differences exist which cause producers in each subarea to react differently to changes in price relationships between their various farm products. The difference in the amount of cropland per farm is an important factor in this regard. The average cultivated acreage of 87 acres per farm in subarea 10-A is approximately twice as large as that of 10-B. Operators of large farms are enabled to produce larger acreages of feed crops in addition to cotton, and thus can keep more livestock than can operators of small farms. This fact allows farmers in 10-A to practice a slightly more diversified system of farming. As a result, a smaller proportion of the land in 10-A has been planted to cotton than in 10-B. In 1930, 48 percent of the cropland in 10-A was in cotton, compared with 68 percent in 10-B. An additional incentive toward the raising of larger acreages of cotton in 10-B is the fact that higher yields of lint are obtained. The estimated yield per acre over the period 1928 to 1932, in-

Fig. 11.—Lamb feeding is an important farm enterprise in the irrigated areas of southern New Mexico.

clusive, was 365 pounds in 10-B compared with 320 pounds in 10-A. Cotton in 10-A has less advantage over other crops and thus a larger proportion of the land is planted to alfalfa, grain sorghums, corn, fruit, and vegetables than in 10-B. In times of low prices for agricultural produce, the farmers in 10-A, especially those with larger-than-average farms, are in a better position to adopt a livestock-feeding enterprise than those in 10-B, where the farms are smaller and the cotton yields are higher.

A study of the percentage distribution of farms among the various types also shows appreciable contrast between the two subareas. In 10-B, 87 percent of the farms were classified as cotton farms in 1929, while in 10-A, 64 percent were so classed. In 10-B, 13 percent were made up of nine types, crop-specialty, part-time, and general being the most

important; while in subarea 10-A several types other than cotton were of considerable importance. In this subarea, crop-specialty farms constituted 8 percent of the total number; general, 6 percent; part-time, 5 percent; fruit, 4 percent; dairy and self-sufficing, 3 percent each; and other types, 7 percent.

PROBLEMS AND ADJUSTMENTS

In any area in which one crop may be more profitable than others, there is always a tendency to swing too far toward specialized farming, from the standpoint of risks involved and the conservation of soil fertility. Many farmers in the area are still engaged in unbalanced farming. From the standpoint of correcting this situation, it is considered that in terms of averages for the entire area, cotton should occupy about 50 percent; alfalfa, 25 percent; and feed and miscellaneous crops, 25 percent of the irrigated land. This would allow for crop rotations and production of more manure through the feeding of additional livestock, which, in turn, would result in increased yields of cotton.

Many farms contain land that is not sufficiently level to irrigate properly. For the purpose of preventing the land from washing and in order to conserve irrigation water, terracing and leveling practices should be increased.

The marketing problems of this area revolve chiefly around alfalfa and truck crops. Marketing conditions for alfalfa hay in the outside market are quite variable from year to year in response to changes in crop conditions. Moreover, the demand for alfalfa in eastern Texas for feeding work stock used in farming and lumbering has been permanently reduced because of increased production of forage crops in that area. As a result of these conditions, the problem of finding other market outlets has become pressing. The high transportation charges on alfalfa hay to outside markets, relative to its market value, have often left little for the producer. In recent years, local feeding of livestock has become an increasingly important outlet. This enterprise is a specialized business, however, which requires a good deal of capital and which, on the present limited scale, has not solved the marketing problem of the small farmer with inadequate capital to assume the risks which feeding involves. In response to lower alfalfa prices, increased quantities have been fed on livestock ranches; also, the demand for alfalfa by dairies in the western Texas and eastern New Mexico oil fields has helped to move some of the hay, but has by no means compensated for the reduced demand in other areas. Unless other outlets are developed, it appears that an increase in local feeding will be necessary if the present acreage is maintained.

Texas and Oklahoma markets offer possibilities for an increasing outlet for truck crops produced in this area. To develop this market to the best advantage, producers in the area need to provide a dependable volume, to standardize the products, and to have them ready for market at a time when competitive conditions are most favorable, insofar as production conditions will permit.

AREA 11. THE HOPE IRRIGATED DISTRICT

GENERAL DESCRIPTION

Area 11 is a small irrigated district located on the Penasco River in northwestern Eddy County. It is situated on a gently sloping plain about midway between the Pecos River on the east and the foothills of the Sacramento Mountains on the west. The elevation of the area is approximately 4,000 feet above sea level.

This area is irrigated by diverting water directly from the Penasco River, which rises in the Sacramento Mountains 70 miles to the west. The flow of this stream is highly seasonal. As a result of the melting of snow in the mountains, the largest volume of water flows past the area during the spring months. The second largest seasonal flow occurs during late summer and is caused by the summer rains. Since no facilities for storing water have been provided, the frequent shortage of water in early summer has seriously interfered with crop production during recent years.

The development of the area began between 1890 and 1900 and reached its peak about 1919. At that time approximately 14,000 acres of cropland were irrigated. In those early years there was a plentiful supply of irrigation water, as is evidenced by the fact that at its highest peak of development approximately 40 percent of the cropland was planted to alfalfa and 20 percent to orchards, principally apples. At one time it was considered to be among the important fruit-producing areas in New Mexico.

According to Weather Bureau records for Fort Stanton, New Mexico, which is the nearest weather station to the Penasco watershed with a long series of records available, the yearly rainfall was above average during the majority of the years in which this area was being developed. At that station during the 20 years from 1900 to 1919, inclusive, the yearly precipitation was above the 57-year average 12 years, or 60 percent of the total 20 years, while during the period from 1919 to 1937, inclusive, the precipitation was above the average only 7 out of the 19 years, or approximately 37 percent of the time. Assuming similar rainfall trends on the Penasco watershed, the above data indicate that there was less irrigation water available to Area 11 from 1919 to 1937 than in the 19 years previous to 1919.

According to residents of the area, the flow of the River during recent years has been much more seasonal in nature than formerly, even in years of average or above-average precipitation. Many perennial springs are either now dry or flow intermittently. Flash floods occur more frequently and a great deal more silt is carried by them. Those who have observed the changes which have occurred in the watershed of this stream state that overgrazing has taken place to such an extent that the vegetative cover has been partially destroyed and that the water flows from the surface of the grazing lands into the arroyos at a rate too rapid to allow it to penetrate the soil. This condition is conducive to greater erosion and to a more irregular stream flow. The fact that along the stream in the mountain valleys above Area 11 there has been an increase in the acreage of crops which require frequent irrigation, such as vege-

tables, is thought by some to have contributed to the shortage of water.

Three factors were mainly responsible for the overdevelopment of the irrigated land from the standpoint of present supplies of irrigation water: Most of the land was either homesteaded or purchased at low prices, the rainfall was above the long-time average; and the development occurred during a period of rising prices, with especially favorable prices from 1915 to 1919. Since 1919, the scarcity of irrigation water, crop failures, and low economic returns have resulted in drastic decreases in crop acreages, only 3200 acres being irrigated in 1939. In 1936 the Government purchased 13,700 acres of land and reduced the number of water users from 60 to 40, the water rights on the purchased land being transferred to the remaining irrigated land in the area. Farmers on the project have the right to graze the purchased land, under a temporary use agreement, by the payment of a grazing fee.

CLIMATE

Climatic conditions are typical of much of southern New Mexico. The frost-free growing season averages 207 days in length, the average date of the first killing frost in the fall being November 1 and that of the last killing frost in the spring, April 8. The average annual precipitation over a 19-year period is 13.7 inches. The lowest yearly precipitation on record, 4.53 inches, occurred in 1924; while the highest, 24.85 inches, was recorded in 1932. Sixty-nine percent of the yearly precipitation, on the average, falls between April 1 and September 30.

SOILS

The soils of the area consist largely of sandy loams, which are comparatively deep and productive. They are alluvial in origin, rather high in organic matter, and are adapted to a wide range of crops.

CROPS

The important crops grown at present (1939) are those which have relatively low water requirements. Grain sorghums occupy approximately 57 percent of the irrigated acreage; cotton, 16 percent; cereals, principally wheat and oats, 16 percent; corn and apples, 4 percent each; and alfalfa, 3 percent. Most of the feed raised in the area is fed to livestock on the farms.

LIVESTOCK

From the standpoint of income received, dairy cattle are the most important class of livestock. There is an average of about 4 head of dairy cattle per farm, which in addition to furnishing home needs, contribute to the farm income by the production of butterfat for sale.

Range sheep and cattle are kept by a relatively few farmers who have range land available outside of Area 11. Hogs are of some importance. About 50 percent are used for home consumption, the remainder being sold in the territory adjacent to the project.

TYPES OF FARMING

In 1929, according to the United States Census, fruit farms constituted 36 percent of all the farms in the area. General farms that year made up 19 percent; crop-specialty, 19; part-time, 8; dairy, 7; stock farms, 2; cash-grain, 3; poultry, 2; and miscellaneous types, 4 percent.

Great changes have taken place in the relative importance of the types of farming carried on in the area since 1929. It is estimated that at present fruit farms make up not more than 3 percent of the total and that there are now no crop-specialty (alfalfa) farms. These have largely been replaced by general farms. The shift in farming types has been brought about, for the most part, by changes in factors governing the supply and distribution of irrigation water.

PROBLEMS AND ADJUSTMENTS

While major adjustments already have taken place in the agriculture of this area, an adequate and continuous supply of irrigation water is still the major problem. Since the water often comes as flash floods, the irrigation ditches are frequently unable to carry it and the flow is so short lived that the entire crop acreage cannot be irrigated. Such floods also damage diversion works and other structures. There is need for a retarding dam for the purpose of slowing up floodwaters, in order to allow for more efficient distribution to the farm lands.

Measures to improve the vegetative cover of the watershed and other soil-conservation practices are needed to prevent soil erosion and to lessen runoff.

AREA 12. SACRAMENTO MOUNTAIN AREA

GENERAL DESCRIPTION

This farming and ranching area is located in the Sacramento Mountains, mainly in Otero County, but it also extends into Chaves County on the eastern slope of the mountains. In the main, the farms are situated on the eastern slope along the Rio Penasco and its upper tributaries, namely, Chiquita Creek and the streams in Cox, James, Elk, and Silver Springs Canyons. Rather extensive farming is also engaged in on the McDonald and Miller flats and in the vicinity of Weed and Avis. Mountain farming is also done on the western slope in the vicinity of Mountain Park and High Rolls. Both irrigation and nonirrigation farming are practiced in this area, floodwater being used for some of the irrigating. Where irrigation is carried on regularly, the water is diverted from streams fed by melting snows, seasonal rains, and springs. While the supply from these sources is usually sufficient for the irrigable land, occasionally there is a shortage in June.

The altitude of this area varies considerably in different localities. The variation on the eastern slope is from approximately 5000 feet in the lower Penasco Valley to about 8000 feet in the upper canyon area. The elevation of the farming section on the western slope varies from 6000 to 6500 feet.

CLIMATE

The annual precipitation varies with the elevation and ranges from an average of 17 to 22 inches as higher elevations are reached. Rather heavy snowfall occurs at the higher levels. The length of the frost-free growing season likewise varies considerably, but averages about 150 days at intermediate elevations.

CROPS

Oats grown mostly for grain and barley for hay are the principal unirrigated crops. Corn is produced on nonirrigated land only in a few locations. Where flood irrigation is practiced, grain sorghums are the leading crops. Practically all farm operators are interested in livestock and the feed crops are used on the farm where produced or within the area. In the vicinity of Weed and Avis, wheat is seeded in August and early September for late fall, winter, and early spring pasture. Later, the wheatland is usually plowed or disked and planted to grain sorghum. Small grains for grain and hay are also produced without irrigation, at the higher elevations.

Under irrigation, corn is the principal crop at the lower elevations, below Mayhill, where excellent yields are secured. Alfalfa, also, is raised in this section of the area. At higher elevations, where the average summer temperature is lower, such crops as cabbage, lettuce, carrots, and cauliflower are produced successfully as cash crops. On the western slope near High Rolls and Mountain Park, apples are the chief cash crop.

In the past, before the development of efficient truck transportation, all of the apples which were sold outside of the area were transported by railway in carlot quantities. At that time, a very limited quantity of vegetables was produced. With the development of trucking and the improvement of roads leading into the area, virtually all apples move out by this method, and vegetable production has increased markedly as opportunities for marketing in Texas and elsewhere have developed.

LIVESTOCK

The range-livestock enterprise, consisting principally of cattle, with some sheep, is an important one in this area. About one-third of the land is in the National Forest, one-third is State land, and one-third is privately owned. Much of the private land lies within the boundaries of the Lincoln National Forest and is located in the small valleys and canyons. A portion of the privately owned land produces crops which are fed to winter livestock. Most of the farm operators have national-forest grazing permits and State-land leases, under some of which yearlong grazing is possible. At the higher elevations, however, the stock is kept off the forest from November to May.

Other operators, at lower elevations in the area, have little or no farm land, in which case the livestock is grazed yearlong, with supplementary feeding of cottonseed cake. Some use corn, barley, and alfalfa produced in the area or trucked in from other areas.

TYPES OF FARMING

From the standpoint of numbers, the general farms are the most important, approximately 21 percent falling in this classification. These farms, as a rule, produce corn, small grains, or vegetables, for sale, or a combination of these crops. They usually carry, also, a range-livestock enterprise. The area cropped on this and other types of farms averages about 40 acres per farm, varying from 11 to 125 acres. Commonly the general farms in the higher elevations which produce vegetables rank below average in size, while those at lower elevations which produce grain crops are larger than average.

The fruit farms, which rank second numerically, make up 19 percent of the total and are practically all located on the western slope of the mountains. Less damage from frost is experienced there than on the eastern slope. The fact that 67 percent of the farms on this slope are classified as fruit farms indicates the advantage which fruit, consisting principally of apples, has in this part of the area. The majority of these farms are comparatively small and their incomes are thus limited. The quality of the fruit, however, is excellent and very little difficulty is experienced in marketing the crop. Most of the apple crop is sold "tree run" to truck operators, who dispose of the larger portion in Texas.

Stock ranches make use of more land in the area than all the other types together, but rank third in numbers and account for approximately 18 percent of the total farms and ranches. Ranches in this area are comparatively small in size, averaging about 100 breeding cows each.

Small farms which employ the operator only a portion of the year and are thus classed as part-time farms, constitute about 13 percent of the total farm and ranch units. The operators of these farms find outside employment in the lumber industry, on stock ranches, and in connection with the tourist trade in Cloudcroft and vicinity. Ten percent of all the farms are in the self-sufficing group. The relatively large number may be accounted for, in part, by the fact that many people have come to the area for their health and have remained on small farms. In most cases, the operators of the self-sufficing farms of this area have other sources of income. The other types, in order of their importance, are crop-specialty, cash-grain, stock farms, dairy, and truck farms.

PROBLEMS AND ADJUSTMENTS

(1) The chief problem in this mountain area is soil erosion. This is serious because of the sloping land and the torrential rains which occur during the summer months. It is most serious on cultivated cropland, but also occurs on range land which has been overgrazed. Erosion may be retarded somewhat by terracing, contour farming, maintaining vegetative or crop-residue cover on the land where possible, and by practicing conservative grazing.

(2) Because of erosion and continuous cropping to clean-cultivated crops, the problem of maintaining the organic matter content of the soil is both important and difficult of solution in some parts of the area.

(3) Many of the farms and ranches are too small to be economically and efficiently operated units.

(4) Injury from insect pests and diseases is a serious problem to producers of fruit and vegetables. Efficient spraying by all orchardists would aid materially in insect control; and evidence points to a direct relationship between soil-fertility depletion and injury from disease in the production of vegetables.

AREA 13. TULAROSA-ALAMOGORDO IRRIGATED AREA

GENERAL DESCRIPTION

This is a small irrigation-farming area located on the plains at the foot of the Sacramento Mountains, near the towns of Tularosa and Alamogordo. The total acreage of crops in the area is governed by the amount of irrigation water available. There are approximately 2800 acres of cropland, but the average crop acreage harvested ranges between 2000 and 2500 acres. The elevation at Alamogordo is 4250 feet, and as the area is located in the relatively flat Tularosa Basin, the altitude varies only slightly.

CLIMATE

This area has a very mild, dry climate. The average annual precipitation is approximately 11 inches, which makes necessary the irrigation of all crops. A frost-free growing season of approximately 210 days assures the possible selection of a wide variety of crops. In general, the climate is very similar to that of the southern part of Area 15 in the Rio Grande Valley.

SOURCE AND SUPPLY OF IRRIGATION WATER

The supply of irrigation water is obtained from streams originating in the Sacramento Mountains. The supply is fairly reliable but somewhat seasonal in character, as no storage facilities are available. The largest flow comes in the spring with the melting of the snows, and in July and August, when heavy showers in the mountains occur.

CROPS

Cotton is the principal crop grown and is followed in importance by alfalfa, corn, and fruit. The soil is very productive and few of the farmers practice systematic rotations. Alfalfa stands are left 5 to 10 years before being plowed up and cotton is planted year after year on the same land, in most instances. While all of the alfalfa and corn not needed on the farms are sold to surrounding ranches, the area cannot supply the demand, and considerable quantities of feed are shipped and trucked into the general territory surrounding Area 13. Apples, the chief fruit crop, are transported out of the area entirely by trucks.

TYPES OF FARMS

The general farm is the most common type in this area, constituting about 22 percent of the total number of all farms. On these farms, as well as on other types which depend on crops for income, very little livestock is kept above that necessary to supply the home needs. Cotton farms constitute 16 percent of the total number; fruit and part-time farms, 14 percent each; alfalfa farms, 12 percent; dairy farms, 8 percent; poultry

and self-sufficing farms, 6 percent each; miscellaneous types making up 2 percent of the total. It will be observed that this is an area of mixed types, with no one type of outstanding importance. This is, no doubt, brought about by the fact that in a measure this is a self-sufficing area, in that most of the farm products are produced for local or near-by consumption, cotton and fruit being the only farm products that are raised for outside markets.

AREA 14. RUIDOSO, BONITO, HONDO IRRIGATED AREA

GENERAL DESCRIPTION

Area 14 is irrigated land which lies in the valleys of three comparatively small mountain streams. Two of the streams, the Ruidoso and Bonito Rivers, rise in the mountains, flow in an easterly direction, and join to form the Hondo River. Near their source the valleys are narrow, but gradually widen as the gradient becomes less. The farm land is distributed along these streams for a distance of approximately 35 miles and includes about 4760 acres. Most of the cropland in the valley proper is fairly well leveled. However, attempts have been made in some places to farm adjacent sloping land, which has resulted in an appreciable amount of erosion. At other points flash floods coming down arroyos which drain adjacent steep slopes have damaged the valley by washing soil or debris onto the farm land, thus making it exceedingly difficult to maintain level fields. The elevation of the area ranges from approximately 4300 feet at its lower end to 6300 feet at its upper extremity.

CLIMATE

Because of the altitude and proximity of the mountains, the climate of this area is relatively cool. The temperature rarely goes above 85 degrees in the summer and often falls below zero during the winter. At the lower altitudes the average annual precipitation is approximately 15 inches, which increases with the altitude to about 21 inches at the higher elevations of the area.

SOILS

The soils are alluvial in nature, are comparatively deep, and vary considerably in texture. In general, loams of medium texture predominate throughout the area, although on the higher benchland, clay loams are most important, while at the mouths of arroyos fan-shaped areas of sand and gravel are to be found.

SOURCE AND SUPPLY OF IRRIGATION WATER

Irrigation water is supplied to the farm land in this area by direct diversion from the streams by means of dams. Some of these dams are of temporary construction, built of timbers and brush, while others are of concrete. Because of the lack of storage, the water supply is seasonal in nature, being greatest in April and May because of melting snows, and again in July and August, when the rainfall is at a maximum. In spite of the seasonal character of the water supply, crops in this area

seldom suffer seriously from lack of water, although in years of light snowfall in the mountains, June is a rather critical month. This is especially true if rainfall is also deficient during that month. Some provision for storage is needed to supply irrigation water during short periods of deficiency.

CROPS

In 1937, approximately 80 percent of the cropland of this area was used for the production of four crops of about equal importance from the standpoint of acreage, i.e., apples, alfalfa, corn, and cabbage. The remaining 20 percent of the land was used that year for miscellaneous crops, such as small grains, sorghums, and vegetables other than cabbage.

Apples are produced largely in the lower half of the area. Conditions in general are comparatively favorable for their production, since the soil is deep and well drained, frost damage is usually not so severe as in areas lower in altitude, and the codling-moth infestation is comparatively light. That apple production is relatively successful is indicated by the fact that considerable acreages of new plantings have been made within the past ten years. With the improvement of the highway through the area and the development of truck transportation, new market outlets for the apple crop have been developed throughout western and southern Texas. Most of the apples are sold in bulk to truck operators at the farm, whereas in former years the crop was graded, boxed, and hauled from 30 to 40 miles for shipment to central markets. The present system of marketing is the more economical of the two.

The alfalfa and corn produced in the area are used for feed on the farms and the surplus is sold principally to surrounding livestock ranches.

Cabbage, the chief vegetable crop, is also sold largely in Texas and is transported by trucks. The crop is marketed in October and November and ordinarily commands ready sale on the Texas markets.

LIVESTOCK

On the smaller farms containing little or no grazing land, no commercial livestock production is carried on. Operators of some of the larger irrigated farms own adjacent grazing land and, in addition, obtain national-forest grazing permits for a few head of cattle. These cattle are fed on the farm and pastured on alfalfa fields during a portion of the winter.

TYPES OF FARMING

Small farms are typical of this area, the average size being 26 acres each. Thirty-three percent of the farms are less than 20 acres and 22 percent are less than 10 acres in size.

Part-time farms are most numerous, accounting for 22 percent of the total number in the area. Operators of these farms find employment on near-by ranches, in the larger orchards, and in road construction. Truck farms make up 19 percent of the total and rank second in numbers. Most of these specialize in cabbage production and also have limited acreages of carrots, onions, cauliflower, celery, and beets. Self-sufficing and crop-specialty farms each constitute 15 percent of the total. Al-

falfa is the principal crop on the crop-specialty farms. The remaining types of farms, in order of importance, are: general, 12 percent; stock, 7 percent; fruit, 4 percent; and miscellaneous types, 6 percent.

PROBLEMS AND ADJUSTMENTS

Irrigation Water.—The problem of adequate supplies of irrigation water during the growing season is of importance in this area. Storage facilities on the Ruidoso River above the area would provide an ample supply to most of the area.

Soil Fertility and Plant Diseases.—On many farms constant cropping to corn and cabbage has resulted in depleting the soil of organic matter and plant-food elements. This has resulted not only in lowered yields, but also has caused the land to become infested with black rot and other diseases. More crop rotation with alfalfa or other soil-building crops is necessary. Such rotations, however, are difficult to use on the smaller farms in the area.

AREA 15. MESILLA-RINCON VALLEYS

GENERAL DESCRIPTION

The Mesilla-Rincon Valleys are an irrigated area situated in the valley of the Rio Grande in south central New Mexico. It consists of two separate irrigated tracts, which have been designated as subarea 15-A (the Mesilla Valley) and subarea 15-B (the Rincon Valley). These two subareas are separated by the hills extending down to the River on each side, there being virtually no irrigable land for a distance of about 12 miles. The elevation varies from approximately 3800 to 4200 feet above sea level.

The area in general is very level, except for old river channels which are to be found in various places. The gradient of the River through the area, which averages a little less than 5 feet to the mile, was insufficient to cause the water to carry its load of sand, silt, and clay. This resulted in the stream bed's being built up to such an extent that the water overflowed its banks, formed new channels, and caused the seepage of lower-lying lands. This was repeated many times and several old channels can be traced through parts of the valleys. Since the building of the Elephant Butte Dam (completed in 1915), located approximately 80 miles northwest of Las Cruces, the danger of floods has been minimized and the river channel has been stabilized. A system of open drains provides drainage for the area. The river channel through the area is being straightened, which will further reduce flood damage, decrease evaporation losses, and provide for the drainage of additional land bordering the River. Caballo Dam, finished in 1938, is an auxiliary structure located 20 miles below Elephant Butte Dam. This serves to regulate the flow of irrigation water, makes possible the generation of electricity at Elephant Butte Dam by holding a reserve of water when not needed for irrigation, and lessens the possibility of floods in the valley below.

CLIMATE

Extreme temperatures are seldom experienced in this area, the temperature rarely going below 12 degrees above zero or above 100 degrees.

The precipitation averages 9 inches a year, most of which falls from July to November, inclusive. These five months have approximately two-thirds of the total yearly rainfall. Snow is not common in this area. The average relative humidity is only 50, which, together with a large percentage of clear days (228 a year on the average) results in an evaporation of 64 inches a year from a free water surface. This, together with low precipitation, emphasizes the necessity of liberal applications of irrigation water for satisfactory crop production.

According to records covering a period of 36 years, the area has an average frost-free growing season of 200 days. The average date of the first killing frost in the autumn is October 26 at State College, although frost has occurred as early as October 1. The average date of the last killing frost in the spring normally is April 9, but frost has occurred as late as May 8.

SOILS

The soils in this area consist of alluvial material laid down by the Rio Grande. The mass of sediment, varying from adobe clay to sand, brought by the River and deposited in an earlier period, has given rise to a very complex soil pattern. Six or more soil types are frequently encountered in a square mile and five or six variations in texture are not uncommon in a six-foot boring. A considerable amount of sediment, consisting of silt and clay, has been deposited on the surface by irrigation water.

In general, the soils of the area have high lime and organic-matter contents, which render the heavier types rather friable. They have been classified largely as belonging in the Gila series, five types being differentiated. In the central part of the area around Las Cruces and State College, the Gila clay and the Gila clay adobe predominate, while in the northern and southern parts Gila silt loam is found over larger areas. The Gila clay adobe is the heaviest type found in the area. This contains 70 percent of clay and 27 percent of silt. It is very productive but is difficult to handle, satisfactory seedbeds being especially difficult to prepare. Gila clay contains 46 percent clay and 43 percent silt and is more friable than the Gila clay adobe soil. The Gila silt loam contains 26 percent clay, 62 percent silt, and 11 percent very fine sand and is the best all-purpose soil found in Area 15. Interspersed with these types are small areas varying from fine sandy loam to pure sand.

In general, the soils are very productive and the area, as a whole, shows soil adaptation to any crop which can be grown within the climatic limitations. Drainage is accomplished efficiently by means of open drains, which have kept saline deposits largely under control.

IRRIGATION WATER

Irrigation water for this area is obtained from water impounded by the Elephant Butte Dam, located on the Rio Grande near Hot Springs. The River channel is used to bring the water from the reservoir to Caballo Dam. Here the flow is regulated for irrigation purposes. Below Caballo Dam the irrigation water is diverted from the River into main

canals at appropriate locations by dams, and then conducted through laterals to the farms. The irrigation system, including Elephant Butte Dam and the irrigation and drainage structures, is a Federal reclamation project. Since the construction of the Dam the supply of irrigation water has been adequate.

CROPS

The main crops grown in this area, in the order of their importance, are cotton, alfalfa, corn, sorghums, vegetables, and fruit—largely apples. Cotton is grown in all parts of the area and is of such importance that the entire farming system is built, to a large extent, around this enterprise. Previous to 1919 alfalfa was the principal cash crop. The acre-

Fig. 12.—Cotton is the most important crop in the irrigated valleys of southern New Mexico.

age devoted to cotton was less than 1 percent of the total crop acreage of the Valley in 1919. It then increased to 65 percent of the total crop area in 1925, thus changing the entire cropping system within six years. Under the price relationship following 1925, it continued to increase until 1929. With the fall in cotton prices and the inauguration of the Agricultural Adjustment Program the acreage has been materially reduced.

A factor favorable to the maintenance of a high percentage of the land in cotton is the relatively high average yield of lint. During the period in which cotton acreage was increasing, that is, from 1919 to 1929, an average of slightly over 400 pounds of lint cotton to the acre was obtained. The average yield per acre from 1934 to 1938 was approximately 620 pounds. These influences have appeared in recent years to increase the yield. First, with larger alfalfa acreage, a greater proportion of the cotton was planted after alfalfa; second, in reducing the cotton acre-

age the lower-yielding land was devoted to other crops; and third, improved strains of cotton are being grown.

During the period from 1919 to 1929 the alfalfa acreage varied only slightly but because of the increase in the area irrigated, the proportion of crop acreage in alfalfa dropped from 23 percent in 1919 to 16 percent in 1929. Under the influence of the Agricultural Conservation Program, the acreage of alfalfa has been increasing. During this period the alfalfa produced in the area above the amount used locally for farm stock was shipped to the southern cotton belt, principally to southeastern Texas. The increase in production of forage crops in the Southern cotton states has caused a decline in the demand for alfalfa in that area, and has tended to lower alfalfa prices in Area 15. Slight increase in the fattening of livestock represents one adjustment which has taken place as a result of the lower alfalfa prices.

In 1934, corn occupied about 11 percent of the irrigated acreage. This is insufficient to supply the demands of the area and this grain is shipped in to fill the needs. In other words, corn has not been able to compete with cotton as a cash crop, under the price relationships which have prevailed.

Sorghums, which rank fourth as a crop enterprise, occupied 5 percent of the cropland in 1934. About three-fourths of this acreage consisted of sweet and grain sorghums cut for ensilage and fodder, while one-fourth was grown for grain. Corn is preferred for grain because of higher yields, higher feeding value, and the fact that a smaller percentage of it is eaten by birds. The ensilage is used in feeding dairy cows and fattening beef cattle.

Truck crops and vegetables are of rather minor importance. The only vegetables shipped out of the State from this area have been cantaloups, sweet potatoes, cabbage, tomatoes, and onions. These crops have given way in competition with cotton until at present cantaloups are the only truck crop moving in appreciable volume, with an occasional car of onions and sweet potatoes. The shipments of cantaloups have shown a tendency to run in cycles, increasing for 2 or 3 years, then decreasing for a like period. The average yearly shipment (10 years, 1927-1936, inclusive) was 381 cars.

Fruit occupies only about 1.5 percent of the irrigated land and consists largely of apples. This enterprise is decreasing, for very few replacements are being made as old trees are pulled. Pecans show some promise as a cash crop. Within the past three or four years a few thousand acres have been planted to Texas or other Gulf State varieties.

LIVESTOCK

The trend of all livestock numbers, except poultry, in this area has been downward as cotton acreage increased and replaced feed crops. At present (1939) dairy cattle are the most important class of farm animals, although commercial dairy production is engaged in on a relatively small number of farms. In recent years with an abundance of relatively low-priced alfalfa, cottonseed meal and hulls, there has been a moderate increase in the cattle- and sheep-feeding industry, the continuance of which

will be conditioned by the comparative prices of alfalfa and cotton. Hogs and poultry are raised for local consumption only.

TYPES OF FARMING

The importance of cotton farming in the area is shown by the fact that 78 percent of the farms were in this class in 1929. The other types of farms, all of minor importance and ranging from 1 to 5 percent each of the total number, consist of part-time, dairy, general, crop-specialty, and poultry.

Cotton farms vary greatly in size, from less than 15 acres to more than 1,000. However, the average size is approximately 44 acres. A typical cotton farm has about 40 acres of crops, consisting of the following approximate acreages: cotton, 25; alfalfa, 10; corn or other feed crops, 3; and 2 acres in garden, orchard, or miscellaneous crops. The livestock consists normally of 3 horses, 2 cows, 25 to 50 chickens, and a hog to be fattened for home use. From the standpoint of utilization of the operator's time and his ability to establish an efficient rotation, a crop area of 40 acres is too small.

The large amount of labor needed on the cotton farms is hired principally on a contract basis. The cotton chopping and hoeing is done by day laborers or by contract on an acre basis, while picking is always hired on a hundredweight seed-cotton basis. Tractors have rapidly replaced horses for field work. This change has resulted in a tendency for operators to lease more land in addition to the acreage previously operated with horses.

The part-time farms are located near the towns and villages. The farms are usually small and outside employment is obtained on larger farms and in various industries. Operators of dairy farms obtain their income from the sale of fluid milk in Las Cruces, El Paso, and other nearby population centers. Relatively high feed prices, due to inability of feed crops to compete with cotton for land, have in the past precluded the possibility of profitable production of butterfat for the general market. The small number of poultry farms is caused by the relatively high costs of production, which tend to limit the market for eggs to local and nearby markets.

SUBAREA 15-A. MESILLA VALLEY

This subarea is the southern part of Area 15. It contains approximately 56,000 acres of irrigated land located in Dona Ana County and extends north from the southern boundary of New Mexico to Radium Springs, a distance of about 60 miles. In general, the land is well leveled and is in a comparatively high state of cultivation.

Cotton is the principal crop, the average yield per acre being higher than in any other cotton area in the State. The soils of the southern half of 15-A average slightly higher in productivity than those in the northern half. In 1934 cotton occupied approximately 56 percent of the total crop acreage. Variation within the subarea is illustrated by the fact that in the La Mesa precinct, located in the southern half, 62 percent of the land was in cotton, while in precinct 20 of Las Cruces, in the northern half, only 47 percent of the land was so used.

The greatest competition for land exists between cotton and alfalfa; the latter crop occupied about 20 percent of the total crop acreage in 1934. Both are cash crops and the relative net return is a large factor in determining the proportion of the land occupied by each, although other considerations enter into the choice of alfalfa, such as the need for a leguminous rotation crop and feed for farm stock.

Feed crops made up about 15 percent of the crop acreage in 1934, corn accounting for 10 percent and sorghums for 5 percent. These crops are used for feed on the farms. In periods when the price of alfalfa is sufficiently low to encourage the fattening of livestock, the acreage of corn and sorghums is somewhat increased.

Truck crops, consisting principally of cantaloups, onions, and sweet potatoes, occupy about 3 percent of the land. Most of these crops, except cantaloups, are transported out of the subarea by trucks and are marketed in western and southern Texas.

Fruit crops, consisting principally of apples and grapes, together with smaller quantities of pears and peaches, are of minor importance and occupy only 1.7 percent of the acreage.

Other minor crops are sugar beets grown for seed, small grains cut for hay, and green manure crops, such as sesbania.

TYPES OF FARMING

A study of the distribution of types of farming in this subarea shows the importance of cotton more realistically than does the percentage of land devoted to this crop. In 1929, 85 percent of the farms were classed as cotton farms. The other 10 types made up the remaining 15 percent, with no one type representing more than 3 percent of the total number of farms.

SUBAREA 15-B. RINCON VALLEY

The Rincon Valley subarea lies in the Rio Grande Valley northwest of subarea 15-A (the Mesilla Valley). It extends along the River from approximately 10 miles south of the town of Rincon to Caballo Dam on the north.

Most of the land has been developed and brought under cultivation more recently than that in the Mesilla Valley. Because of this fact, many of the farms are not so completely leveled nor so well improved. On the average, the soils are of lighter texture and produce slightly lower yields of cotton than those of the Mesilla Valley. Because of these facts, cotton occupies a smaller proportion of the crop area than in subarea 15-A, and alfalfa and corn are of considerably greater importance. In 1934, 30 percent of the land was planted to cotton, 27 percent to alfalfa, 21 percent to corn, and a total of 22 percent to miscellaneous crops, including sorghums, truck crops, and cereal grains.

As a result of this cropping system, sales of alfalfa and corn contribute a larger proportion of the total farm incomes than they do in the Mesilla Valley. A considerable amount of these crops, together with cereal crops cut for hay, is sold to the ranching and mining industries in the mountainous area to the west. A larger proportion of these feeds

is also fed on the farms to dairy cattle than in the Mesilla Valley. Tomatoes rank first among the truck crops, virtually the entire production being processed by canning factories in Hatch.

TYPES OF FARMING

A study of the distribution of the types of farming in this subarea shows much less uniformity than in the Mesilla Valley. In 1930 only 48 percent of the farms were classified as cotton farms. Other types of farms ranked, in order of importance, as follows: General farms constituted 12 percent of the total number; self-sufficing, 11 percent; crop-

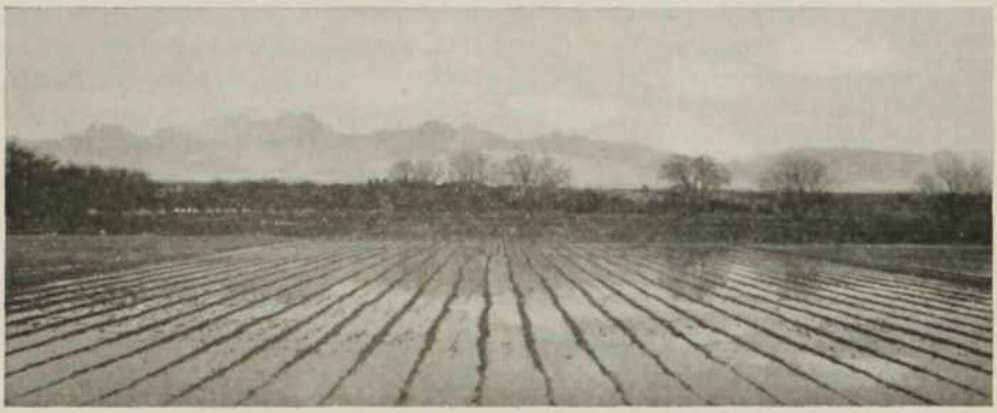

Fig. 13.—Well-leveled fields are essential to the efficient utilization of irrigation water.

specialty, 7; part-time, 7; dairy, 5; truck, 4; cash-grain, 3; and miscellaneous types, 3 percent. General farms in this subarea practice a limited amount of diversification of crops and in some instances include the dairy enterprise in their organization. The income of crop-specialty farms comes largely from the sale of alfalfa, while corn is the most important source of income of the cash-grain group. The dairy farms obtain their income from the sale of whole milk, most of which is hauled by truck to El Paso.

PROBLEMS AND ADJUSTMENTS OF AREA 15

The problems confronting the farmers in Area 15 may be classed under three general heads: (1) The overhead and cash costs per acre are high, making the reduction of unit costs important; (2) with a high percentage of the land in soil-depleting crops, the maintenance of soil fertility is probably deserving of greater consideration than it has received in the past; (3) because of high transportation costs, the market outlets for most products other than cotton are restricted.

Unit production costs may be reduced through two approaches. The first method may be by more efficient production. The average-sized farm of approximately 44 acres is not the most efficient economic unit for cotton production. Overhead costs per acre are lower on the larger farms; in addition, machinery is used more efficiently, tending to reduce operating costs. In the case of alfalfa, especially, labor costs are being reduced on the larger farms. The alfalfa is put in windrows with side-delivery

rakes, and power balers pulled by a tractor pick the hay fom the windrow and bale it in one operation. In some cases the bales are elevated to a trailer and in others they are left on the ground to be picked up later. Two-row cotton planting and cultivating equipment and four-row cotton dusters drawn by tractors are also used to some extent. Such equipment is not practical on small farms. Unit costs are also being reduced on many farms through increased yields without correspondingly increased costs. Through the use of barnyard manure, green manure crops, and rotations with alfalfa, yields of two bales of cotton to the acre are commonly secured, in comparison with approximately a one-bale average for the area. Yields on fields continuously cropped to cotton have not dropped to any extent, because of the facts that the fields have been made more nearly level, better strains of cotton have been introduced, better cultural practices have been adopted, and cotton has been grown in the area for approximately only 20 years. Yet, from the standpoint of continuous agriculture in the area, the maintenance of soil fertility is an important consideration.

The principal markets for the products of the area are located at considerable distances, and thus high freight costs are incurred on products so marketed. Consequently, bulky products of low specific value, such as hay, must find a near-by outlet. At present most of the alfalfa produced is consumed in the immediate vicinity. The practice of converting such bulky products as alfalfa, silage, and cottonseed hulls into slaughter beef for sale at central markets is increasing slowly in the Valley. Many of the vegetables produced in the area are ready for market in August and September, at a time when the markets are well supplied. The low prices during this season of the year, together with high transportation costs, have caused vegetable production in the past to be less profitable than cotton. An exception to the latter statement may be made in the case of a limited production, which may be transported by trucks and sold in near-by States.

From a farm-management standpoint, cotton is the essential enterprise in the organization of the bulk of the farms in the area. The other enterprises are largely complementary, in that they further the comparative advantage of cotton over that of other crops.

AREA 16. DEMING PUMP-IRRIGATED AREA

GENERAL DESCRIPTION

The Deming pump-irrigated area is centrally located in Luna County, New Mexico. It forms but a small part of an extensive, fairly smooth plain that slopes gradually to the east and southeast. It embraces within its borders approximately 176,000 acres of land lying on each side of the channel of the Mimbres River, which, in this area, is an intermittent stream. Only when the flow of the River is at very high flood stage is water to be found in the River channel within Area 16.

Of the 176,000 acres of land contained in the area, about 55,000 acres are in farms, and of the land in farms, only 7,000 acres or thereabouts are irrigated. Thus, less than one-third of the total land area is in farms,

and of this, less than one-eighth is irrigated cropland. Practically all land not irrigated is semidesert grazing land which requires approximately 60 acres to carry an animal unit on a yearlong grazing basis. No crops are produced without irrigation and the irrigation water used is pumped from a subterranean supply. The depth from which the water is pumped varies from about 30 feet to over 100 feet, the average being about 70 feet.

Area 16 lies at an average elevation of about 4300 feet. Its surface is generally smooth, with sufficient slope to irrigate efficiently. In places the surface of the nonirrigated land is hummocky, owing to wind erosion. The area is served by the Southern Pacific and the Atchison, Topeka and Santa Fe Railroads and by U. S. Highways 70, 80, and 260. Deming, the largest town of the area, is the county seat of Luna County and has a population of about 3400. The Southern Pacific Railroad shops, a creamery, and a cotton gin are located at Deming.

CLIMATE

This area has the typical southern New Mexico climate. Relatively high temperatures occur during the summer months, when maxima of 100 to 108 degrees may occur. While winter temperatures below zero have been recorded, the temperature rarely declines to as low as four or five degrees above zero. The mean annual precipitation at Deming is 9.11 inches, approximately 65 percent of which falls between April 1 and September 30 and 43 percent during July and August. The summer rains are frequently torrential in character. The length of the frost-free growing season averages 216 days and has varied from 177 to 234 days. The average date of the last killing frost in the spring is March 28 and of the first killing frost in the fall, October 30. This gives a wide range in time for planting crops in the spring. For example, early potatoes are planted in March, cotton in April, and grain sorghums and pinto beans in June. The predominating winds are from the west. Winds sometimes damage spring-planted crops, especially cotton. Spring winds are also responsible for a limited amount of soil blowing.

SOILS

The soils of Area 16 consist of three series, namely, the Mimbres, Mohave, and Karro. The Mimbres is the most important of the three and occupies about 46 percent of the area. It is made up of four soil types, as follows: silty clay loam, occupying 21 percent; fine sandy loam, 16 percent; loam, 6 percent; and silt loam, about 3 percent.

The two soil types cultivated most widely are the silty clay loam and the loam. These two types are 5 feet or more deep, productive, have a high water-holding capacity, and do not blow to any great extent. The areas occupied by the silty clay loam are comparatively smooth and require but little clearing and leveling when put under irrigation. Of the area occupied by the loam type, about one-half is slightly hummocky, a condition which increases the expense of clearing and leveling for irrigation. Although all crops produced in Area 16 are grown on the soils of these two types, onions do better on the loams than on the silty clays.

The fine sandy loam is cultivated only to a limited extent. However,

this type is well adapted to the production of truck crops. The surface of the areas occupied by this type is not uniform and the water requirement is high. The silt loam is less productive than the other types and in many instances is nearly bare of vegetation.

The soils of the Mohave and the Karro series are cultivated but very little. This is because of shallow depth (caliche frequently being near the surface) and the presence of mounds of wind-blown material on the surface.

The problems of drainage, seepage, and soil salinity are not important in this area. Wind erosion of the lighter soils and especially of abandoned cultivated land has been of some importance. While a small amount of wind erosion occurs in some of the cultivated fields under irrigation, farmers are now using cultural practices which tend to keep such erosion under control.

SOURCE AND SUPPLY OF IRRIGATION WATER

The watershed supplying the underground reservoir from which water is pumped consists of approximately 900 square miles of land lying north and west of Deming. This watershed varies in elevation from 4300 feet at Deming to about 10,000 feet on the summits of some of the peaks of the Black and Mimbres mountain ranges. The precipitation of this watershed falls both as rain and snow and drains into the Mimbres River. A few miles above Deming the water of this stream disappears and supplies much of the water of the underground reservoir from which pumping is done.

The use of water for all purposes in 1929 was estimated at 10,500 acre-feet, and the average annual recharge, at 10,000 acre-feet. Since the water level has dropped from two to fifteen feet in various parts of the area, it appears that the recharge has not been as great as the amount pumped out.

The law, previously mentioned, passed by the New Mexico legislature in 1931, placing the development of irrigation by pumping from underground water supplies under the direction of the State Engineer, has restricted material expansion of pump irrigation in this area during recent years.

CROPS

Water requirements, the cost of pumping, and relative incomes are the principal factors that determine what crops are given preference in the use of land. The more important crops grown include pinto beans, cotton, grain sorghums, potatoes (both early and late), corn, and alfalfa. Some vegetables, especially tomatoes and melons, are also grown. In 1934, 38 percent of the irrigated land was in pinto beans, 25 percent in grain sorghums, 7 percent in corn, 6 percent in alfalfa, 5 percent in cotton, 4 percent in Irish potatoes, 3 percent in other truck crops, and 12 percent in miscellaneous crops. The acreage in cotton was unusually low in 1934, because of the burning of the local cotton gin a few years previously.

The cotton acreage was second to beans in 1929 and again in 1937 and 1938, after the building of a new cotton gin.

Pinto beans (as a cash crop) and grain sorghums and corn (grown for feed) are the crops grown most extensively. Potatoes and tomatoes are the more important minor cash crops. These minor crops find a market outlet in the mining districts of New Mexico and Arizona and to some extent in western Texas. Cotton is adapted to both light and heavy soils. It is a favorite crop on the large farms and on the heavier soils, where but little damage results from soil blowing. The acreage of alfalfa is comparatively small, because of the large amount of water which this crop requires. A few farmers grow alfalfa to meet a limited local demand from dairymen and ranchmen.

LIVESTOCK

Livestock production is relatively unimportant on the majority of farms. From one to three milk cows and a small flock of chickens are generally kept per farm to supply the family with dairy and poultry products. A few operators of irrigated farms located on the margin of this irrigated area who have access to the adjacent grazing lands have small herds of beef cattle. Winter feeding of lambs and cattle is not engaged in at all extensively in this area.

TYPE OF FARMING

The agriculture of Area 16 is primarily a cash-crop type of farming, pinto beans, cotton, and potatoes being the principal cash crops grown.

Crop-specialty farms in 1929 constituted approximately 37 percent of all the farms of the area. They averaged 182 acres in size and contained 69 acres of harvested cropland and 113 acres of pasture, wasteland, and farmstead. The special crops which characterized this type are pinto beans, Irish potatoes, and alfalfa; the beans being the leading crop.

Cotton farms, which are second in importance, made up 13 percent of the total number. They averaged 279 acres in size and contained 110 acres of harvested cropland and 169 acres of other land. The cotton farms are located mostly on the silty clay loam soils, which are the least susceptible to blowing. Approximately 79 percent of the total acreage of crops harvested in 1929 was on the crop-specialty and cotton farms, 48 percent on the former and 31 percent on the latter.

Poultry farms constituted 14 percent of the total number in 1929; general, 10 percent; dairy, 8; part-time, 7; self-sufficing, 6; and stock farms, 3 percent. The general farms harvested an average of 30 acres of crops per farm; stock farms, 29 acres; truck, 26; self-sufficing, 16; dairy, 15; poultry, 10; and part-time, 3 acres.

PROBLEMS

The supply of irrigation water is limited to the natural recharge of the subterranean reservoir lying under the area; the average area under irrigation per farm is low and cannot be greatly increased, because the amount of water being pumped out of the subterranean reservoir annually appears to be equal to or slightly in excess of the annual recharge; the cost of pumping is a heavy burden and during the two-year period

1933-34 ranged between $6.72 an acre for hegari and $22.33 an acre for alfalfa. Alfalfa, tomatoes, and early potatoes are the crops of comparatively high water requirement, and hegari, pinto beans, cotton, corn, and late potatoes the relatively small users of water. Another problem confronting the farmers in this area is the fact that the local market outlets are limited, especially for the intensive crops.

At the present time (1939) the problem of high cost and limited supply of irrigation water is being met, at least in part, by devoting a rather high proportion of the irrigated land to three crops of low water requirement (pinto beans, cotton, and hegari) and by growing only such acreages of the intensive crops (potatoes, tomatoes, melons, onions, etc.) as can be marketed readily and for which water can be spared. There is always a general market for beans and cotton, though the prices have at times been low; and the hegari is usually fed on the farms where grown. Those three crops, however, are soil depleting and when grown extensively tend to reduce soil productivity. Alfalfa is greatly needed in the cropping system to maintain the fertility of the soil, to furnish a leguminous hay for dairy cows and feed for range livestock, and finally to permit of a more nearly balanced type of farming than now prevails. An increase in the winterfeeding of range cattle, using the grain sorghums, bean hulls, cottonseed meal, and winter wheat or rye pasture (the wheat or rye being planted on potato land soon after the early crop has been harvested) should aid materially in maintaining soil productivity and in furnishing profitable labor during the winter months.

AREA 17. UPPER MIMBRES VALLEY IRRIGATED AREA[1]

GENERAL DESCRIPTION

Area 17 is situated mainly in eastern Grant County. It extends from north central Luna County in a northerly direction along the Mimbres River to the Gila National Forest in Grant County, a distance of about 30 miles. The cultivated land lies in many narrow strips along the Mimbres River in the floor of the valley of that stream. These strips vary in width from a few hundred feet to one-half mile and in length from about one-half mile to 6 miles. The elevation ranges from about 5000 to 6500 feet.

The principal development of the area took place from 1870 to 1885. However, it is claimed that a limited part of the land was farmed prior to 1865. The area irrigated since 1900 has fluctuated between 2600 and 3600 acres, the acreage for any one year depending on the availability of water for irrigation. This area is said to have been one of the most prosperous of the small farming districts of New Mexico from early in the seventies to 1915. During at least the early part of that period, it enjoyed a monopoly in the fresh-vegetable and fruit markets of the near-by towns and mining and army camps. The market for these products remained good until the advent of the motorized truck and improved roads.

[1]Compiled largely from a report on a farm-to-farm study in the Upper Mimbres Valley by J. W. Boutz, Soil Conservation Service, United States Department of Agriculture.

The population of the area varies from about 1100 to 1600. When the demand for labor in the mines of the region is good, the farm population decreases, and when the mining activities drop off, this population materially increases. The nonfarming population, which has been estimated at 600, also fluctuates more or less from year to year.

This area is occupied largely by Spanish-speaking people. In September 1937, 2601 acres were being irrigated. There were 84 owner-operated units. One of these controlled 474 acres and three others a total of 362 acres. The remaining 1765 acres belonged to 80 individuals or estates, the average size being 22⅝ acres each. The typical size of these holdings, however, is smaller than the average, since a few holdings are relatively large and bring up the average.

CLIMATE

The climate of this area is somewhat different from that of much of southern New Mexico, because of its higher altitude and its proximity to mountains. There is usually an abundance of sunshine, and compared with areas out on the plains, there is a minimum of wind. The length of the growing season varies considerably, the frost-free periods being about 170 days in the southern and about 150 days in the northern part of the area. The mean annual precipitation varies from about 10 inches at the extreme southern part of the area in Luna County to approximately 16 inches at its upper extremity in Grant County. This variation is attributable to variations in elevation and to proximity to the mountains. Floodwaters rushing down the Mimbres River and coming into the Valley from lateral drainage channels do considerable damage by cutting the riverbanks, by depositing debris on the cultivated fields, and by washing out diversion dams. Old settlers of the area estimate that from 600 to 1000 acres have been destroyed by bank cutting and otherwise.

SOILS

Virtually all of the irrigated land of Area 17 lies in the floor of the Mimbres River Valley. The soils are alluvial and vary from sandy and gravelly loams of fair productivity to very fertile clay loams. The subsoils consist of coarse sand and gravel. In no part of the area has the accumulation of saline material become sufficient to be detrimental to crop production. Drainage is a problem in only one small area.

SOURCE AND SUPPLY OF IRRIGATION WATER

The water for Area 17 is obtained by direct diversion from the Mimbres River, which has a continuous flow through this area. The flow of the River is very erratic, sometimes the decrease being sufficient to cause a reduction of as much as 30 percent in the harvested acreage. There are 31 diversion dams and 33 ditches conducting the water from the River to the irrigated land. All of the dams are temporary and must be repaired after high flood. This makes for an irregular and delayed delivery of the water. While the ditches are large enough to deliver sufficient water under a continuous flow, they are entirely too small to handle the water of flash floods, which seldom run more than 12 hours.

CROPS

In 1937 the irrigated land of this area was used as follows: Approximately 32 percent of the total acreage was devoted to corn, 24 percent to Johnson grass pasture, 19 percent to alfalfa, 8 percent to dry beans, 8 percent to truck crops and home gardens, 7 percent to miscellaneous fruits, and 2 percent to miscellaneous field crops. Seventy-four of the farms produced corn; 66, truck crops and gardens; 59, miscellaneous fruits; 42, field beans; 7, small grains; 5, sorghums; and 1 produced cotton.

LIVESTOCK

Farm flocks of poultry were carried on 62 farms; milk cows on 54 farms; and family requirements for pork were produced on 40 farms. Twenty-five farms were operated in more or less close relationship to range livestock production and one was devoted almost entirely to the production of Johnson grass pasture to supplement the near-by range forage.

SOURCES OF INCOME

Twenty-nine farm operators in 1937 depended entirely on the income from their farms for their living; twenty-five had incomes from both their irrigated land and range livestock; eight owned and operated stores; four drove school buses; and 40 supplemented their incomes from their farms by working in the mines and on neighboring farms and ranches.

PROBLEMS

The farmers of this area are confronted with the problems of handling the following situations:

Farm land is being damaged and in some instances ruined by floodwaters cutting the riverbanks and by lateral flash floods carrying debris onto the fields and in some instances washing gullies across the fields.

The enlargement of the ditches to sufficient capacity to handle and utilize lateral flash-flood water and the construction of permanent diversion dams would do much toward stabilizing the water supply.

There is also great possibility of materially improving the cultural and cropping practices.

Many of the low-income group find difficulty in obtaining outside work with which to supplement the income from their farms.

AREA 18. THE VIRDEN IRRIGATED AREA

GENERAL DESCRIPTION

The Virden irrigated area is located in the northwestern part of Hidalgo County on the Gila River. Beginning at the Arizona-New Mexico boundary line, it extends up the River for a distance of about nine miles. It contains approximately 2900 acres of irrigated land and varies in width from approximately two or three hundred yards to a mile or more. The elevation of the area ranges from 3700 to 3800 feet. The average fall of the Gila River, therefore, is about 11 feet to the mile as it passes though the area from east to west, or about 2.5 inches per 100 feet.

The exact date of the settlement of the area is uncertain. The earliest homestead entries were made in 1882. It appears, however, that squatters occupied the area for several years prior to that date and that a few ranches had been established as early as 1874. It is claimed that practically all of the land now used for crop production was put under irrigation prior to 1900. A group of Latter-day Saints who were forced out of Mexico in 1916 purchased a large unit within the area and subdivided it into family farms. This influx of settlers has had much to do with developing the area and shaping its present agricultural status.

CLIMATE

The Virden area has a semiarid climate. There is no weather observation station within the area and for that reason the exact mean annual precipitation cannot be stated. Based on the rather long records for Lordsburg, Red Rock, and Cliff, the mean annual precipitation appears to be about 11 inches. July and August are the heavy-rainfall months. Much of the summer and early autumn precipitation falls as torrential showers. These showers, however, are less violent than those farther up the Gila River. While there is a small amount of runoff from the cultivated fields, most of the moisture is absorbed as it falls. The floodwaters of the River do more or less damage to the temporary diversion dams and canals and also do a limited amount of riverbank cutting. Perhaps the greatest floodwater damage sustained by the area results from the runoff from the canyon slopes and the near-by hills and mesas during and following heavy showers. Floodwaters from these sources carry soil materials and debris from the higher levels and deposit them on the cultivated lands below.

The area has a long growing season, the frost-free period averaging about 190 days. This permits the growing of cotton and gives a wide range in the dates for planting other crops. The summer temperatures are relatively high and there is an abundance of sunshine. The area is fairly well protected from severe winds.

SOILS

The soils of this area may be considered under three groups. The most productive part of the area lies next to the River. The surface soils of this portion vary from fine sand and sandy loam to silt and clay loam. The subsoil is not uniform and the water table varies from about two and a half or three feet below the surface, in some places, to a much greater depth in others.

Along the margin of the area next to the adjacent uplands much of the soil has been formed from materials washed down from the adjacent slopes, hills, and mesas. The land of this part of the area is generally coarse, gravelly, difficult to work, and much less productive than the land lying next to the River. The water table is some distance below the surface and the surface soil retains moisture poorly.

Between these two strips of land in the wider part of the area is a strip of low-lying heavy soil having a water table comparatively near the surface. This small area of heavy soil has become seeped and is less pro-

ductive than the soils adjacent to the River. It would be materially improved by drainage.

NATURAL VEGETATION

The natural vegetation of the area has been largely destroyed by farming operations. Cottonwood trees, willow brush, grasses, and weeds are still to be found along the riverbanks and on small areas of undisturbed bottom land. On the steep slopes leading down to the irrigated land the dominant types are chamiza, creosote bush, mesquite, and weeds.

SOURCE AND SUPPLY OF IRRIGATION WATER

Irrigation water for the area is obtained chiefly by direct diversion from the Gila River, there being three important diversion canals. Under the present (1939) arrangement of apportioning the summer flow of the River among the several irrigated districts along the Gila River in New Mexico, a shortage of water for the Virden area is likely to occur during June and the first half of July. Especially is there likelihood of this occurring in dry seasons. A number of shallow wells have been drilled and pumps installed during recent years to supplement the summer supply of water obtained directly from the River. The depth of the wells varies from 50 to 70 feet and the lift of the water in pumping, from 15 to 20 feet. The pumps are operated from two to six weeks or as long as the shortage of gravity water continues.

CROPS

The Virden area is a district in which mainly cash crops are produced. Potatoes (both early and late), cotton, alfalfa, and corn are the most important crops raised. The early-potato acreage is usually about twice as large as that of the late crop. The average yield of the former is about 90 sacks to the acre, while that of the latter is about 40 sacks. The average yield of cotton is approximately a bale to the acre. Although it must be hauled to Safford, Arizona, to be ginned, the harvested acreage was increased materially during 1937 and 1938. Alfalfa is cut four or five times a year and yields an average of about 4 tons to the acre. Corn is generally grown for grain, and its average yield is about 40 bushels an acre. The minor crops consist mostly of wheat, oats, grain sorghums, sweet potatoes, deciduous fruits, onions, and other vegetables.

LIVESTOCK

Only a very few of the farms of the area are organized and operated to supplement range livestock production. A few milk cows, a flock of chickens, a few hogs, and the necessary work animals are to be found on most of the farms. As a rule, the meat and livestock products produced are intended for farm and local consumption, rather than for outside markets.

TYPES OF FARMING

Within the Virden irrigated district there are approximately 100 farms. The three most important types (crop-specialty, general, and cotton farms) are grouped fairly closely numerically. The crop-specialty farms

derive the major portion of their gross income from the sale of early and late potatoes, alfalfa hay, and, to a limited extent, from sweet potatoes. The early potato crop is generally marketed during July and August. After the potatoes are harvested the land may be seeded to small grain for winter pasture and for green manure, which is plowed under the following spring in time to plant another early crop of potatoes. The land from which early potatoes have been harvested may also be seeded to alfalfa. The late potatoes may be planted in August on land from which a crop of small grain has been harvested or where a growth of alfalfa has been plowed under during July. The gross income of the general farms is usually derived from a number of sources, none of which amounts to as much as 40 percent of the total. Poultry and dairy products are usually of considerable importance on the general farms. The cotton acreage has increased severalfold during the last two or three years. This, in turn, has caused an increase in the number of farms that classify as cotton farms; that is, there has been a shift in the classification of a number of farms as to type. In addition to the three types mentioned above, there are a limited number of poultry, part-time, self-sufficing, dairy, and truck farms. From the discussion above it should be evident that the type or types of farming carried on in the area are not very stable.

PROBLEMS

The following are the more important problems with which the farmers of Area 18 are confronted:

The shortage of irrigation water during June and July is a very serious handicap in the production of crops. Some of the crops are at a critical condition when the shortage occurs and yields are materially reduced, especially during seasons of severe drouth. This is being alleviated to some extent by the installation of pumps. An adequate storage reservoir is greatly needed to stabilize the supply during June and July.

Many of the farms are too small to produce sufficient income to provide a satisfactory living for the farm operators and their families, and the isolation of the district makes it difficult to obtain employment away from the farm. The average area of irrigated land per farm is about 29 acres. It must be understood, however, that some of the farms contain as much as 100 acres of irrigated land and that many of them are much smaller in area than 29 acres.

The area is confronted with a difficult marketing problem. Its isolation and remoteness from consuming centers make it necessary that its products be transported long distances. A local marketing organization which has been set up is rendering material assistance in handling this problem.

Still another serious problem is the control of such weeds as Johnson grass, bindweed (wild morning-glory), and wild millet.

AREA 19. THE CLIFF-GILA IRRIGATED AREA

GENERAL DESCRIPTION

The Cliff-Gila irrigated area is situated in the western part of Grant

County in what is known as the Upper Gila Valley. It extends along the Gila River from north to south for a distance of about 20 miles. Its width is very irregular and varies from about one-fourth to a trifle over two miles. The elevation of the upper extremity of the area is 4650 feet; that of the lower only 4300 feet. The River thus has an average fall of approximately 17 feet to the mile, or about 4 inches per 100 feet, as it meanders through the area in its shallow and somewhat unstable channel. The riverbanks through a considerable part of the 20 miles are protected by trees, shrubs, grasses, and weeds. The lower part of the area is narrow and subject to flooding. From time to time there is more or less shifting of the location of the River channel. Approximately 4200 acres are under irrigation and about 500 acres more can be irrigated by pumping the water a vertical lift of 10 to 20 feet.

The area was settled during the 70's, the first settler having come to the Valley in 1871. By the close of the century it is said the area had reached approximately its present development, when measured by the acreage under irrigation. Alfalfa and corn were the principal crops grown during the early years of development. These were fed to horses used at that time in freighting supplies to the mines of the region. The demand for horse feed was greatly curtailed, however, about 1915-1917, when motorized trucks were introduced. The alfalfa and corn were then supplemented with wheat, oats, and barley and to a limited extent also with potatoes and truck crops. During recent years potatoes have become an important crop and onions and other truck crops are also grown in a limited way.

The distance to the nearest railroad shipping point varies from 25 to 35 miles and all produce must be transported by truck. An excellent improved highway, U.S. 260, crosses the area from east to west.

CLIMATE

The climate is semiarid; the summers are long and the winters short and mild. The growing season, as measured by the frost-free period, averages about 170 days. The mean annual precipitation is approximately 14 inches, about 50 percent of which falls from July to October, inclusive. Much of the summer precipitation falls as thundershowers. The rains in the hills and mountains above the area are often violent and floods, which sweep down the River, sometimes cut the riverbanks, wash away valuable farm land, and damage the diversion dams, canals, and ditches, which lead irrigation water from the River. Croplands and ditches are also damaged at times by flash floods which descend side canyons from the hills and mesas and deposit debris on the fields and fill the ditches.

SOILS

Virtually all of the irrigated land of the area lies on the floor of the Gila River Valley, only small tracts being situated on the side tributaries. The surface soils, which are generally well supplied with organic matter, are all alluvial and vary from fine sand to silt and heavy clay loams.

The sandy types predominate. They are productive when underlain with subsoils of desirable textures. The subsoils, however, vary from sand and gravel to adobe clay. The soils of the small areas located on the side tributaries are, as a rule, coarser in texture than the river-bottom soils. The water table varies from about one to six feet below the surface. Only one small area has become badly seeped and sufficiently impregnated with saline material to be harmful to crop production.

SOURCE AND SUPPLY OF IRRIGATION WATER

Irrigation water for the area is obtained by direct diversion from the Gila River and its tributaries. Twenty-four canals are used in making the diversions; seventeen of them carry water from the River and seven from its tributaries. The water rights for most of the land under irrigation are excellent. In a few instances, however, the filing of priority rights with the State Engineer was neglected, and small additional acreages of land have also been brought under irrigation since the water rights were adjudicated. Thus, the water rights for a few relatively small tracts of land are somewhat questionable.

The supply of water is considered adequate, except during June and part of July, when there is likely to be a shortage. As a result of this water shortage, growing crops may be stunted and total production curtailed considerably. Irrigation water is applied by the border method; that is, it is allowed to flow gradually over the surface. In general, the slope of the land is nearly twice as great as is considered desirable for irrigating by this method. As would be expected, there is an appreciable amount of washing of soil in some fields. There is need of devising means for retarding the flow of the water as it passes over the surface.

CROPS

In recent years there has been a good deal of variation in the acreage devoted to the respective crops. Alfalfa now occupies about 30 percent of the cropland of the area; wheat, 20 percent; corn, 15; oats and barley, 10 each; early potatoes, 5; truck crops (onions, cabbage, cauliflower, chili, etc.), 5; and miscellaneous crops (sorghums, dry beans, deciduous fruits, gardens, and pastures), 5 percent. These figures are to be considered only as fairly close approximations.

Alfalfa is cut four times a year and yields about 3.5 to 4 tons per acre annually. Corn and the small grains yield approximately 30 to 50 bushels an acre, the production of each individual crop varying widely. The average yield of potatoes is about 100 sacks an acre, while that of onions is approximately 200 sacks.

LIVESTOCK

The livestock kept on the irrigated farms of the area generally consists of a sufficient number of milk cows, poultry, and hogs to provide milk, butter, eggs, and meat for home consumption. On farms where there is a surplus, part of these products is sold. The area is completely surrounded by range land and for that reason it is very closely associated with the beef-cattle industry.

TYPES OF FARMING

There are approximately 100 irrigated farm units within the area. Fourteen of these farms are owned by men interested also in the production of range beef cattle, who make their homes on the irrigated farms and use them as operating centers for the range-cattle business. The crops grown on the irrigated land are produced mostly for sale and only in a limited way to supplement the range forage. This group, it will be noted, is a combination of cash-crop and range-livestock production.

About 75 percent of the total number of farms may be classified as being in the cash-crop group. These farms raise alfalfa hay, small-grain hay, corn, wheat, oats, barley, early potatoes, grain sorghum, and truck crops, such as onions, cabbage, cauliflower, and lettuce; alfalfa, corn, and the small grains being the principal crops. The hay that is produced for sale is generally baled. Up to the present time (1939) there has been little accomplished in the way of working out definite crop rotations and cropping systems, the crop acreages being shifted about from year to year in accordance with local demand, the price outlook, and the operator's ideas of the relative profitableness of the several crops. While this group of farms might be subdivided into a number of types, such as cash-grain, general, crop-specialty, and truck, on the basis of the percentage of the gross receipts which are received from different sources, it is deemed more logical to consider them cash-crop farms, since they shift about from year to year when classified on the basis of percentages of the gross receipts which are derived from different sources.

In addition to the two groups of farms discussed above, some 7 or 8 percent of the total number are made up of self-sufficing or subsistence farms and about 3 percent of part-time farms.

PROBLEMS

Soil Washing.—The average slope of the irrigated land is about 4 inches per 100 feet, which is nearly twice as much as is considered desirable for flood irrigation. The irrigation water flows too rapidly when applied to many of the fields, and as a result, there is considerable washing of the surface soil. The problem is to adopt methods and practices that will retard the flow of the water sufficiently to reduce the washing to a minimum.

Riverbank Cutting.—When the River reaches flood stage, more or less valuable farm land is washed away by the cutting of the banks. As a rule, the individual farmer can do but little toward controlling this problem, for it is one that requires community action.

Water Shortage.—The shortage of irrigation water during June and part of July tends to stunt growing crops and materially reduce yields per acre and total production, especially during such drouthy seasons as 1934 and 1936. The installation of pumps and the construction of a storage reservoir have been suggested as means of handling this problem.

Lateral Flash Floods.—Flash floods caused by torrential rains in the hills and on the mesas to the east and west of the area do a considerable amount of damage to some farms by washing materials onto the fields.

Straightening and deepening the watercourses across the area to the River would do much toward controlling this problem.

Weeds.—Johnson grass, wild morning-glory, and wild millet are among the more troublesome weeds.

AREA 20. THE MIDDLE RIO GRANDE IRRIGATED AREA

GENERAL DESCRIPTION

Area 20 is located in the valley of the Rio Grande in north central New Mexico. It includes all of the irrigated land along that River for a distance of approximately 150 miles; that is, from near the lower end of White Rock Canyon in east central Sandoval County south to a point two miles below the town of San Antonio in Socorro County. Its elevation varies from about 4600 feet at the southern end of the area to approximately 5550 feet at its northern extremity.

The area is well provided with transportation facilities; a paved highway traverses it from north to south; several improved highways (some of them paved) cross it from east to west; the Atchison, Topeka and Santa Fe Railway runs from north to south through all of the area except its most northern portion, and this railway also crosses the area from east to west at Belen.

Albuquerque, with an estimated population of 40,000, is the largest city in the State and the principal local market for farm products. Other important population centers in the area include Bernalillo, Los Lunas, Belen, and Socorro.

This is one of the oldest agricultural districts in the United States. It is known that irrigation has been practiced continuously in it for more than 300 years. The first Spanish explorers entering the Valley in the sixteenth century found it settled by Pueblo Indians, who were living in villages, producing crops under irrigation by diverting water from the Rio Grande, and following well-established customs which indicated long occupancy. At one period or another most of the land in the floor of the Valley has been under cultivation. However, as time passed, silting of the stream channel continued, to the extent that the water was raised above the level of the lower-lying lands of the Valley. This, in turn, caused a rise in the water table, resulting in seeping of the land and the accumulation of saline material. As the silting continued, the condition not only caused a progressive abandonment of farm lands, but increased the severity of floods, which endangered the remaining farms in the area and were a constant threat to some of the population centers.

After much thought and planning, the Middle Rio Grande Conservancy District was organized in 1925. In 1927, the New Mexico legislature enacted a conservancy law which set the District up as a political subdivision of the State, with powers to finance conservancy improvements. Bonds to the extent of $8,700,000 were sold to finance the building of river levees for flood protection; the construction of a storage reservoir of 198,000 acre-foot capacity at El Vado on the upper Chama River, a tributary of the Rio Grande; the building of four diversion dams with necessary main canals and laterals; and a system of open drains.

The farm lands of the Conservancy District are expected to bear approximately one-half the costs of the project, the remainder of the cost being borne by the corporations and municipalities operating within the area. The farm lands are assessed at from $28.60 to $52.80 an acre for construction costs, depending upon the extent of the estimated benefits received, or an average of approximately $44.00 an acre.

Exclusive of urban areas, the District contains about 123,000 acres, 23,000 of which are Indian lands. It is estimated that 119,000 acres will be available for cropping when all the land is developed. In 1936 approximately 65,250 acres of the area were in crops. As indicated, there are many thousands of acres of land yet to be brought into cultivation. Most of the undeveloped land requires leveling, a portion requires clearing of trees and brush, while some is rather high in salinity and requires leaching.

Owing to the differences in the kinds of farming carried on in different parts of Area 20, it has been divided into three subareas; namely, 20-A, in which cash-grain production strongly predominates; 20-B, which is an area of mixed types; and 20-C, in which self-sufficing farms are more than twice as numerous as any other type.

CLIMATE

The climatic conditions provide a growing season of sufficient length for a great variety of crops, rainfall which is insufficient for successful cropping without irrigation, and temperatures which do not approach the extremes found in many other parts of the State. The area is sheltered by high mesas and mountains and thus is not subject to winds of destructive velocity; however, during the spring months the winds carry considerable sand and dust. The mountain ranges to the east and the comparatively low altitude result in a low annual precipitation, the average having been 8.16 inches at Albuquerque and 10.24 inches at Socorro, in the southern end of the area.

The average frost-free growing period varies somewhat in different parts of the area and, over a 44-year period, has averaged 196 days at Socorro, 185 days at Los Lunas, and a slightly shorter period in the northern end of the area. While the summer days are warm, the heat is not oppressive, owing to the low humidity. The nights are relatively cool and the winter temperatures are uncomfortable during only short periods. The temperature exceeds 100 degrees or approaches zero on only a few days in the year. The average maximum temperature of the warmest month (July) at Albuquerque is 80 degrees, while the average minimum temperature of January (the coldest month) is 19 degrees. Snowfall is infrequent and light and snow seldom remains on the ground more than a few days at a time.

SOILS

The soils of the Valley, with two exceptions, are of the Gila series. The materials forming this series consist mainly of sediments brought down from the north by the Rio Grande and deposited over the Valley during periods of high water. They have been derived from a wide

variety of rocks, including sandstones, limestones, and metamorphic and igneous rocks. To these have been added small amounts of alluvial wash and wind-blown materials from the mesa slopes. An appreciable amount of sedimentary material is also deposited each year over the entire irrigated portion of the area by irrigation water. During the long period of irrigation these deposits have increased until in places they are several feet deep. The slopes of the fields in many instances have been materially modified in the vicinity of irrigation canals by deposits from water turned onto the land.

The soils vary widely in texture and soil profile. Five members of the Gila series, ranging in texture from sand to clay, have been identified. The heavy-textured soils of this series within the area seldom have a pronounced adobe structure. The subsoils consist of alternating strata varying in texture from gravel and sand to clay, and generally without regular order of succession. The members of the Gila series best adapted to crop production include the fine sandy loam, loam, clay loam, and clay.

The Gila loam is farmed more extensively than any other type. It covers large areas, is easily cultivated, and has the widest range in crop adaptation. The fine sandy loam is the next most extensive type and is confined mainly to low, flat areas of comparatively recently deposited material along the present river channel or in similar positions to former stream channels. Previous to drainage, much of this soil type was seeped and too wet for crop production. Injurious accumulations of saline materials are frequently present. Gila clay and Gila clay loam are compact soils, being rather refractory and impervious, puddling easily. When well drained they are adapted to growing the principal field crops of the area.

By the construction of an open system of drains in the area, most of the seeped land has been drained. Where saline materials exist in harmful quantities, they must be leached out by the construction of high dirt borders around the areas to be leached, which are then filled with water several times a season, the water being allowed to seep through the soil and out into the drainage canals. The amount of leaching necessary depends on the type of soil and subsoil and the amount and nature of the soil salinity. The feasibility of this recommendation depends, in part, upon the depth to which the water table has been lowered by the drainage canals.

SOURCE AND SUPPLY OF IRRIGATION WATER

Practically all of the water used for irrigation in the area comes from the Rio Grande. It is diverted into the main canals by diversion dams and conveyed to the farms through ditches. A few farms at higher levels, however, are furnished water by pumping from wells.

The building of the El Vado Dam has assured a reliable supply of water. Previous to its construction, water shortages occurred in June after the flow from melting snow had passed and previous to the summer rains in July and August. Often this shortage reduced appreciably the yields of all except the early-maturing crops. The newly constructed irri-

gation system is of material assistance in the equitable and regular distribution of water.

CROPS

Because of the long growing season, an adequate supply of irrigation water, and a variety of soil types, a rather wide diversity of crops is adapted to the area. Livestock feeds, such as alfalfa, corn, and grain sorghums, produce well. Vegetables and fruits, especially apples and

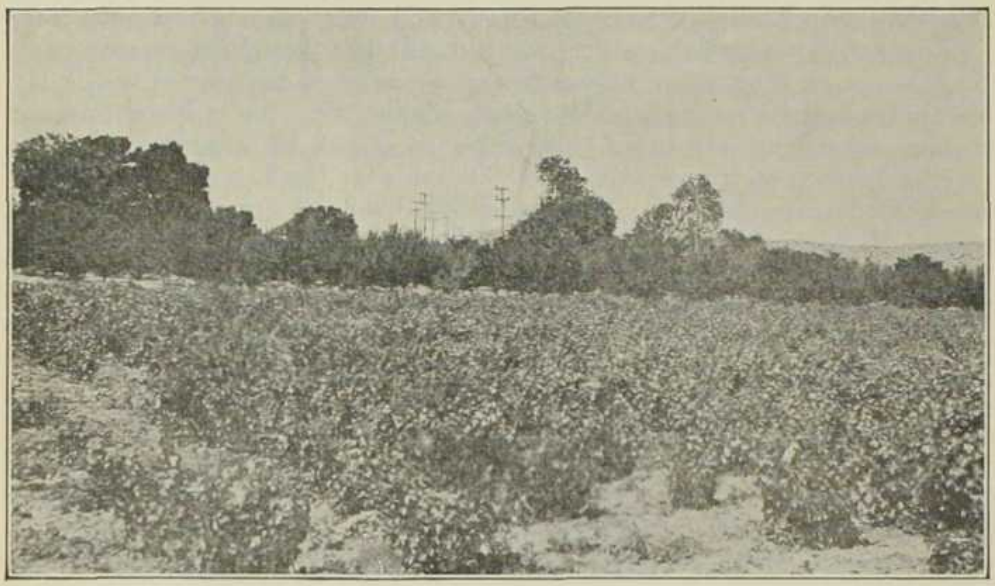

Fig. 14.—Apples and grapes are the most important fruit crops in Area 20.

grapes, are grown to a moderate extent. While wheat is raised, the milling quality, because of its protein content, is not very satisfactory. Cotton is not produced at present. However, there is some likelihood of developing the enterprise in the southern part of the area. Experimental tests also indicate the possibility of sugar-beet production.

Corn and alfalfa are about equal in acreage, in the area as a whole, and together occupy approximately one-half of the cropped land. These are followed, in order of acreage, by wheat, which occupies 15 percent of the total crop acreage; hay, other than alfalfa, 11 percent; dry beans, 9; truck crops, 4; orchards, 3; and miscellaneous crops, 8 percent. Alfalfa, the principal cash crop, is sold to dairies in Albuquerque and in other near-by population centers. It is also trucked to surrounding stock ranches and to mining towns. This rather limited market outlet tends to restrict the acreage to that needed to supply local and near-by demands. Part of the corn and grain sorghums grown in the area is fed to work stock on the farms and most of the remainder is sold to feed dealers, who grind and sell it to local dairymen and poultry producers. A large percentage of the wheat is milled in the area. Many producers haul their wheat to the mill to be made into flour for home use, giving the bran and shorts to the miller as his toll or remuneration.

Vegetable and truck crops are produced mainly for consumption within the area, a portion being trucked to towns in northern New Mexico and to markets in Texas. The principal vegetables raised are onions, cantaloups, tomatoes, asparagus, cabbage, and celery. The marketing period for most of these vegetables extends from July to November.

Most of the apples grown are consumed locally; some of them are transported by truck and sold in Texas and Oklahoma. The varieties of grapes adapted to the making of wine are most common. Virtually all are used locally.

LIVESTOCK

In general, a small amount of livestock is kept on the farms in this area. Commercial dairying is confined mainly to supplying Albuquerque with fluid milk. Limited numbers of beef cattle are raised on the irrigated land, although some are grazed on the grassland which has as yet not been leveled and prepared for crop production. Only a few feed yards for fattening livestock are to be found in the area. The production of poultry and hogs is sufficient to supply only local needs.

TYPES OF FARMS

From the standpoint of sources of income there is a great diversity of types of farming in this area; therefore, it may be classed as an area of mixed types. Also, because the area is in a state of development and readjustment, there is an appreciable amount of shifting in the relative importance of the respective types of farming carried on. The cash-grain type, specializing in the production of corn and wheat, is the most important in the area. Farms of this type make up 20 percent of the total. General farms rank next, with 17 percent. This group, in addition to producing corn, wheat, and alfalfa, has other sources of income, such as livestock, livestock products, fruit, and vegetables. Crop-specialty farms, producing principally alfalfa, with smaller acreages of pinto beans, account for 14 percent of the total number. Self-sufficing farms constitute 14 percent and average less than 10 acres each in size. Other types of farms in the area are truck, which make up 10 percent of the total; fruit, 3 percent; dairy, 2 percent; part-time, 2 percent; poultry, 1 percent; and miscellaneous, 3 percent. The products of all types of farms are consumed mainly within the area.

SUBAREA 20-A

Subarea 20-A is located in the valley of the Rio Grande in southeastern Sandoval County. It extends from near the village of Algodones (located a few miles from the southern boundary of Sandoval County) in a northeasterly direction to the mouth of White Rock Canyon. It includes all of the irrigated land in the River valley between these two points. This subarea is largely occupied and farmed by three tribes of Indians: the San Felipe, Santo Domingo, and Cochiti. There is also a Spanish-American settlement at Penablanca. The populations of the three Indian tribes in 1937 were 623, 923, and 307, respectively. They are pueblo Indians; i. e., they dwell in small villages.

By and large, the farms of this subarea are very small in size and

yield their operators low incomes. The principal crops grown (named in the order of their relative importance when measured by the harvested acreage) are alfalfa, corn, wheat, fruit, vegetables, and dry beans. From 65 to 70 percent of the farms come under the cash-grain classification. These are small and have a small amount of equipment and little livestock other than work stock. Numerically, the self-sufficing farms come next, about 15 percent of the total number belonging to that type. It should be borne in mind that the operator's family, on farms of the self-sufficing type, consumes 50 percent or more of the gross value of all products produced. The remaining farms are made up about equally of three types: general, part-time, and crop-specialty. In this subarea farm incomes are frequently supplemented by that derived (1) from small flocks of sheep which are herded on the grazing lands adjacent to the River, and (2) by the manufacture and sale of pottery.

SUBAREA 20-B

Subarea 20-B is located in the Rio Grande Valley immediately south of subarea 20-A. It includes all of the irrigated land lying in the floor of the Valley in the southern part of Sandoval County and in Bernalillo and Valencia Counties. The types of farming to be found in this subarea have been determined to a considerable extent by the influence of local market demands from the city of Albuquerque. The demand for such products as milk, cream, eggs, fruit, and vegetables has resulted in the development of these enterprises, together with alfalfa, corn, and wheat, which are used in part for dairy and poultry feed. In the southern part of subarea 20-B in Valencia County, fewer vegetables and less fruit are raised, less dairy and poultry production is carried on, and more corn, wheat, and pinto beans are grown.

Part-time and general farms are most numerous in this subarea, each constituting about 20 percent of the total number. Between 1929 and 1939, part-time farms have increased in importance, chiefly as a result of the growth of Albuquerque. Many small farms have been established near the city, whose operators find part-time employment away from the farm. The general farms are those which do not specialize in any one product but which have several sources of income.

In 1929, the crop-specialty type of farm, made up largely of those specializing in alfalfa production, accounted for approximately 15 percent of the total number of farms. They are well distributed throughout 20-B and are an important type. Most of the cash-grain farms produce corn and wheat and are located in Valencia County. About 11 percent of the total number were of this type. They are small in size, the acreage of crops harvested averaging about 16. It is probable that this latter type of farming will decrease in importance as the area becomes more highly developed and opportunities for more profitable enterprises arise. To be successful, this type of farming must be carried on with larger farms than now exist in this subarea. Self-sufficing farms made up 9 percent of the total number. They were very small, containing an average of about 5.5 acres of cropland.

Three types of farms of growing importance in Bernalillo County are

truck, fruit, and dairy. Dairying is carried on mainly for the production of fluid milk and sweet cream, and will, in all probability, increase only as population increases. The success and further development of fruit and vegetable farms are conditioned to a large degree on the production of standard-quality products, graded and packed so as to compete with shipped-in products. Standardization is necessary in order to supply the local demand more completely and to enter outside markets.

SUBAREA 20-C

The section of Area 20 located in the Rio Grande Valley in Socorro County has been designated as subarea 20-C. Because of its distance from Albuquerque, the farming in this subarea has not been influenced to any great extent by the growth of that city. In the past, demand for agricultural products has come largely from the mining and ranching industries to the east and west. These industries furnished a limited market for alfalfa and corn for the work stock, and the mining communities, especially, provided a rather important outlet for fruits and vegetables. Since the World War, mining has not flourished as in previous years. This decline in the industry and the more recent shift from horses and mules to motorized equipment have reduced the demand for the products of this subarea.

In 1929, about 40 percent of the farms of this subarea were classified as self-sufficing, i. e., farms on which the operators and their families consumed 50 percent or more of the gross value of all farm products grown. That year crop-specialty farms (those on which the income is derived mostly from alfalfa) made up 16 percent of the total number; cash-grain, 15 percent; general, 14; part-time, 11; and fruit, nearly 2 percent. The remaining 2 percent were distributed among four other types. The descriptions of these types under subareas 20-A and 20-B will suffice for this subarea.

PROBLEMS AND ADJUSTMENTS IN AREA 20

New problems, difficult of solution, are always encountered in areas which are in the process of reclamation. The fundamental problems in this area, from which other problems develop, may be classed under four heads: small farms, lack of capital among farmers, lack of a market for the crops that are well adapted to the area, and the reclamation of seeped and saline soils.

The small-farm problem is acute in this area. Approximately two-thirds of the farms contain less than 20 acres and about one-third of them range between 3 and 9 acres in size, the average being approximately 22 acres. The fact that profitable market outlets are not available for intensive crops, because of high unit cost of production and high cost of transportation to distant markets, forces farmers into the production of more extensive crops, such as alfalfa and cash grains. Such crops do not yield sufficient income to provide an adequate family living and to finance reclamation costs assessed against the land. Reclamation costs are particularly difficult to finance from the income of small self-sufficing farms. Lack of capital is an important factor preventing producers from

enlarging their operations by acquiring developed land or by leveling and bringing raw land into production. In many cases they do not have the equipment or other facilities to handle larger farms.

Adjustments for the purpose of developing economic commercialized farming in this area must of necessity take one or both of two courses: the introduction of intensive high-value cash crops which can be grown and marketed successfully by operators of small farms, and/or the development of larger farms and the growing of more extensive crops which may be disposed of either on the general market or by feeding to livestock. Additional capital would be necessary for either of the adjustments mentioned. Special crops, such as sugar beets or cotton, may offer a partial solution to the adjustment problem, but these have not been grown commercially in the area as yet.

AREA 21. LAGUNA INDIAN RESERVATION

GENERAL DESCRIPTION

The Laguna Indian Reservation (Area 21) is located in the west central part of subarea 1-E described above, more specifically in the west central part of Valencia County. The physical features and climatic conditions of Area 21 are very similar to those of subarea 1-E.

The lands owned and used exclusively by the Laguna Indians amount to 237,488 acres; most of which is grazing land. About 3000 acres are irrigated and used for crop production. In addition to the above-mentioned land, the Lagunas have the grazing use of approximately 146,667 acres of government-owned grazing lands, which carry 6317 sheep on a yearlong basis. Both the Reservation and the government-owned lands are occupied largely by two types of natural vegetation: the short-grass and the woodland. The yearlong carrying capacity of these grazing lands ranges from about 6 to 9 animal units per section of land.

The 3000 acres of cropland are irrigated with water diverted into storage reservoirs from the Rio San Jose. The Federal Government constructed the reservoirs, the floodgates, and the system of canals and ditches. While no fee is collected for the irrigation water used, each Indian farmer must do his proportional part of the work necessary to keep the canals and ditches in condition for use.

There were 2332 Laguna Indians on the Reservation in 1937. At that time there were 525 families living in seven villages (pueblos), with an average of 4.44 persons per family. The 350 farms contained an average of 8.6 acres of irrigated land per farm. The land in the Laguna Indian Reservation is owned by the Laguna Pueblo as a whole. The heads of the respective families have been given long-time allotments of irrigated land, and the right to use the land has been handed down from generation to generation. The grazing lands are used on a communal basis. In other words, no allotments of grazing lands are made to individuals. In this case a description of the system of managing livestock takes the place of the description of stock ranches in other cases.

CROPS

The principal crops grown in Area 21 are alfalfa, corn, wheat, chili, dry beans, garden vegetables, melons, apples, peaches, and plums. These crops are all grown under irrigation and virtually the total production is consumed within the area by the Indians themselves or by their livestock. Only a small amount of dry farming is carried on in the area.

LIVESTOCK

Range sheep and beef cattle are the principal livestock enterprises. In 1939 the Lagunas had approximately 20,000 sheep of Rambouillet breeding and about 1,000 Hereford cows of good quality. Registered Hereford bulls are being used exclusively and the Indian rams are being replaced with purebred Rambouillets. On the average, the Lagunas keep about 300 horses, of which approximately 75 are brood mares. The stallions used are a combination saddle-horse and work-horse type. They raise their own saddle and work animals and usually have 25 to 30 head to sell each year. Sufficient numbers of burros also are raised to provide the animals needed for moving their sheep camps from place to place. The Lagunas have only about 100 goats and 20 milk cows. About one-fourth of the Indian families have a few hens—an average of a dozen or so each.

MANAGEMENT OF CATTLE, SHEEP, AND GRAZING LAND

The chief problem confronting the Laguna Indians is the restoration of the former carrying capacity of the grazing lands. With this in view they entered into an agreement or contract in 1935 with the Soil Conservation Service of the United States Department of Agriculture which provides for the reduction of their flocks and herds to the carrying capacity of their grazing lands during a period of five years. At the time the agreement was signed (1935), it was estimated that the amount of livestock being carried was twice as great as that justified by the carrying capacity of the grazing lands. With a gradual reduction each year in the breeding stock, which amounted to 35 to 40 percent at the end of four years, production per animal unit had increased to a point where total production was approximately the same as it was at the beginning in 1935.

Cattle.—The cattle of the various owners are grazed yearlong in fenced pastures. The bulls are with the breeding cows from about June 15 to October 15. They are then separated from the cows and placed in a "bull" pasture in which forage has been reserved for late fall, winter, and spring use. Sufficient supplementary feed (cottonseed cake) is given the bulls to keep them in good condition.

The fall work (branding, dehorning, castrating, vaccinating, etc.) usually starts about August 1, under the direction of a range rider (a representative of the Soil Conservation Service) stationed in the area. At this time a complete livestock census is taken. This includes the number of head and the sex and quality of the holdings of each individual Indian owner. When this record is completed a marketing program is then worked out with the livestock owners.

About October 15 the fall roundup begins, under the direction of the

Government range rider. The animals to be sold are collected, classified as to grade, and placed in a holding pasture in which feed has been reserved. Notices are then sent to the cattle buyers, stating the classes of animals to be offered for sale, the number in each class, and the date of the sale. Strict culling is practiced each year. All old and barren cows, all steers of weaner-calf age or older, and some of the heifer calves are sold at public auction to the highest bidder. The heifer calves intended for replacements in the breeding herd are weaned and placed in a separate pasture soon after the auction sales are over.

Sheep.—The sheep of this area are kept on the range throughout the year, under the care of herders. Burros are used as pack animals in moving the sheep camps from place to place. The rams are separated from the ewes at the close of the breeding season, collected into a community herd, and placed in a separate pasture where range feed has been reserved. They are then placed under the care of herders selected by the Indians. The Indian herders receive the wool from the rams as payment for their services. The owners of the sheep generally do their own shearing. They also sack the wool, which is ordinarily pooled and offered to buyers at auction. The lambs are collected and sold at auction about November 1. All wether lambs, part of the ewe lambs, and all aged ewes are disposed of annually. About 10 percent of the wether lambs and old ewes are consumed on the Reservation.

The ewes are bred to lamb between May 1 and June 15. The wool crop averages about 6 pounds per sheep shorn and the lambs at weaning time weigh approximately 48 pounds each. In the flock-improvement program being followed it is the aim to increase the weight of the lambs to 60 pounds and the fleeces to 8 pounds. This is to be accomplished within six or eight years, through the use of better rams. The Indian ram flock was culled severely, one-half being replaced by purebred Rambouillets, the remaining Indian rams to be replaced with Rambouillets as soon as practicable.

SOURCES OF INCOME

The income of the Laguna Indians comes chiefly from the sale of sheep, beef cattle, and wool. Other, minor, sources of income are horses, crops, pottery, beadwork, and outside work. The outside work is chiefly in the Santa Fe Railroad shops and on railroad section crews.

PROBLEMS

The chief agricultural problems confronting the Laguna Indians are: the restoration of the carrying capacity of their range lands, a shortage of irrigated farm land, and an insufficiency of irrigation water for the farm land they now have.

AREA 22. ZUÑI INDIAN RESERVATION

GENERAL DESCRIPTION

Area 22, the Zuñi Indian Reservation, is located in the west central part of subarea 1-E and includes the southwestern part of McKinley County and the northwestern part of Valencia County. In 1937 it con-

tained 300,990 acres of grazing land, 3087 acres of dry-farming land, and 2150 acres of irrigated land.[1] The carrying capacity of the grazing lands is low, averaging, on a yearlong basis, about 8 or 9 animal units per section of land. The physical factors and climatic conditions of Area 22 are very similar to those of subarea 1-E, previously described, and for this reason are discussed below only very briefly.

The general slope of Area 22 is to the southwest. It is drained by the Zuñi River and its tributaries. This stream rises in the Zuñi Mountains northwest of the area, flows in a southwesterly direction through the Zuñi Reservation, and empties into the Little Colorado River in Arizona. It furnishes the water for the irrigated lands of the Reservation.

Area 22 lies at elevations ranging from approximately 6250 feet, at the point at which the Zuñi River flows across the Arizona-New Mexico boundary line, to about 7500 feet in the southeastern and northern parts of the area. The relief features vary from gently sloping valley lands along the Zuñi River to rather rough foothills. The average annual precipitation likewise varies considerably, from less than 10 inches to 20 inches or more. A limited amount of land that is suitable for crop production receives sufficient rainfall for dry farming. The total number of Zuñi Indians in New Mexico in 1937 was 2080.

CROPS

Crops are produced in Area 22 both under and without irrigation. Corn, wheat, alfalfa, and sorghum are the principal crops, with corn predominating. Some orchard fruits, grapes, and potatoes and other vegetables are also grown.

LIVESTOCK

Sheep strongly predominate and in October 1937 there were 33,000 head of ewes and lambs in this area. The usual number on January 1 of each year is about 19,000. Approximately 5,000 lambs are sold each year and some 5,000 to 6,000 are butchered for local consumption. A very good grade of sheep is carried, the flocks having been improved through the use of Rambouillet rams. The lambs weigh about 55 pounds each when marketed and the fleeces average about 5½ pounds each. In addition to the sheep, there are 800 or 900 head of cattle and approximately 400 head of goats. The goats are kept mainly for meat.

TYPES OF FARMING

Self-sufficing or subsistence farms strongly predominate in this area. In 1937 there were 421 irrigated units or farms. The total area irrigated that year was 2150 acres, an average of 5.1 acres per farm. The United States Census of Agriculture indicates that 55 percent of all farms were self-sufficing in 1929. The census also showed one-third of all farms classified as stock farms and ranches.

[1]The Zuñi Indians of New Mexico in 1939 also had the use of 70,000 acres of trust allotted government-owned grazing lands lying both north and south of their reservation. In addition to this, they graze a limited amount of livestock on public land administered under the Taylor Grazing Act.

The sheep and cattle are owned by individual Indian families. The number of sheep owned per family varies from 5 to 800 head. These small flocks (sometimes as many as 20) are combined into community flocks and grazed under the care of herders. By and large, the sheep are grazed yearlong. However, it is occasionally necessary to feed, when snow covers the ground or when the supply of range forage is short because of severe drouth. The feeds used are corn, alfalfa, native-grass hay, and occasionally cottonseed cake.

Since very few of the Zuñi Indians obtain work off the Reservation, there are few part-time farms. Other important sources of income, in addition to the sale of livestock, wool, and crops, are beadwork, silverwork, pottery, and piñon nuts. There is a crop of piñons about one year in four. The Indians also do a good deal of canning.

AREA 23. BLUEWATER-TOLTEC IRRIGATION DISTRICT

GENERAL DESCRIPTION

The Bluewater-Toltec Irrigation District (Area 23) is located in the north central part of Valencia County near the Zuñi Mountains, which rise some 8800 feet above sea level. It is in these mountains that the water supply for the area originates. This area has an elevation of approximately 6500 feet and embraces 9949 acres. The area irrigated varies considerably from year to year, being 2737 acres in 1936, 3168 acres in 1937, and 3085 acres in 1938. This variation is caused by corresponding fluctuations in the supply of irrigation water.

CLIMATE

Because of its comparatively high altitude, the District has a relatively cool climate, with rather severe winters. The mean maximum temperature during July is 86 degrees and the mean minimum temperature in December is 9 degrees. The average annual precipitation is 9.9 inches, thus necessitating the irrigation of all crops grown. The average length of the frost-free period is 134 days.

SOILS

The soils are of alluvial origin and are underlain by a lava bed. In most parts of the area the soils are deep; however, in some places, outcroppings of lava are to be found. Though the soils vary considerably in texture, the bulk of them are sandy loams and silt loams, with small areas of extremely heavy or light soils. In general, the land is productive and well adapted to the crops grown in the area.

SOURCE AND SUPPLY OF IRRIGATION WATER

The water supply originates in the Zuñi Mountains, lying west of the area. The water is impounded in a reservoir located 9 miles northwest of the District. This reservoir has a capacity of 50,300 acre-feet and an elevation of 7434 feet. While the storage capacity is sufficient for the needs of the District, the actual supply of water varies considerably from year to year, and in years when the precipitation has been much below the average, shortages of water have occurred. The inadequacy of the

water supply has prevented full development of the land within the District which is suitable for irrigation. However, if the area cropped is held to the present acreage, it is probable that in the majority of years sufficient water will be available for the production of normal crop yields. The water requirement per acre is comparatively low, an adequate supply having been furnished in 1937 by 1.94 acre-feet per acre.

CROPS

No very stable cropping system has been developed. The acreages devoted to the various crops are varied according to the supply of irrigation water and the market outlook. For example, the acreage planted to pinto beans varied from 348 in 1937 to 1186 in 1938, and that planted to commercial vegetables varied from 874 in 1937 to 231 in 1938. In 1938 the crops ranked, according to acreage planted, as follows: Pinto beans occupied 38 percent of the total crop acreage; alfalfa, 29 percent; corn, 11; small grains, 10; and vegetables, including home gardens, 10 percent.

Pinto beans are well adapted to the area, since they produce well with a relatively small quantity of irrigation water and require only a comparatively short growing season. The large variation in acreage of this crop is due chiefly to variations in the market price of beans relative to the prices of other commodities. Alfalfa is the most stable crop from the standpoint of acreage. Most of the surplus of this crop is marketed in Gallup and on surrounding stock ranches. The larger percentage of the corn and small grains is fed on the farms of the District. Vegetable production has developed considerably during recent years with the advent of trucks, which at present haul most of the production to various markets in New Mexico and Texas. The acreage of the individual vegetable crops varies considerably from year to year. The acreages devoted to the respective crops in 1938 were: cabbage, 61; onions, 54; lettuce, 44; potatoes, 37; cauliflower, 24; peas, 10; carrots and cucumbers together, 2.

LIVESTOCK

The livestock kept on the average farm consists of work animals and only sufficient other livestock to supply home needs. Some of the larger farms have range land on which sheep or cattle are grazed, and on which a portion of the feed raised is consumed. There is one commercial dairy in the area.

TYPES OF FARMING

Crop-specialty farms constituted 85 percent of all the farms in the area in 1929. A large majority of the farms of this type specialized in the production of pinto beans, but only a few in alfalfa and potatoes. The percentage of the farms classed as crop-specialty changes considerably from year to year, increasing in periods of high bean prices and decreasing with low prices, by shifting from bean production to corn and small grains. In 1929 the remaining 15 percent were about equally divided between general and part-time farms.

At the present time (1939) it is estimated that crop-specialty farms constitute not more than 50 percent of the total number. The shift has

been largely to general and truck farms. The general farms, however, still receive most of their income from crops, mainly from beans, corn, wheat, and alfalfa. Commercial truck farming has increased, by reason of the development of new outlets for vegetables through truck transportation.

PROBLEMS AND ADJUSTMENTS

Inadequacy of irrigation water supply.—This is a limiting factor in the full development of the area. Only through the limitation of crop acreage can the most efficient use be made of existing supplies of irrigation water.

Short growing season.—This factor very definitely limits the selection of crops that are adapted to the area. Further information is needed as to varieties of crops best adapted to the growing conditions of the area.

Distance to markets.—The location of the District involves high transportation costs to market centers. This further limits the selection of crops which will return a profit.

AREA 24. NAVAJO INDIAN RESERVATION

GENERAL DESCRIPTION

The Navajo Indian Reservation includes parts of three States: Arizona, New Mexico, and Utah. Area 24 is made up of that part of this Reservation lying within the borders of New Mexico. It is situated in San Juan and McKinley Counties, in the northwestern part of the State, and contains approximately 2,903,800 acres of tribal lands; i. e., lands belonging to the Navajos as a tribe.[1] There were approximately 22,000 Navajo Indians in New Mexico in 1937. Of this number a considerable percentage live on trust-allotted lands outside of the Navajo Indian Reservation, i. e., outside of Area 24. The Navajo Indians are rapidly increasing in numbers.

A large part of Area 24 lies within the San Juan Basin. The area is drained by the San Juan River and its tributaries. This stream rises in the high mountains of Colorado, where the snowfall is heavy; has an abundant flow of water throughout the year; flows south into New Mexico, and then traverses Area 24 from east to west. While the general slope of the area is to the north and northwest, that of the extreme northeastern and southwestern portions slopes to the southwest.

The undulating surface of the area is interrupted here and there by drainage channels, buttes, and the Chuska Mountains. This range extends from near the middle of the western border of the area to the southeast for a distance of about 45 miles, and rises about 2500 feet above the surrounding country.

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[1]In addition to Area 24, the Navajo Indians have 3200 acres of tribal land located in Valencia County. They also have the use of approximately 569,760 acres of Government-owned, trust-allotted lands. Of the trust-allotted lands, 323,520 acres are located in McKinley, 126,560 acres in San Juan, 52,320 acres in Sandoval, 41,600 acres in Valencia, 15,840 acres in Socorro, and 800 acres in Rio Arriba Counties. In addition to the above there are also 3,712 acres of Government-owned-and-administered reserves.

The elevation of Area 24 ranges from approximately 4500 feet, where the San Juan River flows out of the area into Colorado, to about 8900 feet on the summit of the Chuska Mountains. The major part of the area lies at elevations varying from about 4500 to 6500 feet.

CLIMATE

The climate of most of Area 24 is arid to semiarid, the exception being the area occupied by the Chuska Mountains. In the lower portion of the area along the San Juan River the average annual precipitation falls to about 7 inches, the lowest in the State, and over the major portion of the area it averages less than 10 inches. The precipitation increases as the elevation increases, and probably reaches as much as 25 inches on the summit of the Chuska Mountains. Owing to the scantiness of the annual precipitation over all parts of the area suitable for cultivation, all crops must be grown under irrigation.

The part of this area lying at low elevations is almost without snow, the average snowfall being less than 10 inches annually. This makes yearlong grazing possible. The snowfall increases with elevation and reaches about 30 inches at altitudes of 7000 feet and 50 inches or more at 8000 feet. Because of the snowfall and low temperatures, the higher, rougher parts of the area are grazed chiefly during the summer.

SOILS

The soils of Area 24 may be placed in three groups. The first is alluvial in origin and occupies the valley floors along the streams. While mostly sandy loams, the soils of this group vary widely in texture, depth, subsoil, natural drainage, and degree of salinity. The soils of the second group occupy the gentle slopes, mesas, and plateaus and vary in texture from sand to clay. The surface soil of much of the area occupied by this group is shallow. The soils of the third group occupy the rolling, steep, rough, and mountainous portions of the area and are generally shallow and stony.

NATURAL VEGETATION

Four types of natural vegetation are to be found in Area 24. The major part (that lying at the lower elevations where the rainfall is lightest) is occupied by the semidesert-grass type; the short-grass type occupies the extreme southeastern part of the area; the woodland type is to be found in the most northern portion and in a relatively narrow strip skirting the eastern side of the Chuska Mountains; and the forest type covers the Chuska Mountains. Range carrying capacity varies widely within each of the four vegetative types and also as between types. For Area 24 as a whole, it has been estimated at about 9 cows per section of land.

CROPS

Owing to the limited rainfall, as stated above, all crops are grown under irrigation. Corn in 1934 made up about 51 percent of the total area of harvested crops; alfalfa, 29; other tame and wild hay, 8; and wheat, 6 percent. Alfalfa, cantaloups, watermelons, pumpkins, squash, wheat, and beans are the principal crops grown for sale.

LIVESTOCK

The production of range sheep very strongly predominates. However, a good many beef cattle, goats, and horses, but comparatively few hogs, dairy cows, and chickens, are to be found within the area. The production of livestock, especially sheep, is of much greater importance than the production of crops.

TYPES OF FARMING

The farms and ranches located within Area 24 have been classified into eight different types. Stock ranches strongly predominate, with part-time farms second in importance. Then follow the general, crop-specialty, self-sufficing, fruit, cash-grain, and truck farms, named in their numerical order.

There are two types of stock farms and ranches, the irrigated and non-irrigated. In 1937 there were approximately 300 irrigated farms along the San Juan River in the vicinity of the Indian Agency at Shiprock. The most frequent size of these small farms is 10 acres, some being as large as 15 or 20 acres and many less than 10 acres. While some of these irrigated units are strictly crop farms, a small flock of sheep is frequently handled in connection with the operation of most of them. The average size of these flocks is about 40 head.

These small flocks are grazed yearlong on the range lands lying on each side of and adjacent to the San Juan River. A member of the farm family takes the sheep out onto the grazing lands in the morning, remains with the flock all day, and returns it to the farm in the evening. During the day the sheep may range out from the River a distance of about 5 miles. The owners of some of the larger flocks have camps, take their flocks farther out, and do not return at night. Most of the products raised on these combination crop-sheep farms are used for human food, some are sold and very little, if any, are fed to the sheep.

As indicated above, some of these irrigated units are cash-crop farms. Others are part-time, and a very few are self-sufficing. The chief function of all irrigated farms is to produce foods for the farm families, only a few of them having surpluses for sale. In addition to the irrigated land along the San Juan River, numerous small areas along the intermittent streams have been brought under irrigation. Since the supply of water for most of these small areas is uncertain, they are of minor importance.

The nonirrigated stock farms and ranches are principally small sheep-grazing units, there being very little raising of crops in connection with the sheep enterprise. As with other farmers elsewhere, there are both poor and relatively well-to-do Indians. For this reason the flocks vary in size from about 25 head to several hundred, the average being less than 100. There is a herder with each flock. It is a common practice for well-to-do Indians to lease sheep to poor Indians. The lessee receives the wool for taking care of the sheep and the owner or lessor gets the increase of the flock.

The Navajo tribal range lands are used on a competitive basis. In other words, the Federal Government recognizes no range rights and makes no definite allotments of tribal lands to individuals. While the small

flockowners may have a gentleman's agreement among themselves as to the area that each shall use, large-scale sheep owners sometimes graze their flocks over the areas which the small operators are supposed to use.

The effects of these practices on the tribal grazing lands have been very much the same as that of the unrestricted grazing of the public domain. That is to say, (1) there has been little or no chance for the individual flockowner to reserve range feed for future use; (2) there has been heavy overstocking of the grazing lands; (3) the vegetative cover has been seriously depleted and weakened; and (4) soil erosion has been greatly accelerated.

Virtually no supplementary feeding is done in this area. When snow covers the surface of the ground, sheep feed on sagebrush and other browse. Occasionally the death loss is heavy.

Most of the lambs and wool produced in Area 24 are shipped to outside markets. Virtually all of the lambs except those consumed as food locally are shipped either as feeders or stockers. Grass-fat lambs are very rare. About 15 percent of the wool is used locally for weaving rugs, the remainder going into commercial channels and being used for the making of carpets and low-grade clothing. The Navajos are being encouraged to improve their flocks by the use of Rambouillet rams.

SOURCES OF INCOME

Cash income of the Navajo Indians comes chiefly from the sale of sheep and wool. They also receive income from the sale of cattle, surplus crops, and rugs, and from working for wages. Most of the wagework is in the vicinity of Gallup and Shiprock. As one goes into the interior of the Reservation there is less opportunity to work for wages. Very little in the way of agricultural products (except sheep and wool) leaves the area, for, ordinarily, there is a deficit. The Indian farmers who raise irrigated crops sell their surplus to Indian traders who, in turn, resell to other Indians.

PROBLEMS

The principal problem confronting Area 24 is the improvement of the vegetative cover of the grazing land which has been seriously damaged by overstocking. This involves the reduction of livestock numbers sufficiently to give the vegetative cover a chance to recuperate.

Another difficult problem facing this area is the improvement of the Navajo sheep, both the lambs and the wool produced being of very low grade. Since the Navajo lambs are sold as feeders and stockers and since the wool goes into commercial channels and is also used locally for weaving rugs, the problem is to develop a type of sheep that will produce (1) lambs of good weight and quality, and (2) wool that will command at least an average price in the wool markets and at the same time can be woven into rugs of high quality. The Southwestern Range and Sheep Breeding Laboratory, located at Fort Wingate in McKinley County, was established mainly to deal with the latter of the two problems mentioned.

AREA 25. SAN JUAN BASIN IRRIGATED AREA

GENERAL DESCRIPTION

Area 25 is located in the northwestern corner of New Mexico in San Juan County. All of the cropland in the area is irrigated with the water from the San Juan, Las Animas, and La Plata Rivers. These three streams flow into New Mexico from Colorado, the Las Animas and La Plata joining the San Juan in this area, which flows back into Colorado and thence into Utah to join the Colorado River. The irrigated lands are confined to the stream valleys of these three rivers and to the lower-lying areas adjacent to the valleys. In 1934 there were approximately 28,000 acres of land on which crops were harvested.

The elevation varies from approximately 4900 feet, where the San Juan River leaves the western border of the area, to 5900 feet at Cedar Hill, a short distance south of the Colorado-New Mexico state line on the Las Animas River. Farmington, the principal trading center, which is midway between these points, has an elevation of approximately 5250 feet.

The character of the marketing and transportation facilities for the products of this area has influenced to a large extent the type of farming carried on. The area is located a considerable distance from population centers and has no railroad outlet, except by a narrow-gage railway to Durango, Colorado. Albuquerque and Gallup, the nearest population centers of consequence in New Mexico, are 191 and 123 miles, respectively, from Farmington. The development of truck transportation has done much to encourage production for the outside markets. Apples, for which the area is noted, move out almost entirely by truck.

A factor which to some extent offsets the disadvantages due to distance to outside markets is the nearness to the Navajo Indian Reservation. Considerable quantities of alfalfa, apples, corn, and truck crops are sold to traders who, in turn, dispose of the products to the Indians. There is a demand for much of the feed-crop production from stockmen who winter livestock in the vicinity.

CLIMATE

Because of its moderately high altitude and northerly location in the State, the summers are moderate and the winters are comparatively cold. Records at Farmington covering a period of 25 years indicate an average frost-free growing season of 143 days, the average date of the first killing frost in the fall at Farmington being October 4 and the average date of the last killing frost in the spring, May 14. The average annual precipitation amounts to about 9 inches. The average annual snowfall is 16 inches, approximately 14 inches of which falls from December to March, inclusive.

SOILS

Soil conditions vary considerably throughout the area, but, in general, the soils are of medium texture in the valleys and of lighter texture on the adjacent mesa irrigated lands. They are generally deep and well adapted to the production of alfalfa and fruit crops.

Through irrigation over a period of years, a part of the area has become seeped and contains saline materials, which in places have caused

abandonment. From irrigation ditches which carry water during most of the year, a considerable amount of seepage has occurred on sloping lands above the floors of valleys.

SOURCE AND SUPPLY OF IRRIGATION WATER

The irrigation water for the lands in this area is diverted directly from the three streams, as no storage dams have been constructed. As a rule, the supply is adequate and dependable. This is especially true of the lands along the San Juan River. Storage facilities are seldom needed in this area, except on the La Plata River, where the supply of irrigation water is sometimes inadequate.

Fig. 15.—An apple orchard in Area 25 which has been brought into a high state of production by efficient methods of pruning and spraying, together with liberal applications of barnyard manure and thorough cultivation and irrigation.

CROPS

Alfalfa and corn are the leading crops grown. In 1935, approximately 35 percent of the harvested acreage was devoted to alfalfa and 31 percent to corn. The other crops named, in order of acreage, together with the percentages of the total harvested acreage, were: fruit, 7; small grains (mostly wheat), 7; pinto beans, 5; vegetables, 5; potatoes, 4; and miscellaneous crops, 6. During recent years there have been increases in the acreages of corn, alfalfa, potatoes, vegetables, and fruits, and a decrease in the acreages of beans, oats, barley, and several minor crops. The major part of the farm income is derived from the sale of crops.

LIVESTOCK

In general, livestock is the source of a rather small percentage of the income on the farms in this area. There are, on the average, about 3 dairy cows per farm, except on the dairy farms, which carry an average of approximately 10 cows each. While some general farms raise a good many hogs, an average of only 2 or 3 brood sows per farm is kept. A number of farms have beef cattle which are run on grazing land adjacent to the valley or on the national forest in southern Colorado in the summer and wintered on the farms of this area. A few farmers contract to winter cattle which summer in Colorado. These cattle are run in the cornstalk and alfalfa fields and in addition are fed alfalfa hay. A limited amount of dairying for the production of butterfat is carried on.

TYPES OF FARMS

General farms constitute 26 percent of all the farms and are the most important type in the area. These obtain their income from a variety of agricultural enterprises, such as alfalfa, corn, beans, hogs, dairying, fruit, or vegetables. They are of medium size, with an average of approximately 26 crop acres per farm. The other types which are important consist of fruit, which makes up 17 percent of all farms; crop-specialty, 13; cash-grain, 9; and stock farms, 10 percent.

The fruit farms obtain their income principally from apples, which are an important source of income in the area. Most of the fruit farms are comparatively small, averaging 17 crop acres per farm and having few other enterprises, except the production of corn and alfalfa for use on the farm.

The majority of the crop-specialty farms concentrate on the production of pinto beans, and, to some extent, on feed crops. It is a more extensive type of farming and the farms are larger than the fruit farms, the former having an average of approximately 42 crop acres each. A few of the farms in this class specialize on the production and sale of alfalfa.

The cash-grain farms average about the same size as the crop-specialty and derive most of their income from the sale of corn.

Two other types of farming (self-sufficing and part-time) are of minor importance in this area. The farms are relatively small and each type makes up about 8 percent of all farms in the area. The self-sufficing farms may be classed as noncommercial, as they add little to the cash income of the area, although they do furnish a considerable part of the family living. In the case of the part-time farms, the income from the farm is supplemented by outside work away from the farm. The self-sufficing farms in 1929 harvested an average of about 13 acres of crops and the part-time an average of about 5 acres.

SUBAREA 25-A

This subarea is located principally in the Las Animas Valley, extending from the Colorado-New Mexico state line to approximately 3 miles west of Farmington. It also includes the portion of the valley land be-

tween the Las Animas and the San Juan Rivers, known locally as the "peninsula."

Subarea 25-A is well known for its apple production. Approximately 26 percent of the farms obtain the principal part of their income from this source, while a majority of the general farms, which make up 29 percent of all farms in the subarea, also produce and sell fruit, mostly apples.

A large percentage of the apples is produced in two relatively small areas; namely, in the vicinity of Farmington and north of Aztec. A good deal of the land lying between these towns has become seeped and the orchards have been abandoned. In this subarea the crops, other than apples, consist largely of those grown for feed, which are used on the farms.

In 1929, self-sufficing and part-time farms combined made up about 14 percent of the total number. The crop-specialty type ranked next, with 7 percent of the total. Alfalfa is the chief source of income on the majority of these farms, some of them also growing potatoes and/or beans. The remaining types, in the order of their importance, were: stock farms, which constituted 8 percent of all farms; cash-grain and poultry, 5 percent each; and dairy and truck farms, 3 percent each.

SUBAREA 25-B

This subarea extends west of subarea 25-A in the San Juan River Valley to Area 25 and includes the communities of Waterflow, Fruitland, and Kirtland. Alfalfa and corn are the leading crops. Most of the alfalfa is sold to traders on the Navajo Indian Reservation, who trade it to the Indians to be used for feed for horses. Corn is sold both to traders and to sheepmen in the surrounding country. Very little livestock is maintained in this subarea.

The most important types of farming are crop-specialty (alfalfa) and general, which types make up 29 percent and 21 percent, respectively, of the total number. Cash-grain farms, which account for 11 percent of all farms, produce corn as their chief crop. Part-time and self-sufficing farms make up 13 and 8 percent, respectively, of the total number, but are of little importance as commercial farms, because of their limited size. The remaining types in the area are: stock farms, which make up 7 percent of all farms; poultry, 6 percent; and dairy, 3 percent.

SUBAREA 25-C

Subarea 25-C consists of the irrigated cropland lying in the La Plata River Valley from the New Mexico-Colorado state line south to the San Juan River. This is a comparatively narrow valley and most of the farms border the River or are located only short distances from the main irrigation canal. The water for irrigation is diverted from the stream by means of diversion dams. Under the present system of irrigation, water shortages develop during some years of less than average precipitation. For this reason a reservoir is needed, in order to store the spring flow from melting snows for use during the growing season.

General, cash-grain, and stock farms are the three leading types in

this subarea. General farms constitute approximately 30 percent of the total number, while the cash-grain account for 28 percent and stock farms 19 percent. Corn and alfalfa are the most important crops on all of these types. On the general farms the income from crops is supplemented largely by that from hogs and dairy products. The hogs are grazed on alfalfa pasture and fed out on corn. Most of them are marketed in Durango, Colorado. Many operators of the general farms contract with Colorado stockmen to winter cattle or sheep. The stock are allowed to run in cornstalk fields and hay is contracted on a ton basis in the stack.

The principal source of income on the cash-grain farms is the sale of corn. This crop is sold on the Navajo Indian Reservation and to near-by ranchmen, to be used with cottonseed cake in wintering ewe flocks on the range.

Operators of stock farms commonly graze their sheep and cattle on the national forests in Colorado in the summer and winter them on feeds raised in this subarea.

The remaining types of farms are relatively unimportant. Small self-sufficing and part-time farms make up 12 percent of the total number; dairy farms, 5; poultry, 4; and crop-specialty, 2 percent.

SUBAREA 25-D

This subarea is located in the vicinity of the town of Bloomfield, which is 15 miles east of Farmington and 9 miles south of Aztec. The farm land is located in the valley of the San Juan River and on the benchland adjacent thereto. The valley of the River extending from this subarea to subarea 25-A is very narrow for a distance of several miles, there thus being a distinct break between the two subareas.

Most of the land used for crop production lies at the edge of the valley, slightly above the valley proper. This soil is lighter in texture and has better drainage than that of the lower-lying ground. An appreciable acreage of the lowlands is seeped and contains saline materials in quantities injurious to plant growth.

The principal crops, named in order of importance, are pinto beans, alfalfa, and corn. It is a general practice to grow alfalfa on the same land four to six years, change to beans for a few years, and then plant to corn. The practice of sowing sweet clover in the corn after the last cultivation, to be plowed under the following spring and followed by beans, is a rather common one.

There is an abundance of irrigation water available for this subarea. The water for the lands above the valley proper is diverted from the River approximately 25 miles above Bloomfield.

Forty percent of the farms in this subarea are classed as being of the crop-specialty type. The majority of these specialize in bean production. On only a few farms of this type is alfalfa the chief source of cash income. The majority of the bean farms produce only enough alfalfa and corn to supply the needs of the farm livestock.

The other important commercial types of farms, in the order of their importance, are cash-grain, 13 percent; stock farms, 11 percent; and general, 8 percent. The cash-grain farmers produce corn as their chief

source of income, while a few raise a limited amount of wheat. On these farms, as a general rule, very little livestock is kept and consequently a surplus of alfalfa is available for sale, which is disposed of largely to near-by ranches and to the Navajo Indians.

Alfalfa is produced on the major portion of the cropland of the stock farms, while the remaining land on these farms is devoted mainly to corn production. Beef cattle are the chief source of income. The cattle are grazed during the summer on the national forests of southern Colorado and wintered on the farms of this subarea, by being allowed to run in cornstalk and alfalfa fields, and by feeding bean straw and alfalfa hay.

The general farms are of two subtypes. Part of them diversify by producing and selling alfalfa, corn, and beans in approximately equal value; while others have a considerable acreage of beans and alfalfa, and keep beef cattle. In general, the farmers find that the wintering of beef cattle is an efficient means of utilizing bean straw and maintaining the fertility of the soil.

Along the River for several miles in this subarea the valley is very narrow and the irrigated land is broken by frequent arroyos which drain the higher lands adjacent to the River. This situation causes some of the farms to be small. Most of these farms are of the self-sufficing and part-time types, which together in this subarea constitute approximately 24 percent of the total number of farms. Little is produced for market on these farms, the farm families consuming most of the fruit, vegetables, meat, and dairy and poultry products that are produced. A number of the operators of the part-time farms obtain employment in near-by oil fields or on stock ranches and farms.

PROBLEMS AND ADJUSTMENTS

The problems confronting the producers of Area 25 are concerned with both the production and marketing phases of the farming business.

Problems due to Distance to Market.—In general, two lines of attack may be made on this problem: First, anything which reduces the cost of transportation to outside markets increases the advantage of the area over competing areas. Truck transportation has had an important effect in this direction. Second, the construction of all-weather roads to the south and southeast will further reduce the cost of hauling and will induce more trucks to enter the area.

A second general adjustment which may be made to alleviate the disadvantage of distance to market is the production of higher-quality products. In general, products which are above the average in quality have higher-than-average value and thus can be transported profitably over greater distances than those of poorer quality.

Drainage Problems.—In parts of the area a considerable acreage of land is seeped and in a highly saline condition. In the river-bottom lands this may be attributable to irrigation without adequate drainage over a period of years. It is thought that seepage and salinity on the slopes have been caused by seepage from the main canals and also by the application of too much water to the land. It is probable that in order to provide better drainage in certain locations, drainage ditches will need to be con-

structed to carry away excess water. To prevent further damage in places where seepage from the main ditches is serious, the waterproofing of the ditches would prevent recurrence of this damage. In any part of the area where the drainage is poor, better preparation of the land and an economical use of water are of great importance.

Water Storage.—Provisions for water storage for parts of this area would not only bring about more efficient use of water, but with such storage additional land could be brought under cultivation.

Soil Fertility.—On some of the lighter-textured soils of the area, continuous cropping to depleting crops has resulted in the lowering of crop yields. County planning committees have recommended that where such continuous cropping is practiced, 25 percent of the land should be planted to sweet clover, to be plowed under as green manure.