Chapter 6

ANDREW R. AANDAHL
Soil Conservation Service, USDA[1]

Potentials for Increasing Wheat Production in the Great Plains

THE GREAT PLAINS STATES produce about 60 percent of all wheat grown in the United States from about 70 percent of the acreage of harvested wheat (Table 6.1). The United States produces about 15 percent of the world's wheat production (Table 6.2).

Table 6.1. Acreage of All Wheat Threshed in the Great Plains States and the United States in Selected Years

Area	1954	1949	1944
		(Million acres)	
North Dakota	7.6	10.2	9.6
South Dakota	2.6	3.9	3.0
Nebraska	3.0	3.9	2.6
Kansas	9.5	13.4	11.2
Oklahoma	4.5	6.3	5.1
Texas	3.0	5.6	4.4
Montana	4.3	4.6	3.7
Wyoming	.2	.4	.2
Colorado	1.6	2.5	1.2
New Mexico	.1	.5	.3
Great Plains States	36.3	51.3	41.4
United States	51.4	71.2	58.3

Source: Bureau of the Census, U.S. Department of Commerce.

The annual disappearance of wheat in the continental United States, 1946-55, averages 665 million bushels.[2] This includes wheat used for food, seed, industry and feed. This ranged from 754 million bushels in 1947 to 589 million bushels in 1955.

[1] The heads, Departments of Agronomy and/or Soils, Experiment Stations, Great Plains States, and selected members of their staffs provided valuable assistance.
[2] "The wheat situation," Feb., 1960, AMS, USDA.

Table 6.2. Wheat Production in the United States and the World, Five-Year Averages, 1925-59

Year of harvest	United States	World	Percentage of world
Five-year Averages		(Million bushels)	
1925-29	823	5,310	15
1930-34	732	5,560	13
1935-39	759	6,084	12
1940-44	926	5,800	16
1945-49	1,202	5,898	20
1950-54	1,094	6,975	16
1955-59	1,095	7,916	14

Sources: For 1925-49 – Foreign Agricultural Trade Statistical Handbook, Stat. Bul. No. 179, Aug., 1956, USDA. For 1950-59 – "The wheat situation," Feb., 1960, AMS, USDA.

THE GREAT PLAINS

The Great Plains is that dominantly level, treeless, semiarid and subhumid area between the Rocky Mountains and the 98th Meridian. The boundaries are really transition zones. To the Spaniards of the Southwest, it was a land to be avoided. They did not know how to survive, much less live there. To the early explorers, it was the Great American Desert. This was land not fit for human occupation but which must be crossed to reach the fair lands of the West. To the buffaloes it was their true home. They roamed the Plains in herds estimated in the millions. To the American Indians, it was their last retreat. To us, it is home. Its many moods, its capricious nature and its extremes are challenges to us.

We are learning how to live in the Plains; we expect to learn how to live here better in the future. This is a unique area – different from the arid Southwest and the humid East and not a transition from one to the other. In arid areas one is not tempted to grow crops; in the humid areas one grows them with security.

The pioneers of the Plains should have "thrown the book away" before they came. The knowledge, the experiences, the institutions, the ways of living that it contained were not for the Plains. One needs to look only at the Homestead Act to recognize this fact. Our forefathers learned this the hard way, but we are still struggling to write our own "book." One of our difficulties is that many people, both in the Plains and elsewhere, do not realize that we need our own "book."

Climate

The climate of the Plains really is not semiarid or subhumid; it is sometimes subhumid, sometimes arid, sometimes humid and sometimes semiarid, but always unpredictable. Palmer[3] classified the climate of central South Dakota as arid 3 percent of the years; semiarid, 51 percent; dry subhumid, 40 percent; moist subhumid, 3 percent, and humid, 3 percent.

Many people still remember the dry years of the thirties, the "dirty thirties"; more people remember the dry years of the fifties in the Southern Plains. Although no definite cyclical pattern exists, there is some tendency for wet years and dry years to occur together. This tendency makes our problem of adjustment more difficult. People tend to become too optimistic during the wet years and too pessimistic during the dry years.

The normal annual precipitation of the spring wheat area of the Northern Plains ranges from about 14 to 20 inches. The range for the winter wheat area of the Central Plains and Southern Plains is from about 16 to 36 inches. The variability of the precipitation is reflected in the wheat yields shown in Figure 6.3.

During these periods of high rainfall and frequently high prices, farmers were too optimistic. The result was the plowing of much native grassland and planting crops on soils not well suited to cultivation. We have 12,000,000 to 14,000,000 acres of land under cultivation, which the Soil Conservation Service places in capability classes V, VI and VII. A similar amount is placed in capability class IV.

Wind, drought, hail — these are the troublemakers of the Plains. Winds and droughts combine with poor farming to give us dust storms. These not only affect crop production but also make living unpleasant for a time. Ask a lady of the Plains about them, but don't do it just after one! Crop damage from hail is much higher in the Plains than it is in the humid East.[4]

The chinook, the norther and the real blizzard are wind phenomena almost unique to the Plains.[5] An extreme chinook can evaporate the snow and leave dry ground. They are common to the Northern Plains near the mountains. The norther, common to the Southern Plains, can drop the temperature 20 to 30 degrees within a very short time and fill the sky with dust. The blizzard is the grizzly of the Plains.

---

[3] W. C. Palmer. Weekly Weather and Crop Bulletin, U. S. Weather Bureau, 44 (1A), 1957.

[4] S. D. Flora. Hailstorms in the United States, University of Oklahoma Press, Norman, 1956.

[5] W. P. Webb. The Great Plains, Ginn and Company, 1931.

Most winds are dry, but some are hot and dry. These can reduce crop yields drastically within a few days. The severe one from the southwest in 1953 left its mark on the corn as far northeast as Ames, Iowa.

Perhaps the more serious but less noticeable effect is the higher evaporation with its resulting lower efficiency of water use. The wind velocity of the Plains is 30 to 50 percent more than that of the humid East.[6]

The Soil

The soils on which most of the wheat is raised are medium-textured (loamy) ones of the Chernozem, Chestnut, Calcium Carbonate Solonchak, Reddish Prairie, Reddish Chestnut and Brown great soil groups. Most of these are level or nearly level, and perhaps less than 15 percent have slope gradients of more than 5 percent. In the Northern Plains these have formed mainly from drift, loess, alluvium and residual materials from sandstones and shales. In Kansas and adjacent states, loess is the most extensive parent material, but there are many soils formed in alluvium and residual from shales and sandstones.

THE WHEAT LANDS

The location of the land used for growing wheat in the Great Plains States and the United States in 1954 is shown in Figure 6.1. The Sandhills of Nebraska, in general, separate the spring wheat areas of the Northern Plains from the winter wheat areas of the Central Plains and Southern Plains. Little or no spring wheat is grown south of the Sandhills, but some winter wheat is raised in Montana and South Dakota. More winter wheat can and likely will be raised in these areas in the future.

The obvious reason for the large acreage of wheat in the Great Plains States is that the farmers believe it is one of their best alternatives. Other alternatives, however, when compared with those of the humid East, are not numerous. They include native and tame grasses, cotton, sorghum, corn, flax, barley and other small grain and feed crops.[7]

Wheat is a good alternative in the Plains, partly because the quality here is high.

---

[6] S. S. Visher. Climatic Atlas of the United States, Harvard University Press, Cambridge, N. J., 1954.

[7] Other alternatives involving irrigation are not considered here.

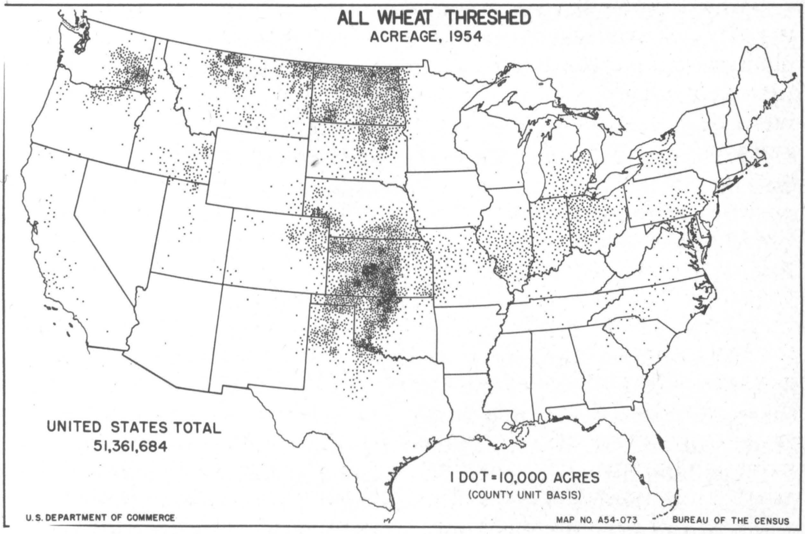

Fig. 6.1. Location of the land used for growing wheat in the Great Plains States and the United States (1954).

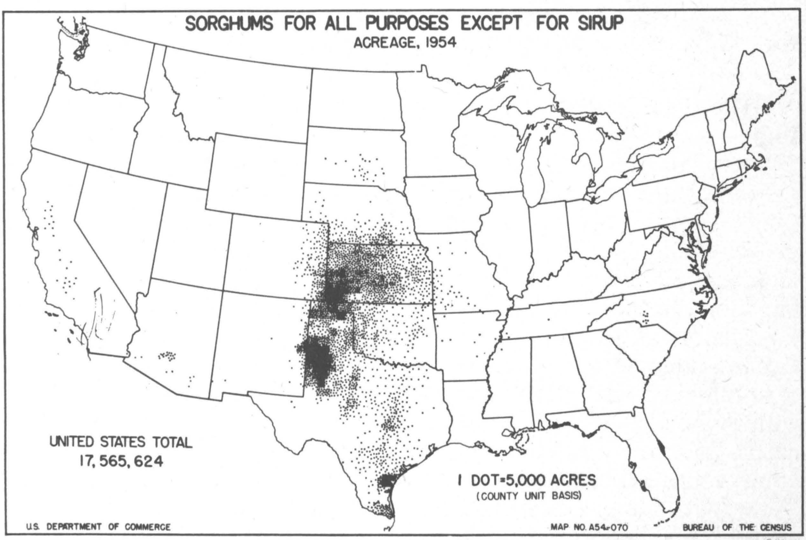

Fig. 6.2. Acreage of sorghum (1954).

Wheat farmers have time to do other things because most of the work of growing wheat is concentrated during the time of planting and harvesting the crop. During other periods, there is little that farmers generally can do to improve the crop. This fact makes the alternative of growing wheat more attractive to many people because it permits them to be active in other business ventures.

Where the rainfall is lower, as on the western edge of the wheat lands, grasses are the better alternative. Sorghum competes with both grass and wheat in the southern transition between the two, especially on the sandier soils.

The status of sorghum as a competitor of both wheat and cotton has improved greatly. Yields have increased for several reasons. Hybrid varieties have been developed, and the yields of these are about 20 percent higher. Farmers are using more nitrogen and phosphorus fertilizers. They are using lower planting rates, and the resulting thinner stands produce better during dry years. These stands thicken during wet years. Surface planting with its lower seedling losses is replacing listing. Seed treatment is becoming more common. All these factors contribute to the higher yields. As a feed, sorghum is about 90 percent as efficient as corn. The 1954 acreage of sorghum is shown in Figure 6.2.

The acreages of sorghums for seven Great Plains States and the United States in 1944, 1949 and 1954 are given in Table 6.3. The 1960 estimate for the United States is 19,800,000 acres. While the acreages have fluctuated greatly, future acreages of

Table 6.3. Sorghum for All Purposes Except for Syrup in Seven Great Plains States and the United States in Selected Years

Area	1954	1949	1944
		(Million acres)	
South Dakota	.1	.1	.5
Nebraska	.8	.3	.7
Kansas	5.4	2.3	3.6
Oklahoma	1.6	1.1	2.4
Texas	7.4	4.6	7.9
Colorado	.8	.6	.7
New Mexico	.4	.5	.7
Great Plains States	16.5	9.6	16.4
United States	17.6	10.1	17.2

Source: Bureau of the Census, U.S. Department of Commerce.

sorghum are likely to remain high. They may increase, especially if more livestock feeding develops in the Central States and Southern Plains States.

The transition between cotton and wheat is usually narrow, with wheat losing in the competition where the season is long enough for good cotton growth. In southwestern Oklahoma and adjacent areas in Texas, however, there is a large area where both cotton and wheat are grown.

Corn dominates the cropping pattern in eastern Nebraska and southeastern South Dakota. There is no reason to believe that excellent wheat cannot be raised in this area, but the farmers have a definite preference for growing corn. There may be a human element here, in addition to the monetary advantage favoring corn, because the settlers in this area, to a large degree, came from the Corn Belt. Also, this area is near Omaha, the world's largest livestock market.

Flax, barley and other feed crops provide several alternatives to wheat in the spring wheat area. The acreages of some of these in North Dakota for selected years are given in Table 6.4. In recent years, barley and flax have been the more common substitute for wheat. Safflower, a relatively new crop, has shown considerable promise.

A study in 1955 of cropland acres diverted from wheat on 927 farms in Kansas, Montana and North Dakota showed 63 percent in west-central Kansas going to grain sorghum; 40 percent to barley and other grains, and 36 percent to flax in north-central North Dakota; and 85 percent to barley and other grains in north-central Montana.[8]

Table 6.4. Acreages of Selected Crops and Cropland in North Dakota in Selected Years

Crops	1954	1949	1944
		(Millions of acres)	
Wheat	7.6	10.2	9.6
Barley	3.0	1.6	2.6
Rye	.3	.2	.1
Oats	2.1	1.6	2.5
Flax	3.1	1.8	.8
Total (5 crops)	16.1	15.4	15.7
Cropland (harvested)	21.2	20.4	20.8
Cropland (total)	27.7	27.6	25.1

Source: Bureau of the Census, U.S. Department of Commerce.

[8] C. W. Nauheim, W. R. Bailey, D. E. Merrick. "Wheat production," Agr. Info. Bul. No. 179, ARS, USDA, March, 1958.

Alternatives in the Great Plains are not as numerous as in the humid part of the United States, and shifts in the short run are often difficult. The establishment of grasses, for example, may require two or three attempts, depending upon the weather. Long-run shifts to more feed crops and more feeding of livestock can be accomplished. These, however, would require considerable change in the living habits of the farmer and his family. There would be a substantial sacrifice of freedom and time to do other things. The net results financially may be more favorable than generally recognized.

POTENTIAL WHEAT PRODUCTION

Increased production of wheat in the Great Plains States could be accomplished by (1) diverting acres in other crops and uses to wheat and (2) increase the yield per acre. Both of these will now be explored, but there is no implication that the possibilities of the first method should be done. As we all know, the country has been trying to do the opposite.

The acres of wheat harvested in the Great Plains States in 1949 were 51.3 million (Table 6.1). The number of acres of wheat that could be harvested is probably over 60 million. For our purpose we will assume that 55 million acres can be harvested. This is about 19 million acres more than in 1954. Most of these could come from the following sources:

Sorghum	8 million
Flax	2 million
Barley	3 million
Corn	2 million
Oats	1 million
Wild hay	1 million

Most of the land in wild hay which is suitable for cultivation is in North Dakota and South Dakota.

Wheat yields per seeded acres for the Great Plains States from 1920 to 1960 are given in Table 6.5 and in Figure 6.3. Although the variations from year to year were great, the upward trend was rather definite.[9] An estimated present average yield of 14 bushels per harvested acre is conservative. The yields given in Table 6.5 are for seeded acres, and average abandonment in the Great Plains is more than 10 percent.

[9] Ibid., pp. 33.

Table 6.5. Wheat Yields Per Seeded Acre for the United States and Two Major Wheat Regions, Ten-Year Averages, 1920-59

Ten-year average	United States	Major wheat regions	
		Hard winter wheat[a]	Spring wheat[b]
	(Bushels)	(Bushels)	(Bushels)
1920-29	12.7	11.5	11.6
1930-39	10.7	9.0	7.1
1940-49	15.7	13.8	14.7
1950-59	17.1	13.3[c]	14.8[d]

[a] Hard winter wheat region includes Kansas, Nebraska, Oklahoma, Texas, Colorado, Wyoming and New Mexico.
[b] Spring wheat region includes Montana, North Dakota and South Dakota.
[c] For 1957-59 winter wheat yields were used after multiplying by the factor .8 to make them more comparable with the yields by wheat regions.
[d] For 1957-59 spring wheat yields were used after multiplying by the factor .96.

Sources: "Wheat production," Agr. Info. Bul. No. 179, March, 1958, ARS, USDA. "The wheat situation," Feb., 1960, ARS, USDA.

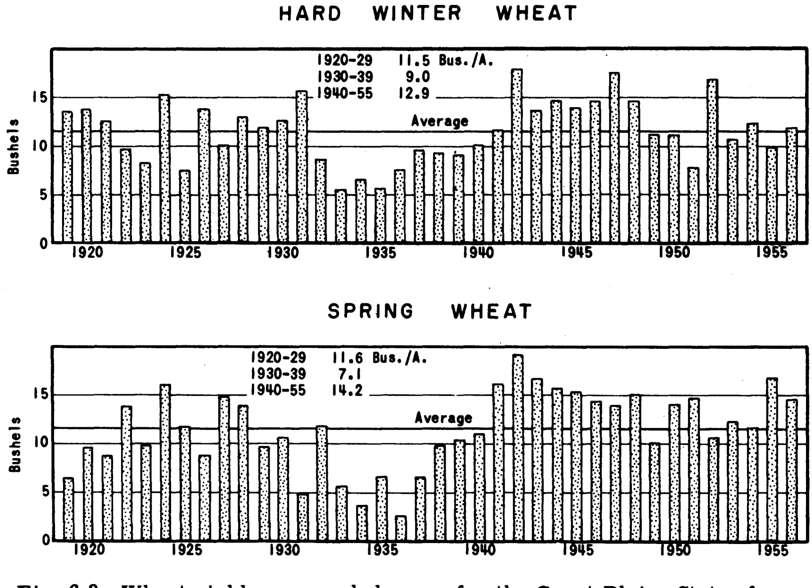

Fig. 6.3. Wheat yields per seeded acres for the Great Plains States from 1920 to 1960.

Potential production from 55,000,000 acres of wheat yielding 14 bushels per acre is 770,000,000 bushels. This is more than the average total disappearance of wheat in continental United States, which is 665,000,000 bushels.

This potential production can be increased further by greater adoption of improved technology. Considerably more nitrogen and phosphorus fertilizers can be profitably used. More drought-resistant and otherwise better varieties are available for use. Better residue management and tillage methods can be used by many farmers. Greater control of weeds, insects and diseases is possible. Some spring wheat, especially in South Dakota and Montana, can be shifted to winter wheat which produces 5 to 10 bushels per acre more. Better erosion control will decrease crop losses. The combined effect of these are reflected in the yield predictions given in Table 6.6. Roughly, the average of

Table 6.6. Predicted Wheat-Acre Yields Under Average and High Management for Level to Gently Undulating Phases of Selected Soil Families in the Spring Wheat and Hard Winter Wheat Areas of the Great Plains States

Soil family[a]	Management level: Average	Management level: High
	(Bushels)	(Bushels)
Spring wheat area		
Aastad (loam)	18	24
Barnes (loam)	14	20
Bearden (loam)	18	28
Williams (loam)	10	14
Hard winter wheat area		
Amarillo (fine sandy loam)	12	16
Colby (silt loam)	10	14
Crete (silty clay loam)	14	20
Dalhart (fine sandy loam)	8	12
Goshen (silt loam)	16	20
Hastings (silty clay loam)[b]	18	26
Hastings (clay loam)[c]	12	16
Holdrege (silt loam)	16	22
Judson (silt loam)	20	28
Kirkland (silt loam)	14	20
Lancaster (loam)	10	16
Pullman (clay loam)[b]	14	18
Pullman (clay loam)[c]	10	14
Sharpsburg (silty clay loam)	20	30
Teller (loam)	14	22
Vebar (fine sandy loam)	12	16
Williams (silt loam)	12	16

[a]Prediction based upon texture indicated.
[b]Eastern part of area. [c]Western part of area.

these yield increases is 40 percent, being slightly higher in the more humid areas.

These yield predictions are based upon those given in soil survey reports, in the interpretations of key or benchmark soils and in other publications.[10] They are the results of the combined judgment of many people who evaluated the available information.

Increasing crop yields 40 percent on the average appears to be possible. If the past trend of increasing yields continues, however, it will be about 1990 before the average yield per harvested acre will be 20 bushels.

If technology were understood and practiced by all farmers, the average annual potential production of wheat in the Great Plains States could be more than a billion bushels.

[10] The interpretations of key and benchmark soils, when completed and kept up to date, will provide basic yield predictions for studies of potentials and other uses. They also will provide the basic interpretations needed for other purposes, such as conservation planning by farmers and ranchers. The philosophy of key or benchmark soils is to provide an approach which makes possible the maximum contribution by people in experiment stations and elsewhere to soil interpretations. Unfortunately, only a start has been made.