On the **great plains**

Agriculture and Environment

Geoff Cunfer

Foreword by Dan L. Flores

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Elam Bartholomew was twenty-two years old when he left his parents' Illinois farm, boarded a train, and stepped off two days later at Hays, Kansas, to make a homestead claim in the middle of the vast North American grassland.[1] It was March 1874, and the most important transition in Bartholomew's life coincided with a tremendous ecological transition in the Great Plains. Between about 1870 and 1930 Americans plowed more than100 million acres of biologically diverse grassland ecosystems and replaced them with single-species cropland. The most important environmental fact about an agricultural region is how much land is plowed and how much is not. Plowing is the ecological equivalent of genocide. Plowing a grassland is comparable to clear-cutting a forest, but more absolute because the effort to maintain only a single species continues year after year. The plow-up of the Great Plains was the most important ecological change to emerge out of the shift from Indian to Euro-American land use, and Elam Bartholomew contributed his small measure of toil to that undertaking.

His family was mobile in a way typical of nineteenth-century Americans. Born in Lancaster County, Pennsylvania, in 1852, Bartholomew as a baby moved with the family to a farm near Granville, Ohio, and then at age twelve to one near Farmington, Illinois. Five years later they shifted to yet another farm in the same vicinity. In 1873 Bartholomew's older brother, Elias, following the family tradition, moved west to take up a homestead on the Kansas plains in Rooks County, and a year later Elam followed. A long day's wagon ride north from the Hays depot brought Bartholomew to his brother's homestead, and the next day Elam rode out to select a place of his own. In a matter of hours he identified a quarter section of land—160 acres—that would be his home farm for the next sixty years. A few days later he filed a homestead claim on a square of Kansas prairie one-half mile on each side.

Bartholomew did not make a farm as quickly as he acquired legal claim to the land. He had none of the materials necessary to start a farm, aside from the land itself. First, he required more physical power than his own muscles could supply; he needed horses. Second, he needed modern technology capable of cutting through tangles of thick prairie

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sod: a steel plow. Lacking these essential items, Bartholomew was unable to plow any of his prairie land for crops. Instead, he worked as a hired hand for Charles Foote, a neighbor, and taught school in the winters. Bartholomew broke sod on Foote's homestead for months at a time. On occasion Foote subcontracted him out to other neighbors to do the same work on their property. But for two long years Bartholomew never plowed his own land as he struggled to raise enough cash to begin a new farm, lamenting on New Year's Eve 1875, "And thus endeth another year of small results! And the unanswered question yet remains for solution: 'What shall the harvest be!'" Finally, in the spring of 1876, he borrowed a pair of horses from Foote and spent four days breaking sod on his homestead. Later that year he built a modest house before boarding a train back to Illinois, where he married his hometown sweetheart, Rachel Montgomery, and brought her to Kansas to join him.[2]

That year's initial sodbreaking opened only a few acres of land. Every spring thereafter he plowed more. Plowing the prairie was Bartholomew's most important ecological action. He took more than twenty years to complete the slow, arduous work. Some springs Bartholomew plowed a few extra acres here and there if he had a free day. On other occasions he devoted weeks at a time to breaking larger parcels of new ground. In May 1879 he borrowed two horses from a neighbor and broke sod for three weeks, relieved occasionally at the plow handles by his brother. A long, hard day of plowing behind the team could open up a little more than 1 acre of new ground. In the first week Bartholomew plowed out 8 acres of prairie, only 6 in the second week, and, taking turns with his brother, 6 more in the third week. Then it was time to plant corn, and the horses had to go back to their owner, so sodbreaking ceased for the year. Three weeks of work by two men and two horses had opened up only 20 acres of new cropland. Bartholomew plowed a few new acres of prairie sod nearly every spring until the 1890s. Slowly the crop acreage expanded, and the prairie receded. By 1885 he had just over half his farm plowed—87 acres, but one of his sons was still breaking new sod twenty-two years after the initial homestead claim. Rooks County reached its peak plow-up level only in 1940. In 1902 Bartholomew, although finished plowing his own land, arranged for a hired hand to break 30 acres of sod for a neighbor, and in 1904 he visited another nearby effort to expand cropland by plowing new ground.[3] Plowing the Great Plains for crop agriculture did not happen quickly. To plow just a third of the grassland was

a Herculean task that took millions of farmers like Bartholomew—and their horses—more than half a century to accomplish.

Native Grass

Bartholomew and his neighbors did not plow every acre of prairie on their homesteads. They determined that only about 55 percent of their land was good for crops. The remaining 45 percent remained in unplowed native grass, which farmers used as pasture for livestock and mowed for hay. The great prairie plow-up was not comprehensive; rather, it was guided by the natural limits of the environment and thus selective of the best land for crops, leaving a considerable store of grassland relatively undisturbed. On Bartholomew's farm, which he expanded from 160 to 320 acres in midcareer, acreage devoted to crops hovered at 54 percent in 1885, 51 percent in 1905, and 53 percent in 1915; rose to a high of 66 percent in 1925; then declined again to 60 percent in 1929.[4] Fully one-third of the Bartholomew farm was never plowed or put to crop use but remained in native grass cover. In most years the family devoted nearly half of its acreage to pasture.

The pattern holds for other farmers in the area. In March 1879 several members of the Bartholomew family followed Elias and Elam to Rooks County to establish farms there, including a third brother.[5] Ed Bartholomew homesteaded 160 acres and began the slow, laborious task of breaking sod. Like his brother, he expanded his farm through the years, to more than 500 acres by the 1930s. In 1885, Ed Bartholomew had only 9 percent of his land in crops, 45 percent by 1905, and then peaked at 65 percent in 1915. Through the 1920s and 1930s he maintained just over 50 percent of his land in crops, the remainder in pasture.[6] The farms of these two brothers illustrate a chronology of land use that generally holds for the entire Great Plains. The conversion of prairie ecosystems to cropland did not happen quickly, but took decades. During the last quarter of the nineteenth and the first quarter of the twentieth centuries farmers increased croplands at the expense of native prairie, acre by acre, year by year, to a peak that arrived on the Bartholomew farms in 1915 and 1925, and on the entire Great Plains in 1935. They plowed all of the land that was viable for crops and left the rest for pasture. Land with poor soil, land too steep or poorly drained, avoided the breaking plow. At least a third of the two Bartholomew farms was never plowed, and nearly half remained in pasture in most years. Both farmers pushed the limits of what was arable, briefly plowing out 65 and 66 percent of their farms for crops,

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but quickly retreated again into the mid–50 percent range. Toward the end of their careers they broke sod on ground that was marginal for crops, discovered that it would not produce, and returned it to pasture, settling on a roughly 55 percent crop–45 percent pasture mix.

The ecological transformation of the several hundred acres of grassland owned by Elam and Ed Bartholomew is representative of the Great Plains as a whole. There were variations in the pattern, and exceptions, but in general the experience on the Bartholomew farms happened throughout the region. The conversion from prairie to cropland was slow everywhere. The great plow-up of the plains happened mostly in the twentieth century, not in the nineteenth. Farmers began the project in the 1870s, but the plains were vast, the people and horses few, and the work difficult. The plains were not entirely converted to cropland. Across the region only about 30 percent of the prairie felt the breaking plow. Fully 70 percent—265 million acres—was not plowed and remains today in relatively undisturbed native vegetation, grazed and mowed for hay, but otherwise intact.

The conversion and use of prairie for cropland happened in three stages. An initial pioneer era lasted from about 1870 to 1930, more than half a century during which farmers expanded cropland and reduced prairie acreage. A short transition era between 1930 and 1940 saw farmers reach the natural limits of arability, plow a bit beyond them, then retreat to a sustainable balance between cropland and pasture. Since 1940, farmers in the plains have maintained that balance in remarkable equilibrium. Dramatic changes in technology, crop prices, weather, and federal farm programs since 1940 have not budged basic land use from the balance established early in the twentieth century. The limits to arability were environmental; although human factors of economy, policy, technology, and culture changed quickly, the environmental parameters of the plains remained the same. Climate, soils, slope, and latitude largely determined whether land was plowed for crops or used for pasture. A jump in wheat prices might have made farmers want to plow out pasture for wheat, but scant rainfall, sandy soils, steep slopes, and short growing seasons did not allow it. It takes a long time for people new to a place to adapt to the landscape. In the Great Plains the process of adaptation began during the pioneer era when farmers selected the best lands and plowed them for crops. But the true period of adaptation was in the transition era, between about 1930 and 1940, when farmers first reached the natural limits of environment, passed them, and were pulled back by nature. It is not sur-

prising that the 1930s are remembered in the Great Plains as a painful time of disruption and exodus. It was then that Euro-Americans finally adapted to their new home on the range.

Plowing Rooks County, Kansas

This chronology of ecological transformation, testing of environmental limits, and establishment of land-use equilibrium is apparent at several scales. At the level of individual farms the Elam and Ed Bartholomew homesteads illustrate the pattern. The Bartholomews spent decades plowing new land, reached and exceeded the environmental limits of their farms in the early twentieth century, then contracted cropland slightly before settling into a stable balance between cropland and pasture. In Rooks County, Kansas, home to the Bartholomews, the conversion of prairie to cropland began in 1872 when the federal government opened public domain homesteading. The county encompasses 570,000 acres in the heart of the Great Plains. In 1872 practically all of it was unplowed prairie. Table 2.1 and Figure 2.1 present the ecological transformation of Rooks County from open range to farm country between 1880 and 1997. Even though each decade in the nineteenth century saw a considerable reduction in prairie ground, as late as 1900 more than 70 percent of the county remained unplowed. The decline in native grassland continued into the twentieth century, reaching a low point in 1925 at about 45 percent prairie, 55 percent cropland. Prairie acreage in Rooks County achieved equilibrium by 1925 and for the next seventy-five years held roughly stable, at between 45 and 55 percent unplowed land.

Other farmers in Rooks County acted much as the Bartholomews had. They plowed new land for several decades before reaching the natural limits of arability. By the 1920s they had plowed practically all the land in the county that could be cropped, then settled into a stable land-use regime for the next eighty years that appears to be sustainable, one in which about half of the county's acreage is devoted to crop production, half to grazing livestock on native prairie. At no point in the county's history has more than 55 percent of its land been plowed for crops, meaning that about 45 percent of the county—255,000 acres—remains today in unplowed native plant cover. Rooks County farmers expanded crop agriculture on good prairie soils, experimented with the natural limits of marginal land, and by the 1920s had determined which land could reliably produce crops and which could not. The last agricultural census of the twentieth century, conducted in 1997, shows a sharp increase in pasture and a sharp decrease in cropland. It is too

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Year	Total Area (acres)	Cropland (acres)	(%)	Grassland (acres)	(%)
1880	570,504	29,483	5	541,021	95
1890	570,475	84,527	15	485,948	85
1900	576,000	142,844	25	433,156	75
1910	569,600	254,223	45	315,377	55
1920	569,600	288,603	51	280,997	49
1925	569,600	311,753	55	257,847	45
1930	569,600	302,461	53	267,139	47
1935	569,600	315,624	55	253,976	45
1940	571,520	316,106	55	255,414	45
1945	571,520	313,282	55	258,238	45
1950	571,520	296,394	52	275,126	48
1954	571,520	299,044	52	272,476	48
1959	568,320	300,963	53	267,357	47
1964	568,320	285,100	50	283,220	50
1978	567,040	273,569	48	293,471	52
1992	568,568	304,666	54	263,902	46
1997	568,568	257,104	45	311,464	55

Table 2.1. Land in Crops and Grassland, Rooks County, Kansas

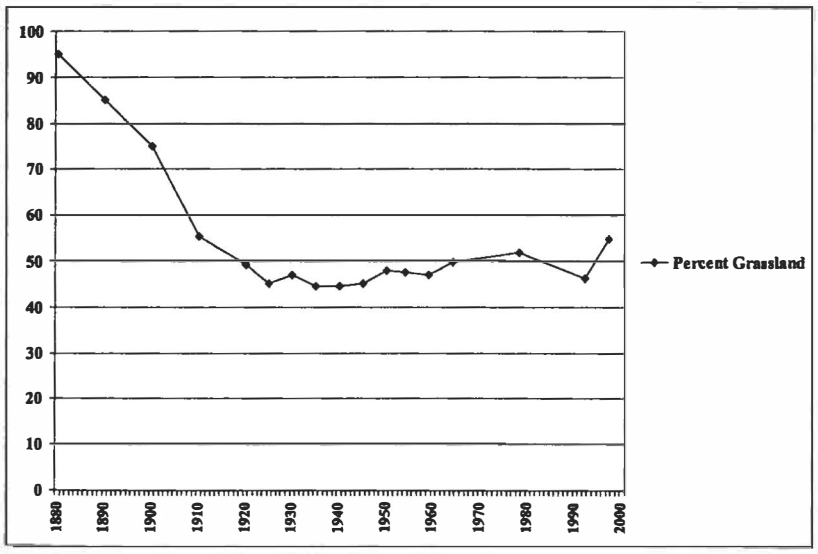

Figure 2.1. Percentage of area in grassland, Rooks County, Kansas.

early to tell if this is the beginning of a major land-use shift or simply a larger than usual variation in the equilibrium pattern. Rooks County farmers operated within the environmental parameters of their place and sustained a consistent land-use balance between native grass cover and cropland that varied little during three-quarters of a century.

Plowing Western North Dakota

Rooks County is in the center of the grassland and in the heart of the wheat belt, but the Great Plains is a large region with considerable environmental and cultural variation. How well does the Rooks County pattern apply to the rest of the plains? A three-county area of western North Dakota provides a comparison. In Billings, Golden Valley, and Slope counties, the chronology of settlement and land conversion was similar to that in Kansas, but with variations caused by differences in the timing of settlement and in key environmental parameters.[7] Western North Dakota remained exclusively ranching country longer than did central Kansas. Because the area is farther west than Kansas, it is considerably drier, averaging only fifteen inches of precipitation per year compared to twenty-four inches in Rooks County.[8] This difference is critical when wheat farmers need twenty inches of rain to make a crop. And because North Dakota is farther north than Kansas, the growing season is shorter. Both factors created greater challenges to crop agriculture in western North Dakota than farmers faced in the central, southern, and eastern plains. Partly for these reasons homestead settlement and the conversion of prairie to cropland happened later in North Dakota, where it was entirely a twentieth-century phenomenon.

The big settlement boom came to Billings, Golden Valley, and Slope counties between 1905 and 1920. Farmers poured into the area, bringing along speculators, land companies, merchants, and lawyers. For more than thirty years, from about 1870 to 1905, the region had been used only by open-range ranchers grazing cattle, sheep, and horses on the public domain. In 1905 the town shipped out sixty-four railroad cars of cattle, twenty-eight of sheep, five of horses, twenty-five of wool, twenty of hay, but only four carloads of grain. The sheep-shearing plant could process 1,250 sheep a day at shearing season, and the biggest business in town was a saddlery employing seven skilled saddle makers serving area ranches. The economy centered on livestock. But then farmers arrived and pushed out the cattle raisers.[9]

The land office at Dickinson, just east of Billings County, opened for business July 1, 1904, to distribute public land to individuals in 160-

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acre blocks. In April 1906 it handled 846 homestead entries. In June it registered more than 600. Immigrants poured into the towns of Sentinel Butte and Beach and out onto the prairies, arriving not in covered wagons, but on trains. Throughout spring and summer 1906 the Sentinel Butte newspaper reported new arrivals weekly: "Four more [railroad] cars of emigrant movables arrived here last Friday and Saturday. It is hard to keep track of them all." Billings County's population rose from 975 in 1900 to 10,186 a decade later. Everyone jumped at the chance to claim a free quarter section of land now that there was a market for it. The editor of the newspaper homesteaded a plot, and Prof. Joseph A. Kitchen quit teaching to take up farming, harvesting thirty bushels of wheat per acre his first year.[10]

The railroad and land speculators got in on the action too. The Northern Pacific Railway had owned a wide swath in North Dakota for decades but only patented its 51,000 acres in Billings County in 1906, at which time it became liable for property taxes and could sell the property in small parcels to immigrant farmers. The biggest real estate operator around Sentinel Butte was the Golden Valley Land and Cattle Company, for whom the western half of Billings County would be named when it split in 1912. Golden Valley brought land seekers from Minnesota, Iowa, and elsewhere to buy large and small parcels. Men traveled west on the train to search out a location, purchased land from Golden Valley, then went back to Minnesota or points east to collect their families and belongings. Throughout 1906 the company did booming business, capped in May when an Iowa speculator purchased three townships—some 69,000 acres—south of Sentinel Butte.[11]

Generous rainfall accompanied the population and land boom. In 1905, the first year after the land office opened, there were fifteen inches of rain, about average. The next year was 30 percent better than average, at twenty inches. Crops did very well in 1906, with newspaper reports of wheat yields of twenty-eight and thirty bushels per acre. Wheat prices hovered between fifty and sixty cents per bushel. It was an unusual convergence for plains farmers: sufficient rain, bumper crops, and decent commodity prices. Everyone made money. Even the ranches, forced to adjust to a loss of free range, could profit. With new farmers arriving, there was a strong local market for horses. J. J. Tomamichel sold his 200 horses in Sentinel Butte for forty dollars apiece in May, then traveled to Wyoming to buy 400 more, which he drove cross-country, arriving back in Sentinel Butte in late June. Within three weeks he had sold all of them at forty-nine dollars apiece, making a nice profit. M. W. Marshall, for the past twenty years operator of

the TD Ranch north of Sentinel Butte, made one final roundup of his free-ranging horses—1,000 of his own and 200 more belonging to an employee—and arranged to ship them to St. Louis where the animals brought sixty dollars apiece. One rancher drove his horses to the railroad for shipment east but sold all of them to local farmers before he could load them; another, a sixteen-year veteran of the region, sold all his horses for $37,000.[12] In 1906 everyone made money.

In this atmosphere the land market boomed. Land prices skyrocketed, fueling speculation. In May 1906, some were still willing to sell land for $5.00 an acre. In June the newspaper reported the astonishing news that a parcel had gone for $15.00 an acre, and in August a man from Wisconsin bought property from the Golden Valley Land and Cattle Company for $17.50, the highest price thus far paid for land in the area. In October J. B. Stoddard sold ten sections of land he had purchased several years earlier—6,400 acres—at a $20,000 profit. "Mr. Stoddard . . . is to be congratulated on his good business foresight in purchasing wild lands when the price was very low," commented the newspaper. By 1915 land dealers and the railroad listed tens of thousands of acres of rolling prairie at between $15.00 and $30.00, with the worst "hilly or broken" badlands starting at $7.50. And anyone could get 160 acres of it for free. Most adults in Billings County took advantage of the government's largesse. As many women as men filed homestead claims. Some people had no intention of farming the land or living on it. Instead, they filed a homestead claim, then sold relinquishments as soon as possible to farmers or other speculators, a procedure that could bring a swift profit of $800 to $1,000. People moved in and out quickly, doing the minimal work necessary to acquire land, sell at a profit, and move on. And plenty of people came who intended to settle and farm. Every week brought news of homes going up on the prairie, fences enclosing small pastures, and farmers arriving. The German Catholic Golden Valley Land Company helped move seventeen clients from St. Cloud, Minnesota, onto farms in the area.[13] The population was very fluid.

As farmers arrived, they began breaking prairie sod for crops. Table 2.2 and Figure 2.2 present the chronology of prairie plow-up in western North Dakota. Although the timing and the amount of land plowed varies from the Kansas case study, the pattern of prairie conversion was remarkably similar. Between 1905 and 1925 pioneers plowed the best land for crops. Between 1925 and 1940 farmers experienced a transition era in which they reached the natural limits of their new home, exceeded those limits temporarily, then settled into an equilibrium of

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land use that varied only slightly for the next sixty years. Figure 2.2 suggests that about 22 percent of the three-county area is viable for crop production over the long term. In the 1920s and 1930s farmers plowed a bit beyond that limit, then retreated. They repeated that transition experience again fifty years later in the 1970s, plowing out some land that was marginal for crops, so the historical low level of native prairie cover arrived only in 1978. Here cultural factors can be seen to influence land-use choices just slightly. In the early 1970s crop prices reached century highs as export markets expanded and concern about global overpopulation led to fears of a looming food shortage. The federal government encouraged an expansion of production and provided financial incentives for new plow-ups. Land-use data show that some farmers in western North Dakota responded with new sodbreaking. Regardless of crop prices and exhortations from the Department of Agriculture, environmental limits prevented a large or permanent expansion of cropland, and by 1992 crop acreage was down again to sustainable levels.

The pattern evident in Kansas holds true for North Dakota as well, although the details vary somewhat. Three differences mark the North Dakota location. First, the conversion of prairie to cropland happened later than in Kansas. Second, it happened faster. Third, farmers plowed much less land for crops in North Dakota than in Kansas. All three of these differences result from environmental distinctions between the two locations. Homesteaders selected Kansas in the 1870s and western North Dakota only after 1905 because Rooks County is better suited to crop agriculture than is western North Dakota. Kansas receives more rainfall than North Dakota, on average, and rainfall is the most limiting factor in plains farming. Cooler temperatures on the northern plains compensate somewhat for lower rainfall because more precipitation evaporates or transpires through plants in warm Kansas than in cool North Dakota. But the northern latitude also means shorter growing seasons. Crops in North Dakota suffer from early fall frosts as well as from occasional droughts.

Another difference between the two locations is topography. Rooks County has mostly rolling upland plains dissected by small, shallow rivers and creeks, whereas a band of badlands follows the Little Missouri River through Billings, Golden Valley, and Slope counties. The badlands of steep, eroded, sandy formations stretch for some fifteen miles on either side of the river and are for all practical purposes useless for crop farming.[14] Despite the hopes of Sentinel Butte boosters and land speculators in 1906, only a small amount of the area was

Year	Total Area (acres)	Cropland (acres)	(%)	Grassland (acres)	(%)
1890	2,186,373	0	0	2,186,373	100
1900	3,936,000	403	0	3,935,597	100
1910	2,178,560	113,570	5	2,064,990	95
1920	2,178,560	246,314	11	1,932,246	89
1925	2,178,560	438,557	20	1,740,003	80
1930	2,178,560	538,026	25	1,640,534	75
1935	2,178,560	560,515	26	1,618,045	74
1940	2,162,560	480,975	22	1,681,585	78
1945	2,162,500	475,204	22	1,687,296	78
1950	2,162,560	457,836	21	1,704,724	79
1954	2,162,560	517,633	24	1,644,927	76
1959	2,162,560	495,682	23	1,666,878	77
1964	2,162,560	501,870	23	1,660,690	77
1978	2,161,920	609,579	28	1,552,341	72
1992	2,157,750	549,430	25	1,608,320	75
1997	2,157,750	422,823	20	1,734,927	80

Table 2.2. Land in Crops and Grassland, Billings, Golden Valley, and Slope Counties, North Dakota

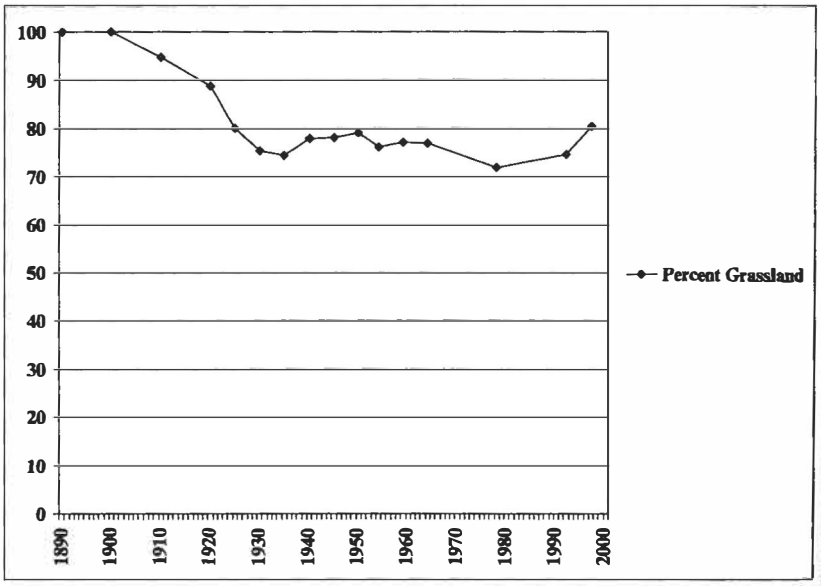

Figure 2.2. Percentage of area in grassland, Billings, Golden Valley, and Slope counties, North Dakota.

Cropland (acres)	(%)	Grassland (acres)	(%)
0	0	2,186,373	100
403	0	3,935,597	100
113,570	5	2,064,990	95
246,314	11	1,932,246	89
438,557	20	1,740,003	80
538,026	25	1,640,534	75
560,515	26	1,618,045	74
480,975	22	1,681,585	78
475,204	22	1,687,296	78
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517,633	24	1,644,927	76
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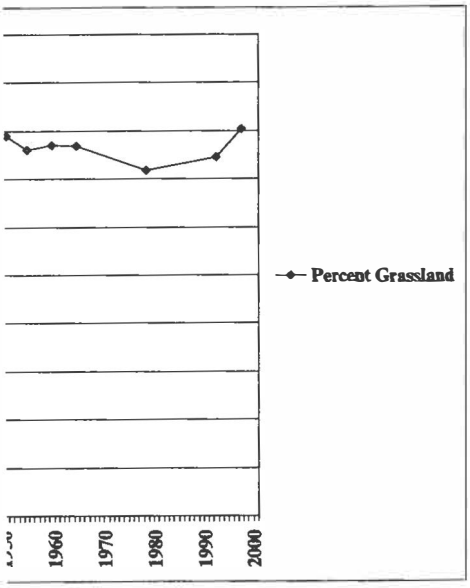

;rassland, Billings, Golden Valley, and Slope

susceptible to crop farming. Because climate, soil, slope, and latitude constrained farmers much more in western North Dakota than in Kansas, there was much more pasture than cropland. The great majority of the three counties remains in unplowed native vegetation. It is ranching country more than wheat country. Farmers broke sod on less than 30 percent of the enormous three-county area, leaving more than 1.5 million acres in natural cover. Because they plowed less than 30 percent of their land, compared to about 55 percent plowed by Kansas farmers, North Dakota farmers finished the plow-up faster. They reached the end of sodbreaking in twenty-five years, whereas Kansans required sixty to do the job. Because North Dakota farmers began their task thirty-five years later than in Kansas, they also had access to tractors to speed the work, such as the giant steam-powered tractor that was breaking twenty-five acres of sod a day in the area in 1914.[15] Compare that to Elam Bartholomew and his neighbors, who managed just over one acre a day with a pair of horses.

Plowing the Great Plains

Throughout the Great Plains, farmers experienced three phases in the transformation of grassland ecosystems and land use. A pioneer era of cropland expansion and prairie reduction came to a head early in the twentieth century as farmers reached the natural limits of their environment. A transition era of only about a decade saw many farmers plow a bit too much marginal land, realize their error, and restore some of it to pasture. Once they adjusted to those natural limits, they sustained a remarkably stable land-use pattern for more than half a century even as the economics, technology, and demography of agriculture evolved quickly. Table 2.3 and Figure 2.3 illustrate this chronology for the entire Great Plains. Of the roughly 380 million acres in the grassland, less than one-third was ever plowed, and two-thirds remains in native prairie cover. The pattern was the same on the Bartholomew homesteads, in Rooks County, in western North Dakota, and in the Great Plains as a whole. The timing and amount of the plow-up varied considerably from one locality to another, however. Understanding those variations more fully requires looking at not just a handful of local case studies, or at the entire region, but evaluating all 450 counties in the Great Plains.

Figures 2.4–2.7 present maps of the Great Plains from 1880 to 1997. They illustrate the spatial and chronological patterns of cropland expansion by indicating what percentage of each county's total area remained unplowed at each time point. Figure 2.4 shows how little of

Year	Total Area (acres)	Cropland (acres)	(%)	Grassland (acres)	(%)
1880	440,076,135	3,150,687	*1*	436,925,448	*99*
1890	372,134,144	16,263,898	*4*	355,870,246	*96*
1900	383,877,120	31,137,360	*8*	352,739,760	*92*
1910	385,175,040	52,959,820	*14*	332,215,220	*86*
1920	383,547,320	69,026,950	*18*	314,520,370	*82*
1925	383,535,700	91,219,645	*24*	292,316,055	*76*
1930	383,532,800	107,243,963	*28*	276,288,837	*72*
1935	384,602,580	118,914,807	*31*	265,687,773	*69*
1940	383,220,480	105,019,416	*27*	278,201,064	*73*
1945	382,489,480	97,288,965	*25*	285,200,515	*75*
1950	382,850,160	104,087,809	*27*	278,762,351	*73*
1954	380,799,640	104,507,115	*27*	276,292,525	*73*
1959	382,268,160	103,955,869	*27*	278,312,291	*73*
1964	382,269,440	105,064,540	*27*	277,204,900	*73*
1978	381,849,600	111,007,366	*29*	270,842,234	*71*
1992	381,792,984	111,720,316	*29*	270,072,668	*71*
1997	381,792,984	93,858,319	*25*	287,934,665	*75*

Table 2.3. Land in Crops and Grassland, All Great Plains Counties

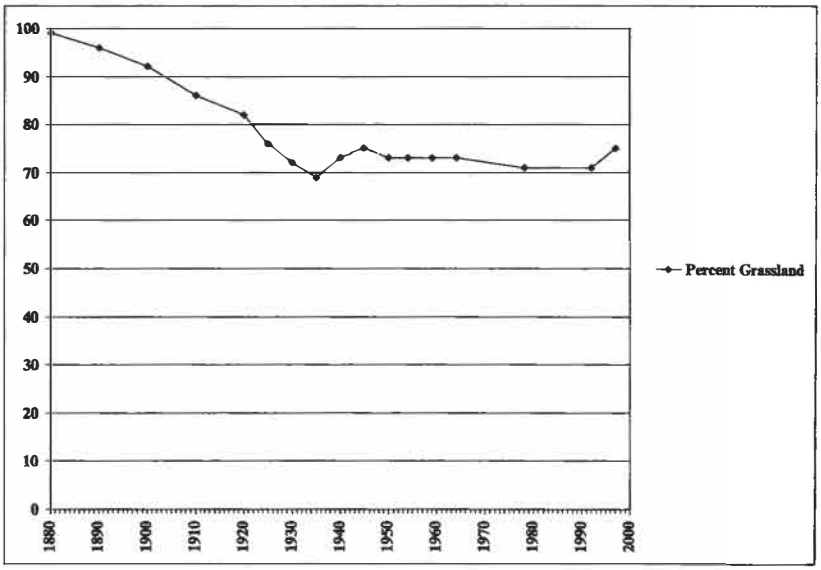

Figure 2.3. Percentage of area in grassland, all Great Plains counties.

Cropland (acres)	(%)	Grassland (acres)	(%)
3,150,687	1	436,925,448	99
16,263,898	4	355,870,246	96
31,137,360	8	352,739,760	92
52,959,820	14	332,215,220	86
69,026,950	18	314,520,370	82
91,219,645	24	292,316,055	76
07,243,963	28	276,288,837	72
18,914,807	31	265,687,773	69
05,019,416	27	278,201,064	73
97,288,965	25	285,200,515	75
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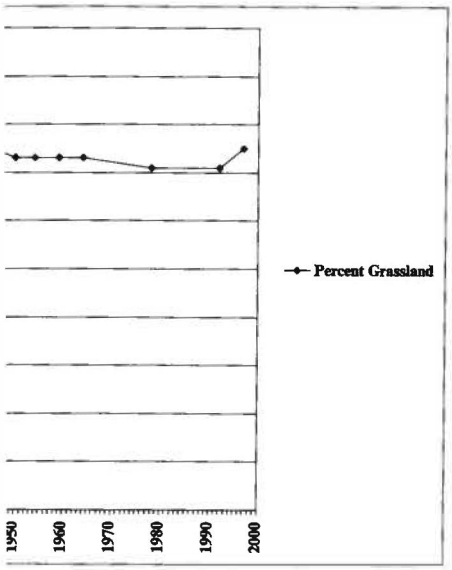
04,507,115	27	276,292,525	73
03,955,869	27	278,312,291	73
05,064,540	27	277,204,900	73
11,007,366	29	270,842,234	71
11,720,316	29	270,072,668	71
93,858,319	25	287,934,665	75

and, All Great Plains Counties



ssland, all Great Plains counties.

the Great Plains was plowed in the nineteenth century. Only in the extreme eastern plains, in central Kansas and Nebraska, and in the eastern Dakotas, did farmers succeed in plowing more than 25 percent of the land by 1900. Most plains sodbusting happened in the early twentieth century. Figure 2.4 brackets the homesteading era on the Great Plains. Although the homestead law and its successors were in effect from 1862 to 1934, most actual homesteading on the grassland happened between 1870 and 1920. By the latter date most potentially arable land was in private ownership, and the only land remaining in the public domain was of poor agricultural quality.

By 1920 the general spatial pattern of cropland was established. The 1920 map shows more plow-up, with many counties exceeding 20 percent of land in crops, and several dozen exceeding 50 percent. Most cropped land was in the eastern plains from the Dakotas to Oklahoma, with a bulge westward around the Kansas-Nebraska border. Very little land in the western plains, from the Texas panhandle and eastern New Mexico northward to western South Dakota and into Montana, was plowed. The western plains remained primarily ranching country, with very little cropland, because much of the western plains was simply too dry to support crops. There most of the land was never plowed.

Rain, or lack of it, is the driving factor in Great Plains land use, and this is evident in the 1920 map of unplowed land. The line demarcating farm country from ranch country followed closely average annual precipitation and natural vegetation. Where there was sufficient rainfall to support tallgrass and mixed-grass prairie, farmers had enough moisture and good soils. Where low rainfall supported only short grasses, farmers did not attempt to plow and focused their economic activity on expansive cattle raising instead. But important as it was, precipitation was not the only factor in plains land use. A second, weaker driving factor behind the 1920 map was temperature. Western North Dakota got as little precipitation as the Texas panhandle. However, because it was colder than Texas, it lost less rain to subsequent evaporation and transpiration. Farmers plowed little land in the Texas panhandle because rainfall was low, but also because high temperatures quickly pulled soil moisture back up into the atmosphere. North Dakota farmers could make meager rainfall go farther than those to the south.

A third factor influencing the maps of land use was soil quality. On the northern plains the most recent glaciations deposited massive amounts of rich topsoil. Soils then developed under prairie sod for some 10,000 years. Those parts of the plains with good soils, such as most of Kansas, eastern South Dakota, and much of North Dakota,

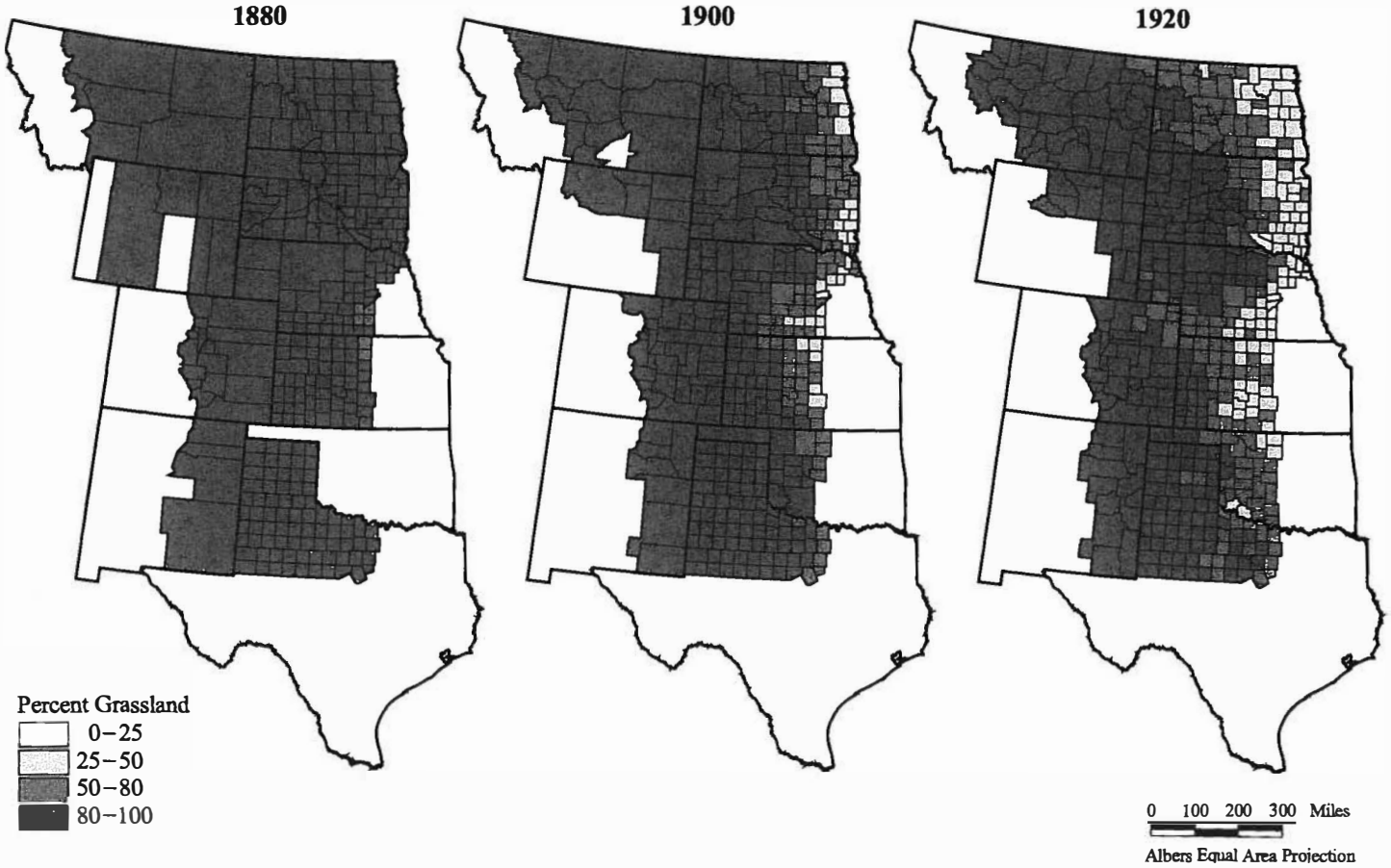
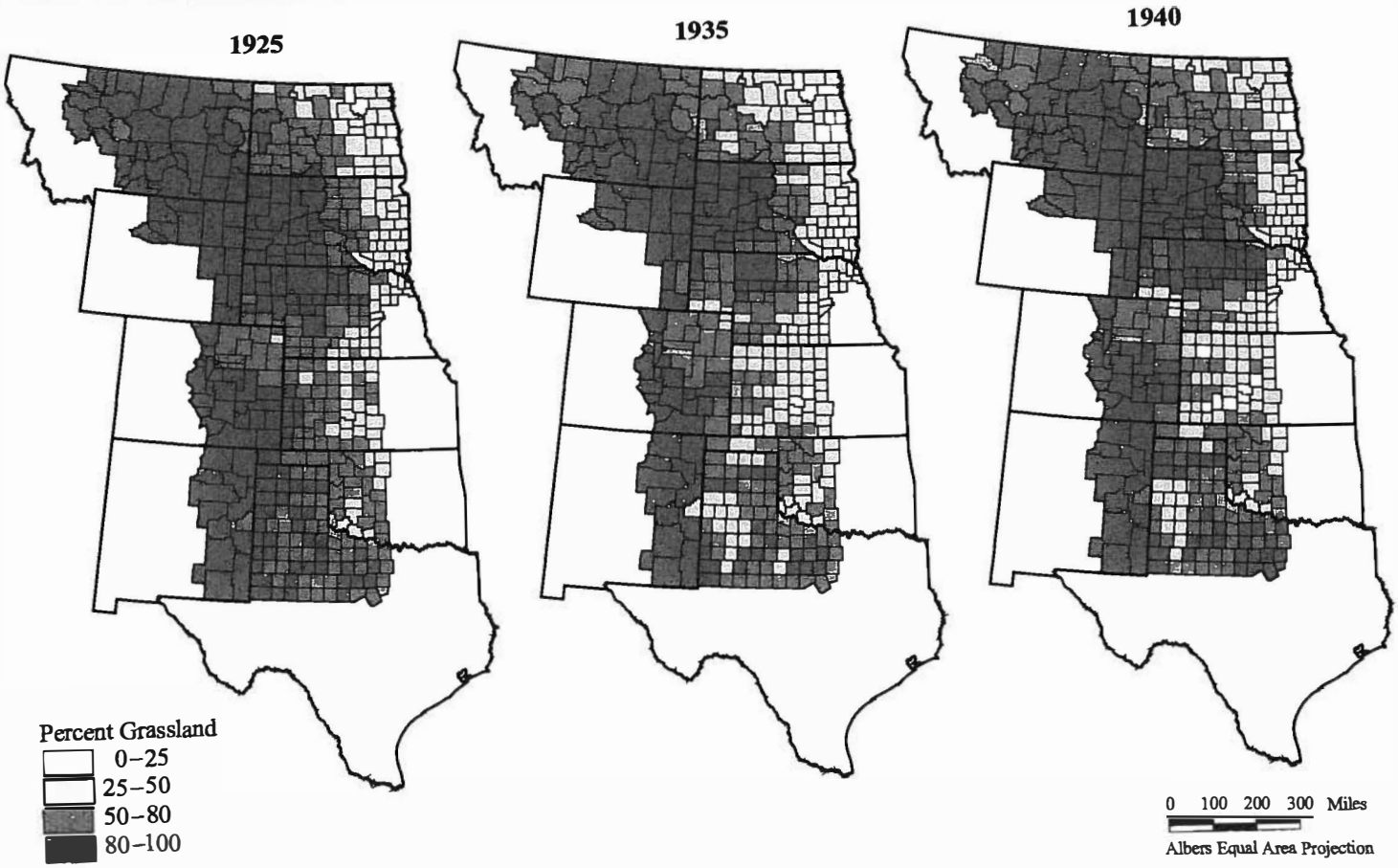


Figure 2.4. Percentage of total county area not plowed, 1880–1920.



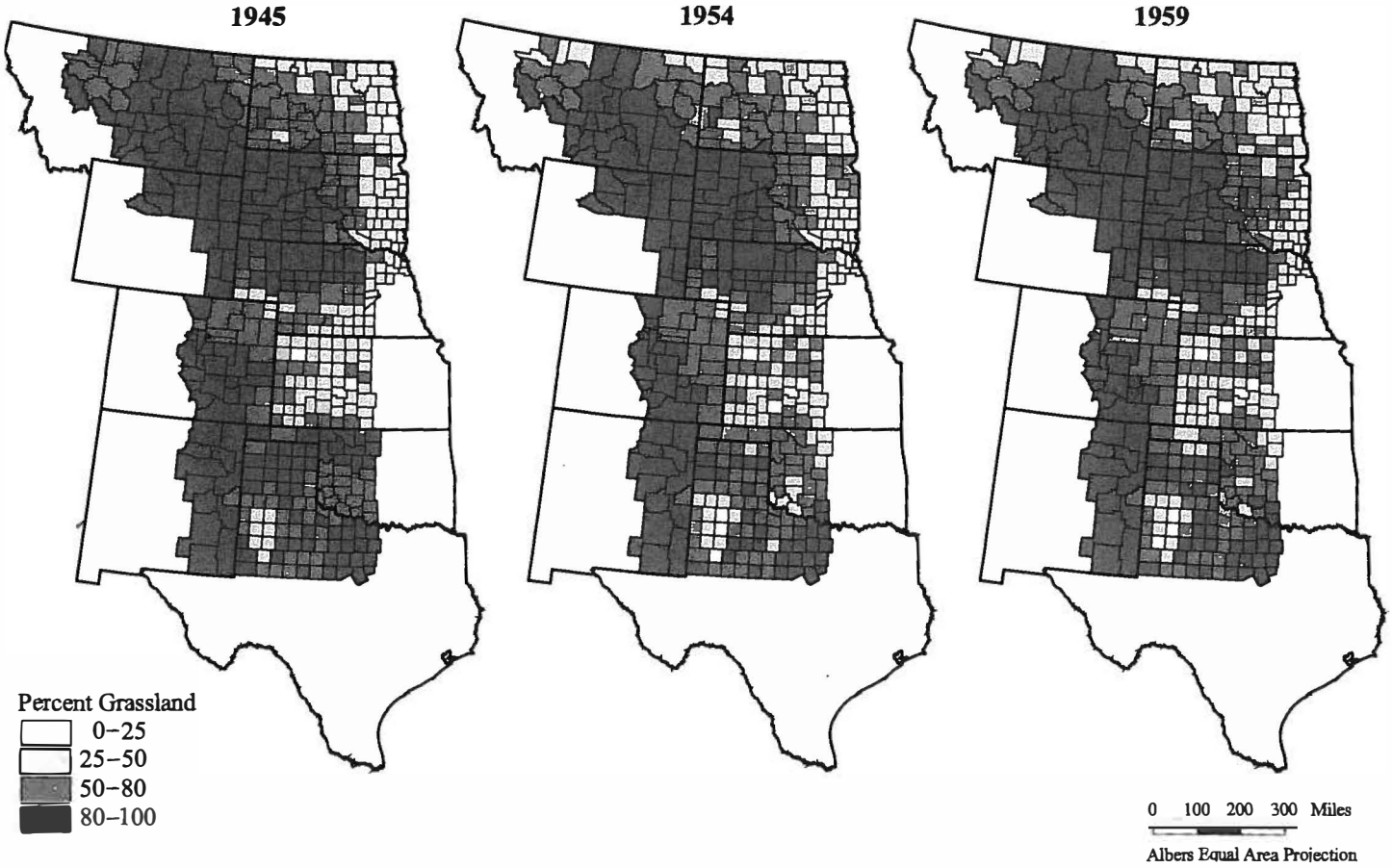
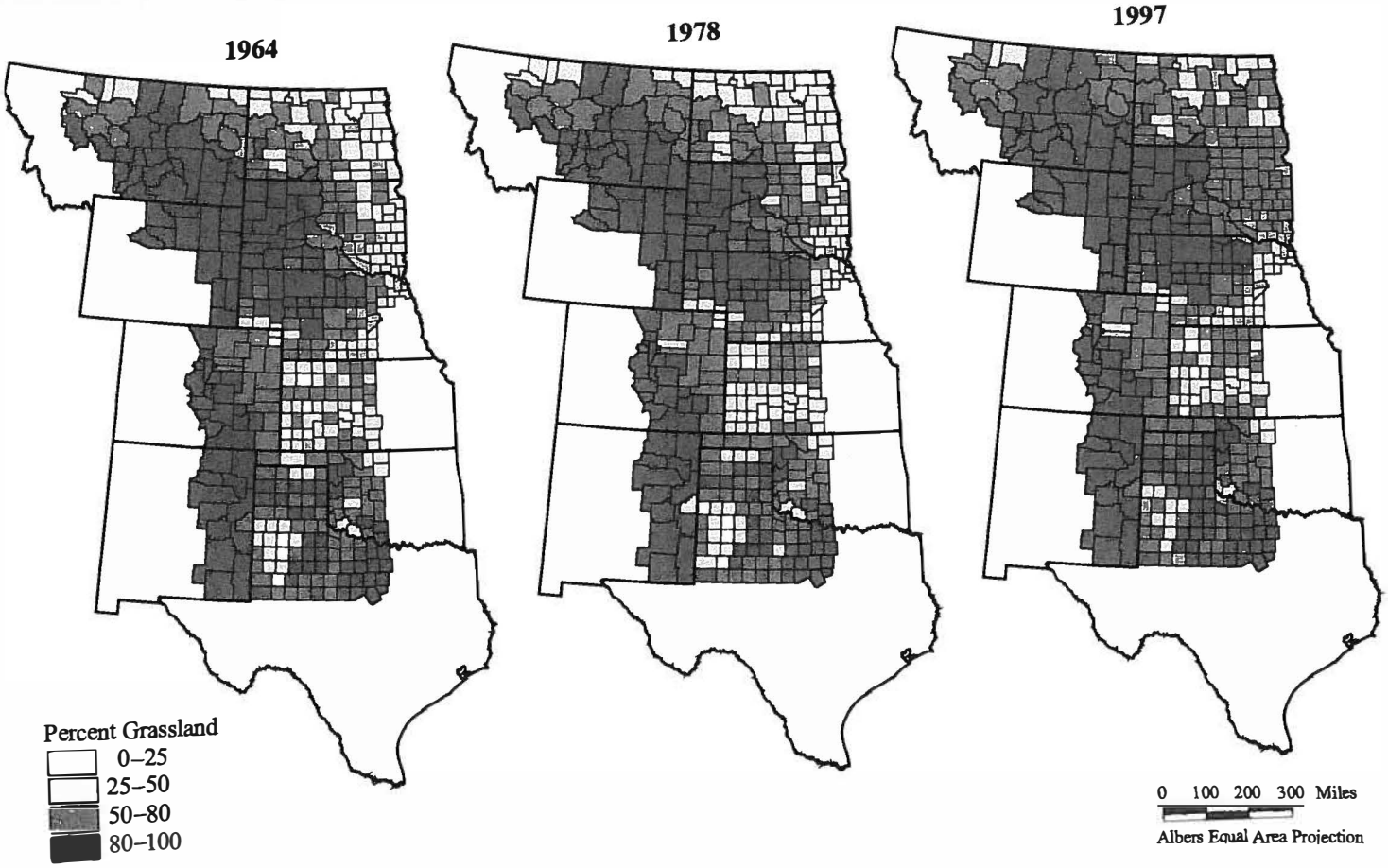


Figure 2.6. Percentage of total county area not plowed, 1945–59.



supported crop agriculture when sufficient soil moisture was available. Western South Dakota had little cropland because glacial soils deposited to the north and east did not reach into that region. In northwestern Nebraska the sand hills area received sufficient rainfall for some cropping, but very sandy soils drained water away too fast for crops to thrive. The 1920 map in Figure 2.4 illustrates the force of environmental determinants on basic land use. There was little farmers could do to alter key parts of their new environment—rainfall, temperature, soil quality, slope. They responded to these natural limitations the only way they could, by plowing and cropping the third of the plains that was arable and by fencing and grazing most of the rest.

The patterns make sense when viewed regionwide and with a century's hindsight. But individual farmers in communities across the Great Plains, lacking long-term weather data, could not always estimate precisely which land would sustain cropping for the long term and which land would not. Between about 1925 and 1940 plains farmers experienced a transition in settlement history, from a time when more prairie land was converted to cropland every year to a time when the balance between crops and pasture remained in rough equilibrium. That transition era happened at different times in different locales. The transition to stability came as early as the 1910s in Elam Bartholomew's Rooks County, where homesteading had begun in the 1870s, but as late as the 1930s in the Texas panhandle, where the conversion from very large ranches to small farms happened only after about 1905. Regionwide, farmers met the natural limits to further expansion of cropland about 1925, plowed straight past those limits by 1935, realized their mistake, and slightly contracted cropland again by 1940. For the Great Plains as a whole, 1935 was the nadir of unplowed grassland, the peak of crop acreage (Figure 2.3). Figure 2.5 brackets the transition era. The 1935 map is the lightest in color of the entire series; the 1940 map marks the beginning of sixty years of general stability, when the cropland-pasture balance remained stable in hundreds of plains counties. The final expansion of cropland from 1925 to 1935 happened especially in western Kansas and in the Oklahoma and Texas panhandles. The contraction from 1935 to 1940 represented a return of some 12.5 million acres from cropland back to pasture. Although the number is large, so is the region, and this retreat was modest in size, dropping land in crops from 31 percent of the total area of the plains to 27 percent.

Figures 2.6 and 2.7 present maps that remain stable. From 1940 to 1978 there was little change in the amount or location of cropland in

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the region. Farmers and communities settled into an agricultural system that was adapted to their environment. In some places that meant devoting 15 percent of their land to crops and 85 percent to pasture for livestock. In other parts of the plains, where soils, rainfall, and temperatures were more congenial to cropping, farmers planted 60 percent of their land in crops, leaving the remainder in grass. But whatever the balance in any locale, there was little change. Rising and dropping crop prices, changes in federal farm programs, droughts and cold snaps, increasing consumerism and consolidation of farms to ever-larger sizes, all had little impact on basic land use. Most counties remained in the same map category year after year; occasionally a few shifted up or down one level. One marked exception to this rule is a dozen counties over the Ogallala Aquifer in the Texas panhandle that expanded their cropland acreage considerably during the middle and late twentieth century. The exception there proves the rule. Natural factors controlled whether farmers plowed land or grazed it. Only in the Texas panhandle were farmers able to overcome the natural limit to their ability to raise crops successfully. There irrigation technology and the existence of an enormous cache of underground water allowed farmers to transgress the limits of aridity and expand cropland between 1940 and 1978 (see chapter 7). As long as they could supplement limited soil moisture through irrigation, farmers could crop more land. Most plains farmers were not so lucky and were forced to live within climatic limits.

The 1997 map in Figure 2.7 shows a marked reduction in crop farming in parts of the plains. In the Dakotas and the Texas panhandle many counties darkened by a category in 1997. Some 18 million acres across the plains shifted out of crop production and into grass between 1992 and 1997 (see Table 2.3). Part of this change was caused by the popularity of the federal Conservation Reserve Program (CRP) begun in 1985, which pays farmers to take land out of crop production for long periods of time. Part of it may also be explained by declining water levels in the Ogallala Aquifer that have forced farmers in west Texas to stop irrigating crops. It is unclear whether a trend toward reconversion of cropland to grass is under way or whether 1997 was an anomaly in an otherwise stable land-use regime.

The most important information necessary to understand the ecological history of an agricultural landscape is how much land was plowed for crops and how much was not. The act of plowing alters vegetation, animal populations, water dynamics, and soil chemistry and physics in catastrophic ways.[16] Leaving land unplowed but grazed, even

intensively, is markedly less disruptive of ecological systems. The next chapter explores some of the ecological consequences of livestock grazing on unplowed grassland. Despite common perceptions that the prairie has been plowed from fencerow to fencerow and that little natural grassland remains, in fact 70 percent of the Great Plains has never been plowed. Only a little over a quarter of the entire area was found to be sustainably arable. The plow-up affected the eastern tallgrass and mixed-grass prairies more than the western short-grass plains. But unlike desert ecosystems drastically altered by grazing or forest ecosystems that have nearly all been cut at least once in the past four centuries, the 265 million acres of unplowed land in the Great Plains represents an enormous stockpile of relatively undisturbed native land cover.

This fact of relative preservation was not the result of an inherent wish to protect nature on the part of plains settlers. It was the result of clear environmental limitations to human land use. The lure of capitalism, the seduction of technological innovation, the subsidy of federal farm programs, and the whims and wishes of farm families have had little influence on the pattern of land use that developed in the grassland at the heart of North America. Instead, parameters of environment stopped sodbusters in their tracks: low rainfall, high temperatures, poor soils, and steep slopes. Wherever farmers could combine good soils, gentle topography, sufficient temperatures and growing seasons, and adequate rainfall, they plowed and planted corn, wheat, sorghum, and cotton. That was no small area, representing nearly 120 million acres. But where one or more of those elements were missing, farmers could not plow and raise crops sustainably, and thus most of the plains has been used only for livestock grazing. That vast expanse of grazing land is the topic of the next chapter. In the Great Plains, environment has been the strongest determinant of land use.

9. Geoff Cunfer, "The New Deal's Land Utilization Program in the Great Plains," *Great Plains Quarterly* 21 (Summer 2001): 193–210.
10. Anne Kelly Knowles, ed., *Past Time, Past Place: GIS for History;* and Ian N. Gregory, *A Place in History: A Guide to Using GIS in Historical Research* (Oxford, UK: Oxbow Books, 2003).

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2. Bartholomew Diary, April 2, 1874–September 10, 1876.
3. Bartholomew Diary, May 15–24, 1877; May 5–23, 1879; May 14–24, 1880; June 10–16, 1880; July 17, 1880; March 30–May 31, 1881; April 15–May 1, 1884; April 1–2, 1885; May 29–31, 1885; May 7–20, 1886; May 23–31, 1888; May 27, 1890; April 7, 1894; June 23, 1894; June 3–11, 1895; April 4, May 5, 1902; May 20–June 11, 1904; KS Agr. Cen., 1885.
4. KS Agr. Cen., 1885, 1905, 1915, 1925; KS Stat. Rolls, 1929.
5. Bartholomew Diary, February 19, 1891.
6. KS Agr. Cen., 1885, 1905, 1915, 1925; KS Stat. Rolls, 1929, 1933, 1936.
7. Between 1870 and 1910 Billings County, North Dakota, changed its boundaries several times before it divided into three counties: Billings, Golden Valley, and Slope in 1912. After 1912 county boundaries remained stable. In the early decades of settlement the total land area reported in Table 2.2 varies accordingly.
8. Frederick P. Aziz, *Soil Survey of Golden Valley County, North Dakota*, 2–3, 96; Cecil D. Palmer, *Soil Survey of Rooks County, Kansas*, 1.
9. *BCR*, August 16, 1906.
10. *BCR*, April 18, May 17, May 31, June 21, July 5, September 6, 1906.
11. *BCR*, May 24, October 25, 1906.
12. *BCR*, April 12, May 24, May 31, June 21, June 28, July 19, August 16, September 6, September 20, 1906.
13. *BCR*, May 17, June 7, July 26, August 30, September 13, October 11, 1906; "List of Land Dealers along the Northern Pacific Yellowstone Park Line," 1915, North Dakota Heritage Center, Bismarck.
14. Geoff Cunfer, "The New Deal's Land Utilization Program in the Great Plains," *Great Plains Quarterly* 21 (Summer 2001): 193–210.
15. Northern Pacific Railway, "North Dakota (Northern Pacific Yellowstone Park Line)," 1914, 8, North Dakota Heritage Center, Bismarck.
16. Maria R. Finckh and Martin S. Wolfe, "The Use of Biodiversity to Restrict Plant Diseases and Some Consequences for Farmers and Society," in *Ecology in Agriculture*, ed. Louise E. Jackson, 203–204; David Tilman, David Wedin, and Johannes Knops, "Productivity and Sustainability Influenced by Biodiversity in Grassland Ecosystems," *Nature* 379 (February 22, 1996): 718–20; Kenneth F. Higging, David E. Nomsen, and W. Alan Wentz, "The Role of the Conservation Reserve Program in Relation to Wildlife," in *Impacts of the Conservation Reserve Program in the Great Plains—Symposium Proceedings, September 16–18, 1987*, ed. John E. Mitchell, 102; and James Stubbendieck, "Historical Development of Native Vegetation on the Great Plains," in *Impacts of the Conservation Reserve Program*, ed. John E. Mitchell, 21–28.

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2. Elaine Anderson, "Who's Who in the Pleistocene: A Mammalian Bestiary," in *Quaternary Extinctions: A Prehistoric Revolution*, ed. Paul S. Martin and Richard G. Klein, 77.

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22. Ibid.