Staff Paper P91-3

January 1991

Staff Papers Series

LAND VALUES AND ENVIRONMENTAL REGULATION

Michael D. Boehlje
Philip M. Raup
Kent D. Olson

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

Staff Paper P91-3 January 1991

LAND VALUES AND ENVIRONMENTAL REGULATION

Michael D. Boehlje
Philip M. Raup
Kent D. Olson*

Staff Paper P91-3 January 1991

LAND VALUES AND ENVIRONMENTAL REGULATION*

Michael D. Boehlje
Philip M. Raup
Kent D. Olson**

* Presented at the 2nd Annual Conference on Agriculture and the Environment, Itasca State Park, September 1990; sponsored by the Center for International Food and Agricultural Policy, University of Minnesota, St. Paul.

** Professor, emeritus professor, and assistant professor, respectively, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul. We are indebted to Steven J. Taff for aid in preparing the section on the Impacts of the Conservation Reserve Program.

Environmental regulation, controls, litigation, and concerns have been an increasingly important dimension of the social and business climate in the U.S. Historically, these concerns have been focused on urban areas and industrial sources of pollution or environmental degradation. But increasing concern about air and water pollution and soil erosion have stimulated the debate about the impact of environmental concerns in rural areas.

The focus of this discussion is on the impact of environmental regulations on land values, land use, and siting decisions. The issues to be discussed include the impact of the Conservation Reserve Program (CRP) on land values and land use, the impact of "swampbuster" and wetlands use regulation on land values, the impacts of management practices to reduce soil erosion or water pollution, the unique environmental problems of animal agriculture including siting decisions and waste disposal, and the impacts on land appraisal and lending practices.

Impacts of the Conservation Reserve Program

The Conservation Reserve Program was incorporated in the National Food Security Act of 1985. Under this program, funds were appropriated to enable the federal government to lease from landowners lands that were subject to erosion; and that would contribute to wildlife habitat improvement and surplus commodity reduction. Leases are for ten years at rates proposed (bid) by landowners, indicating the minimum annual payment per acre they would accept to remove the land from production. Bids at or below a maximum rate per acre set by the U.S. Department of Agriculture and varying by regions or parts of states were accepted if the erosive character of the land was certified by local offices of the U.S. Soil Conservation Service.

Beginning in March 1986 and through October 1989, a total of 33,922,565 formerly cropped acres had been entered in the Conservation Reserve. This is approximately 10 percent of the total area of harvested cropland and 3.5 percent of the total area of land in farms as reported in the 1987 Census of Agriculture.

Regional Concentration

The overwhelming majority of the CRP acres have been planted to grasses or were formerly harvested grasslands, accounting for 29.7 of the 33.9 million acres entered. The distribution of entries by type of conservation practice applied and the projected annual government cost are shown in Table 1.

Figures 1 and 2 provide an overview of the regional significance of these entries. Figure 1 shows in broad outline the major agricultural regions of the U.S. Figure 2 shows a dot-map distribution of acres entered in the CRP. The concentration of entries is clearly the winter and spring wheat regions, portions of the western corn belt, and eastern and western segments of the cotton belt.

The most notable feature of the distribution of entries is the concentration in wheat-producing areas. To the extent that the CRP reduced the acreage planted to crops for which product prices have been supported by federal acreage-reduction programs, the CRP to-date has been primarily a wheat program.

Taff has estimated that the CRP achieved a total reduction in base acres (acres on which planting of price-supported crops is permitted) of 19.6 million acres through the eighth round to February 1989, of which 9.5 million acres or just under one-half had been designated for planting to wheat (Taff, 1990). In contrast, of the total reduction in base acreage achieved by the CRP, corn accounted for 18.1 percent, barley 11.7 percent, soybean 10.5 percent, cotton 5.8 percent, oats 5.2 percent, and all other program crops (rice, tobacco, peanuts) together, 0.4 percent (Table 2). In acreage terms, the big impact of the CRP has been on wheat.

This comparison in terms of acres is misleading if attention is shifted from land use to volume of output. Corn yields in the U.S. average three to four times wheat yields, depending on the region. In terms of physical output quantities, the estimate by Taff of a CRP-induced reduction in base acres in corn of 3,548,357 acres through February 1989 involves a substantially greater reduction in tons of output than does the estimated reduction of 9,489,759 in base acres for wheat (Taff 1990, p. 93). Although one goal of the CRP is the reduction of crop surpluses, it is beyond the scope of this discussion to explore the consequences of the CRP for crop production and total output. Attention is focused, instead, on the implications for land use shifts and resultant impacts on the market for land, and on the environment.

Environmental Effects

The potential environmental effects of the CRP can be seen more clearly by referring to the historical record of drought in the Great Plains. Figure 3 outlines the high risk areas as they were defined by the severe drought years of the 1930s. This definition is reenforced by Figure 4, showing areas of the Great Plains with deficient rainfall of under 20 inches (508 mm.) per year. A reference back to the dot-map of CRP entries in Figure 2 shows how heavily concentrated the entries are in drought-prone regions.

The Great Plains states in which drought is the major environmental threat (Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming) account for 19.9 of the 33.9 million acres entered to-date in the CRP (ASCS, 1990). This is 58.7 percent of the total. Adding in drought-prone but non-Great Plains areas of Idaho, Minnesota, Oregon, and Washington raises the total to approximately two-thirds of all CRP lands for which drought is the principal hazard and wind erosion is the primary environmental concern.

Due to its concentration in these drought-prone areas, the major contribution that the CRP can make will be in the reduction of wind erosion. Much of the emphasis in the debate that led to the adoption of the CRP in 1985 stressed the need to control soil loss through water erosion. This remains a major goal, especially in the corn and cotton belts. But the predominant influence of the CRP will probably not be adequately measured until drought returns to the Great Plains.

Changes in Land Use and Prices

This regional overview obscures the wide variety of land use situations in which the CRP is changing the rural landscape. The method chosen here to illustrate this variety is to focus on one state, Minnesota, for which the data base is well developed.

From the first round of bids in March 1986 through the ninth round in October 1989, a total of 1,830,217 acres have been entered under the CRP program in Minnesota (Table 3). This is 6.9 percent of the area of land in farms in the state, as reported in the 1987 Census of Agriculture. For the state as a whole, approximately one out of every fifteen acres of farmland is now removed from crop use by the CRP. This is double the proportion of land withdrawal achieved by the CRP for the continental U.S. (48 states) as a whole.

Entries under the CRP program are highly concentrated in a few counties and regions, although there are CRP entries in all but three counties (Figure 5). Fourteen of the state's eighty-seven counties in which CRP entries total over 10 percent of the land in farms account for 51 percent of total CRP entries by acres. The concentration is especially marked in the northwest district as defined in Figure 6.

The nine counties in that district, for example, have 18 percent of the total land in farms in the state, but 38.7 percent of total CRP entries. For the district as a whole, CRP entries cover 14.8 percent of all land in farms or almost one of every seven acres, twice the statewide frequency (Table 4).

Within the northwest district, CRP entries are concentrated in the portions of the counties lying outside the lake plain of the Red River Valley, in areas that include some of the lowest priced farmland in the state (Govindan and Raup, 1990). Disaggregation on a county basis fails to reveal the full measure of this concentration. One rule governing the acceptance of entries into the CRP is that total entries shall not exceed 25 percent of the farmland in a given county. As Figure 5 shows, this rule has been exceeded in Pennington and Red Lake counties. This would also be the case if eastern portions of Marshall and Polk counties were considered separately. In this area to the east of the Red River Valley lake plain, there are entire townships in which CRP entries approach or exceed half of all land in farms.

In contrast, the eighteen counties of the southwest district containing the state's highest priced farmland include 24.9 percent of the state's total area of land in farms, but account for only 13.2 percent of the acres entered under the CRP. Within the southwest district, the concentration is marked, with 49 percent of all CRP entries in the district located in three counties, Lincoln, Lyon, and Yellow Medicine. These three counties contain much of the lowest priced farmland in the southwest district.

Other areas of concentration of CRP entries include a band of counties running south from Becker through Otter Tail, Grant, Douglas, Stevens, Pope, and Kandiyohi counties. In the southeast district, there is a notable concentration in Le Sueur and Rice and a less marked concentration in Olmsted and Fillmore counties.

With the exception of the southeastern counties, CRP entries tend to be concentrated in counties or parts of counties with sales prices well below the statewide average. This is not surprising, given the environmental hazards that must be present to qualify land for entry under the CRP. It does have the effect of removing lower priced lands from the frequency base of lands that are sold. Although lands entered in the CRP can be sold, sales of these lands have been infrequent.

The result has been to reduce the probability that lower priced lands will be represented in the listing of lands sold in 1987, 1988, and 1989 with the same frequency that prevailed before the CRP. In areas where CRP entries are concentrated, there is thus an upward drift in reported sales prices over the last three years. This drift could be the result of a truncation of the lower priced tail of the sales distribution, or it could reflect increased demand for the reduced quantities of land not included in the CRP.

By districts, this phenomena can affect the relative significance of districtwide average sales prices. Statewide, it shifts the frequency of reported sales toward the higher priced segments of the market.

In the absence of detailed data on the quality of land actually sold, it is impossible to quantify the effect of this reduction in the frequency of sales of lower priced land. Since CRP contracts are for ten years, it is probable that this "CRP effect" will distort the interpretation of average sales prices until at least the mid-1990s. One effect is to widen the difference between the estimated value of farmland and prices received in actual sales. In the sales prices, the lower end of the land quality scale is currently underrepresented.

Effectiveness and Other Impacts

In terms of a reduction in environmental risk in farming, the CRP in Minnesota can be considered as moderately successful. Much of the land in the program is in areas of the state that have suffered from drought in the past or that have an erosion-prone topography. This reduction in risk to the physical environment has been achieved at a price that is most likely understated if measured by the dollars paid to landowners by the federal government.

An unmeasured, and perhaps unmeasurable, cost has been the disruption to the cultural and commercial environment in areas with the heaviest CRP participation. The volume of local business has declined, out-migration has accelerated, and the social fabric represented by schools, churches, formal and informal clubs, and community activities has been torn.

CRP has resulted in an upward shift in land values in areas of high concentrations of CRP entries. Whether this is a data quirk of underreporting of sales of lower priced properties or a reflection of strong demand for remaining (non-CRP encumbered) properties is unclear. To the extent that increased land values reflect increased rental rates (which appears to be the case in numerous cases), the higher prices are, in part, a result of reduced supplies. In this situation, land values would be expected to soften as CRP properties become more "marketable" at the termination of the ten-year contract.

The CRP program can be viewed as a transitional measure, designed to conserve land while it is held out of production in "protective custody" for possible future needs. In this light, the CRP can be praised. If a more permanent retirement of fragile or environmentally-sensitive land is the goal, then the concept of the environment that has guided policy to-date needs rethinking. Human beings and their institution are a part of that environment.

A land use policy that focuses only on the physical dimensions of use is defective. The ten-year leases that now define the CRP leave unanswered the basic question of, what is to be done with the land when the leases expire? They also ignore the effect on rural communities. It is distressing that so little attention was given to these issues in the discussions resulting in the agricultural policy legislation now before the U.S. Congress. For these reasons, a definitive judgement on the merits of the CRP must be postponed. The crucial decisions are yet to come.

Impacts of Wetlands Regulations

Wetlands are defined in various ways, but generally include those land areas where surface water or water logged soils prohibit typical crop or timber production practices or, at a minimum, make them extremely difficult during the critical growing season. Wetlands originally accounted for about 215 million acres in the U.S., but more than half of this acreage has been drained and converted to other uses and only about 99 million acres of rural wetlands remained in the late-1970s (Tiner). These wetlands are located throughout the U.S. and range from coastal swampland in the southern and southeastern states to "prairie potholes" of the Upper Midwest and Great Plains states. Most of the conversion of wetlands has been to agricultural uses; agricultural and urban development have accounted for 87 percent and 8 percent of the losses of wetlands, respectively. In Minnesota, an estimated 9 million acres of pothole wetlands have been converted to agricultural uses (Tiner).

The value of wetlands has traditionally been realized by conversion to agricultural and other uses as evidenced by the high conversion rates. But we are becoming increasingly aware of the value of wetlands as a breeding ground and habitat for fish and wildlife; to maintain water quality and regulate the microclimate in the locale; and to provide socioeconomic benefits in the form of flood and erosion control, water supplies, timber products, recreation, hunting, fishing, and trapping services, and aesthetics (Tiner). Consequently, public policy has changed from incentives for wetland conversion such as tax writeoffs and low interest loans for drainage to restrictions and/or penalties for conversion and incentives to restore wetlands. The 1985 Food Security Act contained a "swampbuster" provision which made farm operators ineligible for any and all government payments or loans on all land farmed if crops were planted on converted croplands. In 1990, President Bush incorporated a "no-net-loss of wetlands" provision in his budget message to Congress. Changes in federal tax policy in 1986 and 1987 eliminated or restricted the tax breaks for land clearing, soil and water conservation deductions including drainage, and capital gains on land; these changes reduced the tax incentive to convert wetlands to agricultural production. Although the effectiveness of some of these new policies in maintaining wetlands has been questioned (based on the problems of targeting and implementation of such a broad, blunt policy instrument as withholding farm program payments), public opinion and policy has changed significantly from encouraging conversion of wetlands to at least maintaining those wetlands that remain.

The prairie pothole region, which extends from central and western Minnesota northwest through the Dakotas and Montana into Canada, is one of the critical wetlands in the U.S. It is "North America's most valuable waterfowl breeding ground" (Heimlich and Langner, p. 21). Almost half of the original wetlands have been converted to other uses, primarily farmland. One characteristic of the prairie pothole region that significantly impacts both the costs and benefits of conversion of wetlands to farming is the relatively small size of the wetland areas and the dispersion of these small wetland areas among larger areas of relatively productive cropland.

Numerous studies have been completed of the economics of drainage and conversion of wetlands. The studies reveal a wide variation in conversion costs between regions. Generally, conversion costs are higher in the coastal areas of North Carolina ($1,000-$1,500 per acre) and the swamps of Mississippi and Louisiana ($400-$450 per acre), compared to the prairie pothole region of Minnesota ($150-$300 per acre) (Heimlich and Langner). These high costs and the capital outlays required can be a significant barrier to conversion. But when scattered wetlands surrounded by productive cropland reduce the overall efficiency of using largescale equipment and straight row farming, as is frequently the case in the prairie pothole region of Minnesota and the Dakotas, the total benefits over the total farm acreage can be large compared to the total cost of draining a few acres. A Canadian study based on 1985 data indicates that the net present value to the farmer of drained wetland compared to preserved wetland totaled $738 per acre ($1,824 per hectare) (van Vuuren and Roy).

Furthermore, conversion will likely result in increased land values as well as increased income. In an econometric study of the effects of erosion control and drainage on farmland values in North Carolina, Palmquist and Danielson state that "the soil wetness coefficient suggests that draining wet soils would increase land values by 34 percent on average" (p. 60). Upon evaluating estimates of drainage costs, they conclude "Thus, the market is near equilibrium, with drainage costs approximately equal to the increase in land values" (p. 60).

The benefits of conversion of wetlands to agricultural production are sizeable and can typically be captured by the owner through increased income. The benefits of preserving or restoring wetlands are both more difficult to assess and more difficult to capture by the owner. These benefits, as noted earlier, typically accrue in the form of improved habitat for fish and wildlife, a better ecological balance in terms of improved water quality and reduced flooding, and recreational benefits in terms of hunting, fishing, hiking, birdwatching, etc. Many estimates indicate large public benefits per acre, particularly when measures of ecological balance are included. The Canadian study noted earlier estimated that the net present value to the public of preserved wetlands exceeded the agricultural value of drained wetlands by $347 per acre ($858 per hectare). However, it is extremely difficult for a private owner to capture even a modest portion of these public benefits; so without regulation or other incentives, conversion is likely to continue.

So what is the overall impact of wetlands regulations on land values? As long as the private benefits of conversion exceed the private benefits of preserving wetlands, regulations to restrict conversion will reduce private benefits and, thus, the market value of wetlands as well as parcels of land that contain scattered wetlands as is common in the prairie pothole region of the U.S. and Canada. Parcels and/or farms where government program crops are important and the risk of losing program benefits is substantial will be the most significantly impacted. This impact would be mitigated if mechanisms are implemented or expanded to compensate owners for some of the public benefits of preserving wetlands through the payment of annual rents or acquisition of permanent easements. Such mechanisms are available through the USDA Water Bank Program, the Fish and Wildlife Services' Small Wetland Acquisition Program, and the revised Conservation Reserve Program.

Management Strategies

Farmers are expressing significant interest in adopting management strategies that will reduce environmental degradation. Part of this growing interest is stimulated by increased awareness of the environmental impacts, particularly with respect to groundwater and surfacewater pollution, of certain agricultural practices and sincere concern about the environment as well as the health of family members and neighbors. Part of the interest is an attempt to adopt practices that reduce the costs of production, enhance profits, and reduce dependence on purchased inputs. And the prospect of future regulations that would substantially restrict the use of certain practices has certainly stimulated producers to evaluate alternatives.

The management strategies that could be adopted to reduce environmental degradation can be classified into three general categories: (1) changes in the use of purchased inputs such as banding of herbicides and reduced applications of fertilizer that will reduce the potential of runoff of chemicals into surface water or leaching into groundwater, (2) changes in management practices that require capital investments such as terracing, contour farming, or nonconventional tillage practices such as ridge tilling or chisel plowing to reduce soil erosion, and (3) changes in land use patterns that would include the production of more forage crops and small grains and less corn, soybeans or other row crops. These categories can be viewed as those changes which require (1) little, (2) moderate, and (3) large amounts of capital and management input.

The impact of various strategies on land values can best be determined by analyzing the change in profitability or net income per acre if these strategies are adopted and capitalizing this income in a net present value model. Numerous studies of the profitability of these strategies have been completed. Generally, changes in the use of purchased inputs have the least impact on per acre incomes, whereas changes in land use patterns that reduce the production of row crops have the most impact. In fact, there is increasing evidence that better and more timely placement of fertilizer and chemicals may reduce costs, enhance per acre returns, and reduce application rates so as to reduce the risk of surface or groundwater pollution (Olson and Weber; Madden and O'Connell; Lyman et al.; and other studies referenced in Olson and Weber, Journal of Soil & Water Conservation, Vol. 45, No. 1, January-February 1990). Similarly, studies have indicated that adopting some tillage practices, such as ridge tillage, can increase income per acre even after accounting for the capital costs of the new equipment and machinery needed (e.g., Apland et al.).

But if changes in land use patterns from row crops to forages and small grains are required, per acre returns typically decline. Dabbert and Madden report a 7 percent decline in residual returns in a simulation for a case farm in Pennsylvania with changes from "conventional" management to "organic" farming or more sustainable production practices. The most significant change in management practices was to use legume-based rotations to reduce erosion and as a source of nitrogen, and to replace corn acreage with rotations that included high proportions of wheat, alfalfa, and soybeans. Similarly, a Maryland study of conventional, compared to "low-input," agriculture reported an 8 percent decline in farm profitability with the low input option, primarily because of a shift from a concentration in corn and soybeans to more acreage in small grains and forage legumes (Hanson et al.) Crosson and Ostrov review numerous studies of more environmentally sound "alternative agriculture" practices and conclude:

> alternative agriculture is less profitable because what it saves in fertilizer and pesticide costs is not enough to compensate for the additional labor required and for the yield penalty it suffers relative to conventional farming. The main reasons for the yield penalty appear to be the necessary rotation of main crops with low value legumes and the difficulty of controlling weeds without herbicides (p. 36).

In his study of removing certain pesticides from the market, Cox developed estimates of yield reductions using mechanical weed control versus chemical weed control for corn. When both methods received good weather, the "mechanical" yield was estimated to be 95 percent of the "chemical" yield. Mutually exclusive adverse weather affected both yields. Dry weather after planting allowed mechanical control to take place but did not allow the herbicide to be as effective so the "chemical" yield was estimated to be 80 percent of the good weather yield. Wet weather after planting increased the efficiency of herbicides but did not allow mechanical control to take place in a timely fashion dropping the "mechanical" yield to 60 percent of the good weather, "chemical" yield. Adverse weather for chemical control was estimated to have occurred in 38 percent of the past 60 years; for mechanical control, 19 percent.

In addition to the Conservation Reserve Program and the penalties for conversion of wetlands, the 1985 Food Security Act included conservation compliance provisions that require farmers to develop and have approved by 1990 a plan to control soil erosion and reduce water pollution. As with wetlands conversion, the penalty for violating the approved plan (or not developing a plan) is the loss of federal farm program payments and loans. One of the more recent studies of the required adjustments in management practices to reduce soil erosion and improve water quality so as to satisfy the conservation compliance provisions of the 1985 Food Security Act has been completed by Wollenhaupt and Blase. They assess the impact of using various crop rotations and mechanical tillage practices to reduce soil erosion to acceptable soil loss tolerance levels. Conservation practices included various combinations of contouring, conservation tillage with 30 percent residue after planting, and terraces. Enterprise budgeting was used to analyze the impact on per acre returns for different soil types and land capability classes in northern Missouri. Wollenhaupt and Blase conclude that the result of conservation compliance for soil-climatic conditions similar to northern Missouri will be "lower economic returns to land and management and, subsequently, to the value of the land itself. This will be especially critical on erodible land in capability classes III and higher [the more erosive soils]" (p. 158-159). A second conclusion is that much of this more erosive soil will be converted to low input pasture land. "This land is the type presently enrolled in CRP for a maximum bid of $65 per acre in Missouri. The CRP will have placed an artificially high floor price under this land if this return is capitalized into land values" (p. 159).

The impact of management practices to reduce environmental degradation and satisfy conservation compliance regulations on land values will, thus, depend on the land class and the technology or management practice used. For more erosive soils requiring significant changes in cropping patterns to low valued crops or pasture and/or major investments in terraces or other technologies to reduce erosion, land values could decline significantly because of the reduced capitalized value of the income stream. For less erosive soils and/or where changes in the application and use of purchased inputs is all that is required to reduce environmental degradation, land values may not be significantly impacted. In fact, such land may increase in value because of higher net incomes as well as increased demand for land that is environmental benign. One conclusion is straightforward--the differential in value between land that is highly erosive or has other environmental problems and land that is environmentally benign will widen with increased environmental regulation.

Challenges of Animal Agriculture

Most discussions of land values would not include a review of the concerns and challenges of animal agriculture, but animal agriculture could have an impact in certain locales on land values. The most obvious impact is in the forage and grass growing areas of the U.S. where land values are primarily a function of the profitability of cattle and sheep production, forage production, and grazing rights. As suggested earlier, the eventual disposition of CRP acres when they are no longer under government contract will be important in determining the supply or availability of grazing land; if these acres stay in grass, they will increase supplies in the short run and tend to weaken at least annual rents for grass land or grazing rights, if not pasture land values.

But animal agriculture has additional impacts on land values, and these impacts are increasingly important and typically are environmentally-driven. With the exception of grazing activity, animal agriculture is becoming increasingly concentrated in terms of size and geography. A concentrated livestock sector presents new environmental problems, primarily because of the large volumes of waste produced and the potential for both water and air pollution from feedlot runoff, lagoon seepage or inappropriate disposal of animal wastes. A further problem can arise from the large quantities of water required by largescale concentrated livestock operations.

Consequently, siting or location decisions, as well as adoption of the appropriate technology to reduce the potential of air and water pollution, have become major considerations in livestock production. No longer can producers decide to locate livestock facilities nearby or include them as part of the "farmstead" for convenience or security reasons as was commonly the case in the past. The siting decision must include considerations of location relative to streams and waterways where runoff during heavy rainstorms or as a result of accidental spills could result in water pollution. It must consider soil characteristics if a lagoon or other waste storage facility is to be built with preference for high clay content soils that can be packed to eliminate or reduce the potential of seepage or leaching of high concentrations of nitrates and other potential pollutants into underground water supplies. Also of concern is the issue of location relative to urban centers and/or neighbors who may be subject to odors or air pollution from the production facility or from the disposal of animal wastes. For some of the recent siting decisions for largescale hog production facilities (for example, National Farm's decision to locate near Greeley, Colorado), the availability of adequate acreage for land based disposal of animal wastes contiguous to the production facility that can be purchased or leased was a major consideration.

Most of the siting considerations briefly reviewed here are now reflected in state or local regulatlons. Most states require a state permit from an appropriate environmental quality agency for new construction of livestock facilities exceeding specified sizes. In Minnesota, a Pollution Control Agency permit is required for new or modified facilities that will exceed 10 animal units (approximateiy 10 feeder steers, 1,000 chickens or 25 hogs). In many states, considerations in issuing such permits include location relative to watersheds, soil type and slope, location relative to neighbors and urban centers, technology to be used in waste storage and disposal, avail-ability of land for waste disposal, etc. Furthermore, local county zoning authorities also have jurisdiction over siting decisions and frequently hold public hearings to obtain citizen input prior to issuing construction permits. These regulations and "bad press" resulting from such hearings can be a factor in the final decision to locate a livestock production facility at a particular site as evidenced by National Farm's move from a site in South Dakota to one in Colorado and PFS's move from a site in Iowa to one in Missouri.

The eventual impact of the livestock facility siting and location decisions on land values is, thus, relatively localized. Individual parcels that have unique location and physical characteristics that make them attractive for siting livestock facilities may benefit from increased demand and exhibit higher prices than other parcels that do not possess these characteristics. But this phenomena is not expected to have a significant impact on land values that would be detectable in most surveys. The more significant impact of these regulations and decisions will be on land use patterns and investment and operating costs in livestock production. Generally, livestock faciitles will be sited in less populous areas; away from lakes, streams, and waterways; in areas with heavier day type soils; and for unenclosed lots where the climate is relatively dry and hot. Or, alternatively, they will be sited in states or counties where environmental regulations are less restrictive. Regulations concerning the storage and disposal of animal wastes will require additional investments in land and equipment and facilities resulting in higher costs of production.

Impacts on Land Appraisal and Lending Practices

Environmental concerns will have a significant impact on farm real estate appraisal and lending practices. In addition to the financial and economic analyses that have been the traditional focus of farm real estate appraisal, an environmental audit should also be included in the appraisal process. An environmental audit should answer the following questions (Arthur).

(1) If there is an active well on the property, where is it located with respect to fuel tanks, livestock facilities, etc., and has tt been tested for water quality?

(2) Are there any abandoned wells on the property? If so, have they been used as a waste disposal site or have they been capped?

(3) If the property includes livestock facilities, what has been and is the animal waste disposal method used: how dose are the facilities to streams or waterways, towns, and other personal residences; and have proper state and federal permits for construction and waste disposal been obtained?

(4) Has there been any potentiaily hazardous construction material such as asbestos, foam insulation, or lead based paint used in the construction of any of the buildings or facilities on the property?

(5) Are there any disposal sites for empty chemical containers on the property and, if so, where are they located with respect to wells and waterways; what chemicals are included in the site; and what are the soil characteristics underlying the disposal site?

(6) Are there any known or suspected spills or other dumping of chemicals, petroleum products or hazardous or toxic materials on the property and, if so, what cleanup or containment and disposal methods were used?

(7) Are there storage facilities for chemicals such as fertilizer and pesticides on the property and, if so, what is the condition of these facilities, location with respect to water supplies and protection and containment structures in case of leakage or accidental spills?

(8) What facilities are used to store fuel or petroleum products; what is the location of these facilities vis-a-vis water supplies; and what protections are used to contain and prevent damage from leaks and accidental spills?

(9) Are there or have there been any underground storage tanks for fuel or other chemicals on the property; if so, have they been removed or inspected; are there or have there been any known or suspected leaks; and what cleanup procedures were used?

(10) Has part of the property ever been used as a site for production, formulation, distribution or storage of agricultural chemicals such as herbicides, fertilizer, pesticides or petroleum; if so, how were the facilities removed and the site cleaned up and were there any known or suspected spills or other contamination from this site?

(11) Has industrial waste or municipal sludge ever been used as fertilizer on the farm or has any part of the property ever been used as a waste disposal site, municipal dump, or landfill; if so, what disposal techniques and procedures were used, where proper permits' obtained, and what is the location of these sites with respect to ground- and surfacewater sources?

(12) Is the property in compliance with all federal and state rules and regulations with respect to soil erosion and runoff, conservation practices, and CRP land management practices, tiling and conversion of wetlands, etc., and, if not, what procedures are necessary to obtain compliance and what will be the cost?

Although many of these questions can be answered by the property owner, the technical and economic implications of potential environmental problems will frequently require more expertise such as that provided by engineers and economists. An environmental audit can be costly and time-consuming, but the cost and risk of not doing one can be very high-as evidenced by the numerous cases where an owner (or lender upon foreclosure) has had to incur thousands of dollars of expense to clean up property containing a chemical spill or a leaking underground storage tank prior to abandonment of the property.

A significant dimension of agricultural environmental issues that is of particular concern to lenders is the issue of the contingent liability for environmental damages and cleanup costs. This contingent liability can become a reality in a number of ways. First, if a lender receives property under forecfosure or repossession procedures that requires cleanup, the lender will typically be required to incur the cleanup costs. Furthermore, if the property is inflicting environmental damage on others, the lender would be subject to litigation and potential damages by the injured party. And these liabilities would be incurred in addition to the likelihood of a loss in value of the property due to the environmental problem.

Secondly, there may be a wider liability concern. In 1989, Congress passed the U.S. Comprehensive Environmental Response, Compensation and Liability Act, commonly referred to as the "Superfund Law." This legislation identifies those responsible for cleanup and containment costs on contaminated property as any and all of the "potentially responsible parties." Although the applicability of this legislation to agriculture is unclear and case law is still developing in this area, "potentially responsible parties" has been interpreted in some commercial property cases to include lenders as well as present and past owners and operators. Even if lender liability isn't established, the popular perception that the lender has "deep pockets'" will likely result in the lending institutlon being a party to any litigation and having to incur at least legal expenses in its defense. Furthermore, state legislatures are also concerned about establishing regulations on and incentives to prevent environmental damage and to impose financial responsibility for cleanup activities. Thus, a significant financial impact of agricultural environmental problems on lenders may be the liability for cleanup or environmental damages on secured property.

A second impact of agriculturally driven environmental concerns on farm lenders is on loan purpose and volume. If environmental regulations combined with a move to low input sustainable agriculture (LISA) result in reduced demand for purchased inputs such as fertilizer and chemicals, operating loan volume will decline. In contrast, more funds will likely be necessary to comply wlth environmental regulations and/or reduce the potential of agricultural pollution. Examples include the expenditures to store and dispose of animal wastes, to clean up and maintain acceptable pesticide container disposal sites, to clean up unexpected chemical spills from storage and transportation facilities, to replace and correct environmental damage from underground storage tanks, and to clean up or replace contaminated wells. Even if these expenditures are not funded from loan funds, the fact that they do occur will reduce the cash flow available for servicing operating or real estate loans. And the use of borrowed funds for such expenditures presents potentially serious repayment problems because most such expenditures do not generate additional volume or revenue, nor are the funds expended for assets or investments that provide marketable collateral for the loan. In summary, environmental concerns can have a very direct impact on the loan purpose and volume of agricultural lenders.

Conclusion

We have attempted to identify and discuss some of the key issues concerning the impact of environmental regulation on land values. The arguments have not benefiied from detailed empirical analysis, but provide useful hypotheses to guide that analysis. These hypotheses would include:

(1) The Conservation Reserve Program has resulted in an upward drift in land values because of the truncation of the lower tail of the land price distribution and/or the decreased supply of unencumbered land to the market.

(2) Regulations or policies to maintain and/or restore wetlands will result in lower values for effected properties because as long as owners cannot capture more of the public beneftis of wetlands through public purchase of easements or other payments, the private net benefits to owners of conversion for agricultural uses generally exceed the benefiis that owners can capture for maintaining wetlands.

(3) Adoption of management strategies to reduce soil erosion and chemical runoff and leaching may increase the value of environmentally benign land and will likely decrease the value of land that is more erosive or subject to environmental risks. Clearly, the differential in value between land that is highly erosive or has other environmental problems and land that is environmentally benign will widen with increased environmental regulation.

(4) Regulations on the siting of livestock production facilities to reduce the potential of air and water pollution will have a parcel-specific impact on land values, but most likely not one that is detectable in regional or statewide land value surveys. The more significant impact of these regulations will be on location of livestock facilities, land use patterns, and investment and operating costs in livestock production.

(5) Environmental concerns will require changes in land appraisal and lending practices. These changes include completing an environmental audit as part of the land appraisal process, adoption of procedures to protect the lender from the potential liability for environmental damages and cleanup costs, the prospect of reduced cash flows as farmers incur increased cash costs to comply with environmental regulations, and new demands for agricultural loans to reduce environmental problems.

Table 1. Conservation Reserve Program First Through Ninth Singup

Practice	Conservation Cover Summary by Practice		
	Acres	Cost-Share	Cost/Acre*
CP1 Tame Grass	19,818.043	$740,958,422	$37.39
CP2 Native Grass	8,121,510	365,093,838	44.95
CP 3 Trees	2.012,805	79,860,581	39.68
CP 4 Wildlife plantings	1,946,915	73,403,865	37.70
CP5 Field Windbreaks	6,833	1,037,265	151.81
CP 6 Diversions	83,472	808,217	9.68
CP 7 Structures	38,017	1,871,487	49.23
CP 6 Waterways	14,960	1,925,047	128.68
CP9 Wildlife ponds	12,285	1,108,531	90.24
CP10 Already in grass	1,767,440	42,230	0.02
CP11 Already in trees	84,793	39,258	0.46
CP12 Wildlife food plots	14,953	0	0.00
CP13 Filter strips	48,837	2,290,641	46.90
CP14 Wetland trees	83,299	4,826,014	57.94

* Some of the practices listed are usually applied to areas of less than an acre in size.

Source: The Conservation Reserve Program, Agricultural Stablllzation and Conservation Service, U.S. Department of Agriculture, Washington, D.C., January 22, 1990.

Table 2. Reduction in Permitted Planting Base for Program Crops Resulting from CRP Entries through the Eighth Round as of February 1989*

	Reduction in Planting Base	
Crop	Acres	Percent of Total CRP Reduction
Corn	3,548,357	18.1
Wheat	9,486,759	48.3
Oats	1,024,904	5.2
Barley	2,304,011	11.7
Grain sorghum	2,054,270	10.5
All cotton	1,137,396	5.8
Peanuts	57,718	
Rice	22,495	0.4
Tobacco	5,559	
Total	19,641,465	100.0

* Computed from Using the Conservation Reserve Program in Minnesota, 1988-89. Enrollment Characteristics and Proaram Impacts by Steven J. Taff, Minnesota Agricultural Experiment Station, University of Minnesota, St. Paul, 1990, p. 93.

Table 3. Total Acreage Under CRP Enrollment (1986-89) and Total Acreags Under Land in Farms (1987 census)

County	Total CRP Enrollment 1986-89 (Acres)[a]	Total land in Farms (Acres)[b/]	CRP Area as Percentage of Total Land in Farms
Atkin	4274.0	178100	2.4
Anoka	229.3	74443	0.3
Becker	36704.7	397385	9.2
Beltrami	10591.3	243679	4.3
Benton	2741.2	184412	1.5
Big Stone	20074.1	277071	7.2
Blue Earth	11792.6	401557	2.9
Brown	5209.7	335559	1.6
Carlton	332.8	132863	0.2
Carver	2259.6	167532	1.3
Cass	2701.4	195569	1.4
Chippewa	8613.2	327916	2.6
Chisago	2982.8	152717	2.0
Clay	44628.2	588808	7.6
Clearwater	7203.5	229537	3.1
Cook	0.0	1283	0.0
Cottonwood	17455.0	377506	4.6
Crow Wing	3996.1	132410	3.0
Dakota	15141.7	219920	6.9
Dodge	1616.2	239443	0.7
Douglas	34403.8	260294	13.2
Faribauit	3899.0	427986	0.9
Fillmore	48527.3	451054	10.8
Freeborn	25745.2	384001	6.7
Goodhue	17150.7	389539	4.4
Grant	25955.9	286857	9.0
Hennepin	722.9	91078	0.7
Houston	13594.5	285056	4.8
Hubbard	7331 .o	123875	5.9
Isanti	3406.5	142998	2.4
Itasca	34.2	123555	0.02
Jackson	10960.7	394000	2.8
Kanabec	1961.7	164403	1.2
Kandiyohi	35903.3	377392	9.5
Kittson	80095.6	498253	16.1
Lake of the Woods	5226.7	118959	4.4
Le Sueur	31555.8	222523	14.2
Lincoln	60222.6	253044	23.8
Lyon	27553.4	368115	7.5
McLeod	5577.3	258172	2.2
Mahnomen	8957.8	197078	4.5
Marshall	158273.6	819664	19.3
Martin	3210.6	433285	0.7
Meeker	22303.0	298623	7.5
Mille Lacs	231.7	153315	0.2
Morrison	13871.2	430023	3.2
Mower	15614.1	385648	4.0
Murray	17844.3	372454	4.8
Nicollet	2077.6	250061	0.8
Nobles	5662.9	413816	1.4

Table 3. Total Acreage Under CRP Enrollment (1986-89) and Total Acreage Under Land in Farms (1987 census) (continued)

County	Total CRP Enrollment 1986-89 (Acres)[a]	Total Land in Farms (Acres)[b]	CRP Area as Percentage of Total Land in Farms
Norman	60301.0	472449	12.8
Olmsted	33399.9	318748	10.5
Otter Tail	90778.6	876319	10.4
Pennington	77166.4	305784	25.2
Pine	336.2	258878	0.1
Pipestone	11171.2	246804	4.5
Polk	95357.5	1075711	8.9
Pope	39937.6	328165	12.2
Ramsey	0.0	2146	0.0
Red Lake	58196.6	210348	27.7
Redwood	19748.8	514462	3.8
Renville	6050.2	563931	1.1
Rice	30972.9	225762	13.7
Rock	1766.4	260092	0.7
Roseau	125333.9	613736	20.4
St. Louis	136.0	180030	0.1
Scott	2229.2	134420	1.7
Sherburne	808.4	124288	0.7
Sibley	2560.9	336712	0.8
Stearns	32674.9	671895	4.9
Steele	18406.1	234126	7.9
Stevens	26393.5	295499	8.9
Swift	23979.5	395484	6.0
Todd	16838.5	418136	4.0
Traverse	11166.4	312130	3.6
Wabasha	15830.8	255550	6.2
Wadena	6170.1	178124	3.5
Waseca	10637.1	231788	4.6
Washington	1701.9	109442	1.6
Watonwan	3750.9	252824	1.5
Wilken	24086.2	426995	5.6
Winona	9971.0	310325	3.2
Wright	7859.4	288429	2.7
Yellow Medicine	29995.7	412568	7.3
State total	1830217.3	26573819	6.9

Sources:

a/ Steven J. Taff, The Conservation Reserve Program in Minnesota 1986-89 Enrollment Characteristics and Program Impacts, Minnesota Agricultural Experiment Station, University of Minnesota, St. Paul, 1989; plus CRP entries for the ninth round as of February 26, 1990.

b/ 1987 Census of Agriculture.

Summary

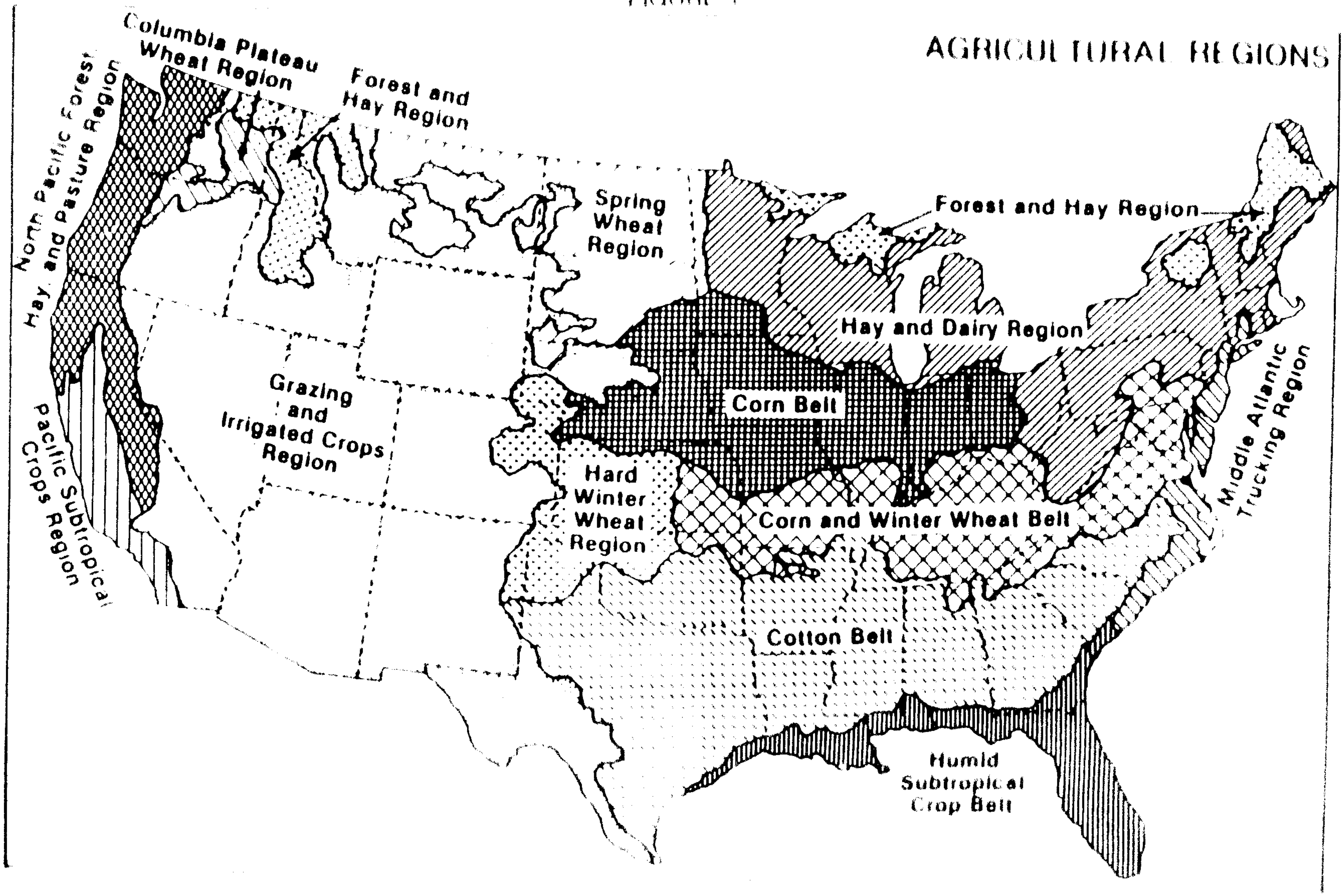
> 20%	4 counties
10-20%	10 counties
< 10%	73 counties

Table 4. Relative Significance of CRP Entries in the Northwest and Southwest Districts, Minnesota, **1989***

	Acres	Percent of State Total
Northwest District		
Area of land in farms	4,781,831	18.0
Area of land in CRP	768,312	38.7
Southwest District		
Area of land in farms	6,614,776	24.9
Area of land in CRP	240,934	13.2
Minnesota		
Area of land in farms	26,573,819	100.0
Area of land in CRP	1,830,217	100.0

* CRP entries through ninth round, October 1989. Area of land in farms from 1987 Census of Agriculture.

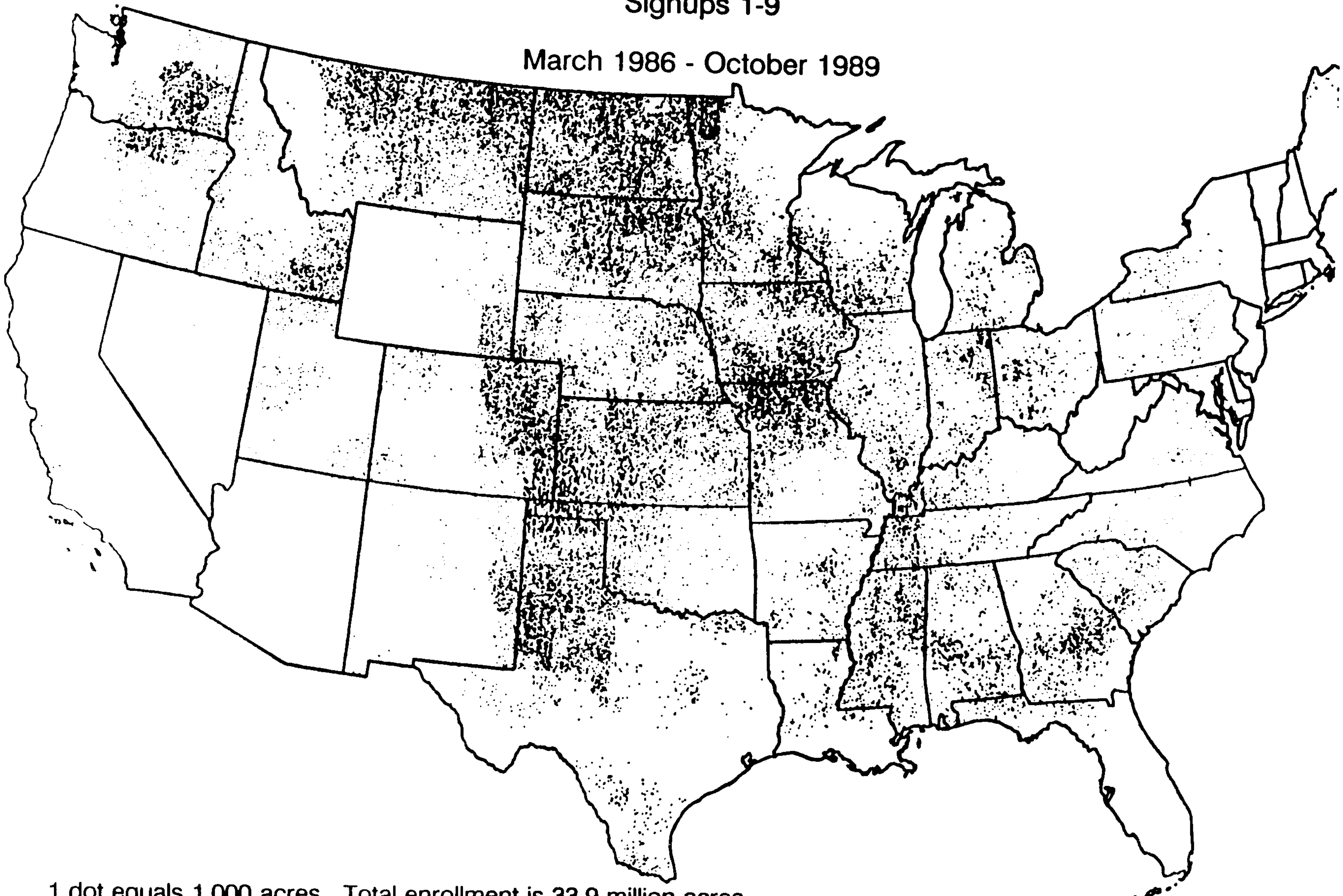
FIGURE 1



Source: Walter Sullivan, Landprints. Times Books, New York: Times Books Co., 1984, p. [illegible]

FIGURE 2
Conservation Reserve Program Enrollment
Signups 1-9

March 1986 - October 1989

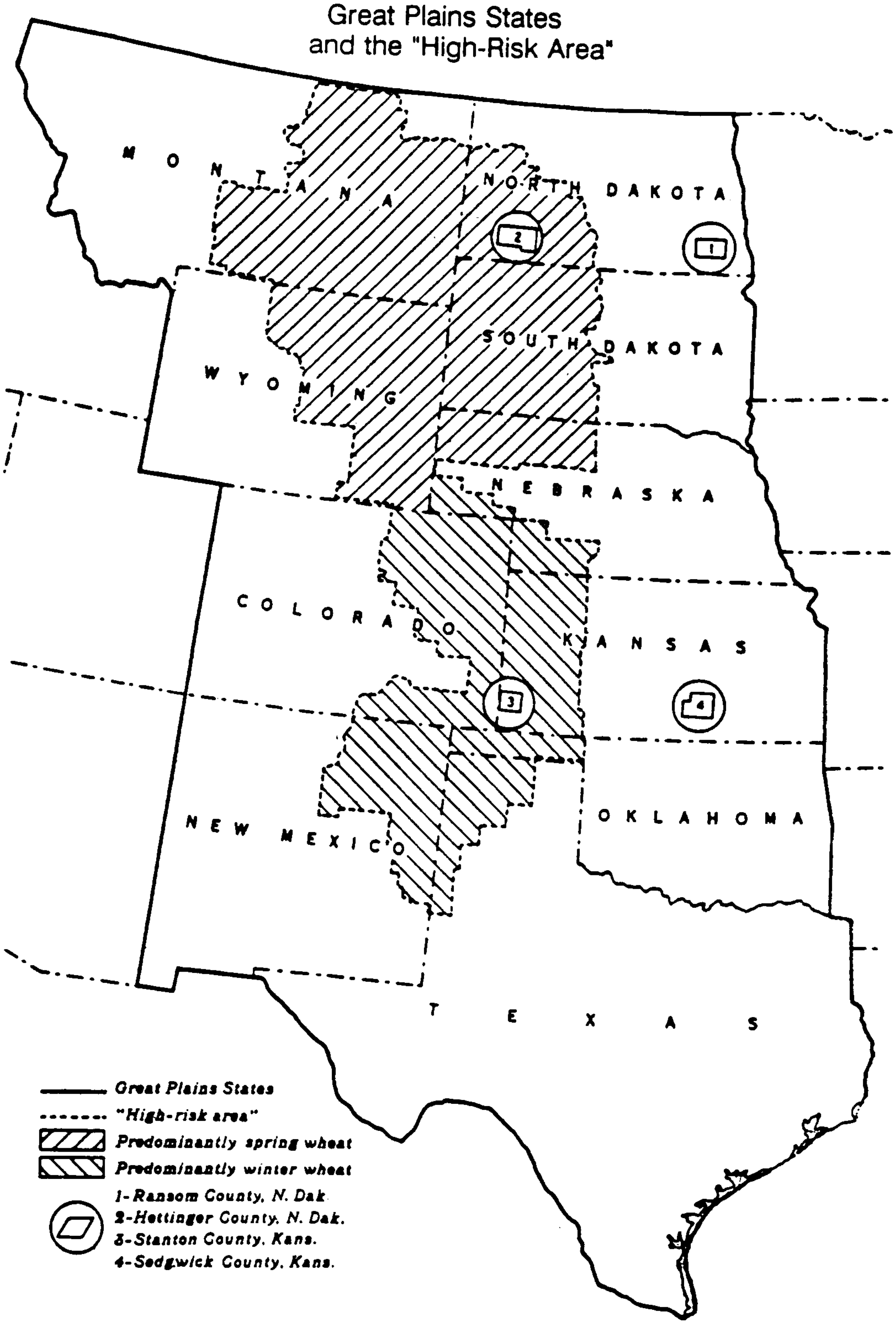


1 dot equals 1,000 acres. Total enrollment is 33.9 million acres.

Source: Economic Research Service, USDA

FIGURE 3

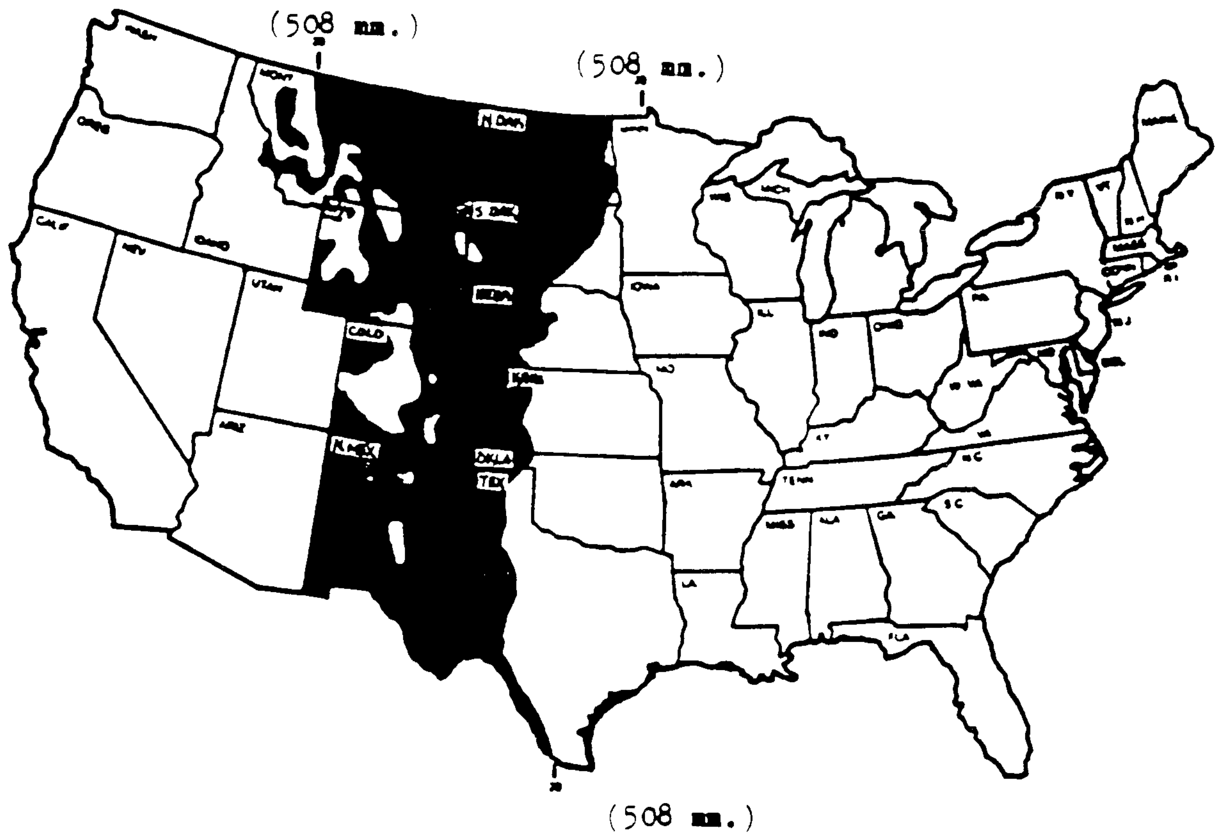
Great Plains States
and the "High-Risk Area"



Source: Orlin J. Scoville and James W. Gibson, The Great Plains and the Supply of Wheat, Bureau of Agricultural Economics, USDA, Washington, D.C., FM-23, May 1941.

FIGURE 4

Cropland Areas of the Great Plains
With Deficient Rainfall
(less than 20 inches)

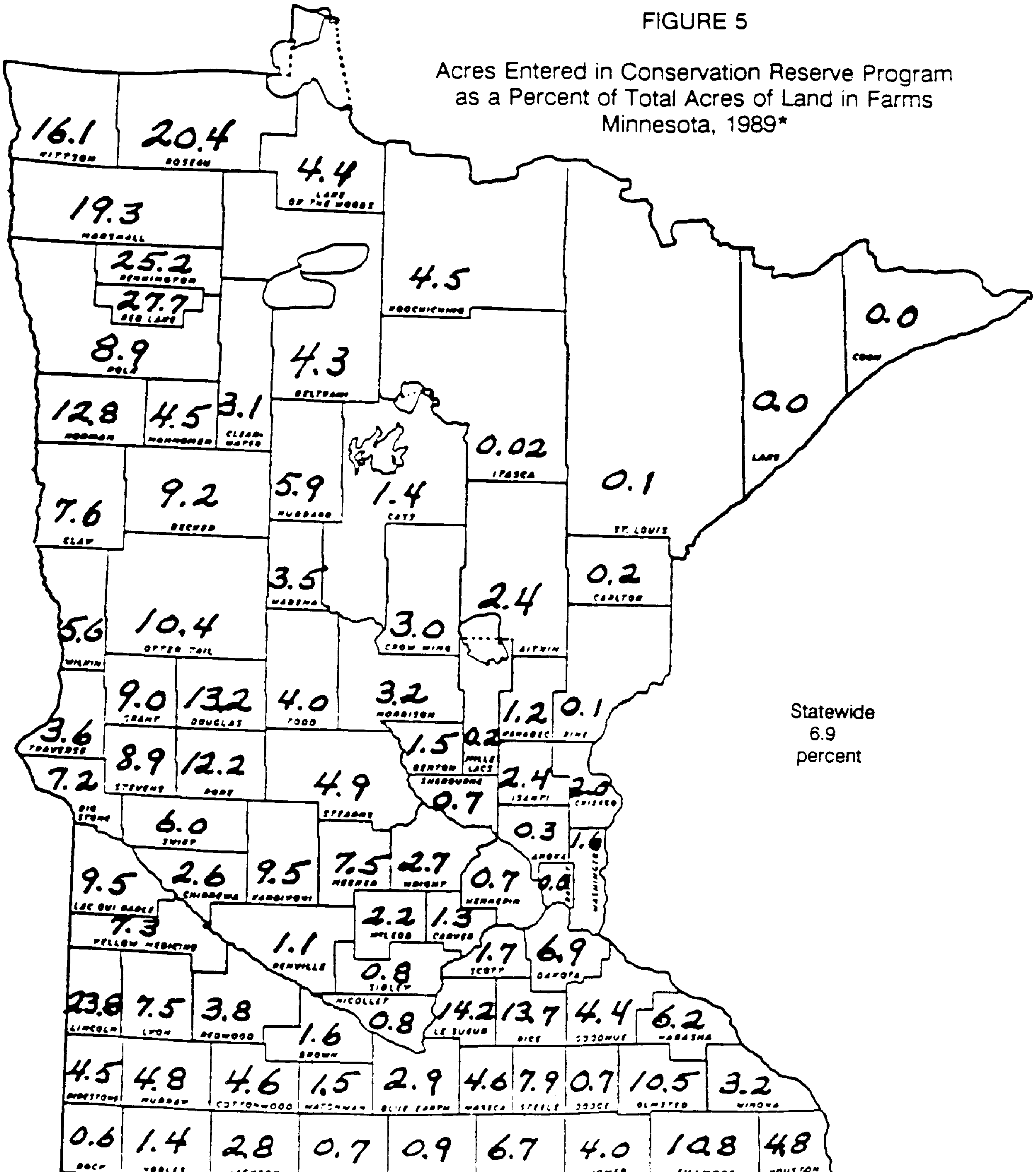


Source: Conservation Tillage in the Great Plains, U.S. Department of Agriculture, Extension Service, PA-1190, July 1977.

Adapted from Climatic Atlas, U.S. Department of Commerce, Environmental Service Administration, Environmental Data Service, 1968.

FIGURE 5

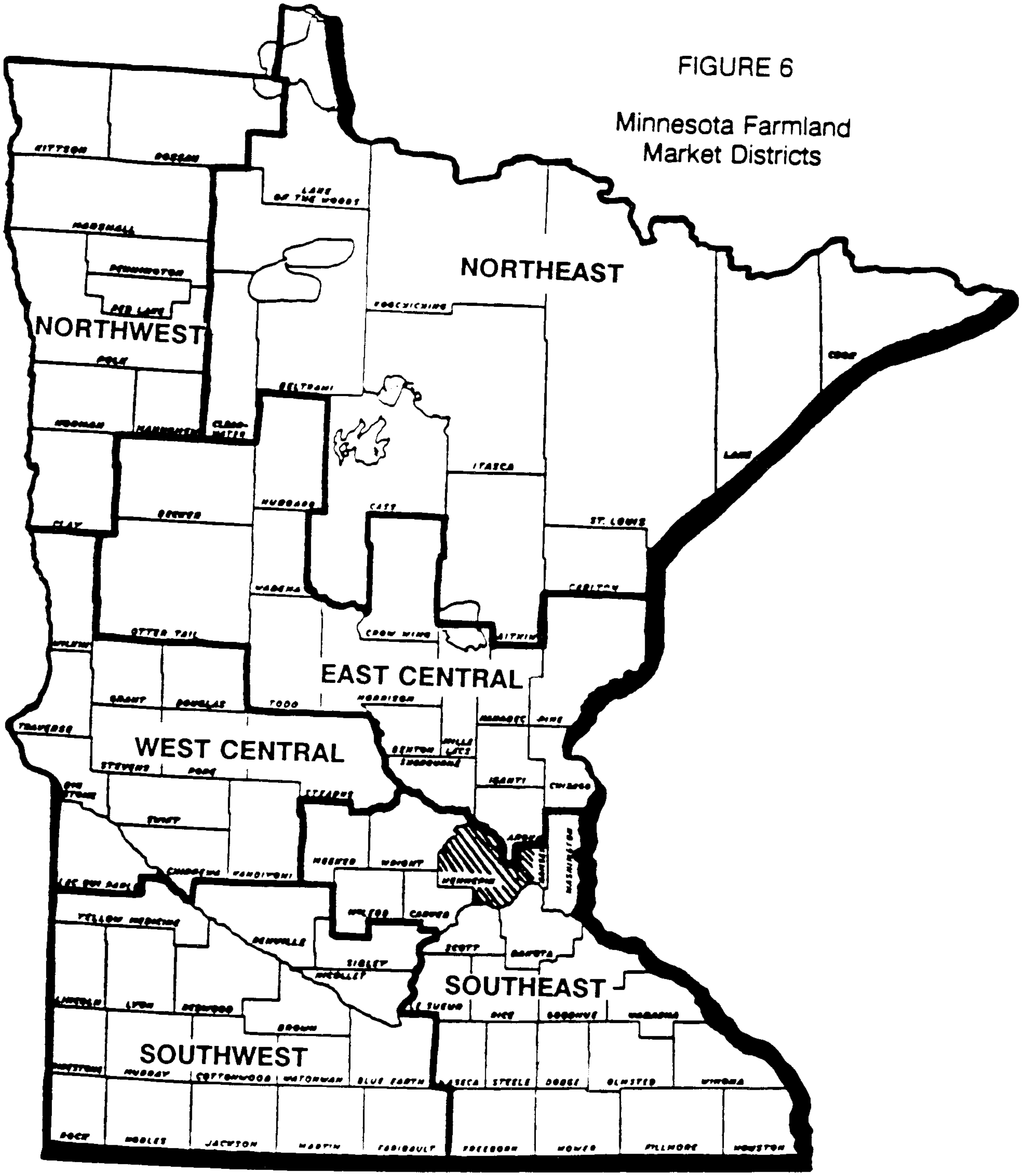
Acres Entered in Conservation Reserve Program
as a Percent of Total Acres of Land in Farms
Minnesota, 1989*



* CRP entries as of ninth round, August 1989. Acres of land in farms from 1987 Census of Agriculture.

FIGURE 6

Minnesota Farmland Market Districts



References

Apland, Jeffrey, Mustapha Hammida, Kent Olson, and John Moncrief. 1969. "Tillage Systems for Minnesota Farms: Alternative Technologies, Economic Considerations, and Data Needs." Staff Paper P89-11. Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, (March).

Arthur, Jane T. 1969. The Effect of Environmental Contamination on Farmland Investments." In Illinois Banker, (August): 10-13.

Cox, Craig A. 1969. Regional Bans of Alachlor and Atrazine: Economic, Environmental and Institutional Effects. Ph. D. diss. Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, (July).

Crosson, Pierre and Janet Ekey Ostrov. 1996. "Sorting Out the Environmental Benefits of Alternative Agriculture." Journal of Soil & Water Conservation. Vol. 45, No. 1, (January-February): 34-41.

Dabbert, Stephan and Patrick Madden. 1966. The Transition to Organic Agriculture: A Multi-year Simulation Model of a Pennsylvania Farm." American Journal of Alternative Agriculture. Vol. 1, No. 3., (Summer): 99-107.

Govindan, Kumaresan, and Philip M. Raup. 1990. The Minnesota Rural Real Estate Market in 1989. Economic Report ER90-5. Department of Agricultural and Applied Economics, University of Minnesota, (July).

Hanson, James C., Dale M. Johnson, Steven E. Peters, and Rhonda R. Janke. 1990. The Profitability of Sustainable Agriculture in the Mid-Atlantic Region - A Case Study Between 1981 and 1989." Working Paper No. 90-12. Department of Agricultural and Resource Economics, University of Maryland, (February).

Heimlich, Ralph E. and Linda L Langner. 1966. Swampbusting: Wetland Conversion and Farm Programs. Agricultural Economic Report Number 551. Economic Research Service, USDA, Washington, D.C., (August).

Lyman, Bruce E., Richard A. Levins, Michael A. Schmitt, and William F. Lazarus. 1996. 'Commodity Programs and Sustainable Cash Grain Farming." Journal of Soil & Water Conservation. Vol. 45, No. 1, (January-February): 86-87.

Madden, J. Patrick and Paul F. O'Connell. 1990. 'USA - Some Early Results." Journal of Soil & Water Conservation. Vol. 45, No. 1. (January-February): 61-64.

Olson, Kent and Craig Weber. 1998. 'Impacts of Alternative Tillage, Fertilization, and Herbicide Application Methods on Corn Production Costs and Returns.' Staff Paper P98-38. Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, (June).

Palmquist, Raymond B. and Leon E. Danielson. 1989. "A Hedonic Study of the Effects of Erosion Control and Drainage on Farmland Values." American Journal of Agricultural Economics. Vol. 71, No. 1. (February): 5562.

Scoville, Orlin J. and James W. Gibson. 1941. The Great Plains and the Supply of Wheat. FM-23. Bureau of Agricultural Economics, USDA, Washington, D.C., (May).

Sullivan, Walter. 1984. Landprints Times Books, N.Y.:Times Book Co.

Tiner, R. W., Jr. 1984. Wetlands of the United States: Current Status and Recent Trends. National Wetlands inventory, U.S. Fish and Wildlife Service, (March).

Taff, Steven J. 1989 The Conservation Reserve Prooram in Minnesota, 1995-89. Enrollment Characteristics and Program Impacts. Minnesota Agricultural Experiment Station, University of Minnesota, St. Paul.

_____. 1999. "Using the Conservation Reserve to Reduce Program Crop Plantings," North Central Journal of Aaricuiturai Economics. Vol. 12, No. I., (January).

U. S. Dept. of Agriculture. 1977. Conservation Tillage in the Great Plains. PA-1199. Extension Service, (July).

_____. 1999. The Conservation Reserve Prooram. Agricultural Stabilization Conservation Service, USDA Washington, D.C., (distributed January 22).

U.S. Dept. of Commerce. 1959. 1997 Census of Agriculture. AC87-A-51. Bureau of the Census. Vol. 1 - Geographic Area Series, Part 51 - United States Summary and State Data, (Issued November).

van Vuuren, Willem and Pierre Roy. 1990. "Social and Private Returns from Wetland Preservation.' in Proceedings on the Symposium on Intemational and Transboundary Water Resources Issues. edited by John E. FitzGibbon, University of Guelph. Symposium sponsored by the American Water Resources Association and the Canadian Water Resources Association, (April I-4).

Wdienhaupt, Nyle C. and Melvin G. Blase. 1990. "The Economic Impact of Conservation Compliance on Northern Missouri Farms.' Journal of Soil & Water Conservation., Vd. 45, No. 1, (January-February): 154-159.