# Chapter 2
# AFFECTED ENVIRONMENT

**Affected Environment**—The environmental impact statement shall succinctly describe the area(s) to be affected or created by the alternatives under consideration. (40 CFR 1502.15).

Chapter 2 describes the natural and socioeconomic environment. In addition, Chapter 2 describes the following:

- The important terrestrial and aquatic ecosystems associated or affected by farming and farm conservation programs in the U.S. through the use of national maps.
- The environments within the major terrestrial and aquatic ecoregions associated with eligible lands in the U.S.
- Sensitive resources including wetlands, grasslands, rare flora and fauna, neo-tropical migratory birds, riparian, and floodplain environments.
- The social and economic aspects of farming from a national perspective and of rural communities that may be affected by CRP enrollment.

## 2.1 LANDS AND RESOURCES AFFECTED BY THE CRP

Under the current CRP Program, according to the CCC Regulations on the Conservation Reserve Program, Sec. 1410.6 Eligible land.

(a) In order to be eligible to be placed in the CRP, land:
(1) Must be cropland that:
(i) Has been annually planted or considered planted to an agricultural commodity in 2 of the 5 most recent crop years, as determined by the Deputy Administrator, provided further that field margins which are incidental to the planting of crops may also be considered qualifying cropland to the extent determined appropriate by the Deputy Administrator; and
(ii) Is physically and legally capable of being planted in a normal manner to an agricultural commodity, as determined by the Deputy Administrator.

Sec. 1410.2. Definitions states that an: Agricultural commodity means any crop planted and produced by annual tilling of the soil or on an annual basis by one-trip planters, or sugar cane planted or produced in a State, or alfalfa and other multi year grasses and legumes in rotation as approved by the Secretary. For purposes of determining crop history, as relevant to eligibility to enroll land in the program, land shall be considered planted to an agricultural commodity during a crop year if, as determined by CCC, an action of the Secretary prevented land from being planted to the commodity during the crop year.

The 2002 Farm Bill amendments changed the planting history requirement and required that eligible cropland be planted or considered planted during four of the last six years, from 1996-2001. Therefore, the environment that would be affected by the FSA Proposed Action consists of the environmental resources and human communities of the croplands of the U.S.. The geographic context of the program is illustrated in Figures 2.1-1 and 2.1-2, which show the distribution of eight principal commodity crops. Resources are mapped at the watershed (USGS 8-digit hydrologic unit code) or county level where data was available or at the State level otherwise.

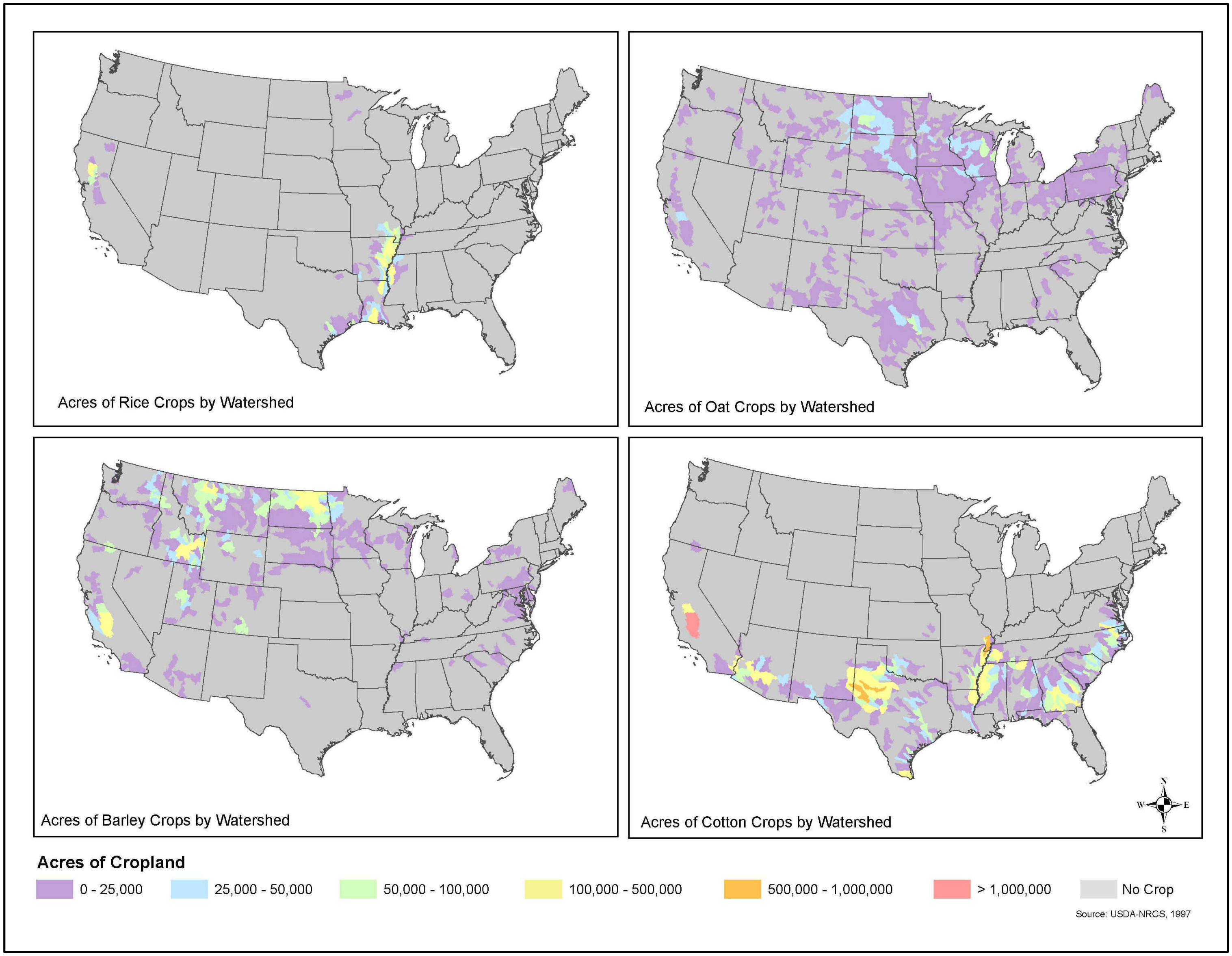



*Fig. 2.1-1. Commodity Crops of the U.S.: Rice, Oats, Barley, and Cotton*

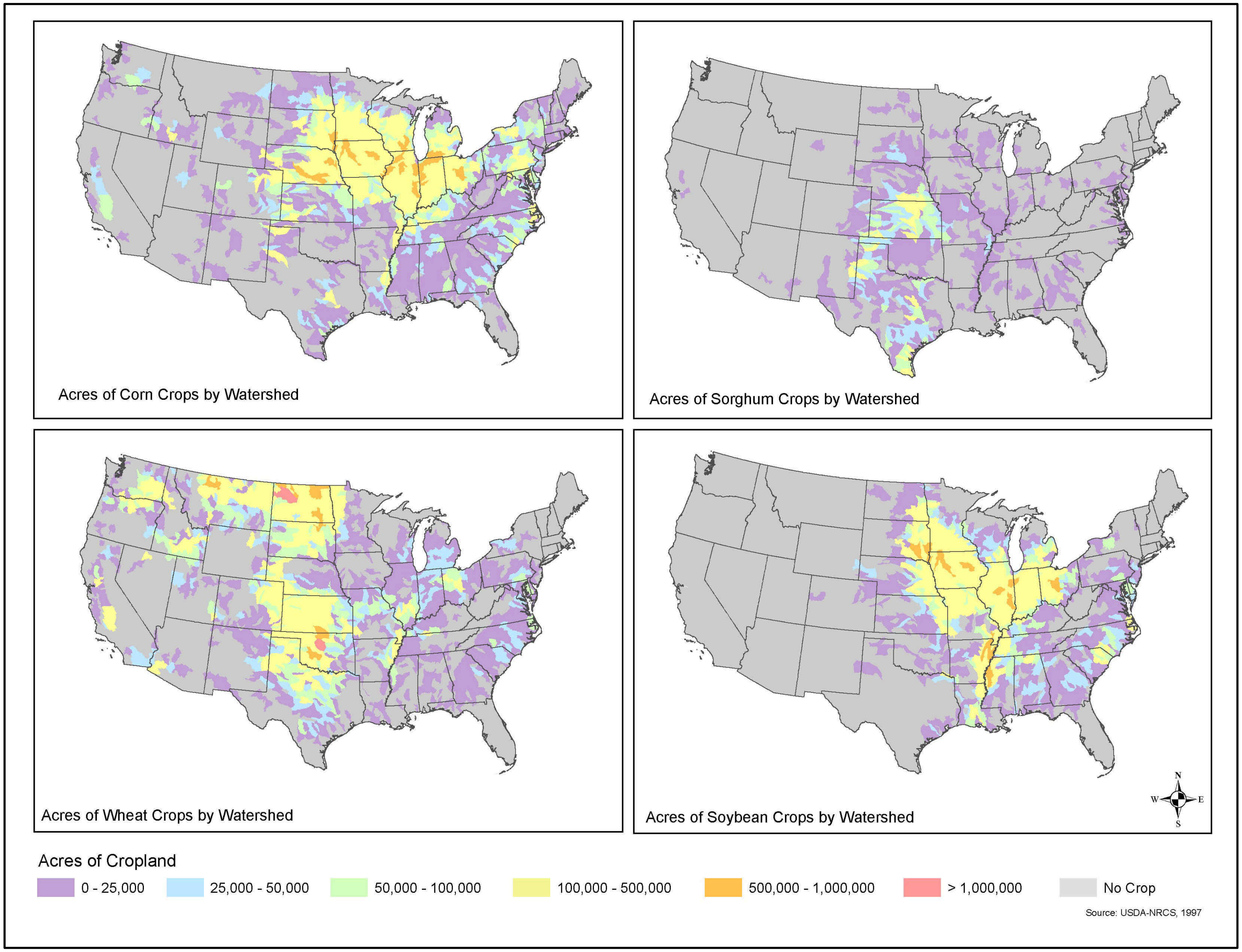



***Fig. 2.1-2. Commodity Crops of the U.S.: Corn, Sorghum, Wheat, and Soybeans***

## 2.2 ENVIRONMENTAL RESOURCES

### 2.2.1 Soils

Soil quality is the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation (NRCS, 2001). Maintenance of soil quality through proper land management is essential for determining whether agriculture or other land uses can contribute to or inhibit water pollution. In general, soils function as a medium in which to root plants, regulate and distribute water flow, and buffer against human use and environmental changes. Preserving soil quality requires protecting the physical, chemical, and biological functions of soils, as well as the situation of soils on the agricultural landscape.

**Five Essential Functions of Soil**

1. **Regulating water**. Soil helps control where rain, snowmelt, and irrigation water goes. Water and dissolved solutes flow over the land as runoff or infiltrate through the soil.

2. **Sustaining plant and animal life**. The diversity and productivity of living things depends on soil to provide a proper environment for growth.

3. **Filtering potential pollutants**. The minerals and microbes in soil are responsible for filtering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials, including industrial and municipal by-products and atmospheric deposits.

4. **Cycling nutrients**. Carbon (C), nitrogen (N), phosphorus (P), and many other nutrients are stored, transformed, and cycled through soil.

5. **Supporting structures**. Buildings need stable soil for support, and archeological treasures associated with human habitation are protected in soils.

Source: NRCS, 2001

The quality of a soil is determined by a combination of texture, water-holding capacity, porosity, organic matter (soil organic carbon) content, and depth, among other characteristics. Water infiltration through the soil surface can be directly regulated by soil quality. If infiltration of agricultural soils can be increased through conservation programs like CRP, damages associated with upland flooding, excessive runoff and erosion, water table depth, and pollution of surface water would be expected to decrease, while the overall health of the soil and its ability to support crop growth without resulting in excessive soil degradation or otherwise harming the environment would be expected to increase.

The inherent tendency of cropland to erode can be characterized by the Erodibility Index (EI), which is based on soil characteristics, climate, and field topography. The higher the EI, the greater the soil conservation effort required to maintain the sustainability of the soil resource. Cropland with EI values greater than 8 is considered highly erodible land (HEL) because it generally requires a much greater conservation effort to maintain the sustainability of the soil to the level that will sustain crop production indefinitely and erode more slowly (Figure 2.2-1). HEL is generally more vulnerable to soil quality problems, but such soils can be productive (AREI, 2000).

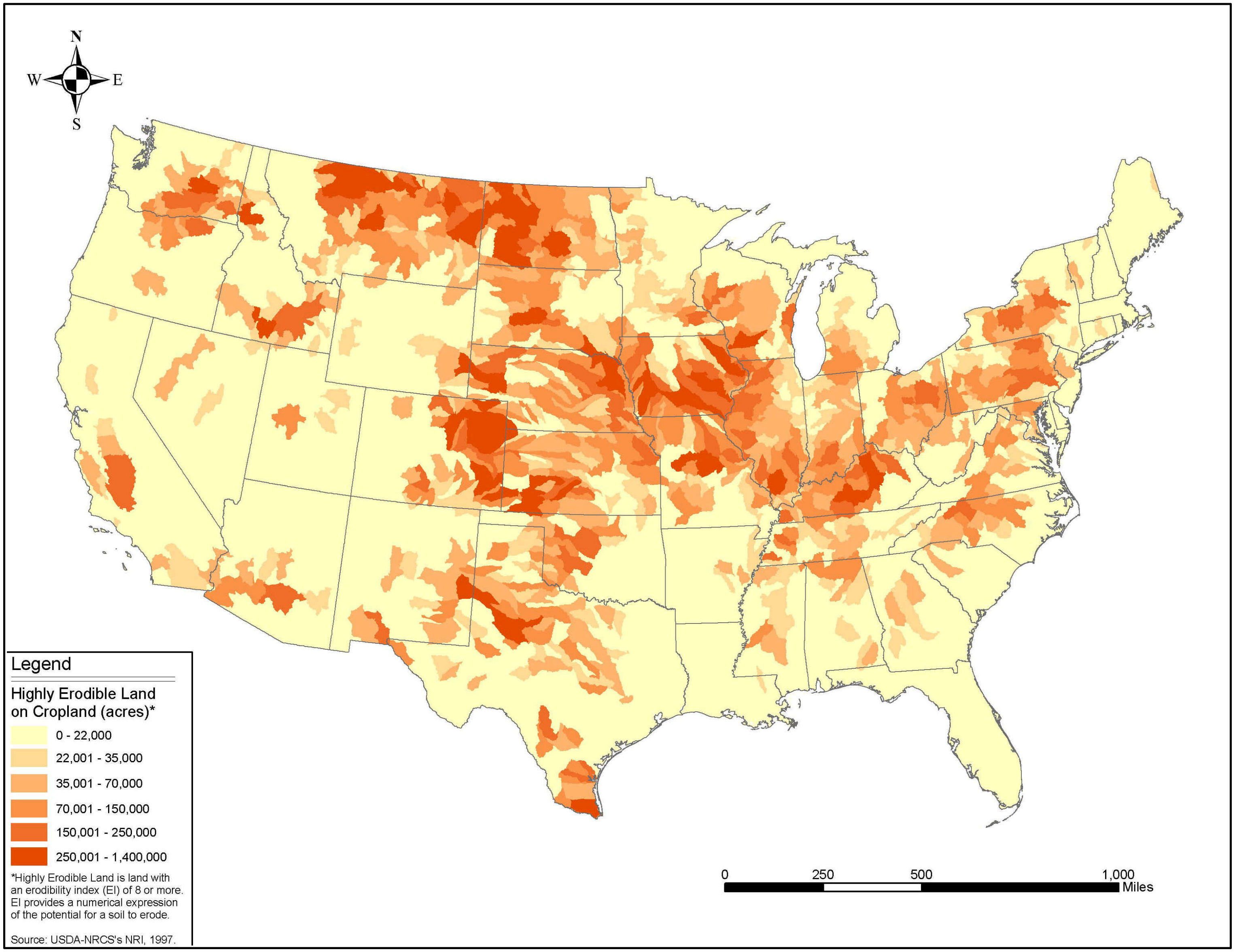



*Fig. 2.2-1. Highly Erodible Land on Cropland in the U.S. (by watershed)*

Erosion control can be a costly practice, using some expensive techniques and structures that may never pay for themselves entirely in terms of on-site benefits. If off-site environmental benefits can be considered, many of the costs may be justified. There is little incentive for landowners to pay for these practices since most of the environmental benefits are off-farm. Further, losses to soil integrity and quality occur over long periods of time. However, these practices are vital to maintaining soil integrity and quality. With agricultural programs like CRP providing major incentives for farmers to install these needed measures, soil quality across the Nation's agricultural landscape can be targeted.

Factors Affecting Soil Erosion

Soil erosion is a natural occurrence, and under natural conditions, erosion rates are relatively slow. However, the rate of erosion can be greatly accelerated by human activity. The loss of protective vegetation through deforestation, over-grazing, certain types of farming practices, and associated agricultural land maintenance, can render soils vulnerable to environmental conditions. Also, poor farming practices can cause the soil to lose its organic matter, structure and cohesion, making it more susceptible to erosion. Erosion removes the topsoil first, which is the layer with the highest organic matter content and where the most biological activity occurs. Once this nutrient-rich layer of soil is gone, plant growth decreases and erosion increases significantly.

**Major Types of Erosion**

- **Scour Erosion** - The clearing and digging action of flowing air or water.
- **Sheet Erosion** - The uniform removal of soil in thin layers from sloping land.
- **Rill Erosion** - Occurs when soil is removed by water from little streamlets that run through land with poor surface draining.
- **Gully Erosion** - Gully erosion is an advanced stage of rill erosion.
- **Wind Erosion** - The detachment and movement of soil by the action of wind.
- **Streambank erosion -** The removal of sand from streambanks by the direct action of stream flow, wind and wave action. It occurs during periods of high stream flow.

Source: Arnold, et. al., 1987

Wind and water are the two main agents that cause soil erosion. The amount of soil that wind and water can carry away depends on the speed in which they pass over the soil. The faster wind or water is allowed to move across the soil's surface, the amount of soil that can be transported increases, and the more potential it has to erode.

Factors affecting soil erosion by wind and water include:

- *Climate*. The amount of wind, the intensity and frequency of precipitation, and a region's humidity, all have the potential to influence erosion.

- *Soil Properties*. Some types of soil are more susceptible to erosion than others. A clay soil is less erodible than a sandy soil. Soils with more organic matter have better soil structure and more porosity that increases water infiltration and root penetration thereby decreasing surface runoff and soil erosion.

- *Slope*. Steepness, length, and shape of the slope affect the rates of runoff and erosion. Increasing the steepness of the slope increases the speed of the runoff, which increases the rate of erosion.

- *Surface Cover*. The amount of protection the soil has from wind and water erosion depends on the amount of vegetative cover it has. Plant cover is essential in slowing down the erosion process. Plants slow the flow of wind and water across the soil surface, plant roots hold the soil in position and prevent it from being carried or washed away, plant residue protects soil surface, and plant residue breaks up the speed at which raindrops hit the soil, thereby reducing their to potential to erode.

Wind Erosion

Wind erosion in the U.S. is most widespread on agricultural land in the Great Plains States (Figure 2.2-3) and west and it is also a serious problem on cultivated organic soils, sandy coastal areas, alluvial soils along river bottoms, and other areas in the U.S. (WERU, 2000).

Wind erosion directly impacts growers through replanting costs, reduced yields due to crop damage, and soil productivity loss over time. In addition, blowing dust creates reduced visibility effecting traffic safety, increases upkeep and cleaning costs of farm machinery, and causes increased road maintenance from the deposition of dust and soil in roadside ditches. Wind erosion physically removes the lighter, less dense soil constituents such as organic matter, clays, and silts or the most fertile part of the soil, lowering soil productivity (WERU, 2000).

***Fig. 2.2-2. Topsoil blowing in wind in north-central Iowa.***
*Photo by Lynn Betts. 1999. NRCS Photo Gallery*

Air quality problems linked to wind erosion have become a public issue, especially in the arid Western U.S. Health-related concerns about the effects of fine particulates in blowing dust from agricultural lands has added to the potential off-site impacts of wind erosion. The 1990 Federal Clean Air Act made States responsible for monitoring and controlling the amount of small air-borne particulates or particulate matter less than 10 microns in aerodynamic diameter (PM10). These particles, which are approximately 1/7th the diameter of a human hair, are small enough to be taken into the body's respiratory system and have been implicated as either causing or aggravating existing respiratory problems.

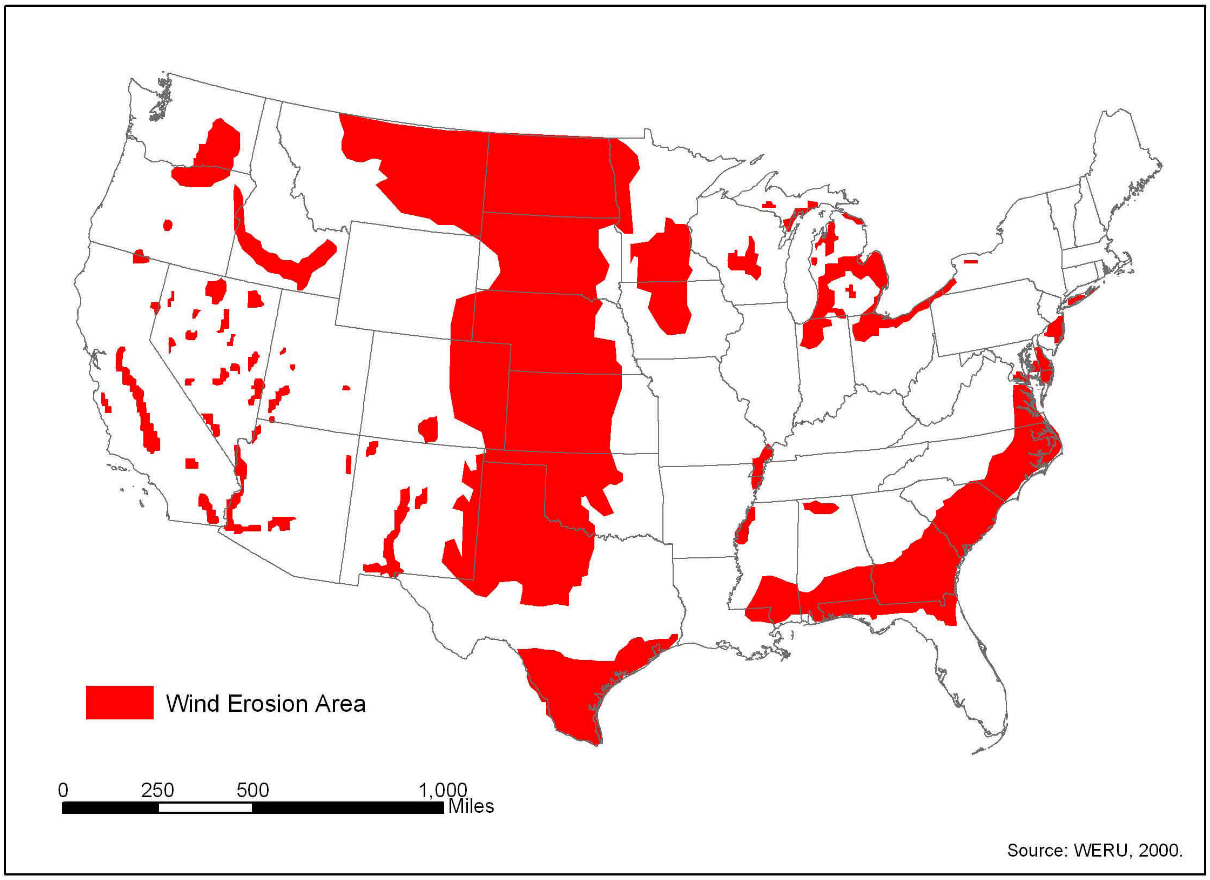



***Fig. 2.2-3. Common Wind Erosion Areas of the U.S.***

Land Cover/Land Use

Land use has more of an effect on soil loss than any other single factor (Figure 2.2-4). Of the major factors affecting soil loss, land use and the practices utilized upon the land (i.e. surface cover) are generally the only factors that can be easily altered to slow soil loss. The effects of climate, soil, and topography are fixed for any specific site, at least for land uses like agriculture. Two major types of erosion practices are available to control soil loss. Cultural practices involve the type of vegetation grown and how the vegetation is grown and managed to reduce soil loss, such as forestland, pastureland, cropland, etc. The second type is commonly referred to as supporting practices, which uses structural measures, such as terraces, contouring, and strips of close-growing vegetation, to control erosion. Frequently, combinations of cultural and structural practices are used in an attempt to control soil erosion as efficiently and cost-effectively as possible (Foster, 1999).

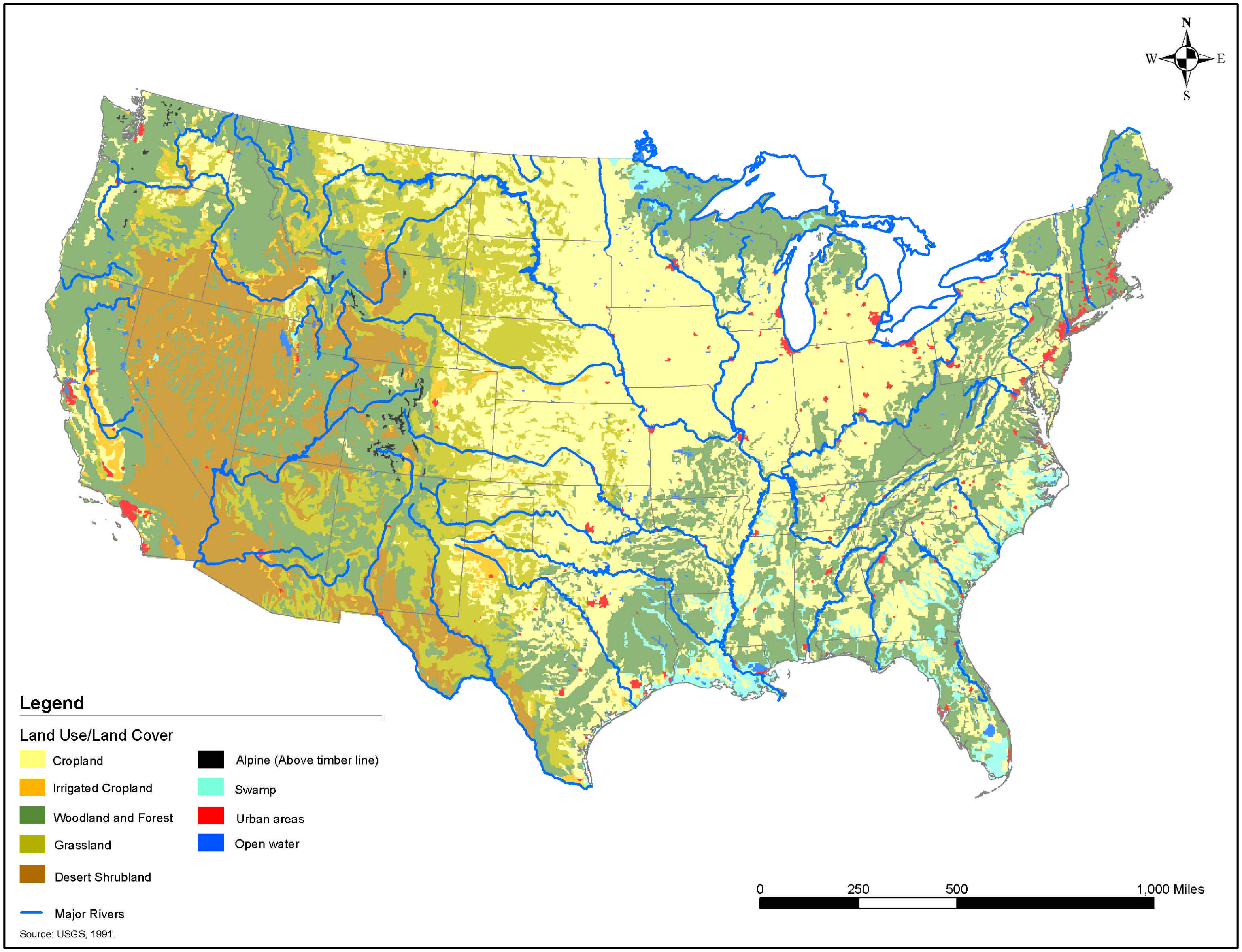



*Fig. 2.2-4. Land Use / Land Cover of the U.S. with Associated Major Rivers*

National Soil Loss

In 1982, prior to CRP and other programs targeting conservation compliance for HEL, along with the adoption of new reduced tillage practices, the estimated amount of soil lost on croplands in the U.S. totaled almost 3.1 billion tons, with the majority of that loss coming from the Corn Belt and the Northern and Southern Plains (Table 2.2-1). In 1997, that number dropped to 1.78 billion tons. The Corn Belt and Plain States still were the major contributors in soil loss, but their numbers were also dramatically decreased. Soil erosion and soil quality were significant agriculture concerns long before the implementation of the conservation compliance provisions in the 1985 Farm Bill. It was not until CRP and conservation compliance provisions that real improvements in soil erosion and soil loss were realized.

*Table 2.2-1. Estimated Erosion on Cropland (1,000 Tons)*
*For Years: 1982 (Pre-CRP) and 1997 (Post-CRP)*

| Region | Sheet & Rill | | Wind | | Total | |
|---|---|---|---|---|---|---|
| | 1982 | 1997 | 1982 | 1997 | 1982 | 1997 |
| Northeast | 62,151 | 42,574 | 242 | 172 | 62,393 | 42,746 |
| Appalachian | 155,166 | 73,674 | 556 | 394 | 155,721 | 74,069 |
| Southeast | 95,781 | 53,141 | 0 | 0 | 95,781 | 53,141 |
| Delta States | 115,433 | 68,202 | 0 | 0 | 115,433 | 68,202 |
| Corn Belt | 606,105 | 321,406 | 85,976 | 23,646 | 692,081 | 345,052 |
| Lake States | 123,571 | 85,408 | 146,698 | 128,742 | 270,269 | 214,151 |
| No. Plains | 256,944 | 161,182 | 337,756 | 180,790 | 594,700 | 341,972 |
| So. Plains | 115,517 | 91,434 | 450,221 | 253,573 | 565,738 | 345,007 |
| Mountain | 86,095 | 55,681 | 340,187 | 171,309 | 426,282 | 226,989 |
| Pacific | 71,717 | 41,541 | 44,209 | 36,962 | 115,926 | 78,503 |
| **U.S.** | **1,688,480** | **994,243** | **1,405,845** | **795,588** | **3,094,324** | **1,789,832** |

Source: USDA, 2000

However, improving or protecting soil quality is a broader undertaking than just erosion control. Preserving soil quality requires protecting the physical, chemical, and biological functions of soils through the management of varying land covers and land uses. Improving soil quality will also increase the carbon sequestered in the soil, which helps offset greenhouse gas emissions. There was approximately 1.4 billion acres of nonfederal rural land in 1982 that were classified under the various land cover/land use categories (Figure 2.2-4). The declining soil quality of these lands and the increasing demand for sustainable agriculture in the early 1980s called attention to the need for restoration of degraded cultivated soils and decreasing soil erosion rates on highly erodible cropland before agricultural productivity was compromised. Further, improving soil quality will increase the carbon sequestered in the soil, which helps offset greenhouse gas emissions.

# 2.2.2 Water Resources and Aquatic Species

### *2.2.2.1 Surface Water – Watersheds of the U.S.*

Water Quality

Water begins as precipitation in the form of rain or snow, falls to earth, and either moves across the soil surface to the nearest water body, or travels through the soil and rock into the groundwater. Land use greatly affects the quality of water. Urban areas, timber production, mining, roads, agriculture, and many other land uses have the potential to impact water quality. Agriculture can be the source of pollutants impacting water quality. Animal waste, fertilizers, pesticides, and other chemicals from agricultural operations can infiltrate the groundwater or be carried to lakes and streams by runoff, negatively impacting water quality. Clean water is essential for healthy ecosystems and healthy communities. Preserving water quality requires limiting the amount of pollutants entering a watershed to the greatest extent possible.

***Fig. 2.2-5. Farm Pond in Iowa.***
*Photo by Tim McCabe. 1999. NRCS Photo Gallery*

Surface Waters

The water quality of lakes, rivers, and streams is determined by the natural, physical, and chemical properties of the land that surrounds them. The topography, soil type, vegetative cover, minerals, and climate, all influence water quality. When land use affects one or more of these natural physical characteristics of the land, water quality is almost always impacted. These impacts may be positive or negative, depending on the type and extent of the change in land use. If water quality is degraded severely enough, the impacts can be devastating for both human communities and for the ecological demands of those species that require clean water for survival. Agricultural practices have the potential to substantively affect water quality due to the vast amount of acreage devoted to farming Nationwide and the great physical and chemical demands that agricultural use has on the land.

Currently in the U.S., pollution of assessed surface water bodies is widespread, according to the EPA's 2000 National Water Quality Inventory, which indicated that 40 percent of streams, 45 percent of lakes, and 50 percent of estuaries that were assessed in the U.S. did not meet minimum water quality standards. About one third of U.S. waters were assessed for this EPA's inventory of water quality. EPA reported that the leading impairments in the assessed waters included nutrients, siltation, bacteria, and metals and the primary sources of these impairments were linked to runoff from agricultural lands, municipal point sources (sewage treatment plants), and hydrologic modifications (such as channelization, flow regulation, and dredging) (EPA, 2000).

Impaired Waters

As a way to identify those bodies of water where water quality has been degraded and do not meet minimum water quality standards, Section 303(d) of the Clean Water Act (CWA) established a process for States to identify those waters within its boundaries that do not meet clean water standards. Waters that do not meet clean water standards are classified under the CWA as "Impaired Waters" (Figure 2.2-6 Miles of Impaired water). States establish a priority ranking for these waters and for the priority waters, develop total maximum daily loads (TMDLs). A TMDL identifies the amount of a specific pollutant or property of a pollutant, from a point source ("end of the pipe"), a nonpoint source (from runoff), and natural background sources, including a margin of safety, that may be discharged to a water body and still ensure that the water body attains water quality standards. When comparing data between States, it is important to know that each State's TMDL program differs and the way they tabulate the total miles of impaired water also differs. For example, some States list entire streams or rivers as being impaired, while other States may only count those stretches of river that are polluted as impaired. This makes comparing the total miles of impaired waters between States difficult. If one State only lists stretches of streams that are impaired, their total miles will be less than those who list entire rivers or streams, when in actuality, the amount of river miles that is impaired may be more.

**Agriculture Practices that Cause Nonpoint Source Pollution**

**Soil Disturbance:**

- Cultivation can result in erosion that will cause sedimentation to streams, lakes, or estuaries.

**Nutrients and Animal Wastes:**

- Results in runoff laden with plant nutrients that can lead to excessive algal growth.
- Nitrates and nitrites can contaminate groundwater.
- Organic wastes in high concentrations can deplete dissolved oxygen in water, resulting in fish kills.
- Nutrient pollution can accelerate eutrophication.
- Coliform bacteria pollution.

**Pesticides:**

- Can be carried off by runoff, contributing to toxic pollution of the receiving waters.
- Can contaminate groundwater.

**Grazing Animals:**

- Can over-graze grass, exposing soil and creating erosion problems.
- Can damage stream banks and riparian areas by wallowing.

Nonpoint Source Pollution

Nonpoint source pollution occurs when moving water, either from precipitation or irrigation, runs over the land or through the ground, picks up pollutants, and deposits them into a body of water or into the groundwater. This type of pollution is referred to as "nonpoint" because it comes from many diffuse sources, and the origin of the pollutant cannot be easily defined. Nonpoint source pollution results from nearly every type of land use, and is the leading cause of water quality degradation in the Nation. According to the EPA's 2000 National Water Quality

Inventory, throughout the U.S., runoff from agricultural lands is a major source of nonpoint pollution and causes significant water quality degradation. Nonpoint source pollution associated with agriculture practices that has the greatest impact on water quality is runoff that contains sediment, nitrogen (N), phosphorus (P), and/or pesticides. These four pollutants have been chosen due to their potential to produce cumulative adverse impacts on human health and the natural environment (Table 2.2-3). Sediments are loose particles of soil and other substances carried by runoff into a water body that settle at the bottom. N and P, in the form of nitrates, nitrites, and phosphates, primarily originate from fertilizers and feedlots and enters the water through runoff. The majority of pesticides, which include herbicides, also enter waterways through runoff from agricultural lands.

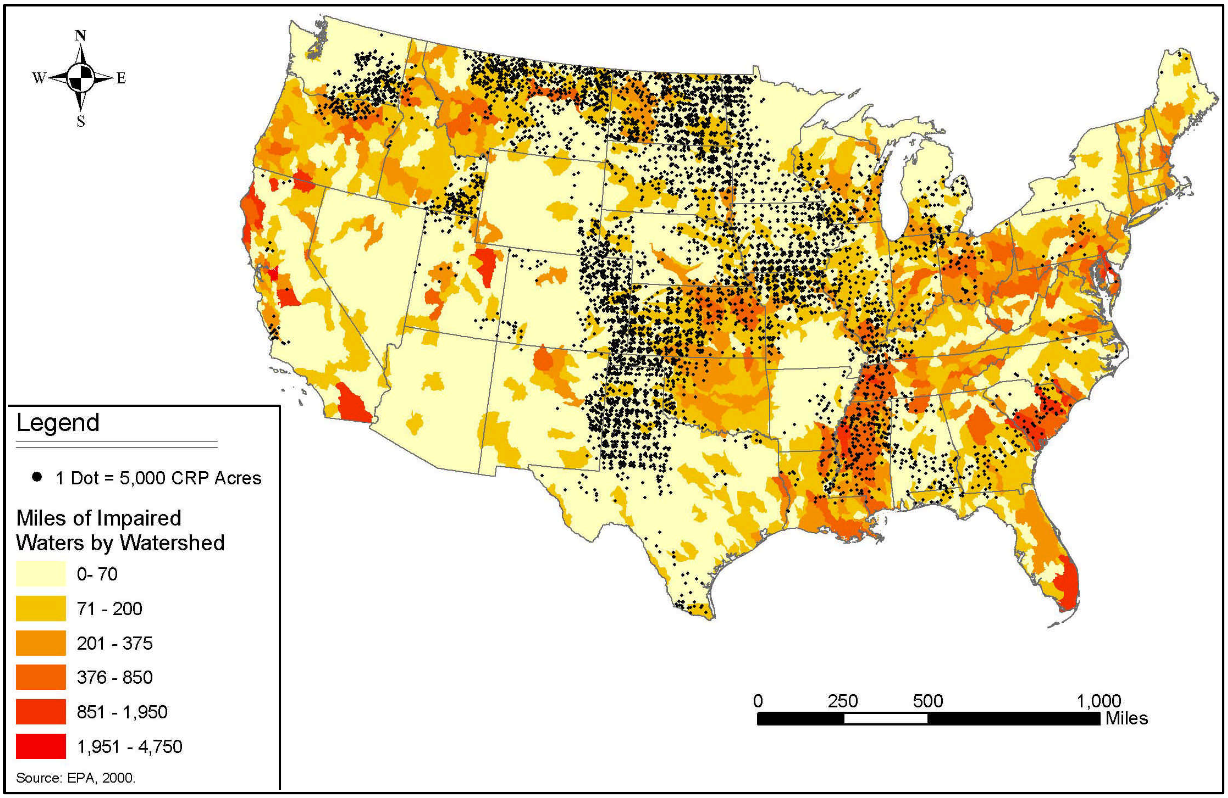



***Fig. 2.2-6. Miles of Impaired Surface Waters by Watershed***

*Table 2.2-3. Negative Impacts of Nonpoint Sources on Water Quality*

| Contaminant | Source | Negative Agricultural Impacts | |
|---|---|---|---|
| | | Human Effects | Natural Environment |
| **Sediment** | Runoff from land in production | May harm the quality of the drinking water | May affect the ecology of lakes and streams by covering up the habitat of those creatures that live on the bottom. |
| **Nitrogen (N)** (Nitrates and Nitrites) | Runoff from lands where fertilizers have been applied. Runoff from animal feedlots. | May cause serious illness; children less than 6 months old highly susceptible to illness known as "Blue-Baby" | May cause excessive growth of aquatic plants and algae, which can increase sedimentation and decrease the amount of dissolved oxygen in the water because of increased respiration and decomposition of excess aquatic plants and algae (causing Hypoxia) negatively affecting fish and other aquatic communities |
| **Phosphorus (P)** (Phosphates) | Runoff from lands where fertilizers have been applied. Also involves runoff from animal feedlots. | May accelerate the growth of certain species of blue-green algae that produce neurotoxin, which can be harmful to humans. | Leading contributor of eutrophication in fresh and salt water. |
| **Pesticides** | Runoff from lands where pesticides and herbicides have been applied | Regulators have issued guidelines for all pesticides to protect human health. | May harm beneficial insects, aquatic organisms, and may result in the bioaccumulation of these toxins in higher organisms. And may be harmful to ecosystems as a whole |

Nitrogen

Increased supplies of N usable by plants and animals have resulted in ecological impacts with significant economic, political, social, and cultural consequences (Ecological Society of America (ESA), No Date). In N-limited aquatic systems, N inputs from the atmosphere, in the form of wet and dry deposition of ammonia, nitrate, and organic N, can stimulate phytoplankton production and change phytoplankton community structure and composition, which in turn can affect water quality in general (hypoxia/anoxia, harmful or nuisance algal blooms, etc.). In many locations in the U.S. (Figure 2.2-7), increased amounts of N are currently being delivered from agricultural systems into sensitive ecosystems. This N deposition can help accelerate the rate of eutrophication and carries with it some potentially serious environmental consequences, including massive die-offs of aquatic plants and animals, loss of biological diversity, growth of nuisance algae potentially toxic to humans and aquatic wildlife, and negative effects on the sustainability of desired fisheries (ESA, No Date).

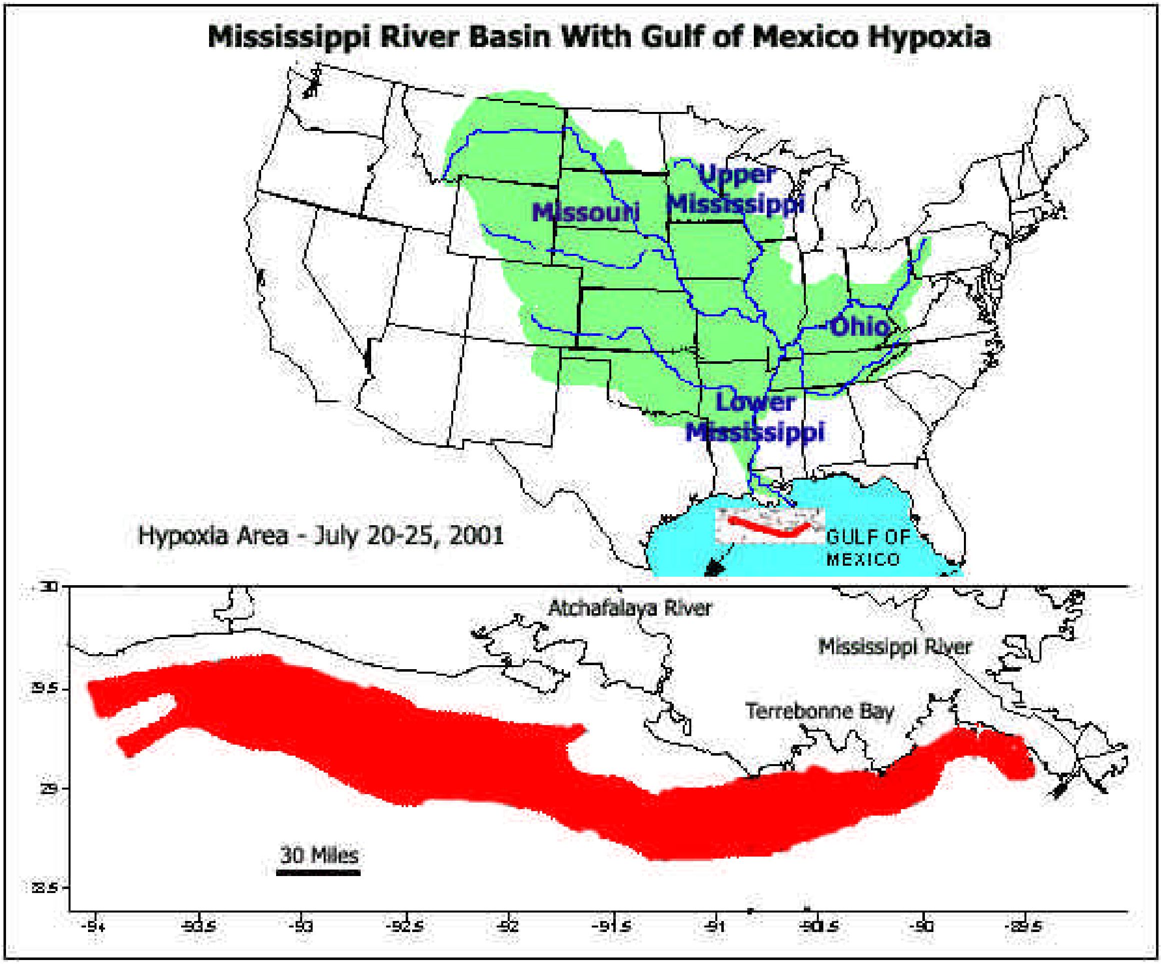



*Fig. 2.2-7. Hypoxia Area*

Hypoxia

Negative impacts of N runoff can be observed in the Gulf of Mexico along the coasts of Louisiana and Texas. Nutrients like N and P originate from agricultural runoff via the Mississippi River, draining all or parts of 31 States and flowing 2,350 miles before it finally reaches the Gulf of Mexico (EPA, 2002b).

> Nutrient concentrations in the Mississippi River have increased dramatically since 1950, coincident with increasing fertilizer use on cropland in the Midwest (Goolsby and Battaglin, 1997). There are a number of sources of nitrogen in the Mississippi River basin, including municipal and industrial point sources, commercial fertilizer and animal manure used on cropland, septic systems, and atmospheric deposition. Nonpoint source pollution from agricultural sources is estimated to contribute more than 80 percent of the nitrogen loadings in the Mississippi basin (Goolsby et al., 1999).
>
> Source: USDA ERS

The locks and dams that altered the river from its original meandering state affecting fish and wildlife habitat, contributing to flooding along with the separation of the river from its original floodplain, and the loss of millions of acres of wetlands, have further hindered the river's ability to absorb and protect against the torrents of spring floodwaters (EPA, 2002b).

Nutrients, such as N and phosphorous, are essential for healthy marine and freshwater environments. However, an over overabundance of nutrients can cause excessive algal growth or eutrophication (Figure 2.2-8) This eutrophication results in reduced sunlight, loss of aquatic habitat, and a decrease in oxygen dissolved in the water (EPA, 2002b).

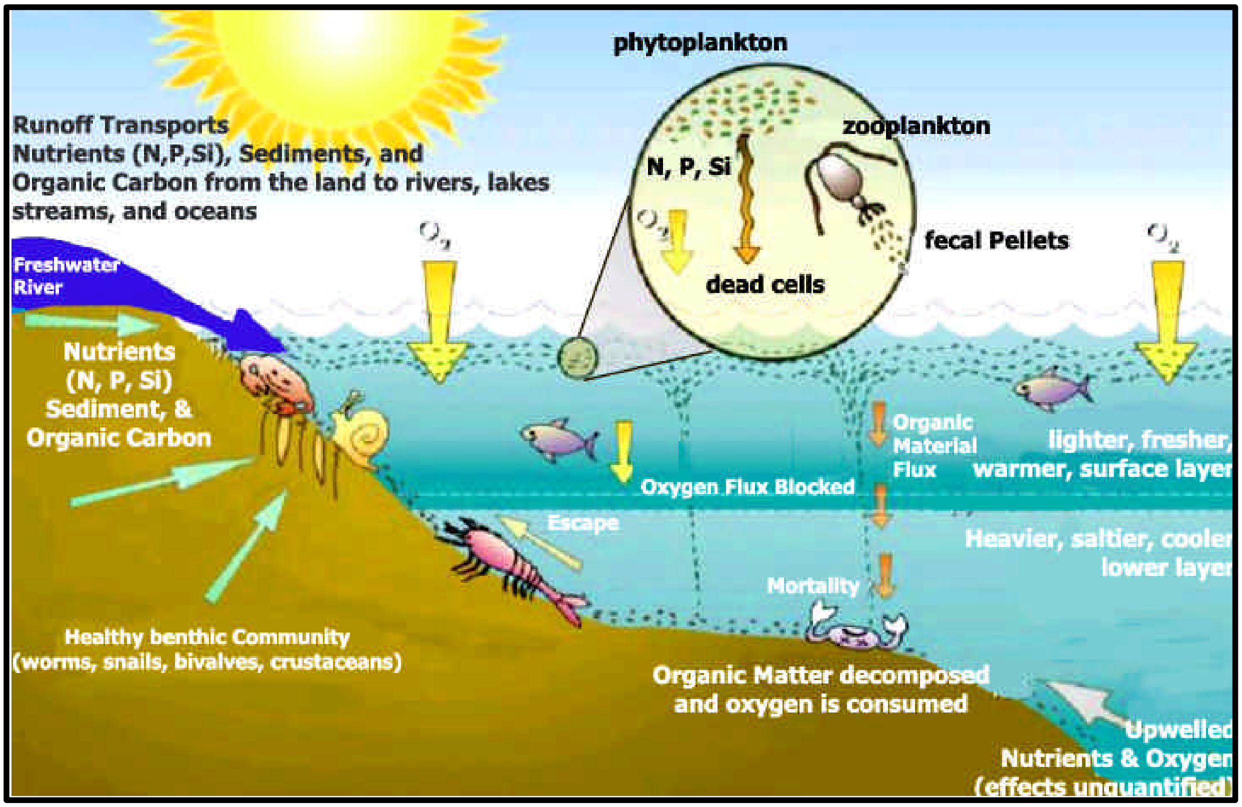



*Fig. 2.2-8. The Eutrophication Process* Source: EPA (2002b)

Even though P is the limiting factor for algal growth in most freshwater bodies, N has been cited as the primary cause of the phenomena known as hypoxia (USGS, 1999). When nutrient-laden runoff reaches the Gulf, eruptive algal blooms occur and, upon decomposition and under the right conditions, severely deplete the oxygen levels in the water, resulting in fish kills and the loss of shellfish beds. N is the principal nutrient yielding excess organic matter sedimentation in the Gulf hypoxic zone with the N export from the Mississippi River system increasing two-to-sevenfold over the last century (Turner and Rabalais, 1991; Goolsby et al., 1999; Howarth et al., 1996). The majority of Mississippi River N originates from agricultural land practices, while other sources include human sewage, nonagricultural fertilizer use, and precipitation (Howarth et al., 1996; Goolsby et al., 1999). Silica and P also play a role, and the changing balance of N, silica, and P can alter marine food webs (Rabalais, 2001).

Hypoxia occurs from late February through early October, nearly continuously from mid-May through mid-September, and is most widespread, persistent, and severe in June, July, and August (Rabalais, 2001). Midsummer coastal hypoxia in the northern Gulf of Mexico was first recorded in the early 1970's, but in recent years (1993-1999), the extent of bottom-water hypoxia has been greater than twice the surface area of the Chesapeake Bay, rivaling extensive hypoxic/anoxic regions of the Baltic and Black Seas (Rabalais, 2001). The comparative size of the hypoxic area in the Gulf has fluctuated over the years (Figure 2.2-7) and was it's smallest in the mid to late 1980's.

The amount of flow in the Mississippi River is dependent on precipitation falling within the basin and is the major factor that determines the size of the hypoxic area in the Gulf of Mexico. Precipitation affects the storage and leaching of N from the soil/ground-water system and transports it through runoff. During high-flow years, the hypoxic area has been known to extend from the mouth of the Mississippi River to just east of Galveston Bay, Texas. In low-flow years, the area is primarily confined to the vicinity around the Mississippi River discharge. The size, location, and duration of the hypoxic zone vary from year to year. In 1988 and 1989, there was little hypoxic area measured, presumably because of low flow from the Mississippi River. In contrast, following the "Great Flood of 1993", the hypoxic zone was measured at slightly over 7,000 square miles. In midsummer 1998, the hypoxic zone decreased to about 4,800 square miles, but increased again to almost 7,800 square miles in midsummer 1999. This represents just over one percent of the Gulf of Mexico. In contrast, during 2000, while much of the Central U.S. suffered severe drought conditions, decreased overall flow of the Mississippi River reduced the size of the hypoxic area in the Gulf to under 5,000 square kilometers (Rabalais, 2001).

Hypoxia not only has detrimental effects on the aquatic environment, but also on those industries in the coastal regions that depend on healthy fish and shellfish stocks for their livelihood (NOS, 2001). Hypoxia has been identified in 60 to 70 major sites, along with many rivers and streams worldwide (ESA, No Date). The highest potentials for runoff containing N and pesticides are located in the upper Midwest and along the Mississippi Valley (Figure 2.2-9). This can be attributed to the amount of fertilizers and pesticides needed to effectively farm these vast areas, coupled with annual rainfalls (Figure 2.2-10), hydrology of the area, and associated farm practices.

Phosphorus

Sources of P contamination of surface waters are numerous and include agriculture, municipal sewage treatment plants, individual septic treatment systems, decaying plant material, runoff from urban areas and construction sites, stream bank erosion, and wildlife. In some areas and under certain conditions, P losses from agriculture are a major source of the P entering lakes and streams (Sharpley, et al, 1999).

Runoff of water either across the soil surface or via subsurface flow can contain significant concentrations of dissolved P. As rainfall or snowmelt moves across the soil surface, the water interacts with a thin layer of soil. During this process, P is extracted from the soil and plant material and dissolved in the runoff water and sediment. Dissolved P can also be lost from standing vegetation (e.g., CRP, alfalfa, or native prairies) via spring snowmelt because P contained in the tissue is released due to breakdown of plant cells by freezing and thawing. The removal of P from plant residue by rainfall or runoff and sediment may account for differences among watersheds and seasonal fluctuations in P movement. Concentrations of dissolved P in subsurface flow are low because the P-deficient subsoils absorb much of the soluble P contained in the water percolating through the soil profile. Exceptions may occur in organic, permeable coarse, and waterlogged soils with low ability to retain P. Thus, the accelerated eutrophication of surface waters by P is mostly associated with inputs from surface rather than subsurface flow (Sharpley et al., 1999).

Eutrophication (Figure 2.2-8) of most fresh water around the world is accelerated by P inputs. Although N and carbon (C) are also essential to the growth of aquatic biota, most attention has focused on P inputs because of the difficulty in controlling the exchange of N and C between the atmosphere and water and the fixation of atmospheric N by some blue-green algae. Therefore, P is most of the time the limiting element, and its control is of prime importance in reducing the accelerated eutrophication of fresh waters. When salinity increases, as in estuaries, N generally becomes the element controlling aquatic productivity. However, in Delaware's inland bays (coastal estuaries), nitrate-N leaching has elevated N concentrations to the point where P is now the limiting factor in eutrophication (Sharpley et al., 1999).

Lake water concentrations of P above 0.02 ppm generally accelerate eutrophication. These values are an order of magnitude lower than P concentrations in soil solution critical for plant growth (0.2 to 0.3 ppm), emphasizing the disparity between critical lake and soil P concentrations and the importance of controlling P losses to limit eutrophication (Sharpley et al., 1999).

Pesticides

Pesticides are widely used throughout the U.S. Agricultural lands, as well as urban and business environments, all utilize pesticides in one form or another. Within the U.S., the areas with the highest use of pesticides are the Midwest and the Mississippi Valley corridor (Figure 2.2-9). Pesticides are classified as insecticides, herbicides, disinfectants, and those products aimed at reducing pests such as insects and rodents. In recent studies of major rivers and streams, it was documented that 96 percent of all fish, 100 percent of all surface water samples, and 33 percent of major aquifers contained one or more pesticides at detectable levels. Pesticides were also identified as one of the 15 causes of impairment for a State's impaired waters list (EPA, 2000). Pesticides have also been shown to have the potential to cause declines in amphibian populations and physical deformities in individual amphibians within those populations. Overall, improper use of pesticides has the potential to cause adverse impacts to water quality of both ground and surface water. This reduces the availability of safe drinking water supplies.

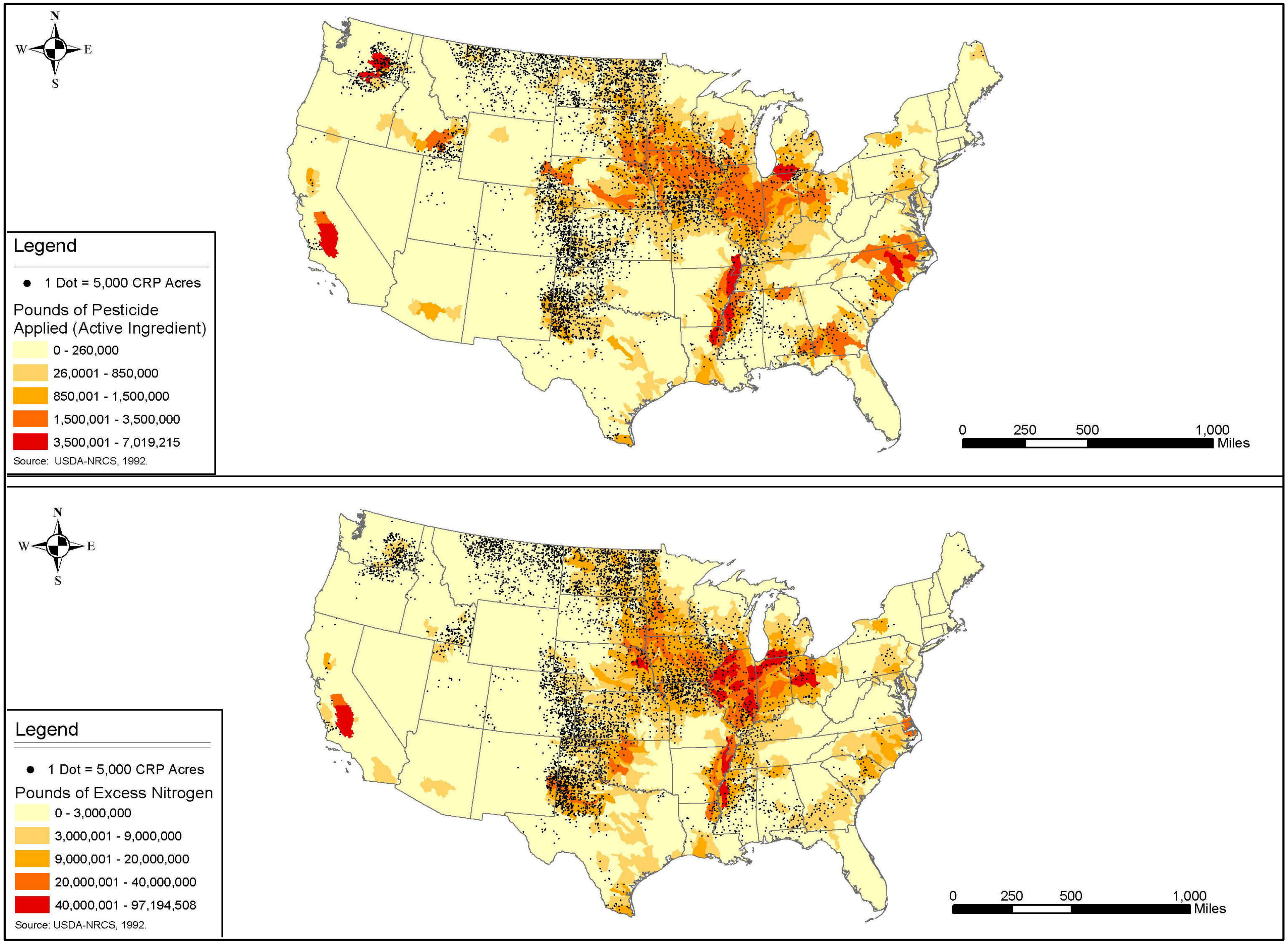



*Fig. 2.2-9. Pounds of Pesticide Active Ingredient Applied to Cropland and Potential Pounds of Excess N in Runoff*

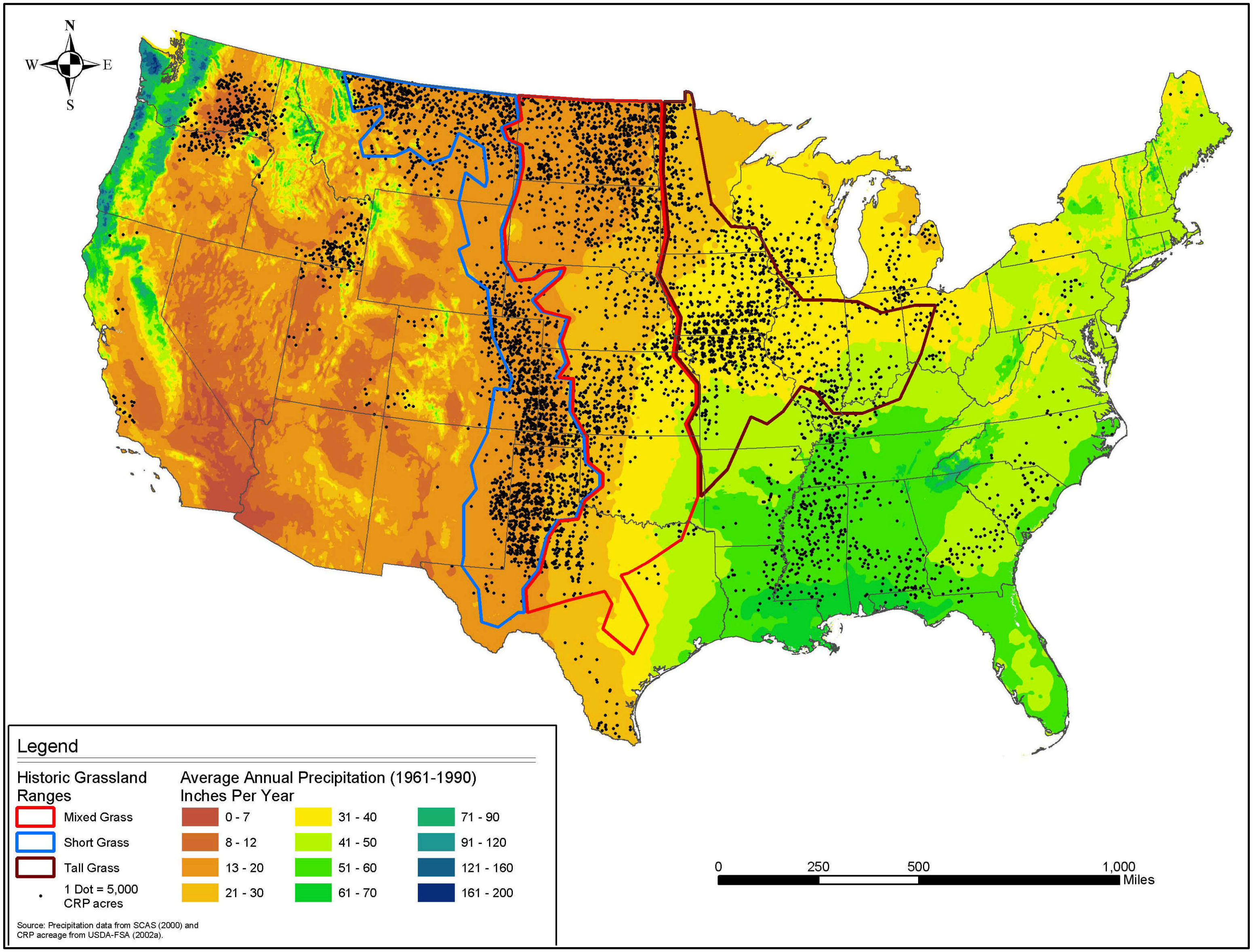



*Fig. 2.2-10. Average Annual Precipitation*

Erosion

Agricultural conservation practices can extensively reduce sediment transport and some sediment sources. Different erosion processes generate different sediment qualities. Sheet and rill erosion produce fine-textured sediment derived from the topsoil layers, and this layer can contain any agriculturally applied chemicals that move with the sediment. Channel erosion produces sediment from multiple soil layers chiseled by the erosion process. This type of erosion can have varying effects based on its location within an ecosystem. In upland areas, for instance, erosion can cause ephemeral gullies that tend to be hidden through standard tillage operations. When high intensity storm events occur, it can create large amounts of sediment transport and further channel incision. Stream banks erode into formerly deposited alluvial sediments, but because they are deposited in and along streams, they still have the potential to absorb agriculturally applied chemicals from the previously deposited soils (Figure 2.2-11).

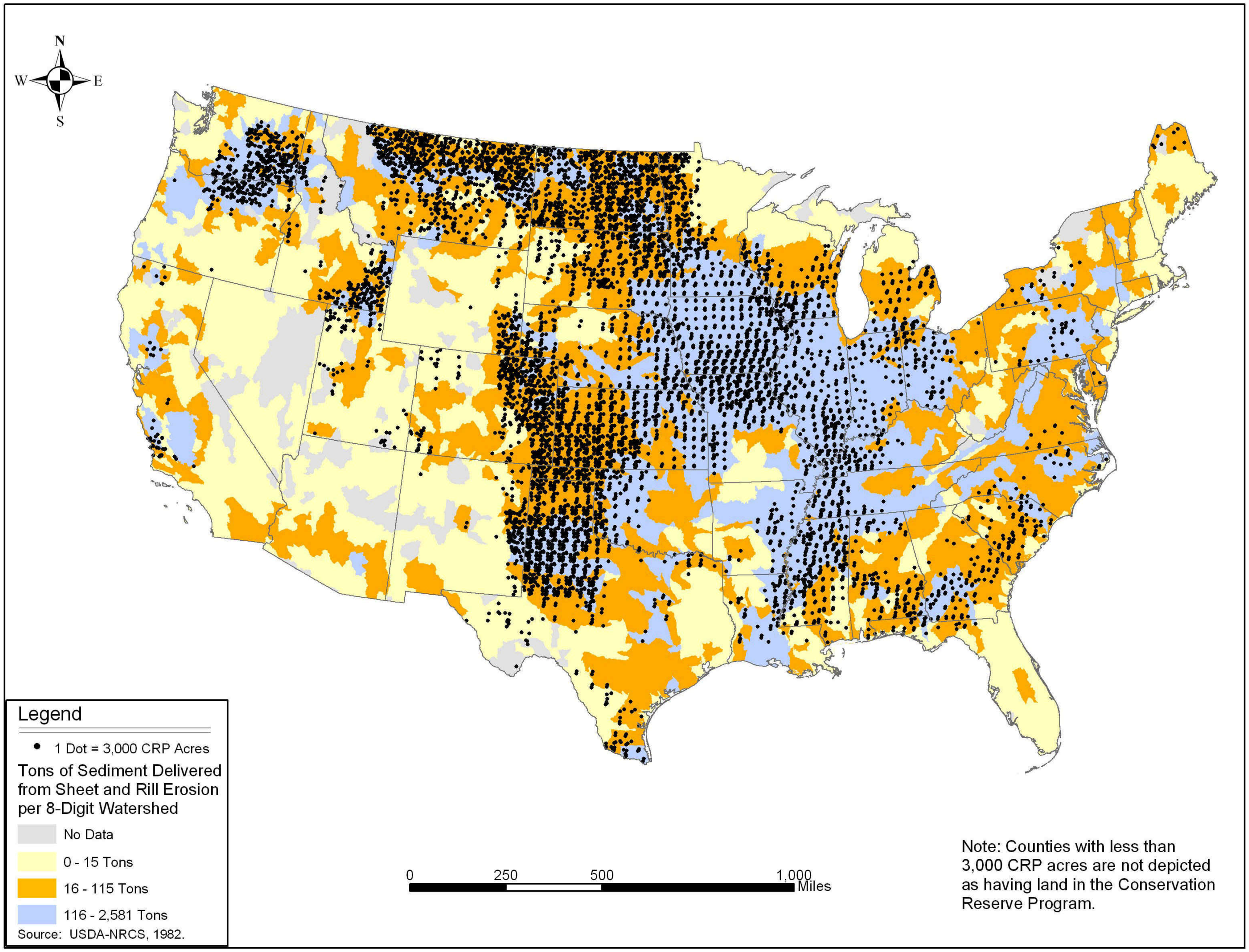



***Fig. 2.2-11. Tons of Sediment delivered from Sheet and Rill Erosion***

Sediment

Sediment deposition is aesthetically unpleasant, carries chemical contaminants, fills up water bodies, and causes physical damage to farmland, wildlife, and water treatment systems. When productive topsoil erodes through the physical and chemical forces of weathering, it becomes sediment suspended in water and deposited where it is not wanted. Sediment deposited on the streambed can suffocate benthic organisms, and is also harmful to stream biota because it inhibits respiration and feeding of aquatic animals and diminishes the transmission of light to plants.

The region with the highest potential for sediment runoff in the U.S. lies within the Mississippi River Valley (Figure 2.2-11), which runs all the way from the Midwest and Central States east to the western slope of the Appalachian Mountains. This high potential is due to the number of farmlands within this area along with the moderate annual rainfalls and hydrology of the areas. Other agricultural areas with a high potential for sediment loss include the areas along the Columbia River in Southern Washington and Northern Oregon, due to arid conditions and the need for intense irrigation to support agriculture. The Western States and Southeast have low to moderate sediment runoff potential.

Runoff Potentials

The potential for runoff and the quantity of runoff in a certain area is dependant on two factors, precipitation and land surface condition.

*Precipitation:* The duration, intensity, and the distribution of precipitation are the driving forces dictating how much runoff can occur.

*Land Surface Condition*: The combination of topography, geology, soils, agricultural chemical amounts, and land use, will dictate how much runoff can occur.

In the U.S., the overall runoff potential appears to be the greatest in the Mississippi River Valley, Delta, and The Great Lakes regions (Figure 2.2-12 through 2.2-14). These high potentials are due to the sheer number of acres devoted to farming, coupled with the moderate to high annual precipitation rates and the geohydrology of that region. Areas in the West do not have as great a potential for runoff due to the fact most of the Western States have less acreage devoted to cultivated agriculture, and less annual precipitation to drive runoff. Those Western areas that do have greater runoff potential are typically heavily irrigated farmlands, such as areas found in Southern California, Southern Washington, and Idaho. Through different conservation practices, concerted efforts in attempting to slow wind and water erosion rates during the past 20 years have been extremely effective for these areas. Within these areas of high runoff potential, decreases in soil erosion rates have ranged from 2 to over 10 tons of soil per acre per year.

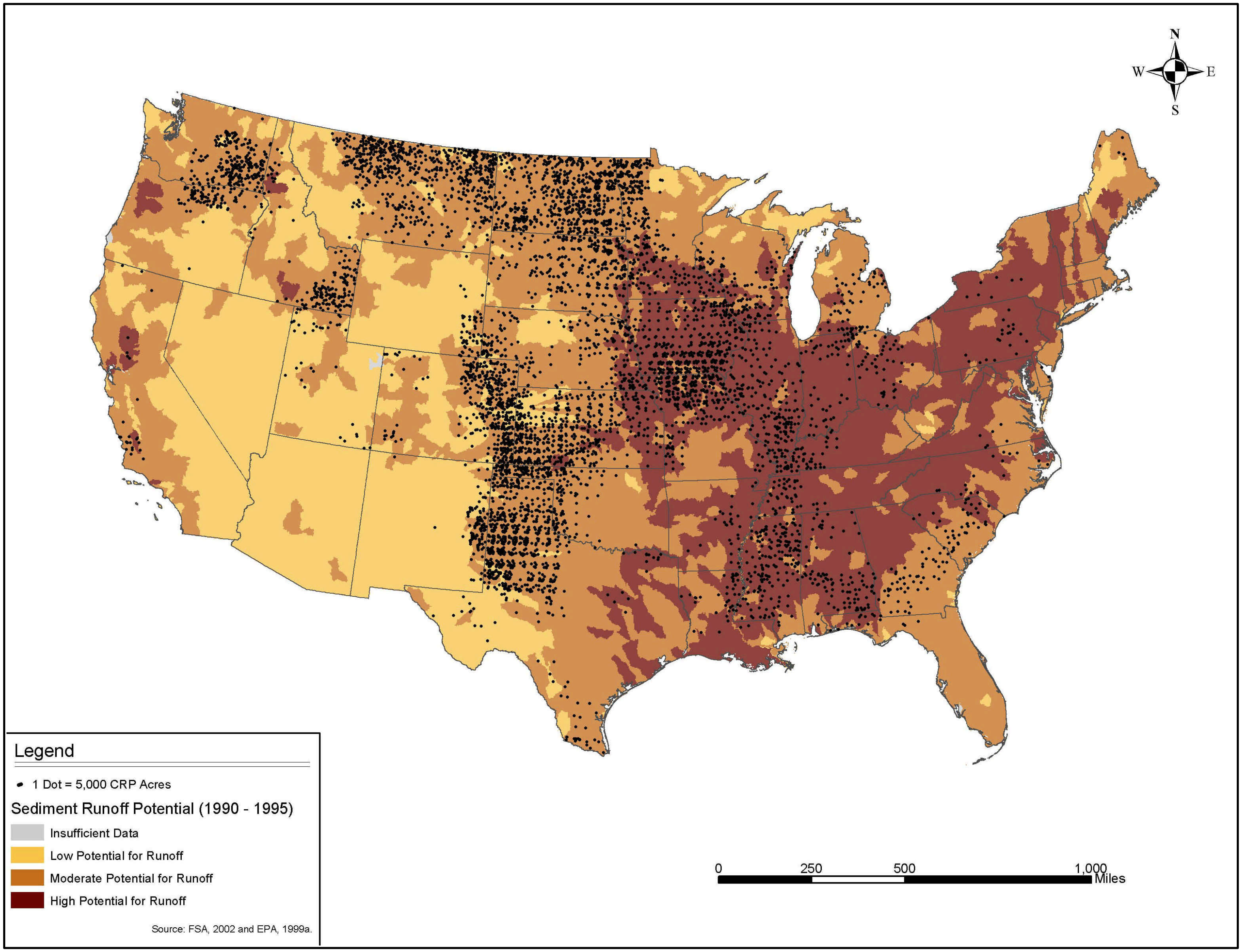



*Fig. 2.2-12. Sediment Runoff Potential*

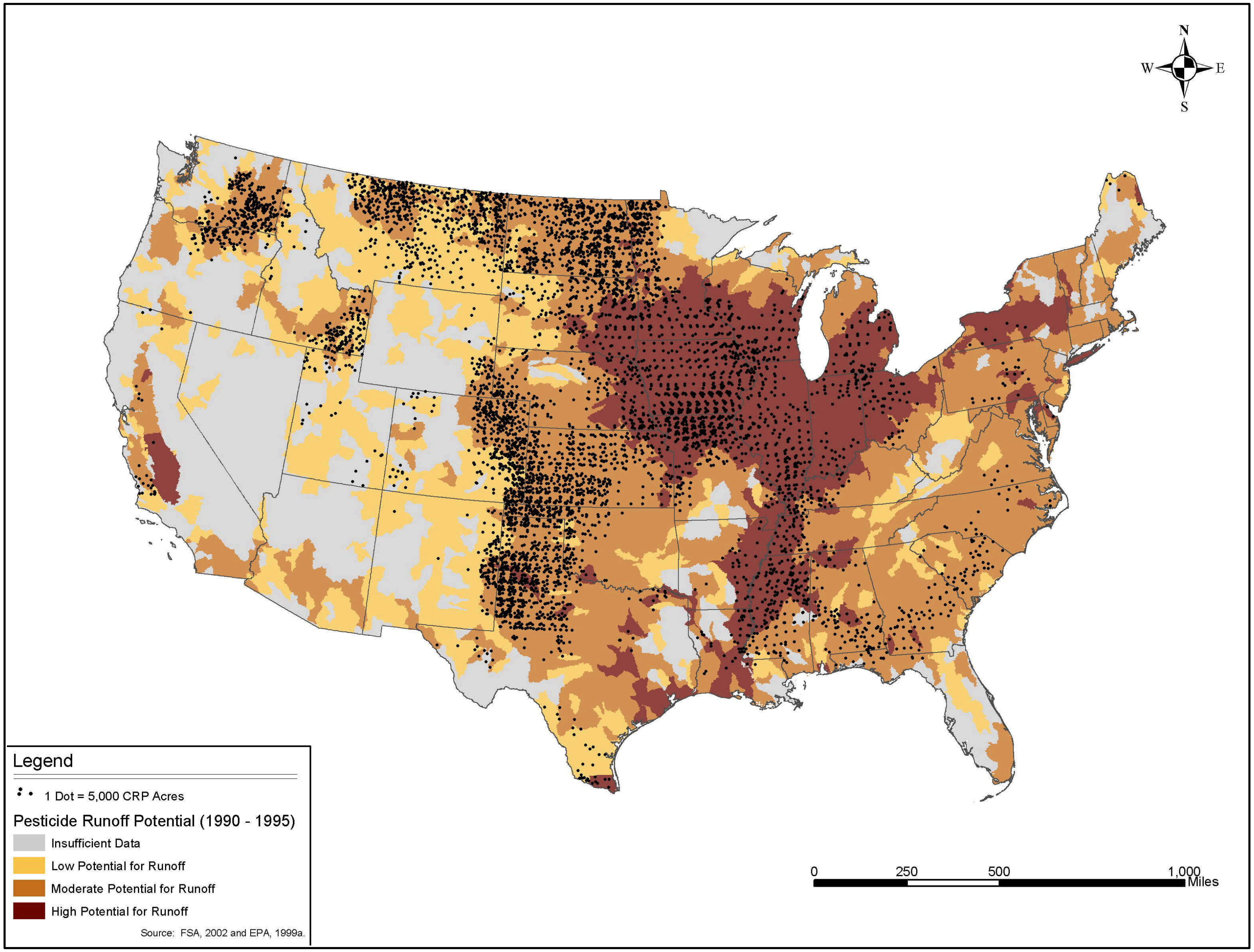



*Fig. 2.2-13. Pesticide Runoff Potential*

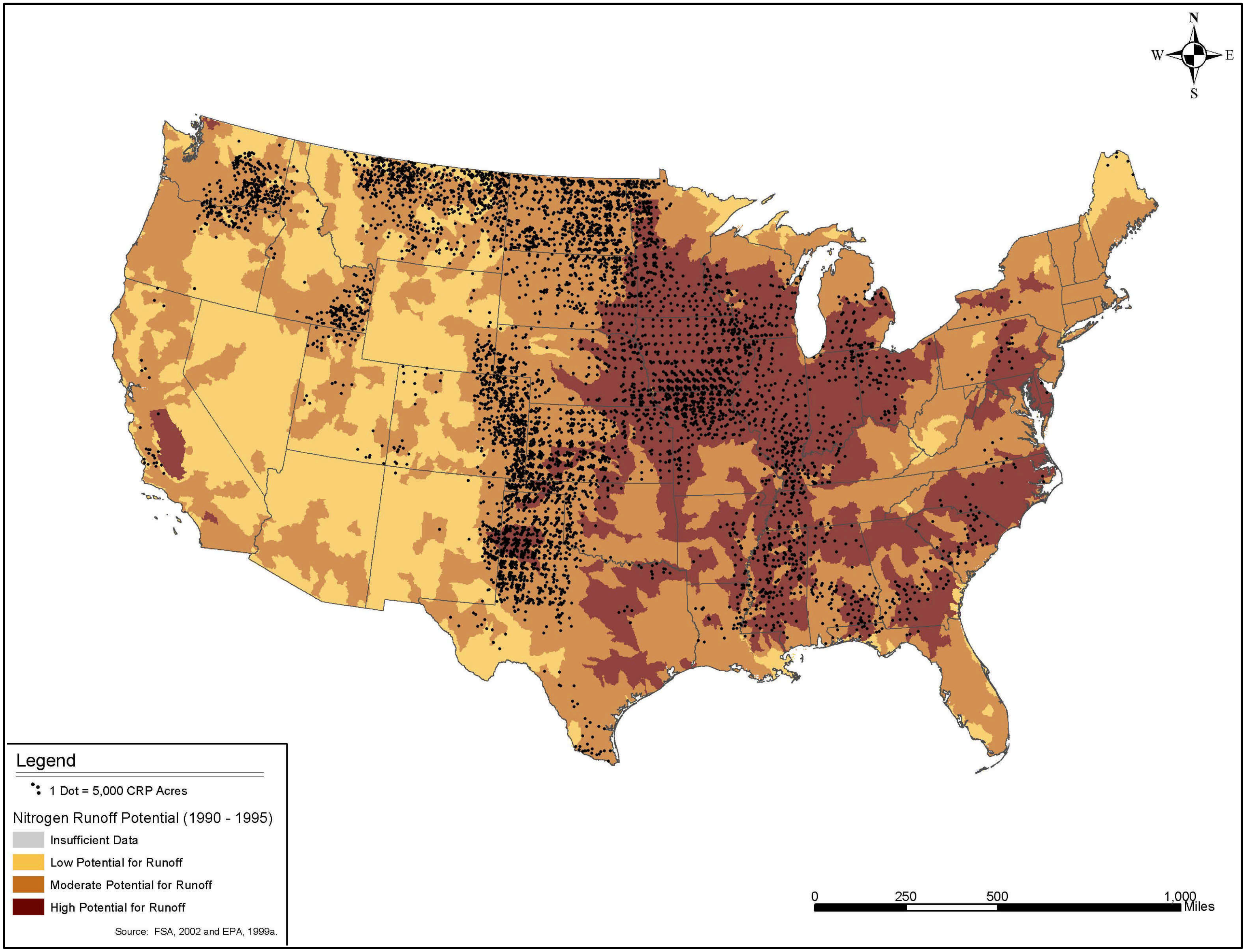



*Fig. 2.2-14. N Runoff Potential*

Buffers

The size of a buffer is strictly dependent upon the buffer's purpose and local conditions such as slope, precipitation, soil type, and upland land use (Figure 2.2-15). Buffers have long been a staple in conservation systems designed to prevent erosion and trap sediment and nutrients from field runoff but have also come to provide additional benefits such as wildlife habitat improvement, streambank protection, and reducing pesticide loss (NRCS, 2000). There is not a generic buffer width that will keep the water clean, stabilize the bank, protect fish and wildlife, and satisfy human demands on the land. The minimum acceptable width should be one that provides acceptable levels of all needed benefits at an acceptable cost to the landowner and the taxpayer.

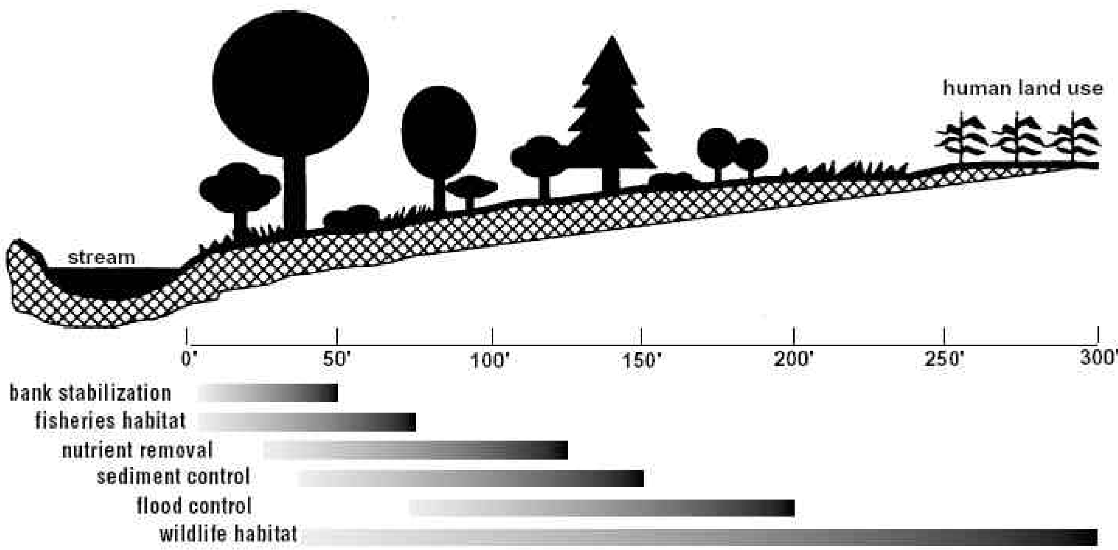



***Fig. 2.2-15. Sample Buffer Sizes of Various Conservation Purposes*** (CRJC,1999)

### *2.2.2.2 Groundwater Resources*

Groundwater is the water that flows underground, and is found in the cracks and crevices between soils, sand, and rocks. It is ecologically important because it sustains ecosystems by releasing a constant supply of water into wetlands and contributes a sizeable amount of flow to permanent streams and rivers (Paddock, 1988).

In the U.S. over 50 percent, approximately 90 billion gallons, of water consumed daily is groundwater (Fig. 2.2-16). More than two-thirds of this amount is used for irrigation, and the remainder is used for drinking water and other domestic uses.

Groundwater is an important source of drinking water for more than half of the people in the U.S. In rural areas, almost all domestic water is supplied by groundwater (Paddock, 1988). A clean, constant supply of drinking water is essential for every community across the county. Groundwater contamination has societal implications because of our need for water. Agricultural sources, including animal wastes, fertilizers, and pesticides, have a direct impact on

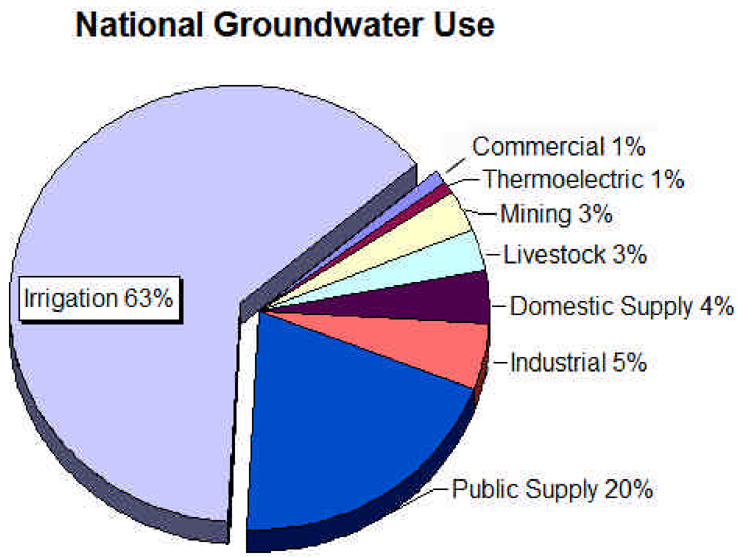



***Fig. 2.2-16 National Groundwater Use.***

***Source: Estimated Use of Water in the U.S. in 1995. U.S. Geological Survey Circular 1200, 1998.***

groundwater quality and supplies. Once groundwater becomes contaminated; it is often times very difficult and very expensive to correct (Thompson, 2001).

Agriculture impacts groundwater quality similar to the way it impacts surface water. However, instead of picking up and transporting contaminants over the soil's surface, contaminants are transported through the soil and deposited into the groundwater. Nitrates, nitrites, phosphates, pesticides, petroleum products, and pathogens are among the most common and serious forms of groundwater pollution associated with agriculture. Agricultural practices that introduce contaminants into the groundwater include fertilizer and pesticide application, spilled oil and gasoline from farm equipment, nitrates, and pathogens from animal manure. Nitrate is the most common groundwater contaminant in the U.S. (Paddock, 1988).

The occurrence of chemical contamination in ground and surface water across the U.S. seems to be fairly common. The majority of States have less than five percent of their samples exceeding half the Maximum Contamination Levels (MCLs). The Midwestern States have the highest number of samples exceeding half of the MCLs: Iowa, Wisconsin, Minnesota, Illinois, and Missouri all have concentrations higher than anywhere else in the Nation (Figure 2.2-16). This can be attributed to the fact that this area, as a whole, applies more tons of pesticides and more tons of N than anywhere else in the Nation (Figure 2.2-14).

**Negative Impacts of Groundwater Contamination Associated with Agriculture**

**Nitrogen (in the form of nitrates and nitrites):** Threat of serious illness and possibly death for children under six months of age. Cause of "Blue-baby Syndrome." Affects the infant's ability to absorb oxygen.

**Pesticides:** May affect human health. If contaminated water is released into streams or wetlands, it may have adverse affects on aquatic organisms.

Other areas for pesticide and N use occur in Southern Idaho, Oregon, and Washington, where herbicides are used extensively in potato production, and in Southern California and the Southeast, where there are intensive agriculture industries.

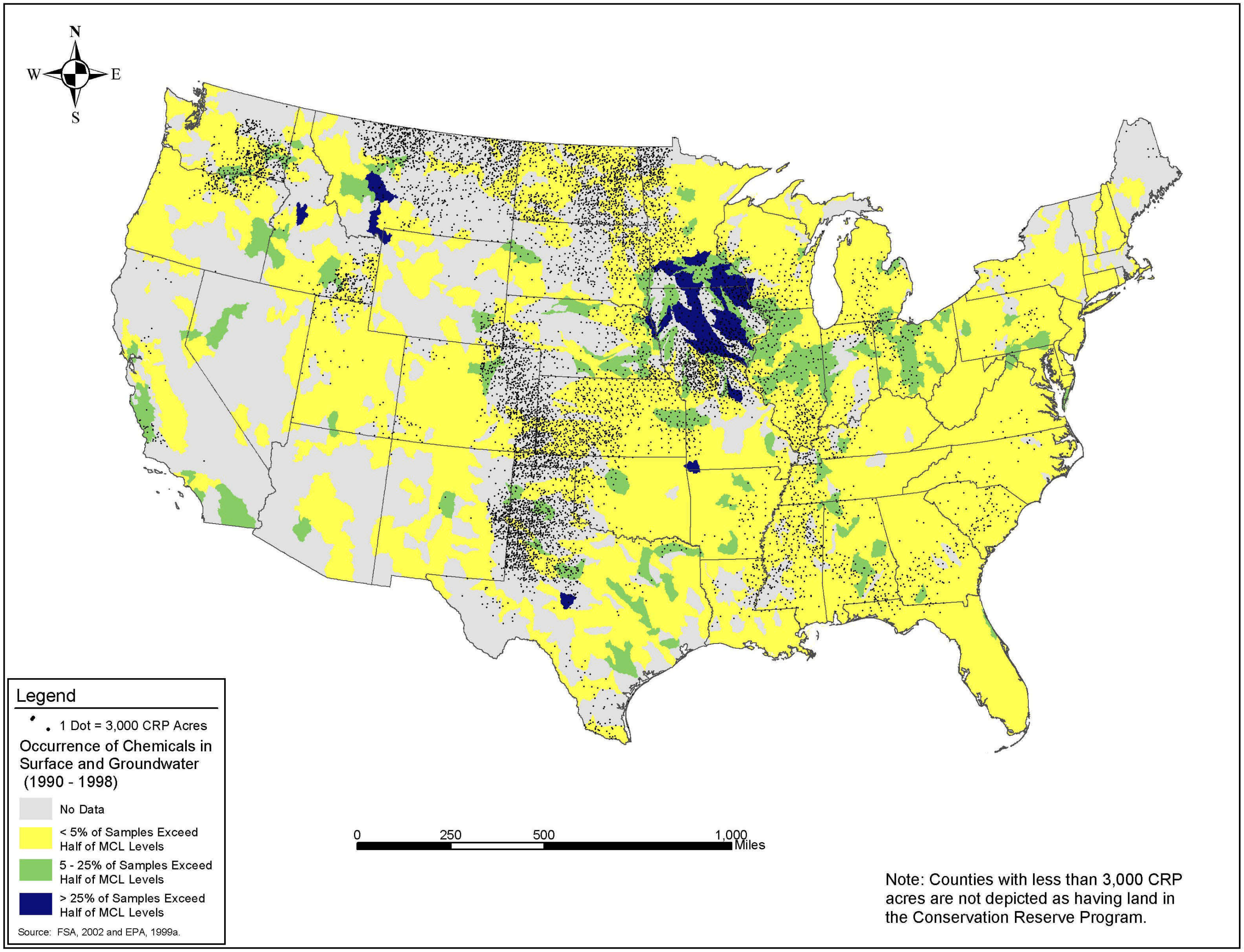



*Fig. 2.2-17. Occurrence of Chemicals in Surface and Groundwater*

Groundwater Supplies

When groundwater is used at a rate faster than it can be replenished, the water table declines, land can subside, and the potential in coastal areas for saltwater intrusion into freshwater aquifers rises (Williams, 1993). If subsidence occurs from groundwater over use, it is impossible for the underlying aquifer capacity to return to its pre-drawdown level.

The largest aquifer in the U.S. is the High Plains Aquifer (also known as the Ogallala Aquifer), which underlies parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. About 30 percent of the groundwater used for irrigation in the U.S. is pumped from this aquifer. In 1990, 15.6 million acre-feet of water were withdrawn from the aquifer to irrigate approximately 14 million acres. This use has led to significant declines from pre-development water levels in many areas. In the central and the Southern High Plains, the depth of the water table has declined from 100 to 200 feet from its historic elevation. Nearly 200,000 wells are withdrawing water from the High Plains Aquifer. Estimates are that withdrawal rates are 10 to 50 times greater than recharge rates (Overmann, No Date). As water is withdrawn, space is left between the soil particles, which subsides and reduces the potential water holding capacity of the aquifer. Even if withdrawal rates can be reduced below recharge rates, the High Plains Aquifer will not be capable of holding as much water as in the past. If all use of groundwater was halted within this aquifer and no impactions had occurred, it would take over 6,000 years to recharge it to historic saturated levels (Overmann, No Date).

Groundwater supplies may also be altered due to natural causes. Years of below-normal precipitation can alter the amount of water entering the aquifer. Likewise, seasonal and year-to-year differences in regional stream flow can cause fluctuation in localized groundwater levels. The combination of intensive pumping and several years of below-normal precipitation can accelerate the downward trend in water levels. This is true because below normal precipitation often results in decreased groundwater recharge. Below normal precipitation also generally results in increased groundwater pumping which can accelerate the groundwater depletion.

However, despite this groundwater use, the National average water application rates have dropped 14 percent since 1970 with the use of conservation techniques and more efficient means of water application. Between 1982 and 1992, 11 million additional irrigated acres were managed with water conservation systems (USDA, 1996).

Conservation techniques focused on enhancing groundwater supply are aimed at increasing the total amount of precipitation that can infiltrate into an aquifer. While the recharge rate of an aquifer is limited to natural constraints such as soil type, slope, and the underlying geology of the land, certain conservation practices can help reach an aquifer's maximum recharge potential. For example, conservation practices that leave fields in permanent vegetative cover generally have faster rates of groundwater recharge. This is because infiltration rates are generally higher for soils with vegetative cover than bare soils. Roots from trees and plants loosen soil particles and provide conduits through which water can more easily infiltrate the soil. Foliage and surface litter reduce the impact of falling rain, keeping soil passages from becoming sealed. A vegetative cover also decreases the velocity of the runoff thereby offering a longer opportunity for the water to seep into the ground. Protecting or restoring natural wetlands can also enhance groundwater recharge (refer to Section 2.2.2.3 for a more in depth discussion on the roll wetlands play in groundwater recharge) (Williams, 1993). Cropping techniques that use less water such as no-till and more efficient irrigation methods and terracing, decrease the burden on groundwater supplies and ultimately increases the recharge rate of the aquifer (USDA, 1996).

Wellhead protection is also an important aspect of groundwater quality. Conservation practices can improve wellhead protection by establishing buffers around wellheads that reduce the introduction of contaminants such as pesticides and nutrients.

### *2.2.2.3 Aquatic Species*

The U.S. Environmental Protection Agency's (EPA) water quality inventory identifies agriculture runoff as the largest source of water quality degradation in the Nation (Figure 2.2-18). Agricultural activities have the potential to introduce siltation, nutrients, pesticides, and organic matter that deplete oxygen. These pollutants can have severe negative impacts on a wide range of aquatic ecosystems because of their potential to spoil habitat and remove the food base.

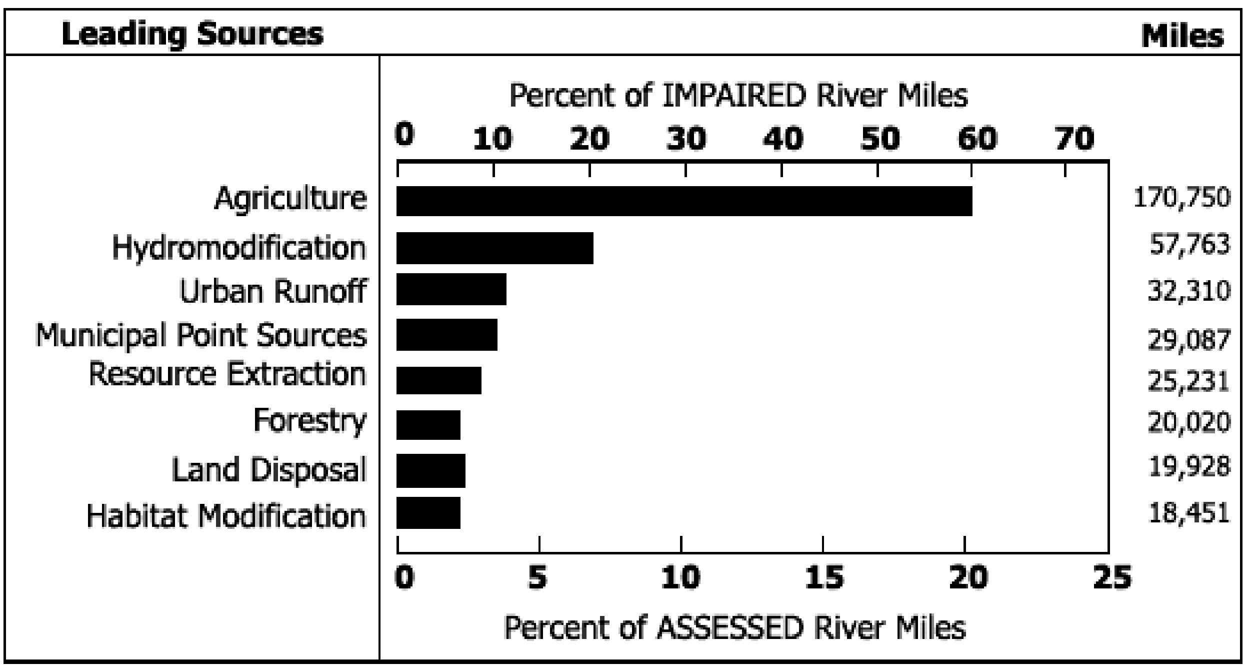



***Fig. 2.2-18. EPA841-S-00-001 Environmental Protection Washington, DC 20460 June 2000***

The areas with the highest concentrations of aquatic species at risk lie along the entire Pacific Coastal region and within a majority of States east of the Mississippi River (Figure 2.2-19). These areas coincide with the EPA's data discussing the number of miles of impaired streams by watershed (see Figure 2.2-6). The relationship between impaired riverine systems and aquatic species at risk is direct with the most widespread area of endangered fish and clam species found in the Southwestern States, and along the Missouri and Mississippi River Valleys. It is along the Missouri and Mississippi River Valleys where a large amount of agricultural cropland is located.

However, the highest number of threatened or endangered species per county can be found in Southwestern Virginia and Northeastern Tennessee within the Tennessee River Watershed where only moderate amounts of agricultural cropland are located.

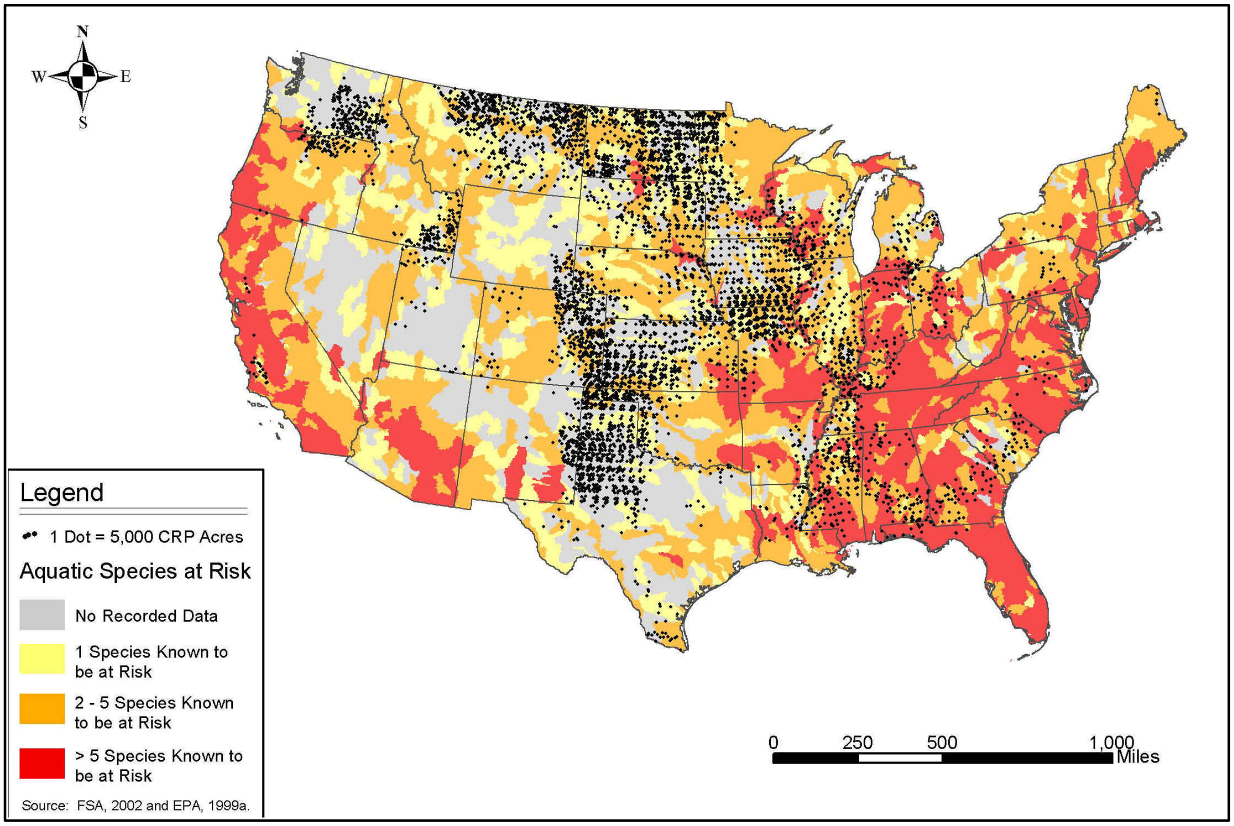



***Fig. 2.2-19. Aquatic Species at Risk***

<u>Fish</u>

The species of fish most affected by agriculture impacts are those that require clean water and a substrate relatively free of excessive organic material for spawning and for a food base. Fertilizers, animal waste, pesticides, and other chemicals can run into streams, creating problems for the plants and fish in downstream rivers and bays. Grazing animals may also harm areas near streams and rivers, creating erosion problems and other impacts on fish habitat.

<u>Mussels and Clams</u>

North America has the highest diversity of freshwater mussels and clams in the world with over 300 species Nationwide. These organisms are considered the most endangered species within the U.S., with about 70 percent of all the species either extinct or imperiled (NPS, 1997). The areas with the highest diversity of mussels are along the Mississippi River Valley and also in Southwestern Virginia. It is also in these areas where some of the most miles of impaired waters are located.

Mussels are relatively immobile organisms. Mussels are filter feeders and are sensitive to long-term fluctuations in water quality and quantity. For habitat, mussels require streams and rivers with good water quality, flow, and a substrate made of firm sand, gravel, or a cobble bottom. They also require an intermediate host, usually a fish, to which the immature larvae attract to complete their life cycle (NPS, 1997).

The decline of mussel populations can be attributed to sedimentation, point and nonpoint source pollution, streambank erosion, toxic spills, and loss of host fish species. Agriculture practices that cause large amounts of sediment to enter streams and rivers can bury gravel and rocky bottoms, and smother mussels (NPS, 1997). This sediment often carries pesticides further polluting the water and degrading the mussel's habitat. When fish populations utilized by the mussels are lost, the mussels have no way to reproduce, because these fish act as host to the mussel larvae and are a necessary part in the mussel's reproductive cycle.

<u>Agriculture Impacts on Fish and Mussels</u>

Fertilizers and Animal Waste:

- Cause excessive plant and algae growth, reducing the amount of livable habitat, reducing water clarity, covering up substrate from dead and dying organic material, decreasing the amount of dissolved oxygen, and creating the potential for Hypoxia.

Pesticides:

- May be toxic to fish and mussels.
- May be toxic to fishes' food base (i.e. aquatic insects).
- Bioaccumulates within fish tissue.

Grazing Animals:

- Cause damage to streambank, causing excessive erosion, destroying riparian habitat, and putting excessive sediments in the stream.
- Introduction of animal waste into water.

<u>Buffers</u>

Fish, mussels, and other aquatic life do not always adapt well to changes on the land around their aquatic habitat. Some stream life is more tolerant of pollution than others, but caddis and mayflies, the favorite food of trout, are usually the first to suffer adverse declines in populations. The shade, which keeps the water cool, also helps it store oxygen. Aquatic weed growth from excess nutrients can reduce oxygen, causing a shift to carp, catfish, suckers, and other fish more tolerant of poor oxygen supplies. Sediment eroding off cropland can abrade fish gills and cover spawning areas.

Keeping a forested buffer along a stream is the single most important thing landowners can do to improve or maintain fish habitat both at home and in the river beyond. Small brooks are actually more vulnerable since they have less water to flush pollutants, and since they are shallower, they can dry out, heat up, or freeze more easily. Leaves, twigs, and other organic matter from streamside vegetation functions as both food and a breeding ground for instream invertebrates, which then in turn feed many other species in the aquatic and terrestrial food chain. Studies show that the wider the buffer, the more kinds of aquatic insects are available for consumption in streams with buffers up to 100' wide (CRJC, 1999). The woody debris stabilizes the stream, helps create plunge pools, riffles, and gravel beds, while fallen logs deflect current and provide cover for fish to rest and hide from predators. For arid of semi-arid systems where forests are not associated with streams, grasses are the appropriate buffers and the width is less.

According to CRJC (1999), the most effective buffers for fish and wildlife have three zones:

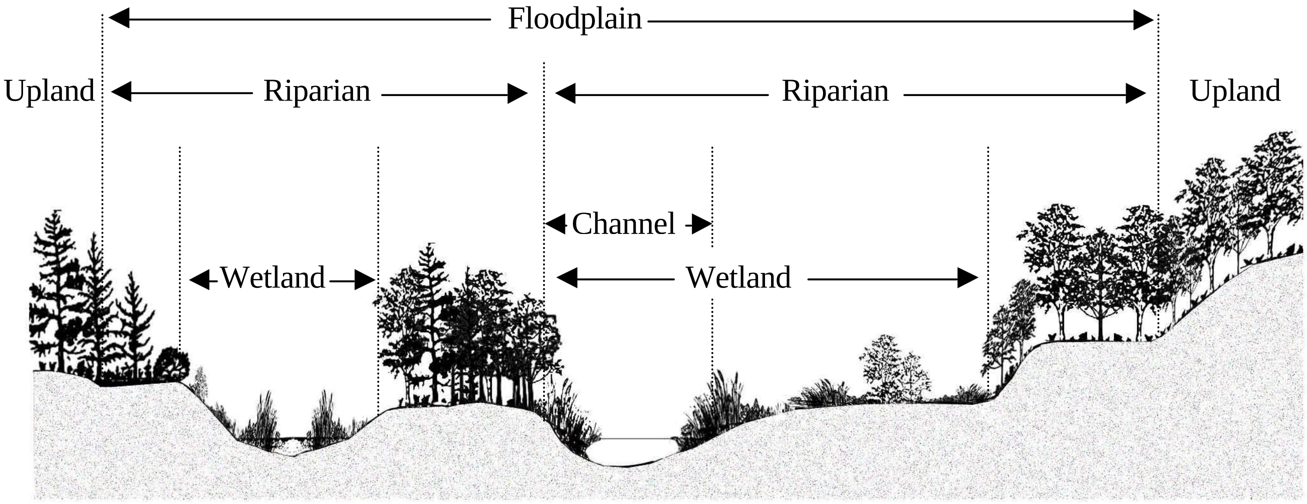
- **Streamside**: protects the stream bank from erosion and offers habitat. The best buffer has mature forest for shade and erosion protection. Large shrubs may be a better choice where large trees have collapsed a bank. However, in areas where trees and shrubs are not endemic, like native prairies, grasses and sedges provide stream bank protection.

- **Middle Zone**: protects water quality and offers habitat. Slows flow, catches sediment. Width depends on size of stream and the slope and use of nearby land. The best buffer has trees and shrubs (where endemic), native and introduces grasses and forbs, and may allow some clearing for recreational use, depending on the species it is intended to accommodate.

- **Outer Zone**: field edges, windbreaks and shelterbelts, pasture or any vegetative area that is contiguous with any working agricultural field or nearest permanent structure and the rest of the buffer.

### *2.2.2.4 Riparian Areas, Floodplains, and Wetlands*

Riparian areas, floodplains, and wetlands are interrelated natural systems as shown in Figure 2.2-20. Riparian areas are the lands adjacent to rivers and streams that are influenced by flooding. They are considered transition zones between the aquatic and terrestrial ecosystem that are connected by direct land-water interaction. Floodplains are the lowlands adjacent to rivers and streams that are also subject to flooding. Flooding occurs when the stream or river overflows its banks. This usually occurs in the early spring during snowmelt or heavy rains. The most extensive riparian ecosystem in the U.S. is associated with the flat, low-lying floodplain of the Mississippi River that is dependent on the flooding continuum of the river. Riparian areas can also be narrow strips of stream bank vegetation along the ephemeral rivers of the arid Western U.S. Wetlands associated with streams and rivers are considered riparian wetlands and are dependent on the floodplain for hydrology.




*Source: Modified from Mitsch and Gosselink, 1993.*

***Fig. 2.2-20. Landscape position of riparian areas, floodplains, and wetlands***

Wetlands are described as the lands transitional between terrestrial and deepwater habitats where the water table usually is at or near the land surface or the land is covered by shallow water (Cowardin et al., 1979). Other definitions of wetlands are used for regulatory purposes (see adjacent text box).

**Definition of wetlands used by the U.S. Department of Agriculture for regulatory purposes as defined in 7CFR § 12.2:**

(1) Has predominance of hydric soils;

(2) Is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions; and

(3) Under normal circumstances does support a prevalence of such vegetation, except that this term does not include lands in Alaska identified as having a high potential for agricultural development and a predominance of permafrost soils.

In wetlands, the upper part of the soil is saturated long enough during the growing season for soil organisms to consume oxygen creating anaerobic soil conditions unsuitable for most plants. Soils formed under these hydrologic conditions are called "hydric" and the plants adapted to these conditions are called "hydrophytes." Wetland hydrology, hydric soils, and hydrophilic vegetation are the three major indicators used to identify and characterize wetlands.

The interaction of hydrology, vegetation, and soil determine the development of different wetland types and characteristics. Wetlands are classified on the basis of these three parameters. The Cowardin classification system (1979) is used by the FWS to map and inventory wetlands in the U.S. (i.e. National Wetlands Inventory (NWI)). The Cowardin system classifies wetlands into five ecological systems: marine, estuarine, riverine, lacustrine, and palustrine. Alternative floods and ebbs of tides in coastal areas influence marine and estuarine wetlands. These wetland types are better known as tidal salt marshes, tidal freshwater marshes, and mangroves. Riverine wetlands are contained within a river channel. Lacustrine wetlands are lakes, reservoirs, or dammed river channels. Palustrine or "marshy" wetlands are all non-tidal or inland wetlands dominated by vegetation such as trees, shrubs, and herbaceous plants. Since this system of classification is a complex hierarchy, a more common description of the major wetland types in the U.S. is provided below.

Major Wetland Types

Major wetland types can be divided into two major groups: coastal and inland. Coastal wetlands cover about 27.4 million acres of the conterminous U.S. and are comprised of forested wetlands, scrub-shrub wetlands, tidal salt marshes, and tidal freshwater marshes. Inland wetlands cover about 79.4 million acres or about 80 percent of the total wetlands in the lower 48 States (Mitsch and Gosselink, 1993). They are found within interior areas of the U.S. and not along the coasts.

Tidal salt marshes are found along protected coastlines of the U.S. primarily along the East Coast from Maine to Florida and along the Gulf Coast in Louisiana and Texas. Salt tolerant grasses dominate these wetlands and are adapted to periodic tidal inundation. Tidal freshwater marshes are found inland from the tidal salt marshes primarily along the middle and South Atlantic Coasts and along the Coasts of Louisiana and Texas. They are tidally influenced but lack the salinity stress of salt marshes. These wetlands are dominated by a variety of grasses and by annual and perennial broad-leaved aquatic plants.

Some of the major types of inland wetlands include freshwater marshes, swamps, riparian-forested wetlands, and peatlands. Freshwater marshes are found throughout the U.S. and dominate the prairie pothole region, the shores of the Great Lakes, and the Florida Everglades. These wetlands can be permanently or temporarily flooded and are characterized by herbaceous plants called "emergents" that grow with their stems partly in and out of the water.

Unlike marshes, swamps are dominated by woody plants (trees and shrubs) and have standing water for most or all of the growing season. These wetlands can occur as isolated depressions fed by rainwater or as alluvial swamps that are flooded by adjacent streams and rivers. One of the largest swamps in the U.S. is the Okefenokee Swamp in Georgia and Florida.

Riparian-forested wetlands occur within the floodplains of rivers and streams and differ from swamps in that they are seasonally flooded and can be dry for varying portions of the growing season. In the Southeast, these wetlands are referred to as bottomland hardwood forests. They can also occur in arid and semiarid regions of the U.S. such as Arizona, Utah, New Mexico, and Wyoming.

Peatlands are peat deposits formed by the gradual accumulation of decomposed plant material under highly acidic and poorly drained conditions (Niering, 1997). The peat creates a floating mat of vegetation (Sphagnum moss) over water. Bogs and fens are the two major types of peatlands. Peatlands occur primarily in Wisconsin, Michigan, and Minnesota (Mitsch and Gosselink, 1993). One of the largest complexes of peatlands is the Glacial Lake Agassiz peatland of Minnesota (USGS, 1997b).

Functions and Values

Riparian areas, floodplains, and wetlands provide many ecological and economic benefits. These ecosystems are biologically productive and support a diversity of species. Fish and wildlife use these highly productive areas for feeding, breeding, nesting, and refuge and contiguous areas provide a major migration corridor for wildlife. The FWS estimates that up to 43 percent of the threatened and endangered species rely directly or indirectly on wetlands for their survival (EPA, 1995). The prairie pothole marshes in the Northern Plains and Midwest provide important waterfowl breeding habitat. The vegetative cover of riparian area benefits aquatic communities by providing shade that keeps the water cool, retaining more dissolved oxygen and encouraging the growth of diatoms, beneficial algae and aquatic insects (ACB, 1996). Leaf litter provides food and habitat for aquatic macroinvertebrates, amphibians, and fish. Felled trees or large woody debris in streams provides fish and aquatic invertebrate habitat. Riparian areas also provide core habitat for many semi-aquatic and terrestrial "ecotone" species including turtles, salamanders, dragonflies, plants and other species that depend on it for life history functions such as feeding, nesting, and over-wintering (Semlitsch and Jensen, 2001).

Riparian areas, floodplains, and wetlands can maintain good water quality and improve degraded water quality conditions of surface waters by intercepting and treating surface runoff. Suspended sediments and contaminants in the water are trapped, retained, and/or transformed through a variety of biological and chemical processes before they reach downstream water bodies. Forested riparian wetland areas in predominantly agricultural watersheds have been shown to remove approximately 80 percent of the phosphorous and 90 percent of the N from water runoff (EPA, 1995). Streams in a Wisconsin basin, which was comprised of 40 percent wetlands, had sediment loads that were 90 percent lower than a comparable basin with no wetlands (USGS, 1997b).

Groundwater discharge and recharge are hydrologic processes in wetlands that can contribute to stream flow and aquifer recharge. These processes are strongly influenced by many physical factors such as topography, soils, climate, etc. Many wetlands are dependent on groundwater discharge for maintaining hydrology. This discharge can also leave the wetland as stream flow. Aquifer recharge is important in areas where groundwater is withdrawn for agricultural, industrial, and municipal purposes. Recharge occurs when the water in the wetland seeps down into the water table. The Ogallala aquifer in West Texas and New Mexico is supplied recharge from thousands of playa lakes (USGS, 1997b).

Wetlands reduce the erosion of shorelines by stabilizing sediments and absorbing and dissipating wave energy (USGS, 1997b). The extent of protection provided is dependent on the wetland type, size of the storm, and other factors such as the amount of abrasive floating debris transported by the waves. Wetland and riparian vegetation, particularly trees, provide streambank and riverbank stabilization by holding the soils in place during high flows, reducing erosion and stream sedimentation.

Riparian areas, floodplains, and wetlands also protect lands from flood damage downstream by reducing the velocity of floodwaters and temporarily storing floodwaters and slowly releasing it back to the stream or river. Reduced velocity and storage of floodwaters combine to lower flood heights and reduce the water's erosive potential. Flood control by these natural systems saves millions of dollars in flood damage and saves the cost of having to construct extensive flood control facilities. They also provide additional economic benefits such as the commercial fish and shellfish industry and recreational opportunities (e.g., hunting, fishing, bird watching, etc.) (USGS, 1997a).

Current Distribution and Conditions

The current distribution and condition of riparian areas, floodplains, and wetlands is significantly different from pre-settlement times. Figure 2.2-4 shows the land use/land cover of the U.S. in 1991 in relation to major rivers. Cropland is the predominant land use/land cover in the Midwest including the floodplains of the major rivers of this region, primarily the Mississippi River Basin. Floodplains make excellent cropland due to the nutrients provided by spring floods. The Sacramento and San Joaquin Rivers in California are bordered by irrigated cropland. The natural vegetation and hydrology of the riparian areas, floodplains, and wetlands along these rivers has been significantly altered.

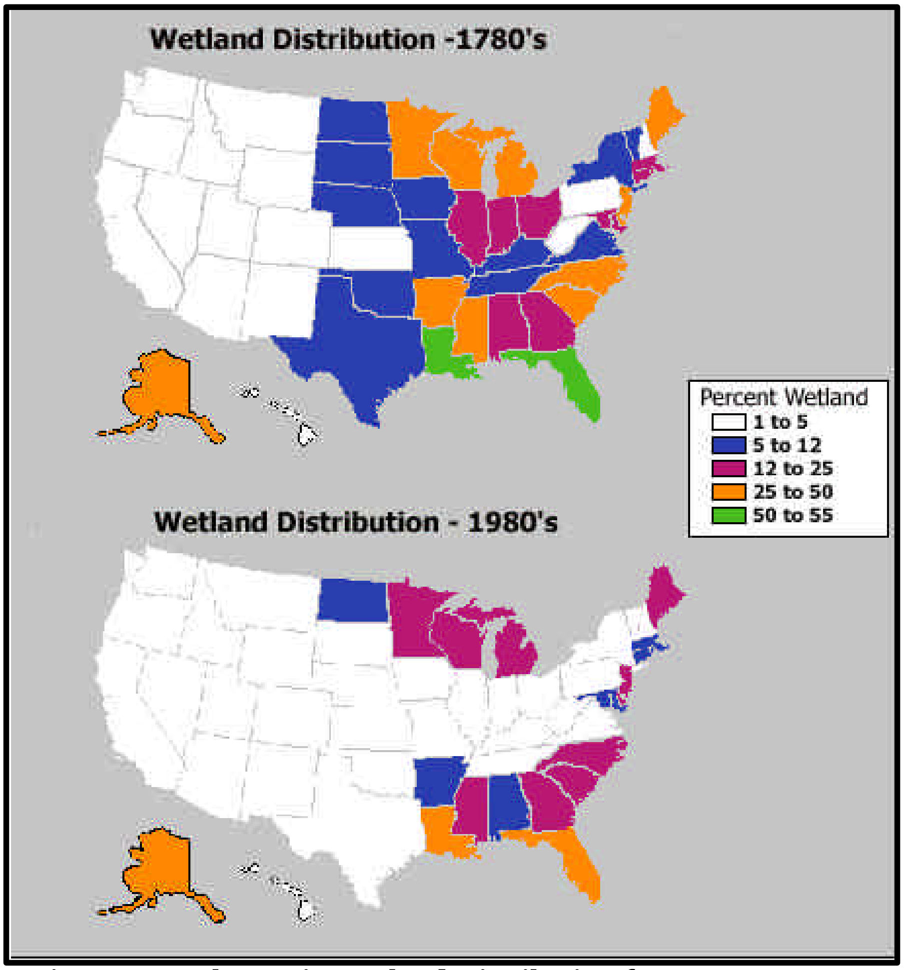



*Fig. 2.2-21. Change in Wetland Distribution from 1780s to 1980s*

Many major rivers have been modified through levees, dams, river channelization, and drainage for flood control to protect developed areas and farmland within the floodplains. For example, the upper Mississippi River has been modified by rock excavation, elimination of rapids, closing of side channels, construction of hundreds of wing dams, 27 navigation dams, and hundreds of miles of levees (USGS, No date). These structural measures of flood control have isolated rivers from much of their floodplains allowing for the draining and development of the floodplain.

During the period from the late 1700s to the mid-1980s, an estimated 53 percent of the original wetlands in the U.S. were lost to agriculture, industry, urbanization and other human activities (Mitsch and Gosselink, 1993, see adjacent figure). Ten States have lost 70 percent or more of their original wetland acreage: Arkansas, California, Connecticut, Illinois, Indiana, Iowa, Kentucky, Maryland, Missouri, and Ohio. California has lost over 90 percent of its wetlands and Florida has lost the most acreage (9.3 million acres) (Dahl, 1990) (see Figure 2.2-19). The major cause of historical wetland losses is conversion to agricultural use. Wetlands were drained and cultivated throughout the U.S., most significantly in the Midwest for grain production. The Federal Government encouraged the draining of wetlands prior to 1977 by providing financial and technical assistance (open ditch and tile drainage). By the late 1970s, the government reversed its policy on wetland drainage and encouraged preservation through Federal programs and regulations (see Section 3.0 *Current Programs*).

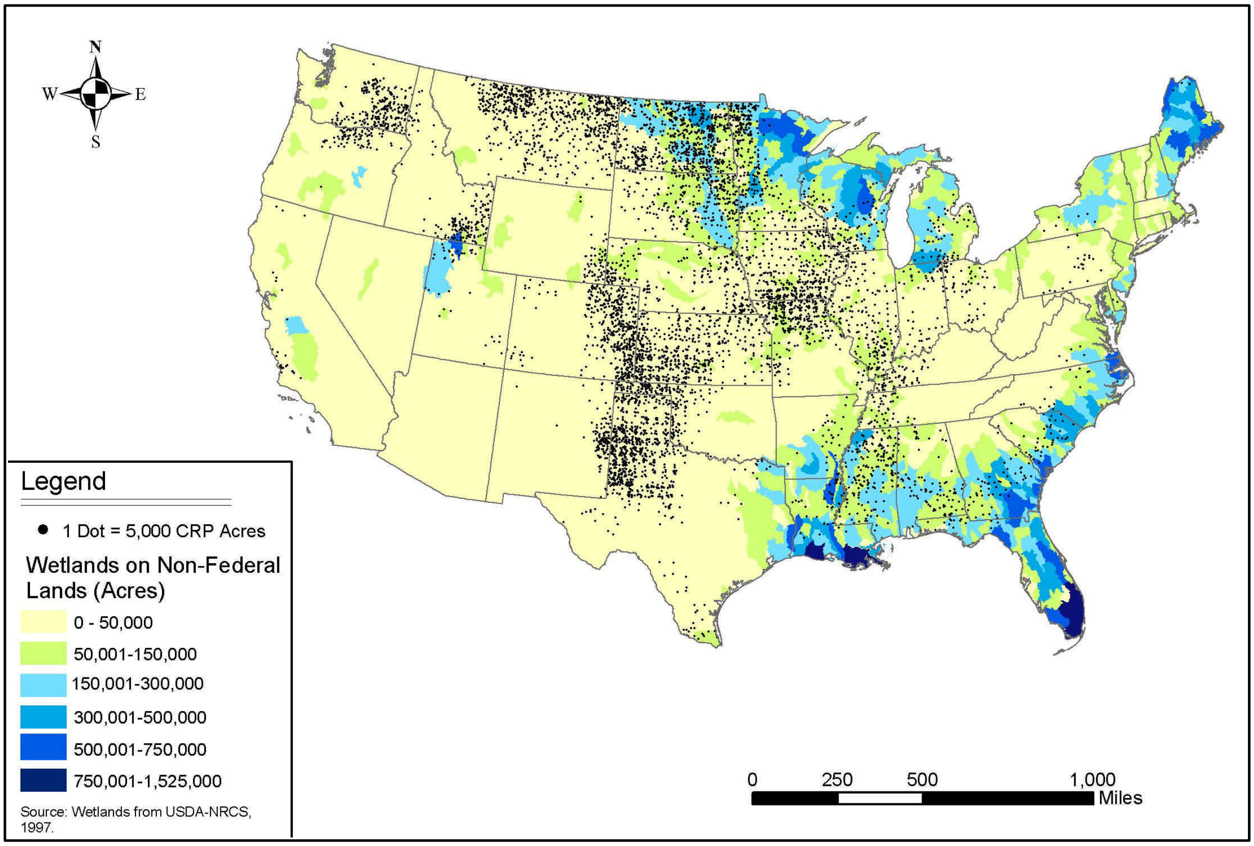



***Fig. 2.2-22. Estimated Wetland Acreage on Non-Federal Lands in 1997***

Figure 2.2-22 presents the estimated acreage of wetlands on non-Federal lands in 1997. The greatest acreage of wetlands is located in the eastern South Central, Southeast, northern Midwest, eastern Northern Plains, and Northeast regions. The wetlands in the West are not well represented due to the significant extent of Federal land ownership. Florida has about 11 million acres of wetlands, more than any other State except Alaska (USGS, 1997a).

Wetlands are often farmed. The prairie potholes of the Northern Plains and Midwest are often drained for crop production or otherwise cropped if hydrologic conditions permit. Farmed wetlands are significantly modified by cultivation but often retain some of their wetland characteristics. The hydrology of the cropped wetland may not be significantly altered and wetland plant seeds remain dormant in the soil. Wetland function can often be restored by simply retiring the cropland from production (Kantrud et al., 1989). In rice cultivation, the rice fields are flooded during cultivation and the fallow period, which retains wetland hydrology.

Figure 2.2-23 is a dot density map that shows wetlands located on non-Federal cropland in 1992. Each dot represents 1,000 acres of wetland and includes all wetland types as classified by the Cowardin system explained previously. The greatest density of wetlands on cropland is located in the Dakotas, Minnesota, Wisconsin, Iowa, and Louisiana. Primarily grain and corn are grown in the Dakotas, Minnesota, Wisconsin, and Iowa, while rice and soybean are the predominant crops in Louisiana.

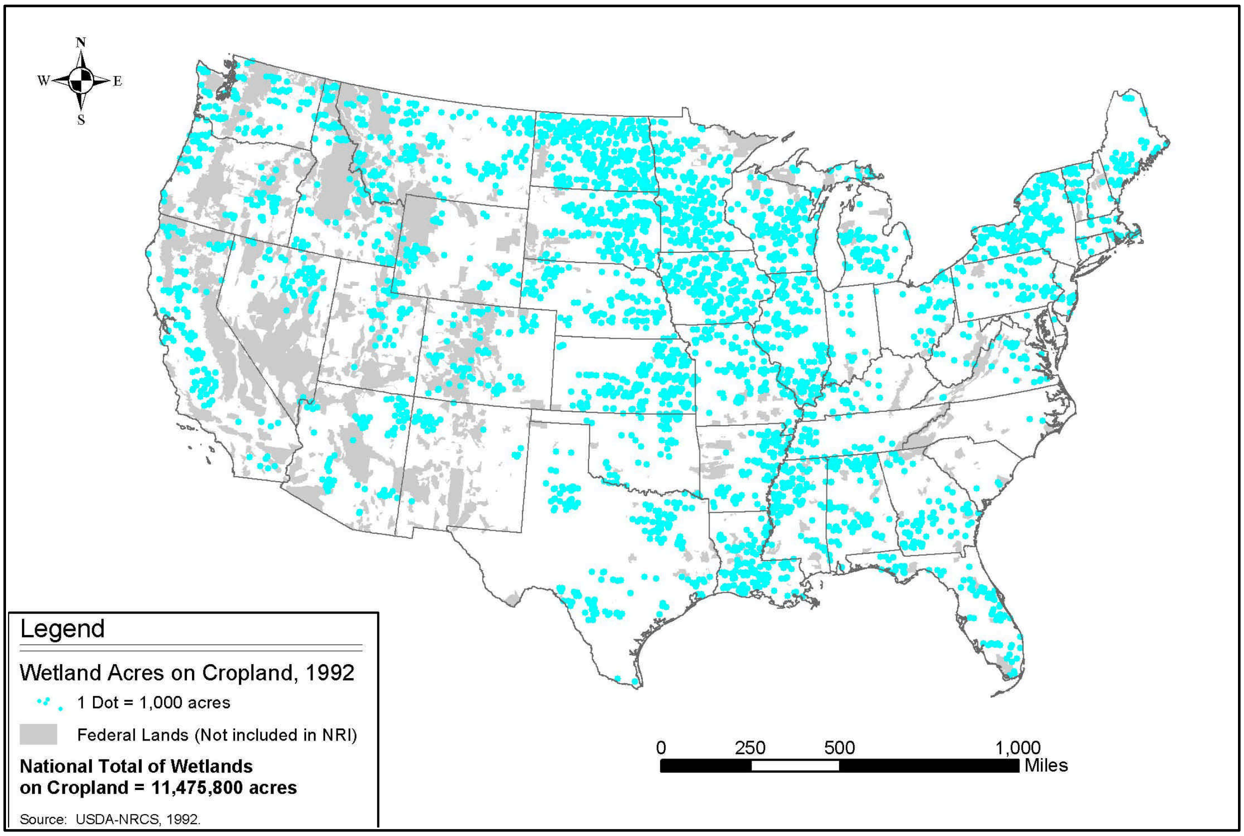



***Fig. 2.2-23. Wetland Acres on Cropland, 1992***

In addition to the conversion of wetlands due to farming, agriculture contributes to nonpoint source pollution of wetlands. The runoff can contain sediment, nutrients, pesticides, salt, and pathogens that degrade the quality and function of receiving wetlands. As much as 15 percent of the N fertilizer and up to 3 percent of pesticides applied to cropland in the Mississippi River Basin makes it’s way to the Gulf of Mexico (ERS, 1997).

Sediment is the largest contaminant of surface water by weight and volume and is identified by States as the leading pollution problem in rivers and streams (ERS, 1997). Figure 2.2-11 in Section 2.2.2.1 shows watersheds in the U.S. where sediment from cropland reaches rivers and streams. As shown, the highest amount of sediment delivery from cropland occurs in the Mississippi River, Missouri River, and Ohio River Basins where cropland is the predominant land use/land cover (see Figure 2.2-4). Wetlands associated with rivers and streams are also impacted. Sedimentation is also extremely common in prairie pothole wetlands located in cropland areas (Kantrud et al., 1989).

Conventional farming practices such as tilling and cultivation disturbs the soil and can leave it without plant cover for extended periods of time accelerating soil erosion. Dislocated soil particles can be carried in water runoff to nearby streams, rivers, lakes, and wetlands. For example, in the prairie pothole region, cropland can be left fallow in the summer, plowed in the fall, and newly cultivated in the spring during the rainy season. Sediment is carried from the upland fields by runoff and deposited in the wetlands. The absence of a protective vegetated buffer around the wetland increases the amount of sediment that reaches the wetland. Sediment can bury wetlands and raise streambed elevations increasing the probability and severity of floods. Aquatic wildlife habitat is also degraded or destroyed. Sediment also carries adsorbed contaminants including nutrients and pesticides from agricultural runoff.

Agriculture is a leading source of nutrient runoff and leaching into water bodies and wetlands. About 11 million tons of N, 5 million tons of potassium (K), and 4 million tons of phosphate fertilizers are applied each year to U.S. cropland (ERS, 1997). Nutrients can enter wetlands and other water resources by runoff to surface waters or leaching to groundwater sources. Runoff from fertilized cropland contains nutrients either dissolved in runoff water or adsorbed into eroded soil particles. Leaching is the movement of pollutants through the soil to groundwater by percolating rain, melting snow, or irrigation water. Watersheds highly vulnerable to N fertilizer runoff and leaching from cropland occur in the Mississippi River, Missouri River, and Ohio River Basins where cropland is the predominant land use/land cover. Potential phosphate fertilizer loss from cropland is greatest in the mid- to lower Mississippi River Basin, Ohio River Basin, and upper Missouri River Basin (ERS, 1997).

N in the form of nitrate is easily soluble and transported in runoff. Phosphate is less soluble than nitrate, not very mobile in soils, and adsorbs to sediment. Erosion can transport sediment-adsorbed phosphate to surface waters. Excess nutrients in water can cause increased biological activity that results in low dissolved oxygen levels, causing eutrophication or hypoxic zones that cannot support life. This has occurred in the northern Gulf of Mexico as a result of increased N loadings from the Mississippi River. Agricultural sources such as commercially applied fertilizer and livestock waste are estimated to contribute more than 80 percent of the N loadings in the Mississippi River Basin (ERS, 1997). Eutrophication of wetlands may also alter species composition. For example, increased phosphorous loading in the Everglades is thought to have caused the spread of cattails (*Typha spp.),* which is replacing the natural sawgrass (*Cladium jamaicense*) (Mitsch and Gosselink, 1993).

Over 500 million pounds of pesticides are applied annually to cropland to control insect pests, fungus, and disease (ERS, 1997). Pesticides can reach wetlands through runoff and leaching similar to nutrients. In addition, pesticides can attach to particulates in the air and deposit in water bodies through rainfall. High concentrations of pesticides can be harmful to freshwater and marine aquatic life. Pesticides were detected mostly at low levels in all 58 rivers and streams sampled by USGS in agricultural basins (ERS, 1997). Large amounts of pesticides are used in the Midwest, which contributes to runoff into area rivers including the Mississippi River.

Return flows of irrigated cropland can carry dissolved salts and naturally occurring toxic minerals such as selenium (Se) and boron (Bo). Mineral selenium is of particular concern because of its harmful effects on wildlife. Selenium from farm irrigation water caused extensive mortality, congenital deformities, and reproductive failures in birds that inhabited the marshes in Kesterson Wildlife Refuge in California's San Joaquin Valley (ERS, 1997 and Mitsch and Gosselink, 1993). Irrigated lands susceptible to selenium contamination occur mostly in arid regions in California, western Kansas, eastern Colorado, and western South Dakota (ERS, 1997).

## 2.2.3 Vegetation

### *2.2.3.1 Grasslands*

There are four specific grassland types in the U.S. (Figure 2.2-24). The tallgrass prairie, which extends from Illinois west through Iowa, southern Minnesota, northern Missouri, to the eastern edges of the Dakotas, Kansas, Nebraska, Oklahoma, and Texas. The mixed grass prairie is located in the western edges of those States and into eastern Montana and Wyoming. The shortgrass prairie is in far western Texas, Oklahoma, Kansas, and Nebraska, and eastern New Mexico, Colorado, and a small portion of Wyoming. The sage grassland is located in various pockets West of the Rockies, in particular, southern Idaho, Nevada, and eastern Oregon.

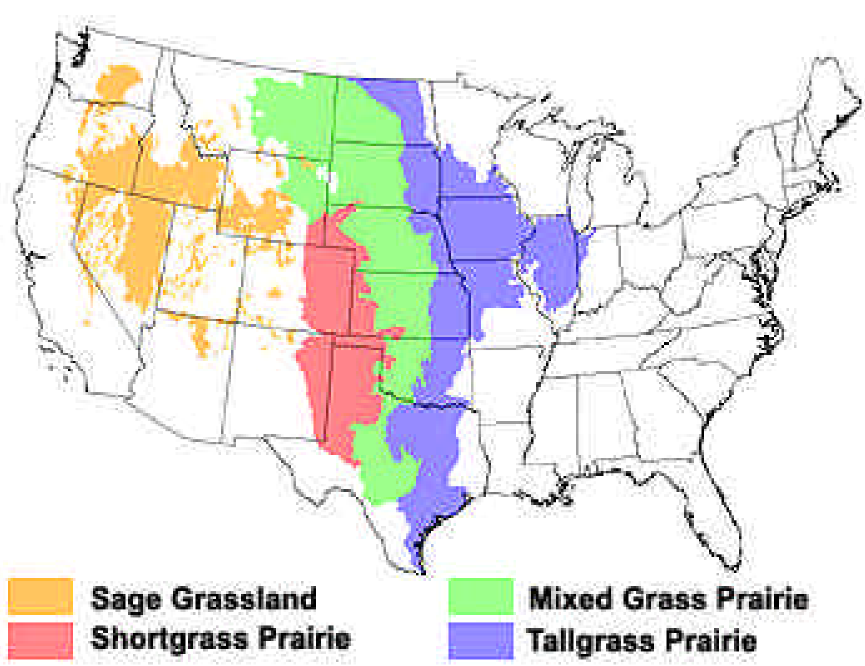



*Fig. 2.2-24. Original Range of Grasslands in the U.S..*
*Map Modified from National Wildlife Federation*.

Native grasslands in the U.S. are considered by some to be the Nation's most threatened ecosystem. Less than one percent of the tallgrass prairie remains. Losses to native grassland totaled 99.9 percent for the tallgrass prairie in many States and 70-80 percent for the mixed-grass prairie. The majority of these losses have been due to intensive agriculture practices in these regions. Associated with this large-scale conversion of prairie to cropland is the paralleled change in the communities of birds and other animals that rely on grassland habitats (NFW, 2002).

Native grasses

Native grasses are the various regional grasses endemic to particular areas of the U.S. Native grasses are being used more and more in a return to naturalized plantings. These species, through evolution, have developed resistances to many of the problems that the newer non-native varieties have not successfully been bred to handle. Characteristics of native grasses are regional with regard to soils, acidity or alkalinity, climate, diseases, and symbiotic coexistence with other plants in the surrounding area.

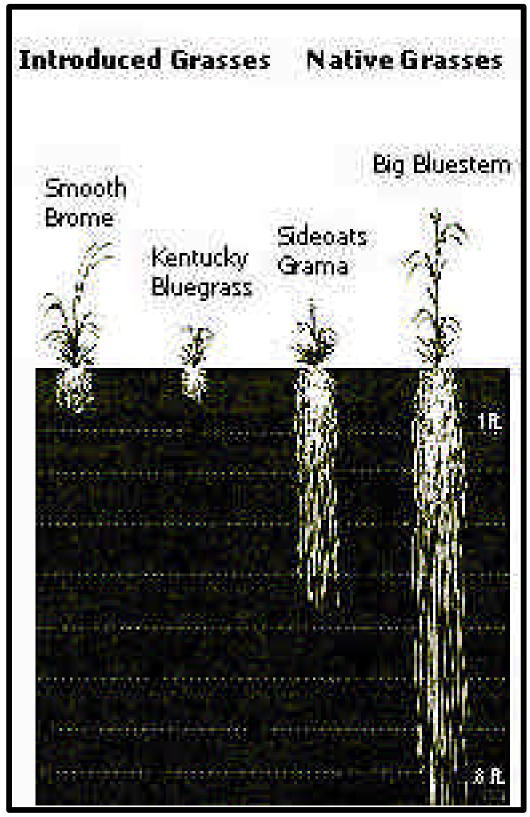



***Fig. 2.2-25. Root Depth of Introduced and Native Grasses***

Native vegetation does not require excessive maintenance or high fertilization, soil additives, excessive watering, or insecticides and it is usually the most beneficial to the native wildlife species. Herbicides are generally not needed because of the adaptability of native grasses to resist invasion. While the amount of maintenance required is moderate, it is necessary, especially at the beginning of the planting, to ensure the native grasses and forbs become established before unwanted, opportunistic vegetation can take over. Once established and managed properly, they can effectively keep weeds from becoming established and dominating the native range. Native grasses are usually the preferred vegetative cover for erosion control purposes due to their deep root depth and stability after establishment (see Figure 2.2-25). However, some native (i.e. buffalograss and switchgrass) and nonnative (i.e. smooth brome and Kentucky bluegrass) sod-forming grasses can be a better choice for controlling sheet erosion due to their shallow root depths providing for a denser and tight knit ground cover.

Native grasses are planted in the U.S. for a variety of reasons. They adapt well to marginal soil types within their home range, provide dependable forage and cover production, require low maintenance (pesticide and herbicide treatments are generally not required), provide excellent soil-holding capabilities and drought tolerance in response to their deep root system, and increase soil fertility from regeneration of the root system. Native grasses also benefit wildlife by providing nesting cover, supporting seed and insect populations, and remaining erect during winter months, thereby offering winter cover and shelter. Table 2.2-3 provides a listing of common native grasses available for planting in the U.S.

A majority of the native grasses are commonly referred to as ‘warm-season’ grasses, due to their inherent ability to thrive in warm climates during the heat of the summer, which is when they add most of their growth. Those grasses adapted to growing in the cooler conditions of spring and falls are referred to as ‘cool-season’ grasses. Cool-season grasses usually thrive during the spring, when growing temperatures are right and before competition with warm-season grasses becomes overwhelming. The most widely utilized native cool-season grass is western wheatgrass (*Pascopyrum smithii*). It currently has minor use in revegetating agricultural lands in the Great Plains to which it is native. A cool-season grass cannot withstand extreme cold, snow, or ice, and therefore, makes it extremely poor wintering habitat for wildlife.

*Table 2.2-3. Common Native Grasses Available for Planting in the U.S.*

| Common Name | Scientific Name | Common Name | Scientific Name |
|---|---|---|---|
| Beak grass | Diarrhena Americana | Porcupine grass | Stipa spartea |
| Bebb's sedge | Carex bebbii | Porcupine sedge | Carex hystericina |
| Big bluestem | Andropogon gerardi | Prairie cord grass | Spartina pectinata |
| Blue grama | Bouteloua gracilis | Prairie dropseed (Northern) | Sporobolus heterolepsis |
| Blue joint grass | Calamagrostis canadensis | Rattlesnake grass | Glyceria Canadensis |
| Bottlebrush grass | Hystrix patula | Reed manna grass | Glyceria grandis |
| Bristly sedge | Carex comosa | Rice cut grass | Leersia oryzoides |
| Canada wild rye | Elymus Canadensis | Rough dropseed | Sporobolus asper |
| Common rush | Juncus effuses | Sand dropseed | Sporobolus cryptandrus |
| Eastern gamma grass | Tripsacum dactyloides | Side-oats grama | Bouteloua curtipendula |
| Fox sedge | Carex vulpinoidea | Silky wild rye | Elymus villosus |
| Fringed brome | Bromus ciliatus | Soft-stem bulrush | Scirpus validus |
| Green bulrush | Scirpus atrovirens | Switch grass | Panicum virgatum |
| Indian grass | Sorghastrum nutans | Virginia wild rye | Elymus virginicus |
| June grass | Koeleria cristata | Woodland brome | Bromus purgans |
| Little bluestem | Schizachyrium scoparium | Wool grass | Scripus cyperinus |

These native grasses comprise four types of prairies located in the Nation. The tall-grass prairie is the wettest of the grassland types located in the eastern portion of the Midwest, receiving approximately 40 inches of precipitation a year overall (Table 2.2-4). This prairie once covered millions of acres, and now is present only as scattered remnants within the historic range. West of this prairie is the mixed grass prairie in the Midwestern U.S., which contains the floristic elements of the tall and short grass prairies combined. It has a rich forb flora containing some of the highest floral complexity of any North American grassland ecoregion (WWF, 2001). The mixed-grass prairie is followed by short-grass prairie, which borders the Rocky Mountains and receives approximately 16 inches of annual precipitation (Table 2.2-4). All grasslands provide a natural defense against drought and soil erosion, while also providing diverse habitat and cover for large ungulates, upland birds, and threatened and endangered species. However, much of this prairie type has become fragmented and has, therefore, lost most of its natural ecological strength.

*Table 2.2-4. Principal Grassland Types of the U.S.*

| Grassland Type | Approximate Average Annual Precipitation (inches) | Predominant Grass Cover |
|---|---|---|
| Tall-grass Prairie | 37 | Bunch grasses (bluestem, cordgrass, panic grass, Indian grass, and wild-rye) |
| Short-grass Prairie | 16 | Sod grasses (blue grama and buffalo grass) |
| Mid-grass Prairie | 15-27 | Mixture of tall-grass and short-grass species, including buffalo grass, needlegrass, various bluestem species, and hairy grama |
| Sage Grassland | <12 | Habitats dominated by sagebrush flats and native bunch and black grama grasses. |

Grass is the key to maintaining the productivity of highly erodible areas (see Figure 2.2-1). Grass species and condition can impact water quality, hydrology, and wildlife. Native grassland ecosystems support many endemic species of wildlife. If native grasses are removed, the rate of erosion increases, the windswept ground cannot absorb water; the water runs off quickly, carrying silt into streams and ponds, and grassland dependant wildlife suffers.

Clean water flows off restored watersheds to be used miles downstream. Wildlife, including many declining, threatened, or endangered species, thrives in rejuvenated habitats. Soil rebuilds its fertility. The construction of livestock ponds has expanded the range of many wildlife species by providing water where none existed before. The scattered watering ponds allow for more cattle grazing throughout the grassland and also benefit wildlife habitat. Private farmlands within the National Grassland boundary add diversity to the prairie habitat. Conserving grassland ecosystems produces a variety of goods and services, which have helped to maintain rural economies and lifestyles (USFS, 1999).

Introduced Grasses

Introduced species are those that evolved elsewhere and have been transported and purposely or accidentally disseminated by humans. Many terms describe these species: alien, exotic, non-native, and non-indigenous. The rate and scale of these introduced species were more rapid than natural incursions during the past century. The spread of non-native species in human-disturbed habitats is a direct reflection of urban and agricultural development and the attempt to improve forage resources.

Introduced species disrupt the functioning of native ecosystems upon which humans depend. Many non-native species rapidly disperse into communities in which they have not evolved displacing native species because of evolutionary disparity. These grasses are commonly referred to as ‘cool-season’ grasses, since the majority of their growth occurs in the coolness of the fall and spring. However, some introduced species are considered warm-season grasses (e.g. plains bluestem, weeping lovegrass).

The economic costs sustained from these non-native species can be extensive with non-native species damaging agricultural crops and disrupting vital ecosystem functions. Some species that have become pests were first introduced to establish a desired landscape. Introduced grass species can create new problems on agricultural land through massive disturbances in the landscape, thereby affecting native species' resistance to invaders and stressing native populations. However, in some cases, the planting of introduced species can provide a quicker and more reliable cover to decrease erosion potential

Invasive Species

The Federal Noxious Weed Act, which stated " *that no person shall import or enter and noxious weed identified in regulation into or through the United States*," authorized Animal and Plant Health Inspection Service (APHIS) to restrict the introduction and spread of non-native noxious weeds through port-of-entry and follow-up activities. However, this authority does not take into account native U.S. species that are introduced to other regions of the Nation.

> APHIS defines noxious weeds as:
>
> "Any living stage (including but not limited to, seeds and reproductive parts) of any parasitic or other plant of a kind, or subdivision of a kind, which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants livestock, or poultry or other interests of agriculture, including …the fish and wildlife resources of the United States or the public health."

An "invasive species" is defined as a species that is:

1) Non-native (or alien) to the ecosystem under consideration, **and**
2) Whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112). Invasive species generally tend to progress into communities that posses a few general communal characteristics, including, but not limited to:

- Climatically similar to original habitat of invader;
- Low diversity of native species present;
- Recently disturbed (early successional);
- Absence of predators on invading species; and
- Previously disturbed by humans.

Ecosystem-level changes that modify water, nutrient, productivity, and biomass directly affect our society. Ecosystem-level consequences of invasive, non-indigenous species have major ecological and economic implications that directly affect human health. Conservation practices have created an environment on agricultural landscapes where introduced grasses and legumes are competing with native grass species suddenly introduced to new environments.

Invasive species are organisms (usually transported by humans) which successfully establish themselves in and then overcome otherwise intact, pre-existing native ecosystems. For example, the planting of trees in the Great Plains for windbreaks and shelterbelts has had negative impacts on native grassland ecosystems. When trees are planted in native grassland ecosystems, they may:

- Fragment native grassland habitats.
- Act as corridors and habitat for nonnative wildlife (see discussion in Section 5.4).
- Out-compete the surrounding native vegetation for space, water, and light.
- Disrupt the natural progression of grasslands when added fire suppression is needed.

However, most frequently, trees planted in former grassland areas are planted on cropland, which does provide species diversity among areas planted in soybeans, corn, wheat, or other commodity crops, and do not result in a conversion of grass to trees.

This process, together with habitat destruction, has been a major cause of extinction of native species throughout the world in the past few centuries. Although in the past many of these losses have gone unrecorded, today there is an increasing realization of the ecological costs of biological invasion in terms of irretrievable loss of native biodiversity.

Introduced and invasive species are a Nationwide problem for farmers and conservationists alike. Noxious weeds may become interspersed in crops or in conservation areas, such as grassland or wetland conservation areas. Many species of introduced and invasive species have been identified over the years and some of the major kinds can be found practically all over the Nation. Because many of these transplanted plants are not acclimated to climate patterns and tend to die off, they leave the soil bare during the harshest months and fail to protect the soil from erosion. Table 2.2-5 describes the Federal laws prohibiting or restricting the introduction and movement of nonnative species.

***Table 2.2-5. Federal Laws and Executive Order for Invasive Species***

| Federal Law | Year | Description |
|---|---|---|
| Plant Quarantine Act | 1912 | Regulates imports or interstate shipments of plants or their parts and propagates to prevent introduction of plant diseases and insect pests |
| National Park Service Organic Act | 1916 | Promotes the eradication and control of nonindigenous species and prohibits most introductions in National parks |
| Federal Seed Act | 1939 | Authorizes the U.S. Department of Agriculture to set standards for seed purity and to reduce the interstate movement and importation of nonindigenous plants |
| Federal Insecticide, Fungicide and Rodenticide Act | 1947 | Controls movement of nonindigenous microbes into and through the U.S. |
| Importation of Certain Mollusks | 1951 | Provides for the inspection and treatment of goods entering the U.S. from areas infested with any terrestrial or freshwater mollusks to control entry of such organisms |
| Department of Agriculture Organic Act | 1956 | Animal and Plant Health Inspection Service is authorized to conduct an eradication program in countries adjacent to or near the U.S. |
| Federal Plant Pest Act | 1957 | Restricts agricultural pests (pathogens, noxious weeds, animal and plant pests) from importation and interstate movements |

| Table 2.2-5. Federal Laws and Executive Order for Invasive Species | | |
|---|---|---|
| Federal Noxious Weed Act | 1974 | Provides program support to control undesirable plants on federal lands |
| Executive Order 11987 Exotic Organisms | 1977 | Restricts the introduction of exotic species into natural ecosystems under federal agency authority |
| Cooperative Forestry Assistance Act | 1978 | U.S. Forest Service is responsible for detecting, identifying, surveying, and controlling forest pests |
| Agricultural Quarantine Enforcement Act | 1989 | Prohibits shipping of plants, fruits, and vegetables via first-class mail |
| Food, Agriculture, Conservation and Trade Act | 1990 | Genetic Resources Program--purpose is to collect, classify, preserve, and disseminate genetic material important to agriculture |
| Great Lakes Fish and Wildlife Restoration Act | 1990 | Controls the sea lamprey |
| Lacy Act | 1990 | Strengthens and supports state wildlife conservation laws and promotes agricultural and horticultural interests by prohibiting importation of injurious wildlife |
| Toxic Substances Control Act | 1990 | Enables the Environmental Protection Agency to regulate nonindigenous microbes |
| Nonindigenous Aquatic Nuisance Prevention and Control Act | 1990 | Controls and reduces the spread of aquatic pest species |
| Executive Order 13112 | 1999 | Order established the National Invasive Species Council and directs the Council to form a non-Federal Invasive Species Advisory Committee (ISAC) |

Major Invasive Plant Species

***Purple Loosestrife***

Purple loosestrife (*Lythrum salicaria L)* is an introduced exotic weed species (Fig. 2.2-26). It is an erect perennial herb that grows up to 8 feet tall, develops a strong taproot, and may produce up to 50 stems from its base. Immigrants may have introduced it in the early 1800's, though it did not become a problem until after 1930. Sudden colonization and spread is attributed to the disturbance of natural systems by human activities, including agriculture settlement, construction of transportation routes, and possible high nutrient loads in inland waterways. Purple loosestrife is found in the northeastern U.S., the Midwest, and in scattered locations across the West. This species tolerates a wide variety of soil conditions, however it's typical habitat is cattail marshes, sedge meadows, and bogs. It is also commonly found along ditches, streams, riverbanks, lakeshores, and other wet areas. Purple loosestrife tends to form dense exclusive stands that can grow to thousands of acres and displace native, sometimes rare, plant species. Open water habitat may also be eliminated. Purple loosestrife stands cause agriculture loss of wetland pastures and hay meadow by replacing more acceptable native grasses and sedges.

Purple loosestrife, also known as spiked lythrum, salicaire, and bouquet violet, has been labeled the "purple plague" because of its epidemic devastation to natural communities. This plant

*Fig. 2.2-26 Field of Purple Loosestrife*
©John M. Randall/The Nature Conservancy

prefers moist, highly organic soils but can tolerate a wide range of conditions. It grows on calcareous to acidic soils, can withstand shallow flooding and tolerates up to 50 percent shade. It has low nutrient requirements and can withstand nutrient poor sites. Survival and growth of purple loosestrife has been greatly improved by fertilizer treatment and greater spacing between plants. Study results suggest that excessive use of fertilizers and the release of P; nitrates and ammonia into the environment have enhanced the success of the species. Seed production is prolific, on average a mature plant can produce about 2.7 million seeds annually which are then dispersed by water, wind, and mud, attaching to wildlife, livestock, vehicle tires, boats, and people. Seeds are relatively long lived and remain 80 percent viable for 2-3 years and have minimal requirements for germination. This plant can also spread vegetatively by resprouting from stem and root cuttings. Purple loosestrife invades over 450,000 acres of wetland annually. It is mostly abundant in the Midwest and northeast where it infests about 20,000 acres in Minnesota, 30,000 acres in Wisconsin, over 30,000 acres in Ohio, and a larger area in New York. Stands have also been identified in every county in Connecticut. It is very difficult to control and nearly impossible to eradicate because of its rapid growth and abundant seed production.

### *Leafy Spurge*

Leafy spurge (*Euphorbia esula L.)* is an introduced perennial herb. It ranges in height from 6-36 inches. The plant forms an extensive root system that occupies a large volume of soil. Flowers are insect pollinated. Seeds yield can be high and are dispersed in mid to late July in the U.S. Each stalk produces about 200 seeds where the plant competes with annual weeds and at least 252 in areas where it competes with native grass species. Seeds have a high

*Fig. 2.2-27. Leafy Spurge.*
© Barry A. Rice/The Nature Conservancy

germination rate and may remain dormant for 5-8 years following maturity. Seeds are dispersed explosively from the seed capsule, and may be ejected and distributed between one and thirteen feet from the plant. Water and possibly birds may carry the seeds. Leafy spurge occurs primarily in untilled, non-cropland habitats, which include disturbed and undisturbed abandoned cropland, pastures, rangelands, woodlands, prairies, and roadside sites. It is tolerant of a wide range of habitats and may occur in rich damp soils such on the stream banks or on extremely dry, nutrient poor, dry soils found in western rangelands. It is most aggressive in semi-arid areas where species competition is not as intense.

Leafy spurge, also known as spurge, is rarely eradicated. A control is possible if management procedures are implemented in the early stages of infestation. Control measures must be followed over a several year period to be effective. Control measures such as herbicide applications or prescribed burning are best in applicable areas. Rapid re-infestation can occur given the opportunity. Approximately 2.5 million acres are infested with leafy spurge in the U.S. and Canada and continues to increase annually. It is found in all regions of the Nation except the southeast.

### *Chinese Privet*

***Fig. 2.2-28. Chinese Privet***
© Barry A. Rice/The Nature Conservancy

Chinese privet (*Ligustrum sinense Lour.)* is an invasive weed with a wide distribution mainly in the southeast up to New England and West to the eastern parts of Kansas, Oklahoma, and Texas. It was introduced from China in 1852 for ornamental uses. It is used for hedge and mass planting and sometimes as single specimens for its foliage and profusion of small white flowers. The greatest threat from this plant species is large-scale ecosystem modification due to its adaptability to compete with and replace native vegetation. This plant matures rapidly and is a prolific seed producer. It reproduces vegetatively by means of root suckers. It is difficult to eradicate because of its reproductive capacity. Chinese privet is a major threat to natural landscapes and it can be directly harmful to humans as all introduced Ligustrum species produce fruit that is toxic to humans and floral odors may cause respiratory irritation. Various control methods have been demonstrated for Chinese privet. The effectiveness and method to use depends on the size of the infestation.

### *Chinese tallow (Tree)*

Chinese tallow (*Triasdica sebifera L. or Sapium sebiferum*), a native of China, is an invasive, fast growing exotic tree that may reach 50 feet. This plant, also known as popcorn trees, chicken tree, and Florida aspen has been introduced to the southernmost region of Texas, north to southern Oklahoma and northwestern Arkansas, east to North Carolina and Florida. The species is adaptable and can survive various environments. It is generally found in low, swampy places and along margins of bodies of fresh waster. It can also invade dry upland areas and tolerates salinity. They grow best in full sunlight but tolerate shade. Chinese tallow causes large-scale ecosystem alteration by replacing native vegetation and reducing or destroying species diversity, which destroys wildlife habitat reduces wildlife diversity. This species is virtually impossible to eliminate by known methods and it has no known biological control agents. They can become the dominant plant species in disturbed vacant lots and abandoned agriculture areas. It will invade natural, wet prairies and bottomland forests.

***Fig. 2.2-29. Chinese Tallow***
© John M. Randal/The Nature Conservancy

Chinese tallow has toxic properties to humans and some animals. Chinese tallow has been in the U.S. since 1776 and was cultivated as a seed crop for the waxy tallow derived from the seed covering, which can be used to make soap, candles, oil for lamps and machinery, and possible petroleum substitute, among other uses. Chinese tallow has incredible reproductive capabilities. It may reach reproductive age in as little as three years and will remain productive for 100 years.

C***ommon gorse***

Common gorse (*Ulex europapeus L.)*, also known as gorse, is an introduced perennial shrub found in California, Washington, Oregon, Massachusetts, New York, Pennsylvania, West Virginia, Virginia, and Hawaii. It is considered a class "B" noxious weed in both California and Oregon. The only information available on this plant indicates it is a flowering plant in the Pea family and reproduces from seeds. See Appendix E for a list of common invasive and introduced plant species.

*Canada Thistle*

Canada thistle (*Cirsium arvense*) is a native of southeast Europe that was introduced accidentally to North America in the late 1700s (Figures 2.2-30 and 2.2-31). Since that time it has become one of the most troublesome perennial weeds throughout the northern U.S.. Canada thistle is declared a "noxious weed" throughout the U.S. and has long been recognized as a major agricultural pest costing tens of millions of dollars in direct crop losses annually and additional millions costs for control. Only recently have the harmful impacts of Canada thistle to native species and natural ecosystems received notable attention (Haber, 1997). Canada thistle is a perennial herb with, slender, spiny-leaved, branched aerial shoots, arising from a deep and wide-spreading root system

When Canada thistle is allowed to grow without competition or soil disturbance, it spreads rapidly. Research done in three States on the dispersion rate of Canada thistle planted either a single root segment 12 inches long or a 6-inch diameter plug of Canada thistle plants in a 4 x 4 x 8-foot above-ground boxes. No tillage was done and no crops were planted. Within 12 to 16 months, buds on these roots produced an average of 174 shoots and 930 feet of new roots.

***Fig. 2.2-30. Canada Thistle.***
© Robert G. Wilson/University of Nebraska Cooperative Extension

Canada thistle is a common and widespread weed in agricultural regions throughout its native and naturalized range in temperate regions. It is considered to be one of the most economically important agricultural weeds. It infests crops of all kinds and reduces forage yields of pasturelands. Infestations decrease moisture and nutrients, occupy space, and the plants compete for light, all of which reduce crop yields and modify community structure and species composition in natural areas (Haber, 1997).

Heavy infestations of Canada thistle growing in corn, soybeans and wheat have been shown to reduce crop yields by up to 81, 95, and 60 percent, respectively (Wilson, 1997). Heavy infestations growing in pasture can reduce native grass production by as much as 60 percent. The plant is also host to a variety of damaging insects (Wilson, 1997). In the U.S., it is a host for bean aphid and stalk borer, insects that affect corn and tomatoes, and for sod-web worm (Crampus sp.) that damages corn. Canada thistle also produces toxic substances that are released into the soil and inhibit the growth of certain plants. It has been shown to impede the growth of sugarbeets, wheat, and alfalfa. Canada thistle also harbors various insect pests, serves as the alternate host for pathogens and increases the cost of harvesting of certain crops such as peas because special precautions need to be taken to remove thistle buds prior to canning. Much effort and funding is expended in the general control of this weed in cultivated lands, in disturbed areas and in natural habitats (Wilson, 1997).

***Fig.2.2-31. Canada Thistle.***
© Judy Feldman/Island County Noxious Weed Control Board. Coupeville, WA.

Forestland

Managing forestland to achieve multiple objectives requires careful planning and an understanding of the varying methods available. Some methods available for forestland management target species diversity, including the use of open spaces, by managing forest edge habitat for wildlife, using prescribed burning for maintenance, and harvesting to regenerate the forest. These methods can all be accomplished through the use of standardized practices.

Forest openings, pastures, cropland, clearings, and young stands have important ecological and visual value. Planned spaces can enhance views, improve wildlife habitat, and increase plant variety. Large tracts of similar age or species composition can be made more diverse with the use of well-planned clearings. Openings and clearings are beneficial in that they can accentuate vistas and other natural sites, concentrate or attract wildlife, maintain historical and traditional landscapes, create and maintain habitat diversity, add to recreational opportunities, and soften existing linear spaces, such as roadsides or utility rights-of-way.

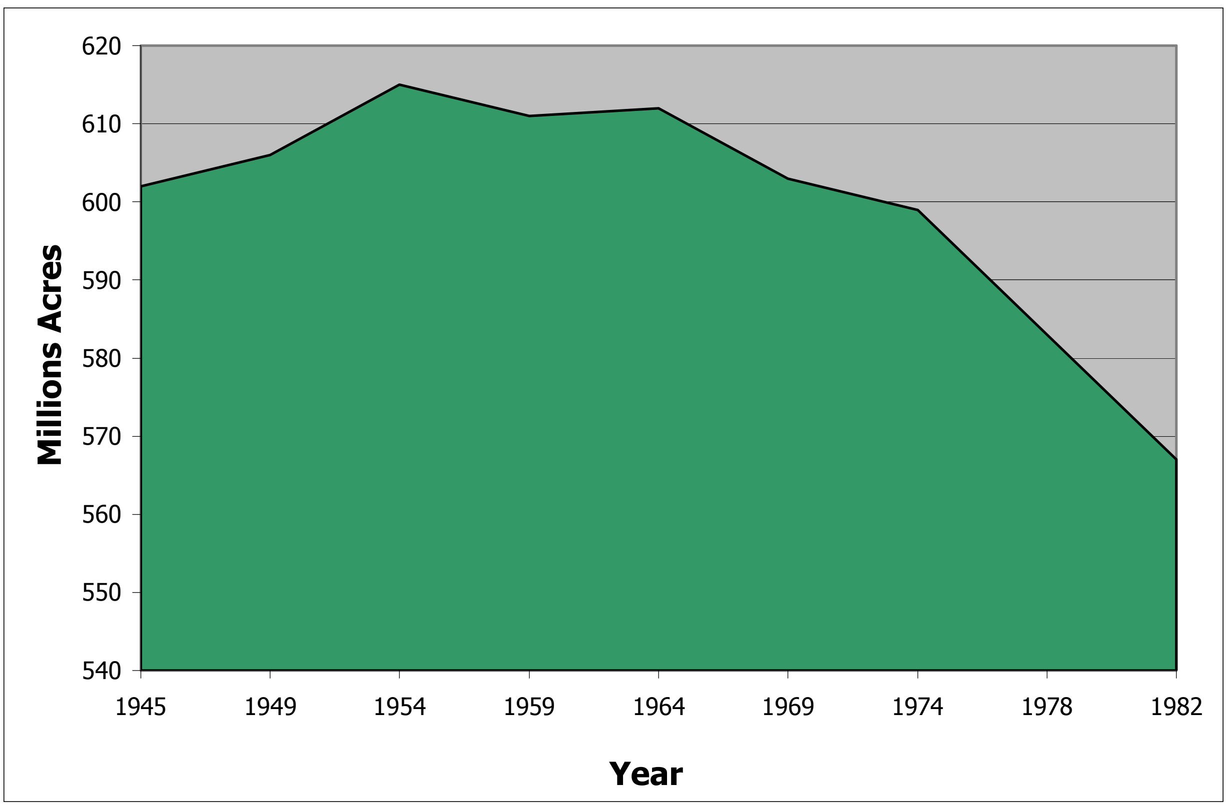



***Fig. 2.2-32. Forest-use land between 1945 and 1982 in the U.S.***

Forest-use land has been on the gradual decline since 1954 (Figure 2.2-32). Possible factors contributing to this decrease could be attributed to increased timber harvest, urbanization and sprawl, or the loss of forest-use land to recreation and wildlife areas.

Buffers

Forest vegetation along streambanks provides a "living filter" for both surface and subsurface water running off the land, trapping sediment, nutrients, chemicals, and other pollutants (CRJC, 1999). Woody debris helps create plunge pools, riffles, and gravel beds. Streamside forests capture rainfall better than any other land use types by preventing flooding and recharging groundwater so the stream doesn't become ephemeral during the summer months.

CRJC (1999) describes the following principle for a three-part forested buffer system in Figure 2.2-33 that would provide optimal environmental benefits for multiple environmental resources:

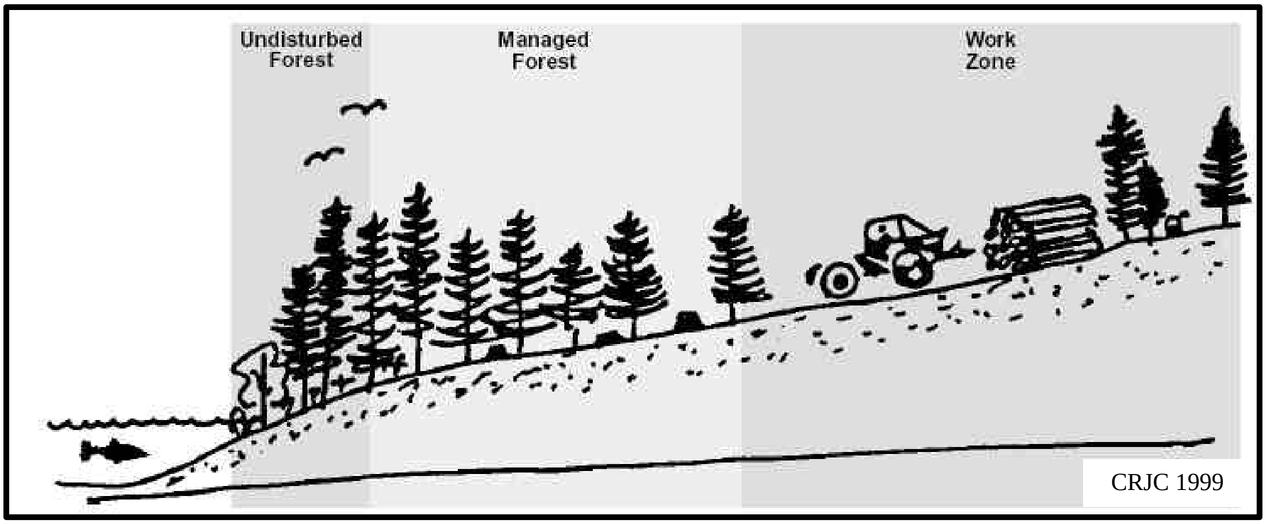



***Fig. 2.2-33. Representative Three-part Forested Buffer System***

- **Undisturbed Streamside Forest -** Undisturbed trees shade stream and help stabilize bank; natural woody debris improves fish habitat. Forest with long-term rotation; soils and natural litter remove N, promote infiltration of water; trees use excess nutrients for growth; wildlife habitat.

- **Managed Forest -** Forest with long-term rotation; soils and natural litter remove N, promote infiltration of water; trees use excess nutrients for growth; wildlife habitat.

- **Outer Work Zone -** Managed forest or open area. Spreads surface water flow before it enters the middle zone.

Carbon Sequestration

The carbon cycle refers to the fixation of atmospheric carbon dioxide ($CO_2$) through photosynthesis and the simultaneous or subsequent release of carbon dioxide through respiration. Through this process, carbon is cycled continuously through three main global reservoirs or carbon pools: the oceans, the atmosphere, and the terrestrial biosphere (including vegetation and soils).

Emissions of $CO_2$ along with other greenhouse gases from human activities (i.e. the burning of fossil fuels, land use) are increasing the amount of carbon in the atmosphere creating the potential for global climate change. The concept of carbon sequestration has generated interest because of its potential to take much of this excess atmospheric carbon and incorporate it back into the soil. Carbon sequestration in terrestrial ecosystems can be defined as the net removal or fixation of $CO_2$ from the atmosphere or other carbon sink into long-lived pools of carbon through biological or physical processes. These pools can be living, above-ground biomass (e.g., trees, plants, and grasses), products with a long, useful life created from biomass (e.g., lumber), living biomass in soils (e.g., roots and microorganisms), or recalcitrant organic and inorganic carbon in soils, and water bodies. Increasing photosynthetic carbon fixation alone is not enough as carbon must be fixed into long-lived pools.

**Carbon Sink:** A process or an activity that absorbs or takes up released carbon (greenhouse gases) from another part of the carbon cycle. The four sinks, which are ecosystem-based, within which carbon behaves in a systematic manner are the *atmosphere, terrestrial biosphere* (including freshwater systems), *oceans*, and *sediments* (including fossil fuels).

The terrestrial biosphere is estimated to sequester approximately 2.2 billion tons of carbon per year (DOE, No Date) with the total carbon sequestration and fossil fuel offset potential of U.S. cropland estimated to be 170 million tons of carbon per year (USDA, 1998). The two main fundamentally accepted approaches to sequestering carbon in terrestrial ecosystems, including agricultural land and forests, are: (1) protection of ecosystems that store carbon so that sequestration can be maintained or increased; and (2) manipulation of ecosystems to increase carbon sequestration beyond current conditions. The DOE (No Date) provides means in which the following ecosystems offer significant opportunities for carbon sequestration:

- **Forest lands.** The focus includes below-ground carbon and long-term management and utilization of standing stocks, understory, ground cover, and litter.
- **Agricultural lands.** The focus includes croplands, grasslands, and rangelands with emphasis on increasing long-lived soil carbon.
- **Biomass croplands.** As a complement to ongoing efforts related to biofuels, the focus is on long-term increases in soil carbon.
- **Deserts and degraded lands.** Restoration of degraded lands offers significant benefits and carbon sequestration potential in both belowground and aboveground systems.
- **Boreal wetlands and peatlands.** The focus includes management of soil carbon pools and perhaps limited conversion to forest or grassland vegetation, where ecologically acceptable.

While many processes occur at the molecular level (i.e., photosynthesis, formation and protection of soil organic matter, etc.), management and conservation practices to enhance carbon sequestration need to be implemented at the landscape scale. At this scale, agricultural ecosystems can be the main functional units for estimating productivity and carbon sequestration, and for assessing potentially harmful impacts associated with efforts to increase carbon in these and other ecosystems. CRP contract land provides the optimal conditions for landscape level ecosystem carbon sequestration to occur.

Current literature documents rates of carbon sequestration under the CRP by use of models. Such estimates indicate rates of carbon sequestration for the western and central U.S. are less than 90 to 360 pounds per acre per year (lbs/ac/yr) of soil organic matter and 220 to 1200 lbs/ac/yr of total below ground carbon, including roots. Some estimates suggest that about 450 and 580 lbs below ground carbon per acre per year are sequestered under the CRP as soil organic carbon in the 0 to 2 and 0 to 4 inch depths, respectively. Research reported in 1994 at five sites across Texas, Kansas, and Nebraska indicated that about 710 and 980 lbs soil organic carbon/ac/yr were sequestered in the 0 to 15 and 0 to 120 inch depths under CRP land (Follett, No Date).

Assuming that 500 to 800 lbs of soil organic carbon/ac/yr are sequestered across the 33.8 million acres of CRP land in the U.S., between 8.5 and 13.5 million tons of soil organic carbon are sequestered annually within the U.S. All U.S. agriculture has been reported to emit about 47.3 million tons of carbon/yr and, thus, the CRP can be estimated to offset from 25 to perhaps 40 percent of agriculture's $CO_2$ emissions, in addition to other environmental benefits attributed to the CRP (Follett, No Date).

USDA programs such as the CRP and others help to increase soil organic carbon. This is accomplished by improving soil quality by raising productivity and contributing to sustainable land use, enhancing the overall environmental quality through improved wildlife habitat, higher water quality, and erosion reduction (USDA, 1998). Also important are various strategies for sustainable management of the soil, such as:

(1) Conservation tillage
(2) Management of crop residue and application of organic materials and manures;
(3) Soil fertility optimization through site-specific management;
(4) Elimination of summer fallow;
(5) Use of winter cover crops and rotations; and
(6) Other techniques that may improve crop yields and reduce on-site and off-site production risks (USDA, 1998).

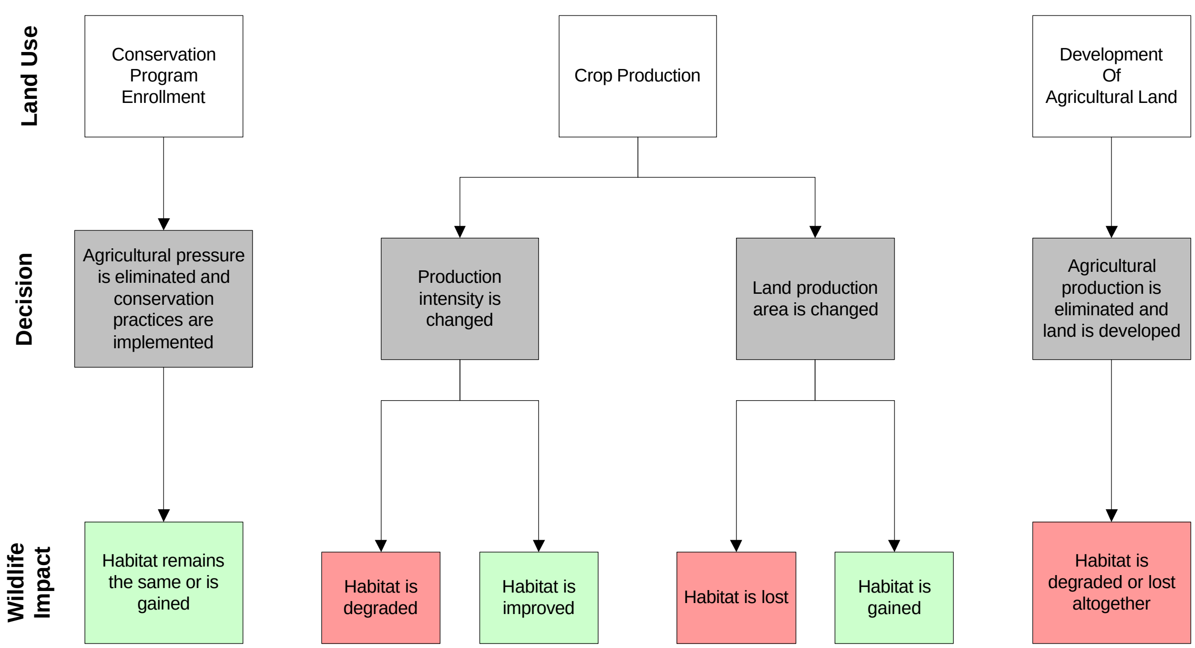
# 2.2.4 Wildlife

### *2.2.4.1 Wildlife*

In an effort to improve the nation's natural resources, agricultural conservation programs have stepped-up to dramatically improve the health and size of wildlife populations around the Nation. Management of private lands, good stewardship, and creating ideal environmental habitat conditions provide agricultural conservation programs with the tools needed to produce positive wildlife impacts in the various regions and ecosystems within the U.S.. The combined size of wildlife habitats created by agricultural conservation programs is currently twice as large as the National Wildlife Refuge System and all State-owned wildlife areas in the contiguous 48 States combined (Brady, 2000).

Agricultural land use decisions are pivotal in producing the desired wildlife benefits and in determining which decisions directly impact wildlife populations (Figure 2.2-34).

***Fig. 2.2-34. Wildlife Impacts from Agricultural Land Use Decisions***




*Source: AERI (2000)*

Agricultural and developmental land use changes can alter both the area and the configuration of a habitat through the introduction of manmade structures, such as access roads and fences that can act to fragment habitats. Plants and animals are affected as habitats diminish in size or become fragmented. Fragmentation can cause the loss of wildlife species in solitary habitat patches, as well as losses in the regional landscape. Maintaining large patches of native habitat and protecting natural corridors through the use of conservation practices on previously cropped land can provide the most diverse wildlife habitat. Studies have also shown that wildlife corridors can provide predators with increased access to prey species.

Wildlife species may be directly eliminated from segments of the landscape where habitat has been converted to agricultural uses. The size of patch habitat controls the number of species that can live within each patch and is correlated with the number of different crop species planted, irrigation use, and domestic livestock grazing. Conversion of habitat is not the only stress that agriculture may have on wildlife. Other agricultural stressors that affect wildlife habitat include:

- The application of fertilizers, pesticides, and herbicides.
- The conversion/alteration of wetlands and the conversion of prairies and woodlands to cropland.
- Haying and grazing may destroy nesting habitat and cover for waterfowl, songbirds, and upland game birds, kill chicks still in the nest, and force birds to locate to other suitable habitat. Many grassland bird species respond negatively the following year in fields that were grazed the previous year. Some of these include the horned lark, chestnut collared longspur, and lark bunting, all species that favor short and sparse vegetation. Many more species, however, responded with reduced densities the year following haying. Among these were vesper sparrow, sedge wren, common yellowthroat, bobolink, clay-colored sparrow, dickcissel, and Le Conte's sparrow (Johnson, 2000).

Agricultural stressors directly and indirectly affect multiple ecosystems, including wetland and waterfowl systems, native grasslands, aquatic and riparian dependent species, and forestland habitat (Johnson, 2000). One of the most impacted ecosystems affected by agriculture is the native grasslands. The loss of well over 80 percent of native grasslands in the U.S. due to agricultural conversion and other reasons (refer to discussion in Section 2.2.2), has caused dramatic negative impacts on the wildlife that has adapted to grassland ecosystems. Not only does wildlife suffer from the loss of these native grassland ranges, but (Johnson, 2000) examined the following three negative impacts produced by the loss of native grassland ranges:

**1. Fragmentation of Existing Habitat**

Many remaining grassland habitats are of reduced quality and those natural grasslands that remain tend to occur as small fragmented patches. Because of their large ranges, birds are especially vulnerable to fragmentation effects above and beyond habitat loss. Fragmentation reduces the size of habitat patches, increases exposure of birds to often-deleterious edge effects, and isolates habitat patches from one another.

**2. Unsuitable Habitat**

The croplands and agricultural practices that largely displace many large tracts of native grasslands are often avoided by many bird species that cannot find the necessary habitat structure in cultivated fields. The majority of these birds that nest in cropland suffer reproductive failure because of frequent agricultural operations. Grassland birds often use hayfields however; mowing operations can kill or displace nesting birds and destroy nests. Many times in these cultivated areas, bird reproduction is not sufficient to offset mortality and ultimately maintain healthy, stable populations.

### 3. Woody vegetation

In the Great Plains, many farmers planted trees as windbreaks and shelterbelts to protect their farmsteads and fields from the windy conditions of the region. The increase in agriculture also led to increased fire suppression that has also lead to the spread of woody vegetation into the grassland ecoregions.

Grasslands invaded by woody vegetation tend to have a higher diversity of bird species than those without. Those species, however, tend to be edge or generalist species that are able to make use of many types of habitats. Among these species are brown thrasher, gray catbird, song sparrow, American robin, and common grackle. These species are common in many parts of the U.S. and can utilize many types of different habitats. The addition of trees may also reduce the quality of habitat for true grassland species such as Sprague's pipit and Baird's sparrow. These prairie species have more restricted habitats and breeding ranges, requiring maintenance of open grasslands for their survival.

Woody vegetation can influence grassland birds in several ways. First, it reduces and fragments the total area of grassland.  Second, it precludes certain species from using the grassland areas that remain. Third, trees and shrubs provide perches for raptors, other avian predators, and cowbirds, and provide travel lanes for mammalian predators. Fourth, species attracted to the woody vegetation may forage in adjacent grasslands and compete with prairie species.

Many native grassland birds need large unbroken areas of grass habitat with few trees and shrubs. Examples include: western meadowlarks, bobolinks, dickcissels, lark buntings, grasshopper sparrows, upland sandpipers, and greater prairie chickens. Although reasons for the declines are unclear, studies show that near woody cover, grassland birds can be at greater risk from predation by various bird and mammal predators and from brood parasitism by brown-headed cowbirds. Other prairie animals, such as the pronghorn antelope may also be affected (Johnson, 2000).

Most frequently, trees are planted on cropland that was once native grasslands.  These trees provide species diversity among the areas' planted monoculture crops, and often times trees planted as windbreaks, shelterbelts, and living snowfences provide nesting habitat for squirrels, cottontail rabbits, small rodents and numerous bird species. Trees provide direct sources of food such as fruits and nuts, as well as habitat for insects and other invertebrates, which in turn are a food source for other wildlife. Raptors (such as hawks) often use the high branches of a windbreak to perch and scan for prey (Brandle and Hodges, No Date).  They are also often used as corridors for species not normally found in grassland ecosystems to extend their range. These opportunistic species many times out compete and drive out native grassland species. Magpies, crows, jays, foxes, skunks, and raccoons are a few examples of species that have utilized these corridors to extend their range and often out compete and prey on the eggs and hatchlings of native grassland birds.

Wildlife Buffers

A buffer that benefits wildlife usually requires a larger streamside forested buffer than for water quality purposes alone. Connecticut River Joint Commissions (CRJC,1999) argues that the generally accepted minimum width is 300 feet. However, the actual width depends upon how much land is available and what wildlife species the landowner hopes to accommodate with the buffer.

A buffer should not only provide enough room for a species to take shelter, find food, successfully raise young, and hide from predators, but must also provide the right conditions, such as; water that is clean and cool, suitable vegetation, and freedom from disturbance the animal cannot tolerate. Connecticut River Joint Commissions (CRJC,1999) offers the following examples of buffer sizes for some wildlife species:

- **Wildlife dependent on wetlands or watercourses 30-600 Feet**
  - Bald eagle, nesting heron, cavity nesting ducks 600 Feet
  - Pleated woodpecker 450 Feet
  - Beaver, dabbling ducks, mink 300 Feet
  - Bobcat, red fox, fisher, otter, muskrat 330 Feet
  - Amphibians and reptiles 100-330 Feet
  - Belted kingfisher 100-200 Feet
- **Songbirds 40-660 Feet**
  - Scarlet tanager, American redstart, rufous-sided towhee 660 Feet
  - Brown thrasher, hairy woodpecker, red-eyed vireo 130 Feet
  - Blue jay, black capped chickadee, downy woodpecker 50 Feet
  - Cardinal 40 Feet
- **Cold water fisheries 100-300 Feet**

### *2.2.4.2 Wildlife-Based Recreation*

Wildlife-based recreation is an important aspect to not only the U.S. economy, but also the American people. Wildlife viewing, hiking, hunting, and fishing are just some of the activities in which Americans participate that are directly related to wildlife populations and habitat. Participation in wildlife-based activities is not the only aspect involved in the wildlife conservation effort; wildlife preservation is also a component. Agricultural landscapes within the U.S. not only supply most of the wildlife habitat in this Nation, but also play a major role in the preservation and enhancement of wildlife resources. However, habitat loss associated with agricultural practices on over 400 million acres of cropland is the primary factor depressing wildlife populations in North America (Wildlife Management Institute, 1995).

Federal- and State-managed wildlife and recreation areas are used by the public for hunting, but can often be located adjacent to dense farming regions. Agricultural conservation programs provide for the ability to expand the amount of suitable vegetative cover on cropland adjacent to these managed areas, thus resulting in more robust game and non-game wildlife populations.

### *2.2.4.3 Federal Threatened and Endangered Species*

Agriculture is thought to affect the survival of 380 species listed by the Federal Government as threatened or endangered in the continental U.S. (AREI, 2000). Based on a 1997 Risk Assessment produced for FSA, the percentage of threatened and endangered species affected by agricultural development range from amphibians (most affected) to mammals (least affected), with the most frequent cause of habitat loss or alteration leading to classification as threatened or endangered being agricultural development.

The purposes of the Endangered Species Act (ESA) are to protect endangered and threatened species and provide a means by which to conserve their ecosystems. Under the ESA, species may be listed as either "threatened" or "endangered." Threatened means a species is likely to become endangered within the foreseeable future. Endangered means a species is in danger of extinction throughout its entire range or at least a significant portion of its range. All species of plants and animals, except pest insects, are eligible for listing as threatened or endangered.

Landscapes dominated by croplands and other agricultural lands constitute the lands on which many species have historically depended for food, cover and water. These species often have nowhere else to go and must continue to survive on those lands if they are to survive. Because these croplands often provide critical habitat for a wide variety of wildlife species, many producers are working with various State and Federal agencies to protect and restore wildlife habitat on cropland through the use of conservation practices such as the restoration of native grasslands, creation of wildlife food plots, and restoration of lost wetlands. Large-scale conservation programs are addressing threatened and endangered species associated with agricultural lands and are proving to be successful.

Current Conditions of Threatened and Endangered Species in the U.S.

There are currently 517 species of animals (including birds, fish, mammals, insects, reptiles, and amphibians) and 744 species of plants in the U.S. that are listed as threatened or endangered by the U.S.F.W.S. (USF&WS, 2002). The ESA gives authority to the FWS to determine which species to add to the Federal list of threatened and endangered wildlife and plants. Once a species is federally listed, it is then given the full range of protections available under the ESA, which include prohibitions on killing, harming, or otherwise taking a species. Protection of the species' primary habitat is also included under the ESA. If a listed species is found to be using a particular parcel of farmland as its primary habitat, limitations may be placed on the land if it is found that production would seriously impact that habitat.

The distributions of threatened and endangered species throughout the U.S. vary for each taxon. Taxa are used as a way to classify groups of similar species. The Taxa used by the EPA to develop the following maps were: Fish and Clam Species, Amphibian and Reptiles, Plants, Birds, and Mammals.

*Fish and Clam Species (Figure 2.2-35)*

The most widespread areas of threatened or endangered fish and clam species are found in the southwestern States and along the Missouri and Mississippi River Valleys. The highest concentrations (greatest number of threatened or endangered species per county) however, are found in southwestern Virginia and northeastern Tennessee within the Tennessee River watershed.

*Amphibian and Reptile Species (Figure 2.2-35)*

The most widespread areas containing the highest concentrations of threatened and endangered amphibian and reptile species are located in: the deserts of southern California and Nevada, the wetlands and salt marshes of Florida, and north along the eastern seashore.

*Bird Species (Figure 2.2-36)*

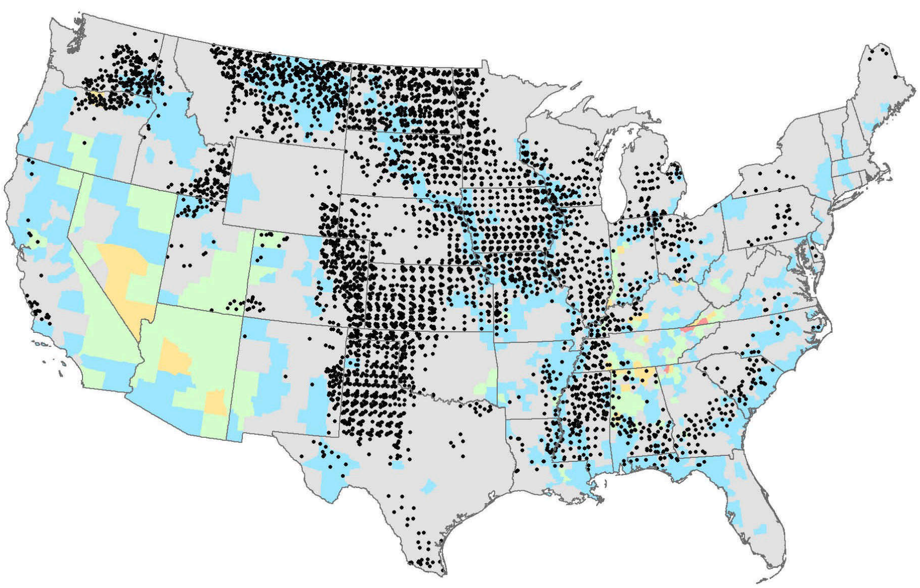
The distribution of bird species listed as threatened or endangered is fairly uniform across the nation except for areas along the entire Pacific coast and most of Florida where the number of listed species per county is highest.

*Mammal Species (Figure 2.2-36)*

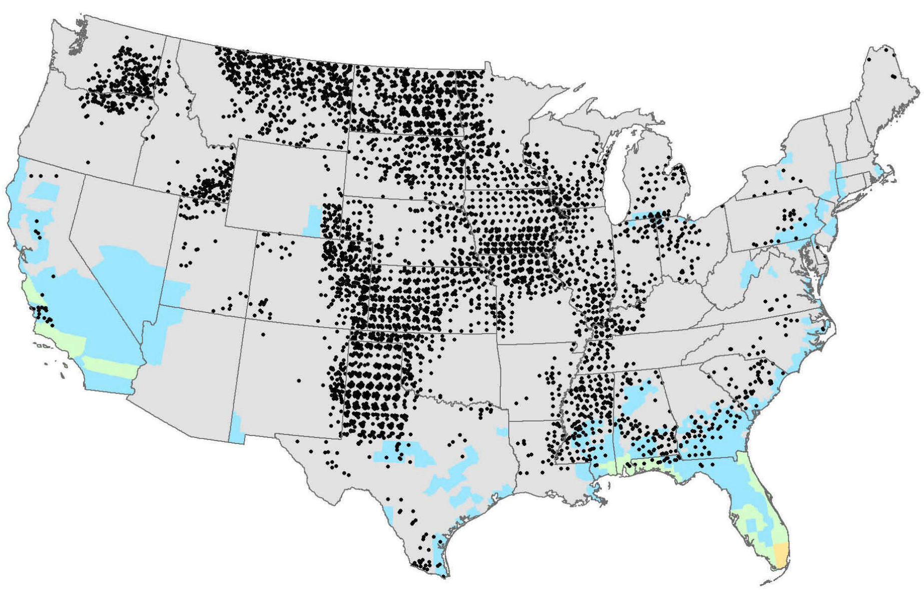
Threatened and endangered mammals occur sporadically across the Nation with areas in southern California and Florida having the highest concentrations.

*Plant Species (Figure 2.2-37)*

The distribution of threatened and endangered plant species throughout the U.S. is fairly sporadic. Those areas with the highest concentrations are associated with drier and alpine environments along with the fragile wetland and scrub ecosystems of Florida.



Number of Threatened and Endangered Fish and Clam Species by County



Number of Threatened and Endangered Amphibian and Reptile Species by County

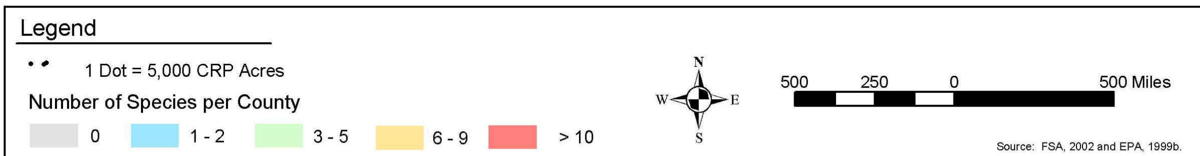



*Fig. 2.2-35. Threatened and Endangered Aquatic Species by County*

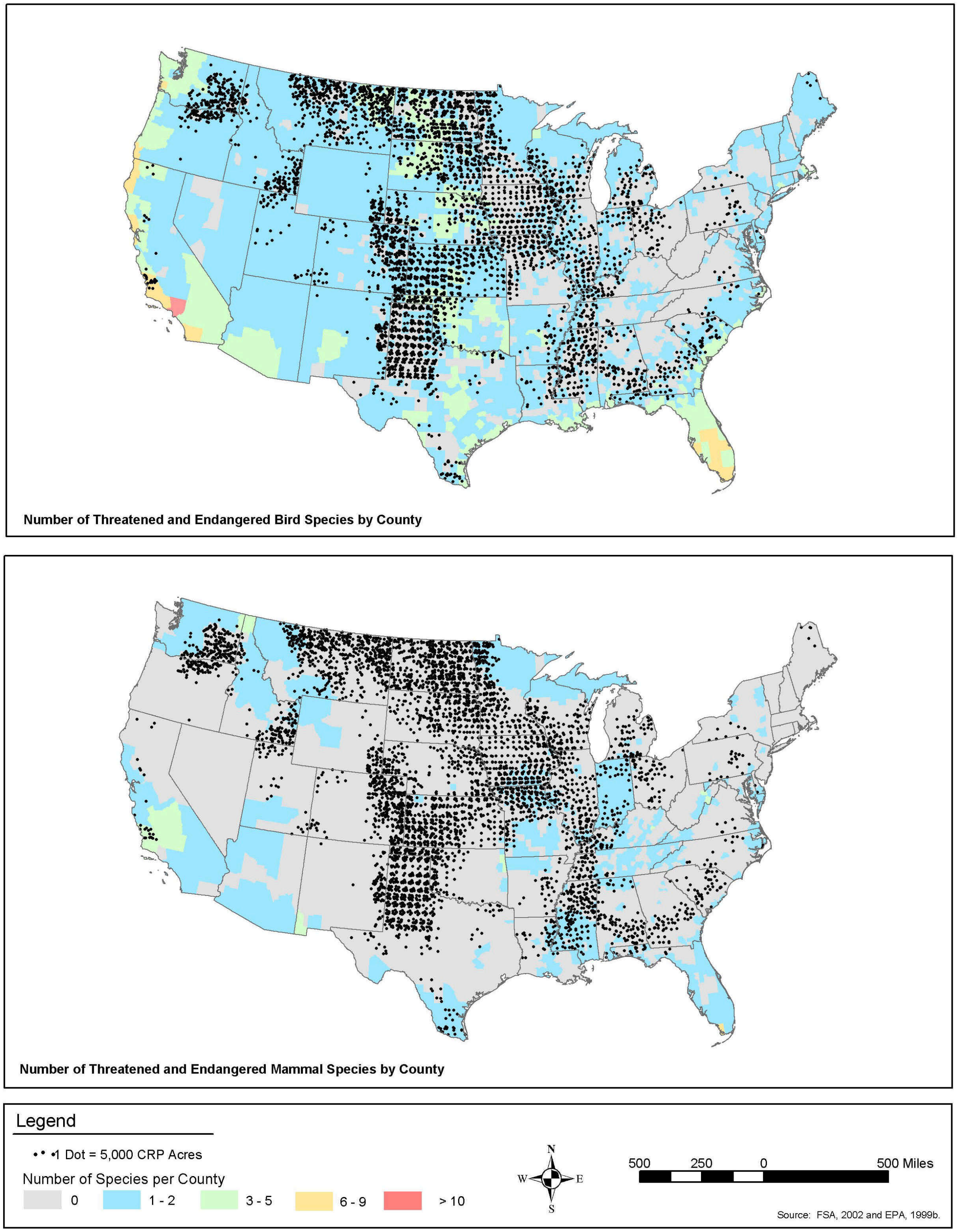



*Fig. 2.2-36. Threatened and Endangered Terrestrial Species by County*

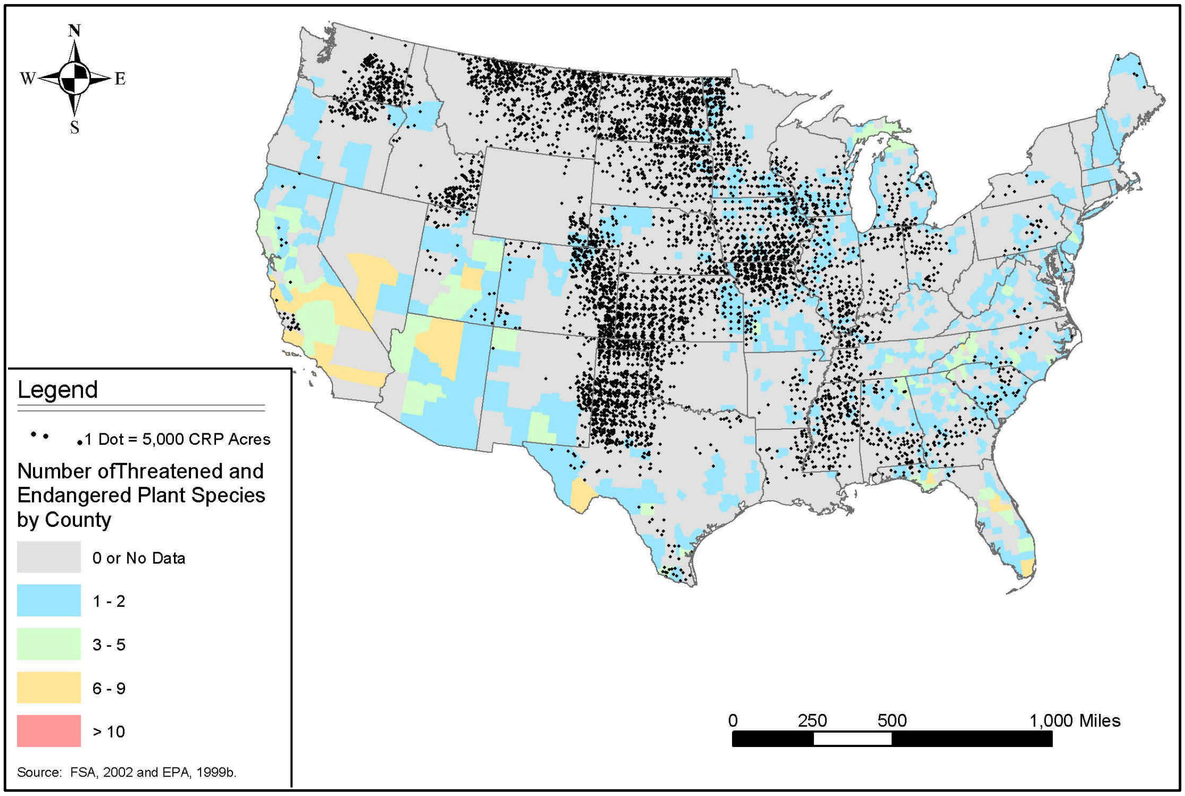



*Fig. 2.2-37. Threatened and Endangered Plant Species by County*

Rare and Sensitive Species

Rare and sensitive species are defined as native or once-native species of wildlife that exist locally in small numbers and has been determined to need monitoring to ensure the sustainability of their population. Agricultural-related land use is a contributing factor to habitat alteration and loss, leading to species endangerment, but the exact causes can be considered variable. Some causes of habitat alteration and loss include the loss of grasslands, wetlands, and surface water degradation. This relationship between agricultural land use and understanding the affected ecosystems can provide an increased environmental targeting conservation effort and produce the best possible ecological outcome for rare and sensitive species.

Neotropical migrants

Bird migration in North America is generally thought to conform very closely to those major topographical features that lie in the general north/south direction of travel (Zimmerman et al., 1998). These topological features of the land include coastlines, mountain ranges, and major river valleys. Migration routes are defined as the route of an individual bird species to a particular breeding or wintering ground. Flyways, on the other hand, are a more general term used to describe common migrating patterns among different species, based on definite geographic regions (Zimmerman et al., 1998). There are four major North American flyways: the Atlantic, the Mississippi, the Central, and the Pacific (see Figure 2.2-38).

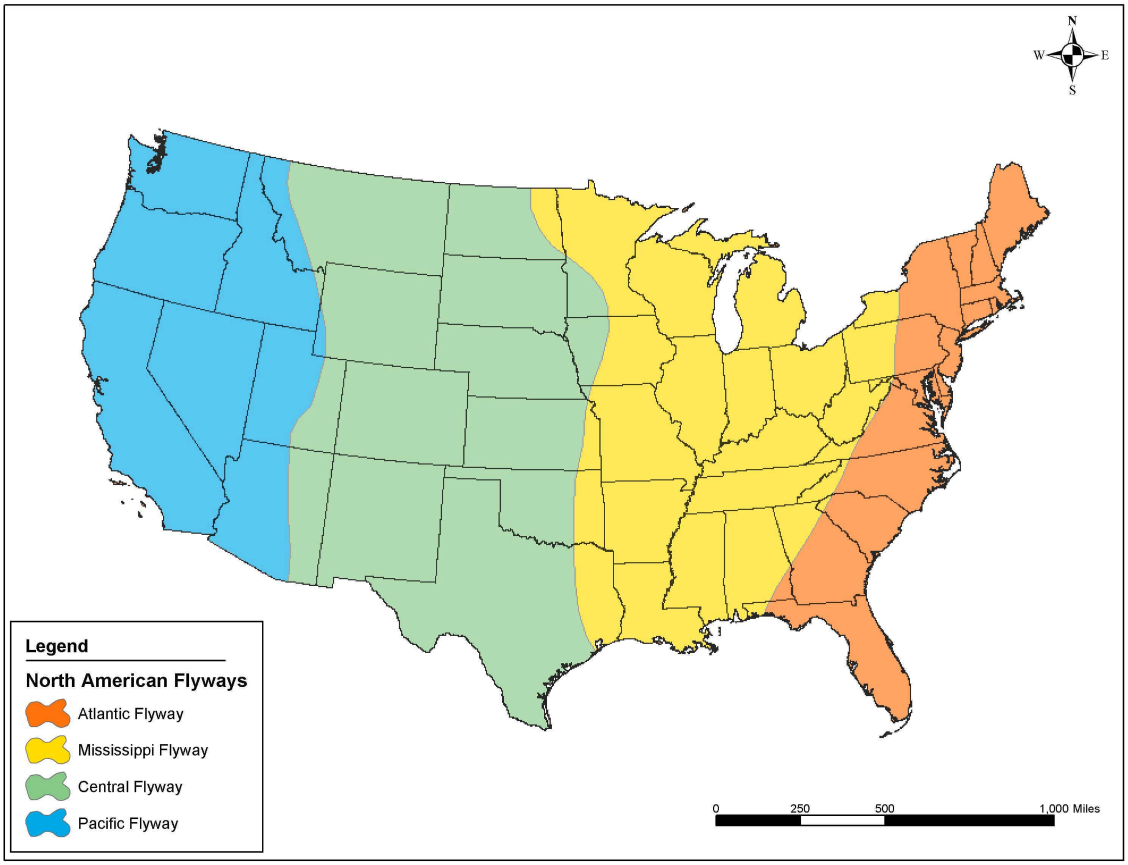



***Fig. 2.2-38. North American Flyways***

Along these flyways, hundreds of bird species annually migrate to the tropics during the northern winters months; these birds are referred to as neotropical migrants (Zimmerman et al., 1998). For these birds to be successful in these migrations, they must have a consistent series of areas along their route that provide food, shelter, and water specific to the types of habitats required by the particular species (Zimmerman et al., 1998). Farmlands often compete with these species for the same space, water, and other resources, which may have significant negative impacts on these neotropical species. However, agricultural use of land (especially crop harvest residues) provides food for migrating birds.

Agriculture affects neotropical birds in several ways. Cultivation practices, such as pesticide application, can effectively destroy the food base for foraging birds. Tilling, mowing, or other forms of farm maintenance may destroy nesting areas. In addition, the draining of wetlands and potholes for farming destroys habitat for waterfowl and other aquatic organisms (Bolen and Robinson, 1995). This may force birds to travel farther and spend more energy looking for suitable nesting habitat. Another significant problem that affects those species is exhibited behavior known as "migrational homing." Migrational homing is when birds return to the same nesting grounds year after year, a behavior most common in waterfowl. When these traditional nesting grounds are converted to farmlands, additional stress is put on these birds to find new nesting grounds. Through the use of various conservation practices, the amount of competition for resources is diminished due to the significant increase in available permanent cover and habitat, wetted areas, and corridors (Bolen and Robinson, 1995).

## 2.3 Economic and Social Resources

The analysis of impacts to economic and social resources provides a mechanism for the identification, comparison, and evaluation of the effects of significant policy actions or regulatory practices before these effects can occur. The intent is to identify those elements of the socioeconomic environment that are sensitive to changes that may result from the proposed alternatives. Specifically, the assessment considers how these actions might affect individuals, institutions, and the larger social and economic systems of the various communities affected by the CRP program.

CRP is a voluntary program directed primarily to the owners and operators of eligible cropland in the U.S. Land ownership may include individuals, partnerships, or corporations that own either all or some part of the subject acreage. Landowners may be working farm operators, absentee owners, investors, or the heirs to an estate. However, the program may also influence other users of the land, including tenants who farm the land under contract, hunters, or other recreational users of the land.

The largest private land retirement program operated by USDA, FSA's CRP provides income support to the owners of farm acreage through annual land rental payments and cost-share assistance in exchange for the installation and maintenance of long-term, resource-conserving covers on eligible farmland. Rental payments made to participants by the FSA are based on the dryland agriculture rental value of the land. CCC also provides cost-share assistance for up to 50 percent of participants' costs in establishing approved conservation practices. CRP contract terms range from 10 to 15 years. Through September 30, 2002, CRP contracts averaged approximately 57 acres each, with an average rental rate of $47.27 per acre.

The description of the affected environment for the analysis of socioeconomic effects of the CRP provides a summary of the economic and social characteristics within a designated area or social community. Through various mechanisms, the programs under consideration here have the potential to directly affect the structure and practices of individual agricultural producers or to indirectly affect the characteristics, social patterns, and economies of rural and other agricultural communities or the larger agricultural economy of the U.S. These communities represent the object of any direct effects associated with the demographic, economic, and fiscal impacts resulting from the proposed action that could reasonably be expected to have some influence on the social community.

At the programmatic level, the affected environment is a generalization of the social characteristics of the agricultural communities of the U.S. that are the focus of the CRP. The affected environment is represented geographically at the level of whole counties. Counties represent the smallest administrative unit for CRP implementation. Counties also represent the smallest analytical unit for which meaningful and consistent data are available on a national basis.

Consistent with the agricultural base of the programs under consideration here, the communities typically affected will be smaller and non-metropolitan in character. However, agricultural production is not confined to primarily rural areas. Urban farms now constitute an estimated 33 percent (726,000 farms) of all U.S. farms and encompass 16 percent of all cropland (CAST, 2002). Suburban and urban fringe communities that contain or are adjacent to cropland acreage may also be affected. Larger more metropolitan communities may also be indirectly affected either as the result of any environmental improvements associated with the program, by any payments made to absentee landowners or farmers who reside in these areas, or by program influences on the larger agricultural economy of the U.S.

## 2.3.1. Social Characteristics of U.S. Farmland Communities

Both historically and in contemporary America, agriculture plays an important role for economic and social development. Of the total 3,066 counties in the continental U.S. only 34 contained less than 1,000 acres of farmland. The influence of agricultural production in the U.S. is experienced in both rural areas where base agriculture is located, as well as in the economies and lifestyles of more urban, non-farm areas.

### *2.3.1.1 The Structure of Agricultural Production*

The world's largest producer of crops, livestock, and poultry, the U.S. supported a total of 1,911,859 farms, involving a land area of 931,795,255 acres in 1997 (USDA, 1997). However, the structure and practice of farming in the U.S. has changed dramatically over the past century. As late as the 1930s, farms, farmers, the farm household, and farming communities were relatively homogeneous and intertwined (USDA, 2001). However, in the ensuing 70 years, the structure of farm operations has undergone substantial changes. Along with other economic and lifestyle changes, technical advances in farming and the globalization of commodity markets have led to an increasing diversity and concentration of farm operations.

Since the beginning of the twentieth century, the ownership and control over agricultural assets has been increasingly concentrated into fewer and larger entities (USDA, 1998). The introduction of mechanized processes and advanced technologies along with Government price supports have combined to encourage farmers to increase the size of their farms in order to gain production efficiencies. The large capital expenditures required for contemporary farming encourage increased specialization and the production of larger quantities of a limited number of products (USDA, No Date).

Farm Typology

ERS has developed a farm typology that categorizes farms into homogeneous groups that describe the range of U.S. farms (USDA, 2000). [For further definition of farm typologies see text box below.] Based on this typology, 91 percent of all farms were classified as small farms for the year 1998. These small farms account for approximately 68 percent of the nation’s total farm assets and land. However, large farms, very large farms, and corporate farms account for approximately 66 percent of total production (USDA, 2001).

Farm Tenure

As of 1997, approximately 41 percent of the farmland in the U.S. was leased (Soule et al, 2000). Farmland includes woodlands, pastures, idle lands, and cropland. Cropland is what is primarily enrolled in CRP. Total cropland, as defined in the Census of Agriculture, is a broad category. [For further definition of cropland see text box below.] The definition of cropland used by FSA to determine CRP eligibility is more narrowly defined in 7 CFR 718.2 as:

[Land] which the county committee determines meets any of the following conditions:

- Is currently being tilled for the production of a crop for harvest;
- Is not currently tilled, but it can be established that such land has been tilled in a prior year and is suitable for crop production;
- Is currently devoted to a one- or two-row shelterbelt planting, orchard, or vineyard;
- Is in terraces, that were cropped in the past, even though they are no longer capable of being cropped;
- Is in sod waterways or filter strips planted to a perennial cover; or
- Is preserved as cropland in accordance with part 704 or 1410 of 7 CFR.

As farming operations have become more concentrated and farming practices more intensified, the need to access additional crop acreage has induced more farmers to adopt leasing as a land acquisition strategy. Of the 41 percent of U.S. farmland that was leased, 29 percent was leased to tenants (who rent all the land they farm) and 71 percent was leased to part owners (who own some portion of the land they operate, but also rent additional land) (USDA, 2001c).

**Farm Typology Groups Defined**

**SMALL FAMILY FARMS (sales less than $250,000):**

**Limited-resource:** Any small farm with: gross sales less than $100,000, total farm assets less $150,000, and total operator household income less than $20,000. Limited-resource farmers may report farming, a nonfarm occupation, or retirement as their major occupation.
**Retirement.** Small farms whose operators report they are retired (excludes limited-resource farms operated by retired farmers)
**Residential/lifestyle.** Small farms whose operators report a major occupation other than farming (excludes limited-resource farms with operators reporting a nonfarm major occupation).
**Farming occupation/lower-sales.** Small farms with sales less than $100,000 whose operators report farming as their major occupation (excludes limited-resource farms whose operators report farming as their major occupation).
**Farming occupation/higher-sales.** Small farms with sales between $100,000 and $249,999 whose operators report farming as their major occupation.

**OTHER FARMS:**

**Large family**. Farms with sales between $250,000 and $499,999.
**Very large family**. Farms with sales of $500,000 or more.
**Nonfamily.** Farms organized as nonfamily corporations or cooperatives, as well as farms operated by hired managers.

Source: USDA ERS, 2000

The most pertinent category of cropland for tenancy issues is harvested cropland, since this is generally the high yielding land and the land most likely to be enrolled in CRP. The number of harvested cropland acres being rented in the U.S. cannot be estimated directly from Census of

Agriculture data, due to the way land tenure is classified. There are three tenure classifications in the Census. Full owners operated only land they owned. Part owners operated land they owned and land they rented. Tenants operated only land they rented from others.

Both the number of farms and the total farm acreage in full ownership has increased during the five-year period from 1992 to 1997. This would indicate that at least some portion of the decrease in individual farms and in the total land in farms could be attributable to a decrease in tenant farming operations during this period. The number of farms and total farmland acres in various ownership types is illustrated in Table 2.3-1 for the years 1992 and 1997.

Removing land from production through CRP enrollment, assuming no new land is converted to cropland, decreases the supply of land available for rent. Since there is less land available for rent, new tenants, and existing tenants on CRP enrolled land wanting to continue farming, are in greater competition to rent land and rents can rise.

There are two types of leases. Most cropland is leased using a cash rental agreement in which a fixed payment is agreed upon, on an annual basis, prior to planting. The tenant bears all of the production and market-price risk. This cash rental rate, for non-irrigated land, is used to set the CRP rental caps specific to soils mapped by NRCS for each of the soil survey areas in the county. In a share lease, rent varies with the amount of production. This allows the landlord and tenant to share market and production risks.

***Table 2.3-1. Acreage and Tenure of Farm Operators (1992 and 1997)***

| | Total (%) | Full Owner* (%) | Part Owner* (%) | Tenant (%) |
|---|---|---|---|---|
| Number of Farms 1992** | 1,925 (100.0) | 1,112 (57.7) | 597 (31.0) | 217 (11.3) |
| Number of Farms 1997 ** | 1,912 (100.0) | 1,147 (60.0) | 574 (30.0) | 191 (10.0) |
| Land in Farms 1992 *** | 946 (100.0) | 296 (31.3) | 527 (55.7) | 123 (13.0) |
| Land in Farms 1997*** | 932 (100.0) | 316 (33.9) | 508 (54.5) | 108 (11.6) |

Source: USDA, 2001

*Note: *Full owners own all the land they operate. Part owners own a part and rent from others the rest of the land they operate.*

** Numbers in '000s

***Numbers in millions of acres

The highest proportion of harvested cropland that is rented is in the Corn Belt States of Iowa and Illinois, where the combined rental average is approximately 40 percent over the past 20 years (see Table 2.3-2). Texas and Washington also have relatively large proportions of harvested cropland rented, each averaging around 25 percent over the past 20 years. In the Northeast, Maryland and New Jersey have averaged 17 and 15 percent, respectively. The lowest percentage of rented land is in the Lake States, Florida, New York, Vermont, New Hampshire and Maine. Throughout the rest of the nation, the proportion of harvested cropland rented by tenants generally ranges from 10 – 15 percent.

| *Table 2.3-2. Portion of Harvested Cropland Rented by Tenants* | | | | |
|---|---|---|---|---|
| | **1997** | **1992** | **1987** | **1982** |
| **U.S.** | 14.81% | 16.37% | 16.38% | 14.39% |
| **Southeast** | | | | |
| Alabama | 10.28% | 11.88% | 12.48% | 7.21% |
| Florida | 6.35% | 8.15% | 7.95% | 13.53% |
| Georgia | 10.36% | 11.19% | 11.38% | 6.23% |
| Mississippi | 34.33% | 35.96% | 30.89% | 11.63% |
| S. Carolina | 9.60% | 11.89% | 9.89% | 5.62% |
| **Corn Belt** | | | | |
| Iowa | 18.15% | 20.41% | 22.03% | 20.03% |
| Illinois | 18.22% | 21.17% | 21.74% | 11.59% |
| Indiana | 11.56% | 12.88% | 13.73% | 19.11% |
| Missouri | 11.12% | 12.14% | 13.81% | 9.73% |
| Ohio | 11.64% | 13.53% | 13.55% | 11.23% |
| **Northern Plains** | | | | |
| Kansas | 14.22% | 15.36% | 15.92% | 13.64% |
| Minnesota | 11.29% | 12.36% | 13.69% | 10.27% |
| N. Dakota | 12.37% | 13.18% | 13.80% | 14.03% |
| Nebraska | 15.95% | 17.55% | 19.63% | 11.16% |
| S. Dakota | 10.65% | 11.88% | 12.47% | 10.27% |
| **Southern Plains** | | | | |
| Oklahoma | 11.53% | 12.44% | 12.76% | 10.91% |
| Texas | 21.69% | 24.19% | 22.97% | 30.96% |
| **Mountain** | | | | |
| Colorado | 14.11% | 16.68% | 16.87% | 11.43% |
| Idaho | 13.08% | 14.19% | 14.52% | 9.19% |
| Montana | 11.95% | 14.00% | 13.33% | 8.77% |
| New Mexico | 12.21% | 11.30% | 17.05% | 28.35% |
| **Pacific** | | | | |
| Oregon | 17.17% | 17.68% | 14.87% | 10.45% |
| Washington | 24.66% | 25.13% | 23.89% | 14.80% |
| **Lake** | | | | |
| Michigan | 6.96% | 7.67% | 6.35% | 5.04% |
| Wisconsin | 7.57% | 8.90% | 8.54% | 7.44% |
| **Northeast** | | | | |
| Connecticut | 9.88% | 11.38% | 8.48% | 7.01% |
| Delaware | 12.38% | 12.72% | 12.99% | 10.73% |
| Massachusetts | 9.04% | 10.80% | 8.11% | 2.39% |
| Maryland | 16.81% | 17.76% | 16.00% | 13.20% |
| Maine | 5.44% | 5.45% | 4.31% | 5.09% |
| New Hampshire | 6.81% | 6.93% | 6.10% | 3.85% |
| New Jersey | 14.38% | 16.30% | 16.78% | 14.51% |
| New York | 5.76% | 6.35% | 5.44% | 4.62% |
| Pennsylvania | 11.29% | 11.74% | 10.97% | 8.27% |
| Rhode Island | 11.83% | 12.97% | 10.21% | 8.35% |
| Vermont | 9.32% | 8.03% | 7.12% | 5.49% |
| Source: Census of Agriculture, 1997, 1992, 1987, and 1982. | | | | |

Farm Income

The median farm household income in 1997 was $52,347 (USDA, 1999). This is substantially higher than the median for all U.S. Households, $37,005 (see Section 2.3.1.3, Demographic Summary of Rural Communities). The breakdown of income for the average farm household in 1997 includes: farm income, 11.4 percent; wages and salaries, 53.9 percent; off-farm business, 12.1 percent; interest and dividends, 6.8 percent; and other sources, 15.8 percent (USDA, 1999).

Approximately 43 percent of all farm households had a primary off-farm occupation that contributed to household income. Off-farm income is derived from sources such as wages and salaries from off-farm employment; the proceeds of an off-farm business, or unearned income such as interest, dividends, insurance or annuity payments. The proportion of farm income derived from various sources depends on the size and type of farm. Generally, as farm income and average household income increase, the proportion of that income that derives from off-farm sources decreases (USDA, 1999).

Federal Farm Subsidy Payments

Government payments in the form of subsidies represent another form of income to U.S. farms and farm households. The 1997 Census of Agriculture reported that approximately 36 percent of all farms received government payments. For the year 2001, this figure increased to 43 percent of all farms, comprising 11 percent of the gross cash farm income in that year (Young and Morehart, 2001). As with agricultural production itself, government subsidy and other payments to agricultural producers are increasingly concentrated among the largest producers, normally large family farms and corporate or cooperative producers.

In recent years (prior to 2001), almost 80 percent of farm payments were made to large or medium size farms (GAO, 2001). In 1999, large farms with gross sales of $250,000 or more constituted 7 percent of all farms but received approximately 45 percent of all payments (GAO, 2001). To some extent, the government allocation of payments is attributable to the level or heterogeneity in the farm sector. Factors influencing farm payments include farm size (acreage), location, types of commodities produced, and other operator and household characteristics. (Young and Morehart, 2001).

CRP rental payments also tend to be concentrated by geographic area, crop type, and availability of eligible land. As shown in Figure 2.3-1, for the 10-year period from 1991 to 2001, States in the Midwest and Northwest regions of the nation received the major portion of CRP payments.

### *2.3.1.2 Characteristics of Agricultural Communities*

In many instances, rural communities and agriculture are considered together. Rural communities tend to have certain characteristic structures, social patterns and cultural practices in common, but there is a degree of diversity within the rural community as well. Rural communities have undergone a shift from dependence on farming and farming related activity (ERS, 1995) to a more diverse economic base.

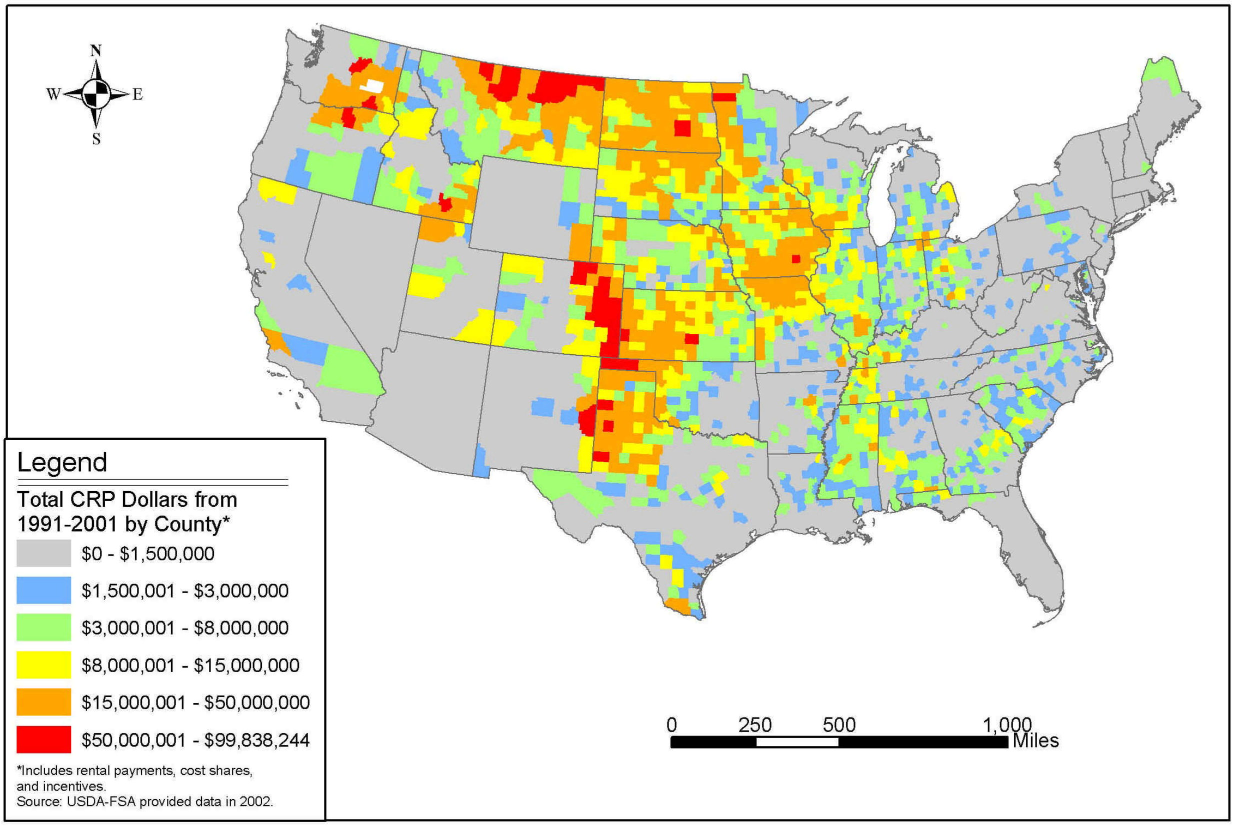



*Fig. 2.3-1. CRP Payments by County for the U.S.*

Farming Dependency

Of the 2,259 non-metropolitan counties classified by the ERS typology in 1989 (Cook and Mizer, 1994), 556 were identified as farming-dependent where farming contributed a weighted annual average of 20 percent or more of total labor and proprietor income over the previous 3 years.

The expansion of the U.S. economy during the decade of the 1990s has reduced the number of farming dependent counties in the U.S. (Gale, 2000). By 1999, only 258 counties were classified as farming dependent (USDA, 2002). However, although fewer communities rely on farming, it remains a major income source and defining characteristic for rural communities, especially those in the Central and Midwest portions of the Nation. Farming-dependent counties are primarily concentrated in the Great Plains; the western portions of the Midwest; the southern U.S., including parts of eastern Texas, Oklahoma, and the Mississippi Delta; and, the coastal plain of Georgia. The remaining counties are located mostly in the northwestern States.

Farms, Total Land In Farms, and Farm Size

Nationally, the total number of farms has decreased by 8.5 percent over the previous decade, from 2,087,759 in 1987 to 1,911,859 in 1997 (USDA, 1997). This decline slowed somewhat during the latter half of the decade during which the number decreased by less than one percent and reversed the trend of the previous 15 years in which almost 30,000 farms were lost nationwide (Gale, 2000a). Correspondingly, the total land in farms has also been reduced from over 964 million acres in 1987 to slightly less than 932 million acres in 1997; a decrease of approximately 3.4 percent.

Although the numbers of farms and the total land in farms have decreased during the decade from 1987 to 1997, the average farm size has increased from 462 acres in 1987 to 487 acres in 1997, approximately 5 percent. According to Gale (2000a), this increase is due in part to the need for farm operators who earn their primary living from farming to seek to expand their farms in order to cover fixed costs. Gale also notes a rise in the number of small farms whose operators earn a major portion of their income from non-farm activity. By contrast, the number of new farm start-ups by younger entrants to farming is showing a steady decline.

Rural Communities

Several important characteristics of the communities directly affected are important to the description of the potential impact of CRP. In recent years, rural communities have undergone what is frequently characterized as an economic restructuring (Reeder, 1990). One result of this restructuring process has been an increasing difficulty in maintaining the current residential and employment base, as well as in attracting new residents or business investment to the community.

Although the median income of agricultural households tends to be higher than that for non-agricultural households, rural communities, in general, have undergone an economic and social transformation that in many cases has resulted in a drop in per capita income during the past two decades. As Leistritz (1994) notes, this significant loss of purchasing power through outmigration (and a general decline in employment opportunity resulting from productivity increases in primary sector industries such as agriculture and manufacturing) have reduced communities' ability to mobilize residents and resources to address critical problems

The susceptibility of individual rural communities to the effects of land conservation programs, and the importance of CRP activity to the continued maintenance and future development of communities will be unique to each community. Where agriculture was once the dominant defining rural characteristic, contemporary rural communities, while still strongly influenced by their predominant economic activity, display socioeconomic patterns that are no longer dominated by a single industrial mode, residential configuration, or lifestyle. Manufacturing and service industries are now a more important part of the rural economy, and rural communities have become more popular as tourist and recreational centers and as residential areas for retirees and families (ERS, 1995).

Urban Communities

However, not all agricultural production is rural based. At a time when the overall number of farms continues to decline, the interconnectedness of agricultural systems with urban infrastructure, such as transportation systems (highways, airlines), computer technology, social networks, currency exchange and investments has caused urban farming to increase.

In 1997, 33 percent of all farms were located in counties that contained at least one metropolitan area (Heimlich and Anderson, 2001). These farms accounted for 39 percent of all farm assets and 18 percent of acreage in operation. Of U.S. counties that contained at least one metropolitan area in 1997, 802 also contained farmland. The average number of farms per county was 772 (CAST, 2002). For non-metropolitan counties that were adjacent to a metropolitan area, the average number of farms per county was 659 (CAST, 2002).

Urban farm operations are often characterized by greater variations in structure and practice than their more traditional rural counterparts. Urban farming involves diverse operations such as horticulture, aquaculture, arboricultural, poultry and animal husbandry, and includes niche farms, hobby farms, hunting preserves, dude ranches, 'you-pick' operations, direct-to-consumer sales and more (Brown, 2002; USDA, 2001). Of the urban farms identified in 1997, only about 34 percent were traditional in structure, while 54 percent were classified as "recreational" (Heimlich and Anderson, 2001). Farms located in urban counties are also more likely to be small farms meaning those of size less than 10 acres (Brown, 2002).

Increasingly, agricultural land is impacted by urban development, contributing to a significant loss of productive acreage. According to the NRCS's revised National Resources Inventory, the total amount of agricultural land (crop, pasture, range, and CRP) converted to developed uses between 1992 and 1997 totaled approximately 6 million acres or an average annual rate of 1.2 million acres (CAST, 2002). This development may be either in the form of low density housing at the urban fringe or it may occur beyond the urban fringe in the form of large lot single family housing on formerly agricultural land (Heimlich and Anderson, 2001).

Urban influence can have multiple effects on farming and rural areas, but the primary effect is to increase the market value of farmland for development above its value when used for agricultural production (Barnard, 2000). Agricultural production in or near metropolitan environments has some economic advantage for the operator. However, rural/urban conflicts and the increasing value of farmland for development purposes act as inducements for some farmers to sell land for non-farm uses. Of the Nation's farmland, 17 percent may be considered "urban-influenced" (Barnard, 2000).

#### *2.3.1.3 Demographic Summary of Rural Communities*

In 2000, the total population of the U.S. was 281,421,906 or an increase of 13.1 percent over the previous decade (Bureau of Census, 2002). During this same period, the population of non-metropolitan or rural America grew by 10.3 percent or 5.3 million people (Cromartie, 2002). The Nation's population was 75.1 percent white in 2000, with a median age of 35.3 years. The average household size was 2.59 persons. Persons living at or below poverty accounted for 13.3

percent of the population. Median household income for 1997 was $37,005. Using 1997 as the base year (the last year for which Agricultural Census data are available) a State-level summary of the entire population along with farming and CRP participation is presented in Table 2.3-3.

*Table 2.3-3. State Level Summary of Population, Farming, and CRP Participation*

| State | Total Population 1997 est. | Percent Minority | Percent Poverty | Median Household Income | Total Counties | Agriculture Dependent Counties (1) | Total Farms | Land in Farms | CRP Counties | Farms with CRP or WRP Land | CRP or WRP Land |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 4319154 | 26.8 | 16.2% | $30,790 | 67 | 2 | 41384 | 8704385 | 66 | 5198 | 416061 |
| Arizona | 4554966 | 11.1 | 15.5% | $34,751 | 75 | 1 | 6135 | 26866722 | 1 | 0 | 0 |
| Arkansas | 2522810 | 17.3 | 17.5% | $27,875 | 15 | 26 | 45142 | 14364955 | 55 | 1713 | 169105 |
| California | 32268301 | 20.0 | 16.0% | $39,595 | 58 | 6 | 74126 | 27698779 | 14 | 38747 | 2582084 |
| Colorado | 3892644 | 7.5 | 10.2% | $40,853 | 64 | 17 | 28268 | 32634221 | 36 | 3692 | 1567513 |
| Connecticut | 3269858 | 11.6 | 8.9% | $46,648 | 8 | 0 | 3687 | 359313 | 4 | 82 | 4017 |
| Delaware | 731581 | 21.0 | 10.0% | $41,315 | 3 | 0 | 2460 | 579545 | 3 | 58 | 2225 |
| Florida | 14653945 | 17.1 | 14.4% | $32,877 | 67 | 5 | 34799 | 10454217 | 22 | 1624 | 125878 |
| Georgia | 7486242 | 30.2 | 14.7% | $36,372 | 159 | 17 | 40334 | 10671246 | 138 | 6275 | 453602 |
| Idaho | 1210232 | 2.9 | 13.0% | $33,612 | 44 | 18 | 22314 | 11830167 | 41 | 2426 | 705407 |
| Illinois | 11895849 | 18.6 | 11.3% | $41,179 | 102 | 7 | 73051 | 27204780 | 99 | 12119 | 657665 |
| Indiana | 5864108 | 9.3 | 9.9% | $37,909 | 92 | 3 | 57916 | 15111022 | 91 | 7722 | 364177 |
| Iowa | 2852423 | 3.4 | 9.9% | $35,427 | 99 | 41 | 90792 | 31166699 | 99 | 24137 | 1707901 |
| Kansas | 2594840 | 8.4 | 10.9% | $36,488 | 105 | 44 | 61593 | 46089268 | 105 | 16434 | 2493625 |
| Kentucky | 3908124 | 8.0 | 16.0% | $31,730 | 120 | 9 | 82273 | 13334234 | 84 | 6189 | 330431 |
| Louisiana | 4351769 | 33.7 | 18.4% | $30,466 | 64 | 8 | 23823 | 7876528 | 45 | 1302 | 157988 |
| Maine | 1242051 | 1.6 | 10.7% | $33,140 | 16 | 0 | 5810 | 1211648 | 7 | 352 | 22217 |
| Maryland | 5094289 | 31.1 | 9.5% | $45,289 | 24 | 0 | 12084 | 2154875 | 23 | 605 | 25507 |
| Massachusetts | 6117520 | 9.7 | 10.7% | $43,015 | 14 | 0 | 5574 | 518299 | 5 | 71 | 2690 |
| Michigan | 9773892 | 16.4 | 11.5% | $38,883 | 83 | 2 | 46027 | 9872812 | 71 | 5251 | 287081 |
| Minnesota | 4685549 | 6.4 | 8.9% | $41,591 | 87 | 29 | 73367 | 25994621 | 84 | 14523 | 1264917 |
| Mississippi | 2730501 | 37.3 | 18.1% | $28,527 | 82 | 11 | 31318 | 10124822 | 81 | 5331 | 572593 |
| Missouri | 5402058 | 12.6 | 12.2% | $34,502 | 115 | 13 | 98860 | 28826188 | 104 | 14780 | 1476609 |
| Montana | 878810 | 7.1 | 15.5% | $29,672 | 56 | 21 | 24279 | 58607778 | 49 | 4899 | 2635081 |
| Nebraska | 1656870 | 6.0 | 9.6% | $35,337 | 93 | 70 | 51454 | 45525414 | 92 | 9402 | 1181808 |
| Nevada | 1676809 | 13.4 | 10.7% | $39,280 | 17 | 0 | 2829 | 6409288 | 1 | 52 | Withheld |
| New Hampshire | 1172709 | 2.0 | 7.5% | $42,023 | 10 | 0 | 2937 | 415031 | 3 | 59 | 2737 |
| New Jersey | 8052849 | 19.7 | 9.3% | $47,903 | 21 | 0 | 9101 | 832600 | 11 | 107 | 2425 |
| New Mexico | 1729751 | 13.0 | 19.3% | $30,836 | 33 | 7 | 14094 | 45787108 | 17 | 1158 | 428448 |
| New York | 18137226 | 23.1 | 15.6% | $36,369 | 58 | 0 | 31757 | 7254470 | 49 | 1762 | 84827 |
| North Carolina | 7425183 | 24.6 | 12.6% | $35,320 | 100 | 6 | 49406 | 9122379 | 83 | 3328 | 133346 |
| North Dakota | 640883 | 6.9 | 12.5% | $31,764 | 53 | 28 | 30504 | 39359346 | 53 | 10079 | 2538335 |

*Table 2.3-3. State Level Summary of Population, Farming, and CRP Participation*

| State | Total Population 1997 est. | Percent Minority | Percent Poverty | Median Household Income | Total Counties | Agriculture Dependent Counties (1) | Total Farms | Land in Farms | CRP Counties | Farms with CRP or WRP Land | CRP or WRP Land |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ohio | 11186331 | 12.6 | 11.0% | $36,029 | 88 | 0 | 68591 | 14103085 | 85 | 8193 | 350123 |
| Oklahoma | 3317091 | 16.8 | 16.3% | $30,002 | 77 | 19 | 74214 | 33218677 | 65 | 5443 | 955313 |
| Oregon | 3243487 | 6.2 | 11.6% | $37,284 | 36 | 8 | 34030 | 17449293 | 24 | 1512 | 492735 |
| Pennsylvania | 12019661 | 11.3 | 10.9% | $37,267 | 67 | 0 | 45457 | 7167906 | 60 | 1971 | 93444 |
| Rhode Island | 987429 | 7.3 | 11.2% | $36,699 | 5 | 0 | 735 | 55256 | 0 | 5 | Withheld |
| South Carolina | 3760181 | 31.2 | 14.9% | $33,325 | 46 | 1 | 20189 | 4593452 | 46 | 2811 | 218211 |
| South Dakota | 737973 | 9.0 | 14.0% | $31,354 | 66 | 49 | 31284 | 44354880 | 66 | 6632 | 1454341 |
| Tennessee | 5368198 | 17.6 | 13.6% | $32,047 | 95 | 1 | 76818 | 11122363 | 80 | 5357 | 335299 |
| Texas | 19439337 | 15.3 | 16.7% | $34,478 | 254 | 65 | 194301 | 131308286 | 181 | 13522 | 3418277 |
| Utah | 2059148 | 4.6 | 10.0% | $38,884 | 29 | 3 | 14181 | 12024661 | 13 | 845 | 228701 |
| Vermont | 588978 | 1.8 | 9.7% | $35,210 | 14 | 0 | 5828 | 1262155 | 6 | 116 | 8289 |
| Virginia | 6733996 | 23.4 | 11.6% | $40,209 | 96 | 2 | 41095 | 8228226 | 82 | 2144 | 90681 |
| Washington | 5610362 | 10.6 | 10.2% | $41,715 | 39 | 11 | 29011 | 15179710 | 23 | 2431 | 931706 |
| West Virginia | 1815787 | 3.2 | 16.8% | $27,432 | 55 | 0 | 17772 | 3455532 | 14 | 229 | 7822 |
| Wisconsin | 5169677 | 7.8 | 9.2% | $39,800 | 72 | 6 | 65602 | 14900205 | 68 | 11907 | 593739 |
| Wyoming | 479743 | 3.8 | 12.0% | $33,197 | 23 | 0 | 9232 | 34088692 | 12 | 550 | 229607 |
| U.S. | 259195652 | | | $37,005 | 3066 | 556 | 1905838 | 929475139 | 2461 | 263145 | 7516673 |

Sources: U.S. Census of Population, USA Counties; 1997 Census of Agriculture
Notes: (1) Based on USDA ERS County Typology (Cook and Mizer, 1994)

### *2.3.1.4 Environmental Justice Populations*

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that Federal Agencies consider as a part of their action, any disproportionately high and adverse human health or environmental effects to minority and low-income populations. Agencies are required to ensure that these potential effects are identified and addressed.

EPA defines environmental justice as, "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." In this context, fair treatment means that no group of people should bear a disproportionate share of negative environmental consequences resulting from the action.

Consideration of the potential consequences of the proposed action for environmental justice requires three main components:

- A demographic assessment of the affected community to identify the presence of minority or low income populations that may be potentially affected;
- An integrated assessment of all potential impacts identified to determine if any result in a disproportionately high and adverse impact to these groups; and
- Involvement of the affected communities in the decision-making process and the formation of any mitigation strategies.

USDA's strategy for implementing E.O. 12898 is to incorporate environmental justice considerations into USDA's programs and activities and to address environmental justice across mission areas and to identify and prevent to the greatest extent practicable, disproportionately high and adverse human health or environmental effects of USDA programs and activities on minority and low-income populations (USDA REGS).

<u>Minority Populations</u>

According to the U.S. Census of Agriculture (USDA, 1997), there were 29,397 full time minority farm owners in the U.S. in 1997. This represents an increase of 3.4 percent over the previous decade. An additional 11,472 minority individuals were part owners in 1997. Minority tenant farmers included approximately 6,789 individuals. Combined, the total land in farms operated by minority owners, part owners, and tenants included 58,738,577 acres. Of this acreage, tenant farms represented the smallest acreage total, 2,192,725 acres. The distribution of minority farms in the U.S. is illustrated in Figure 2.3-2 below.

Limited Resource Farmers

Limited resource farms include any small farm with gross sales less than $100,000, total farm assets less $150,000, and total operator household income less than $20,000. In 1998, limited resource farms accounted for 7.3 percent of all farms and 0.8 percent of total farm production. Collectively, they controlled approximately 1.1 percent of total farm assets and 1.2 percent of all farmland owned (Hoppe, 2001). Table 2.3-4 provides summary data for limited resource farms in the U.S.

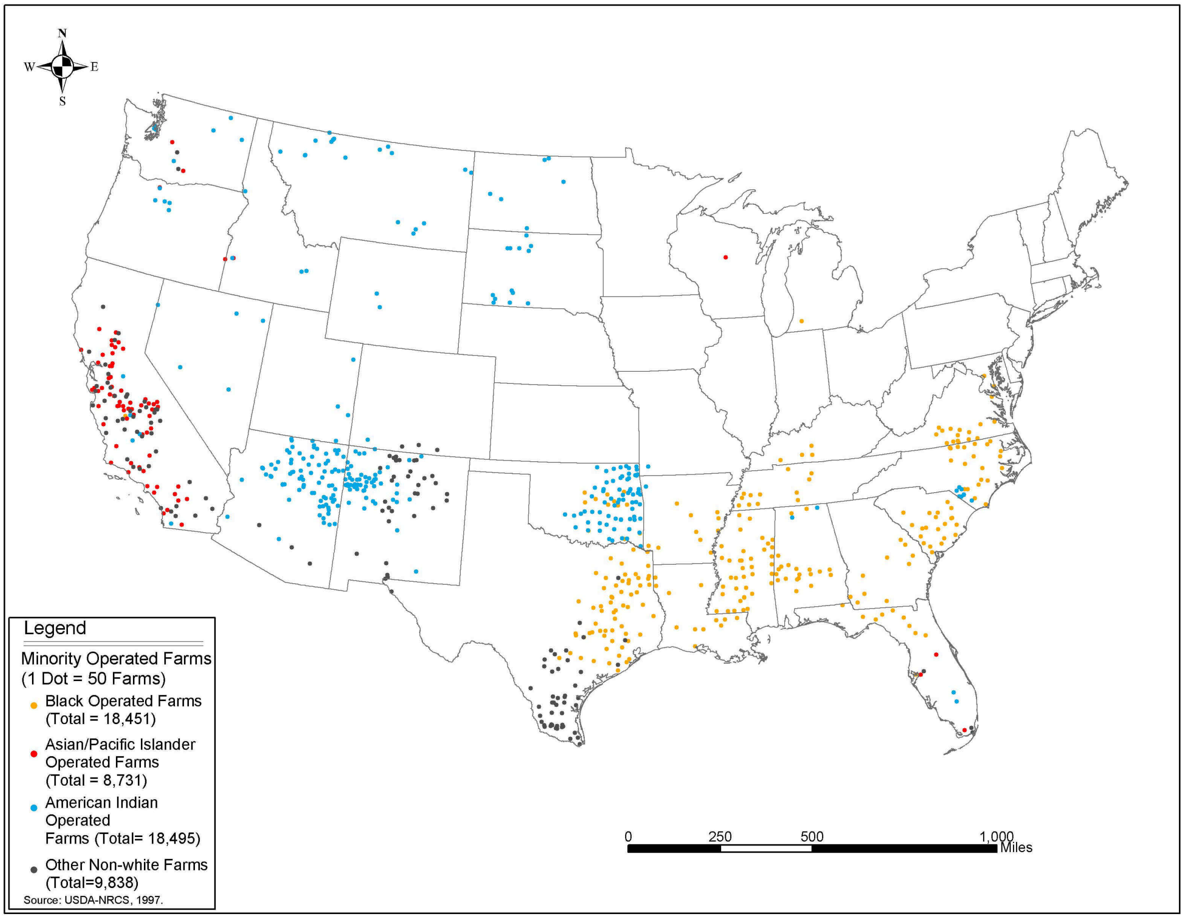



*Fig. 2.3-2. Distribution of Minority Farms in the U.S., 1997*

| *Table 2.3-4. Comparison of Limited Resource Farms to All Farming Types* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Small Family Farms** | | | | | **Large Family Farms** | **Very Large Family Farms** | **Non Family Farms** | **All Farms** |
| | **Limited Resource** | **Retire ment** | **Residential Lifestyle** | **Farming Occupation** | | | | | |
| | | | | **Low Sales** | **High Sales** | | | | |
| **Number** | | | | | | | | | |
| Total Farms | 128,674 | 320,055 | 913,876 | 453,791 | 171,824 | 78,382 | 54,886 | 44,572 | 2,166,060 |
| **Percent of U.S. Total** | | | | | | | | | |
| Farms | 5.9 | 14.8 | 42.2 | 21 | 7.9 | 3.6 | 2.5 | 2.1 | 100 |
| CRP and WRP Payment | 3.7 | 22.1 | 23.5 | 18.4 | 12.4 | 11.3 | 3.5 | 5.1 | 100 |
| Land Enrolled in CRP or WRP | 4.3 | 18.2 | 21.1 | 20 | 14.2 | 13.8 | 3.6 | 4.8 | 100 |
| **Percent of Group** | | | | | | | | | |
| Receive Gov. Payment *** | 23.8 | 37.2 | 31.1 | 51.7 | 81.2 | 83.2 | 70.2 | 46.3 | 43 |
| CRP and WRP | 12 | 20.3 | 7.3 | 8.6 | 13.2 | 18.9 | 11.6 | *15.3 | 10.9 |
| **Percent of Land Operated** | | | | | | | | | |
| Land Enrolled in CRP or WRP | NA | 43.3 | 32.3 | 20.5 | 12.4 | *10.2 | 4.7 | **10.5 | 17.1 |
| **Dollars per Participating Firm** | | | | | | | | | |
| Total Gov. Payment *** | 3,767 | 3,980 | 5,373 | 9,500 | 28,897 | 57,430 | 85,345 | 32,788 | 17,258 |
| CRP and WRP | 2,862 | 4,101 | 4,243 | 5,671 | 6,588 | 9,183 | 6,529 | 8,915 | 5,078 |

Source: USDA, ERS, based on 2000 Agricultural Resource Management Survey data.
Notes: NA indicates that data has been suppressed due to insufficient observations.
* The standard error exceeds 25 percent of the estimate, but it is no more than 50 percent of the estimate.
** The standard error exceeds 50 percent of the estimate, but it is no more than 75 percent of the estimate.
*** Includes EQIP, not shown separately.

## 2.3.2 Economy of U.S. Farming and Farm Communities

Since the beginning of the CRP in 1985, some have raised concerns about the program's local economic impacts. Changes in rural economies cannot be solely tied to land retirement programs, i.e. correlation does not always mean causation. Land retirement programs have existed in one form or the other since the mid-1930s. [For further information on Land

Retirement Programs see text box below.] The lack of continuity between programs means that there have been cycles of land retirement, with increases in input demand between programs, and a decline during the programs.

Economic impacts of the CRP may be felt on-site or off-site, may be beneficial or adverse, and may be at the local (i.e. county, township or farm-level), regional or national level. On-site impacts, which are by nature at the farm level, may include (Young and Osborn, 1990; Ribaudo et. al., 1990; Hughes et. al., 1995):

- Preservation of soil productivity
- Improvement in water quality
- Increase wildlife habitat
- Increase in land value
- Decreased income variability
- Un- or under-employment of production and marketing resources
- Decreased cost of sedimentation removal from drainage ditches

Off-site impacts at the local and regional level can include (Napier, 1987; Woods and Sanders, 1987; Ribaudo et. al., 1990; Young and Osborn, 1990; ERS, 1991):

- Decline in agricultural services business and employment
- Shift in local spending patterns from one economic sector to another
- Increases in land values and land rents
- Improved recreational opportunities for residents
- Increased expenditures by non-residents on recreational services such as hunting and fishing
- Decreased cost of sedimentation removal from reservoirs
- Decreased water treatment costs
- Reductions in damage from air pollution including maintenance, cleaning, machinery, and health costs
- Damages avoided from sedimentation that causes flooding and blocks navigation channels

Off-site impacts at the national level may include (Bartlett, 1987, Woods and Sanders, 1987; Ribaudo et. al., 1990; De La Torre Ugarte et. al., 1995, FSA, 1997; ERS, 2000a):

- Increasing consumer food prices
- Decreased costs of surplus commodity price supports
- Increased government cost of rental and cost share payments
- Carbon sequestration
- Recovery of declining wildlife populations
- Reduced net loss of wetlands
- Reduced exports
- Reduced agricultural equipment sales and input expenditures

**Land Retirement Programs**

Land idling and retirement programs have been in use since the 1930s. Some programs required the planting of soil conserving crops, while others did not. The primary purposes of land retirement programs have included one or more of the following: supply control, income support and erosion control.

**Agricultural Adjustment Act of 1933:** First major price support and acreage reduction program. Producers were paid to reduce their acreage of cotton, wheat, corn, rye, tobacco, hogs and milk.

**Soil Conservation and Domestic Allotment Act of 1936:** Producers were paid to plant soil-conserving covers instead of soil-depleting crops.

**Agricultural Act of 1956:** Created the Soil Bank to control surplus commodities. The two programs in the Soil Bank were the Acreage Reserve Program and the Conservation Reserve Program. The ARP paid farmers to reduce their plantings of wheat, cotton, corn, tobacco, peanuts and rice. It was ended after two years because of high costs. The CRP provided 3 – 10 year contracts to retire land with no requirements on land cover from 1959-1972. Over 30 million acres was enrolled by 1960. Enrolled land did not have to meet erodibility requirements. The Soil Bank Program may have caused economic stress in agriculturally-dependent areas where enrollment was high.

**Payment-in-Kind of 1983:** The program was initiated to reduce surplus commodities. In return for a producer idling grain, upland cotton and rice land, they received payments for commodities.

**Acreage Reduction Program:** The program was initiated with the Emergency Feed Grain Program of 1961 and applied to corn and sorghum. It was later extended to wheat, feed grains, cotton, and rice. The ARP was an annual cropland retirement program in which farmers, in order to be eligible for nonrecourse loans and deficiency payments, were mandated to idle a crop-specific, nationally set portion of their base acreage during years of surplus. The idled acreage was devoted to a conserving use. The goal was to reduce supplies, thereby raising market prices. Additionally, idled acres did not earn deficiency payments, thus reducing commodity program costs. The FAIR Act of 1996 did not reauthorize authority for ARPs.

**Set Aside Program:** A program (not used since the late 1970s) under which farmers are required to set aside a certain percentage of their total planted acreage and devote this land to approved conservation uses (such as grasses, legumes, and small grain which is not allowed to mature) in order to be eligible for nonrecourse loans and deficiency payments. Set-aside acreage was based on the number of acres a farmer actually planted in the program year as opposed to being based on prior crop years. The authority for set-aside was eliminated by the FAIR Act of 1996. This program differs from the acreage reduction program in that specific crops were not targeted (UHCA, Various).

**Paid Diversion:** A program, repealed by the FAIR Act of 1996, under which farmers were paid to voluntarily take acreage out of production. The diverted land was devoted to approved conservation practices (UHCA, various). Unlike acreage reduction and set-aside programs, participation in a paid diversion program was not normally a condition of eligibility for other support program benefits. Paid diversion was often coupled with Payment-In-Kind certificates in which producers that agreed to divert land received payments in the form of crops from CCC stocks.

**Food Security Act of 1985:** Created the Conservation Reserve Program to reduce erosion on highly erodible lands, provide food security through soil productivity maintenance, improve water quality, create wildlife habitat; control surplus commodities, and provide income support. Also created the 50/92 for cotton and rice producers program in which deficiency payments on 92% of land were provided if at 50 - 85% of permitted acreage is planted and the rest is in soil conserving uses. A similar program, 0/92, was created in 1988 for wheat and feed grain producers.

Source: (Outlaw and Klose, 2002; Smith, 2000; Abel, Daft & Earley, 1994; Young and Osborn, 1990; UHCA, various).

In the rest of this section, information is presented in two areas with the potential to be impacted the most by CRP: (1) local economic conditions and (2) cropland supply and value. Local economic conditions include an examination of employment trends, tourism spending, and spending on agricultural inputs. Cropland supply and value affects the affordability of land for rent and crop output. Crop output is influenced by the yield produced on the non-idled acres and the amount of land harvested.

### *2.3.2.1 The Rural Economy and CRP*

When land is enrolled in CRP, the inputs necessary for production may no longer be needed, except in the initial period when the cover is being established. The operator no longer purchases seed, fertilizer, and pesticides at the local supplier. He or she no longer needs to hire labor to plant and harvest. The operator is no longer producing crops on the enrolled land that need to be stored locally or distributed. As demand for productive inputs and agricultural-related services declines, the businesses selling these products and services may no longer need to have the same capacity or need to employ as many people, all other factors being equal.

The size of the decline in farming-sector jobs and output is dependent not only on how much land is enrolled in the CRP, but the operator's reaction to this enrollment. Agricultural chemicals and labor may be applied more intensively to the remaining cropland to increase yields and non-cultivated land may be brought into production (see the discussion on 'Slippage' below for more information). Nevertheless, the overall effect on non-diversified local and regional economic conditions has the potential to be adverse.

<u>Employment in the Agricultural Sector of the Economy</u>

Employment within the agricultural sector of the economy is comprised of farm employment, agricultural services, forestry and fishing, and other miscellaneous categories. Farm employment figures reflect the number of paid agricultural production workers on farms, including paid family members. Agricultural services, forestry and fishing and other employment figures are the number of persons employed in these industries, and can include the number of persons working on the farm as well as off-farm workers involved in providing services to farm operators (NAICS, 1997; Albetski, 2002). [For further explanation of the composition of the Agricultural Services, Forestry and Fishing, and Other category see text box below.]

Farm employment in the U.S. increased 46 percent from 1980 to 2000, from 46,902,000 to 68,574,000, while non-farm employment grew at a similar rate of 47 percent. Agricultural services employment increased 138 percent during the same period, from 891,000 to 2,123,000. This latter figure is more reflective of natural resource based employment (excluding mining) since the category reported by the Bureau of Economic Analysis (BEA) is based on the U.S. Economic Census definition, which includes fishing and forestry employment in the statistic. [For further information on trends in farm and agricultural services see Appendix F.]

These are national figures, however, and may mask regional trends positive. On-farm employment decreased in five regions of the Nation and increased in another five. The Appalachian, Delta, Mountain and Northern Plains regions had declines of 26 – 32 percent, while

Agricultural Services, Forestry and Fishing, and Other

This employment category includes persons employed by agricultural services, forestry, commercial fishing, hunting and trapping, and related businesses.

Agricultural services include establishments primarily engaged in supplying soil preparation services, crop services, landscape and horticultural services, veterinary and other animal services, and farm labor and management services.

Forestry includes establishments primarily engaged in the operation of timber tracts, tree farms, or forest nurseries; in the gathering of forest products; or in performing forestry services. It does not include logging firms.

The fishing category includes businesses primarily engaged in commercial fishing (including shellfish and marine products); in operating fish hatcheries and fish and game preserves; and game preserves (commercial), game propagation, animal hunting, and game retreats.

Source: (Economic Census, 1997; NAICS, 2002).

the Southeast experienced a more moderate 3 percent drop (see Table 2.3-5). Non-farm employment experienced similar drops in the Appalachian, Delta and Northern Plains regions, indicating that the decline in employment was an overall economic trend, not one specific to the agricultural sector. The decline of farm employment in the Mountain region was clearly offset by increases in off-farm employment. This occurred to a lesser extent in the Southeast region. The Corn Belt and Southern Plains regions were the only ones where the growth in farm employment exceeded the growth in non-farm employment.

*Table 2.3-5. Change in Farm and Non-Farm Employment, 1980-2000, By Region*

| | **Change, 1980-2000** | | |
|---|---|---|---|
| **Region** | **Non-Farm Employment** | **Farm Employment** | **Ag. Services, Forestry, Fishing, & Other** |
| Appalachia | -23% | -26% | 194% |
| Corn Belt | 30% | 57% | 180% |
| Delta | -25% | -27% | 151% |
| Lake States | 43% | 36% | 167% |
| Mountain | 12% | -32% | 204% |
| Northeast | 57% | 36% | 113% |
| Northern Plains | -27% | -29% | 174% |
| Pacific | 77% | 46% | 101% |
| Southeast | 4% | -3% | 133% |
| Southern Plains | 61% | 93% | 160% |
| U.S. | 47% | 46% | 138% |

Source: (BEA, various); (ERS, various)

#### *2.3.2.2 The Agricultural Services Sector and the CRP*

Production Expenditures

When land is in production, operators purchase many of the inputs locally. The primary sectors of the economy where inputs are purchased are retail trade (e.g. seed, pesticide, fertilizer, and fuel), business and personal services (e.g. machinery repairs, custom farm operations, legal services) and finance, insurance and real estate (e.g. crop insurance, interest on borrowed capital).

When land is enrolled in the CRP, the only inputs that need to be purchased over the contract period are those needed to establish the cover crop and nominal maintenance expenses. The CRP rental payments may or may not be spent in these areas, depending on the operator's financial situation. CRP payments can be used to supplement household income, if the operator lives in the area, or it can be used to increase productivity on his or her remaining productive land or new land that is brought into production. In most cases, the net effect is that less rent is being spent in the agricultural services sector, and more of it is likely to leak out of the local economy. If the rental payment is used to supplement household income, a larger percentage is likely to be spent on goods and services where value is added outside the community. For example, when a t-shirt is purchased locally, typically only the retail mark-up remains with the local business. The rest of the value of the product was added in a foreign fabrication facility. When grain is stored in the local elevator, the money spent is paid out to local laborers.

The effect of CRP enrollment on local economic conditions differs across regions. As indicated by several studies, and comments received during the public scoping process, the areas most adversely impacted are the Northern Plains, Mountain, and Pacific regions, in particular, those areas where wheat growing is prevalent. Beneficial economic impacts occur primarily in the timber-growing States of the Southeast. Planting trees creates an asset base and future opportunities for logging at the end of the CRP contract, or later, if the trees have not yet reached optimum size. For instance, Moorhead and Dangerfield (1996) found that in Georgia, 500 jobs and a $9 million increase in annual personal income could be attributed to the CRP. The net benefits to landowners of cost-sharing tree-establishment costs and avoiding crop production losses were found to be $29 million.

Relationship of Agricultural Production Expenditures and the CRP Enrollment

CRP enrollment can have several impacts on local economic conditions. In its most simple form, the number of agricultural input sector jobs may decline due to lowered demand for seeds, agricultural chemicals, custom farm work, and fertilizer. At the same time, the number of employees in the timber and recreation industries may increase, as tree planting and, eventually, logging opportunities expand, and the improvement in wildlife habitat and water quality attracts hunters and fishermen. Livestock production may or may not increase as landowners turn to alternate sources of income on their non-cropland.

*Table 2.3-6. Distribution, By County, of Total Cropland Enrolled in the CRP & WRP*

| | No. Counties, By Region | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **% of Counties** | **Southeast** | **Northern Plains** | **Southern Plains** | **Corn Belt** | **Mountain** | **Pacific** | **Lake States** | **Total** |
| 0% | 70 | 3 | 92 | 10 | 47 | 9 | 16 | 247 |
| 1 - 5% | 186 | 182 | 136 | 350 | 46 | 39 | 98 | 1037 |
| 6 - 10% | 74 | 107 | 23 | 57 | 18 | 4 | 31 | 314 |
| 11 - 15% | 46 | 54 | 10 | 37 | 18 | 4 | 6 | 175 |
| 16 - 20% | 20 | 32 | 14 | 20 | 12 | 4 | 3 | 105 |
| 21- 25% | 10 | 16 | 26 | 14 | 28 | 6 | 1 | 101 |
| 26 - 30% | 6 | 5 | 18 | 7 | 12 | 3 | 0 | 51 |
| 31 - 35% | 0 | 2 | 3 | 0 | 5 | 2 | 0 | 12 |
| 36%+ | 5 | 3 | 4 | 0 | 3 | 1 | 0 | 16 |
| Total exceeding 20% | 21 | 26 | 51 | 21 | 48 | 12 | 1 | 180 |

Source: (FSA, 2002)
Note: * No. Counties is less than the actual number of counties in all of the States in each region because data is not available for all counties.

Southeast States: Alabama, Florida, Georgia, Mississippi, South Carolina
Northern Plains States: Kansas, Minnesota, Nebraska, North Dakota, South Dakota
Southern Plains States: Oklahoma, Texas
Corn Belt States: Illinois, Indiana, Iowa, Missouri, Ohio
Mountain States: Colorado, Idaho, Montana, New Mexico
Pacific States: Oregon, Washington
Lake States: Michigan, Wisconsin

As the number of acres enrolled in the CRP rises, the level of agricultural production expenditures should fall and the decline in agricultural production expenditures is likely to be higher in areas with high CRP and WRP enrollment. The 25 percent county cap on cropland enrollment in the CRP and WRP will tend to limit the potential impacts. Table 2.3-6 shows the distribution of land, by region, for counties with CRP enrollment. The Southern Plains and Mountain regions have the most counties where CRP enrollment exceeds the 20 percent of cropland, followed by the Southeast, Northern Plains and Corn Belt regions. In total, there are 180 counties that exceed 20 percent.

In some of these counties, operators may substitute livestock for crop production on land newly converted to pasture and range land potentially offsetting at least some of the decline in agricultural expenditures. Nevertheless, the businesses that supply inputs for crop production may not be the same as those that supply inputs for livestock production. This matter will be explored further in the Environmental Consequences section of the PEIS.

### *2.3.2.3 Tourism, Recreation and CRP*

One of the objectives of CRP and one of the benefits of land retirement in general is the creation of wildlife habitat. Wildlife, including upland birds, waterfowl, small and big game, are attracted to the conserved lands. The attraction of wildlife creates an environment conducive to consumptive (e.g. fishing and hunting) and nonconsumptive (e.g. wildlife viewing, hiking and photography) recreation. Another objective of CRP is to improve water quality. This also creates an environment conducive to consumptive recreation (e.g. swimming and boating). Improved recreational opportunities attract both in- and out-of-State residents. As tourism improves, money external to the local economy is expended in a community or region, at least partially offsetting the decline in agricultural expenditures that has been attributed to CRP. This has been particularly true in areas under migratory bird routes because the birds and waterfowl now have places to sojourn.

Recreational benefits have been linked to CRP in several studies. A reduction in the runoff of pollutants and soil erosion into waterways improves the physical and biological attributes and makes for more hospitable aquatic habitat and swimming areas. These benefits do not happen overnight, necessitating a length of time for the habitat to be restored and water quality to improve. Ribaudo (1989), for instance, found that recreational fishing benefits from the first five signups of CRP was $0. The first five signups occurred between March 1986 and July 1987, indicating less than a year of land retirement for the land enrolled, since enrollment years begin on October 1. However, he projected benefits of $229 million (in 1986 dollars) over the 10-year enrollment period once the then-maximum authorized 45 million acres was enrolled with many of the benefits occurring in the Appalachian and Corn Belt regions. Young and Osborn (1990) also estimated the recreational fishing benefits to be largest in these regions. Ribaudo and Piper (1991) estimated the net present value of water quality related angling benefits due to CRP over 10 years to be $46 million. Feather, Hellerstein and Hansen (1999) estimated freshwater recreation benefits from CRP in 1992 to be $36.35 million annually, with the largest benefits accruing in the more highly populated Northeast and Southeast regions of the Nation. Douglas and Johnson (2001) estimated recreation-related water quality benefits on a more local level, the Lower Klamath River basin, at $241 million annually.
Ribaudo et al. (1990) extended the analysis he did in 1989 by examining the size and distribution of CRP benefits under three different land targeting scenarios:

(1) The Forestry Scenario: land is targeted so that it is planted with trees after retirement.
(2) The Environmentally Sensitive Scenario: environmentally sensitive land is targeted.
(3) The Baseline Scenario: CRP retired land following the same manner in which it was being done from 1985-1987.

In the baseline scenario the largest share of benefits, 40 percent, is from improved wildlife habitat, followed by improved surface water quality at 37 percent. In the environmental and forestry scenarios, wildlife habitat and surface water quality benefits increase over the baseline while the benefits of improved soil productivity, air quality and groundwater quality remain constant. This is because these scenarios enroll more land from east of the Mississippi where wind erosion and groundwater supply problems are not as acute. Also, eastern States have higher population densities and resource demands, so almost all of the economic benefits are valued more highly than in the western States. The study was done before wetlands and farmed wetlands became eligible and the continuous enrollment program was established. Estimates suggest that water quality and wildlife habitat benefits would increase as a result of these changes.

Total wildlife benefits have not been estimated although pieces have been on a national basis. Young and Osborn (1990) estimated the benefits of small game hunting from CRP over 1986 – 1999 to range from $3.0 - $4.7 billion, with the largest amounts accruing in the Corn Belt and Lake States. The annual benefits were estimated at $440 million. They indicated that although wildlife-viewing benefits were not measured, they were likely to be the highest in the Lake and Corn Belt States that had the highest percentage gain in grassland habitat. John (1993) estimated the annual waterfowl hunting benefits at $180 million. Feather, Hellerstein and Hansen (1999) estimated the annual benefits of pheasant hunting to be $80.28 million, with the highest benefits accruing in the Northeastern and Northern Plains States. They estimated wildlife viewing benefits at a much larger $347.71 million annually with the largest benefits felt in the Northeast and Southern Plains States. The cost benefit analysis done for CRP in 1997 (USDA-FSA, 1997a) estimated consumptive and non-consumptive uses of wildlife to have an annual benefit of $2 billion.

The benefits are primarily measured as increases in participation that links to increased tourism expenditures. In most of the above referenced benefit studies, surface water quality benefits are effected through increased participation, i.e. existing fishermen fish more days in the affected waterbody and/or new fishermen are attracted to fish in the affected waterbody. Wildlife benefits are estimated as equivalent to increased number of days spent hunting. The forestry scenario generated the largest hunting benefits.

Most studies of the economic impact of CRP have concentrated on the affects on the agricultural production sector. There have not been many studies that have looked at the increase in tourism-related expenditures. Tourism was not viewed as a potentially large economic benefit at the beginning of the CRP program although it was seen as one way to diversify the economy (Harmon, 1987).

Most of the studies done on the impacts on tourism expenditures have been done in the Northern Plains States, North Dakota in particular. A 1998 study of the economic impacts of CRP mentioned the positive impact of recreation expenditures and their ability to offset some of the negative impacts of CRP (Leistritz, 1998). In a survey of CRP landowners, Hodur et al. (2002), found that 74 percent of respondents indicated that CRP had a positive impact on the number of hunters and the amount of time spent upland hunting. Sixty nine percent indicated a positive impact on big game hunting and 62 percent felt waterfowl hunting had been positively impacted. Approximately one-quarter of the respondents did not know if there had been an increase in participation. In a survey of local leaders, Hodur et al. (2002) found that almost 77 percent believed hunting and trapping had increased as a result of CRP, and 29 percent thought the increase to be substantial. Both landowners and local leaders thought that the impact on wildlife viewing and camping had been slight, if at all.

In the same study, 55 percent of landowners believed that convenience stores had experienced positive effects from CRP while 49 percent indicated a positive effect on restaurants and sporting goods stores. Other businesses that were thought to benefit, to a lesser extent, were taxidermy businesses and guides and outfitters. The local leaders' responses to these questions were consistent with the landowners' responses.

Another North Dakota study explicitly examined the economic effects of increased tourism expenditures due to CRP (Bangsund et al, 2002). The number of nonresident small game license sales had been fairly stable from 1975 through the early 1990s. From 1990 to 2000, nonresident small game license sales increased a substantial 340 percent. The number of nonresident waterfowl hunter licenses increased 356 percent from 1990 to 2000, reversing a downward trend. The percentage of nonresident pheasant hunter licenses had been increasing since 1975, but the increase accelerated after 1987. The number of nonresident pheasant hunters in 1996 – 2001 was 544 percent higher than in 1982-1986, with 90 percent of this increase attributed to the CRP. Seventy percent of the 40 percent increase in nonresident deer hunters was attributed to CRP.

Overall, the study found the number of nonresident hunter licenses in 1996 – 2000 was 332 percent higher than in 1982-1986. Although not all of this increase can be directly linked to CRP, these large increases defy national trends, which show a 7 percent decline in the number of hunters from 1991 – 2001. Most of this decrease occurred in small game and other animal hunting, not big game and migratory bird hunting (FWS, 2002). A comparison of the wildlife participation in North Dakota in the 1996 and 2001 National Surveys of Fishing, Hunting and Wildlife Associated Recreation (FWS, 2002 and 1997) is indicative of this trend: an imperceptible amount of nonresidents were observed in North Dakota in 1996, versus 190,000 observed in 2001. The adjacent State of Minnesota saw a similar increase, from 214,000 in 1996 to 2,155,000 in 2001.

**What is Cropland?**

Total cropland includes five components: cropland harvested, crop failure, cultivated summer fallow, cropland used only for pasture, and idle cropland.

**Cropland harvested** includes row crops and closely sown crops; tree fruits, small fruits, and tree nuts; vegetables; other minor crops and hay. (Double cropped acres were only counted once.)

**Crop failure** consists mainly of the acreage on which crops failed because of weather, insects, and diseases, but includes some land not harvested due to lack of labor, low market prices, or other factors. The acreage planted to cover and soil improvement crops not intended for harvest (including CRP land) is excluded.

**Cultivated summer fallow** refers to cropland in sub-humid regions of the Western U.S. cultivated for a season or more to control weeds and accumulate moisture before small grains are planted.

**Cropland used only for pasture** generally is considered in the long-term crop rotation, as being tilled, planted in field crops, and then re-seeded to pasture at varying intervals. However, some cropland pasture is marginal for crop uses and may remain in pasture indefinitely. This category also includes land that was used for pasture before crops reach maturity and some land used for pasture that could have been cropped without additional improvement. Cropland pasture and permanent grassland pasture have not always been clearly distinguished in agricultural surveys.

**Idle cropland** includes land in cover and soil improvement crops and completely idle cropland. Some cropland is idle each year for various physical and economic reasons. Acreage diverted from production under acreage set-asides and other Federal farm programs is included in this category. CRP is also included in this category.

Source: (ERSa, various)

The contribution of these non-resident hunters to the State economy was almost $5 million from 1996 – 2000. The increased expenditures by both resident and non-resident hunters from 1996 – 2000 offset an average of 25.6 percent of the negative economic impacts of CRP. County offsets ranged from a low of 10.6 percent to a high of 88.2 percent.

More research needs to be done on the impact of CRP on tourism expenditures. The available evidence supports a positive impact on both recreational opportunities and tourism expenditures, with the latter offsetting at least some of the negative economic effects of retiring productive cropland.

### *2.3.2.4 CRP and Land Allocation*

There are a number of factors that influence a landowner's land allocation decision. Most impact the financial feasibility of a particular land use. Acreage can have physical restrictions on use such as wetlands, access, soil productivity, and erosion potential, making specific uses financially infeasible. There are economic forces at work such as crop demand; costs of pesticides, fertilizer, hired labor and other inputs; presence of an agricultural support infrastructure; commodity programs; existence of off-farm employment opportunities; and development pressures that also narrow the land use decision. Regulatory constraints may involve risk trade-offs such as loss of price supports if one does not have crop insurance or farming highly erodible land without a conservation plan.

Non-monetary concerns also contribute to the decision. For instance, recreational use of the land, environmental benefits or damages avoided from a particular use, either on- or off-site; and attitudes towards environmental stewardship.

Cropland Acreage

As shown in Table 2.3-7, there were 420,954,000 acres of cropland in the United States in 1982 (NRCS, 2000). Over the next five years, cropland acres declined less than one percent. The decline accelerated slightly between 1987 and 1992, dropping by approximately 4 million acres (most of the 24 million acres was land that was enrolled in CRP). The CRP began in 1986 and by the end of Fiscal Year 1993 had 34 million acres enrolled (FSA, 2001). The CRP and land set asides were not the only reason for the decline in harvested acres. There were surplus commodity supplies and falling world commodity prices, contributing to economic stress in farming communities. Between 1992 and 1997 the decline rose slightly to 1.6 percent. The CRP enrollment increased slightly during this time, reaching 34.5 million by the end of Fiscal Year 1997. Lands enrolled in CRP are considered cropland when calculating total cropland acres.

***Table 2.3-7. Change In U.S. Cropland Acres***

| | Cropland Acres (000's) | % Change |
|---|---|---|
| 1982 | 420,954.0 | |
| 1987 | 420,440.2 | -0.1% |
| 1992 | 416,357.3 | -0.9% |
| 1997 | 409,693.9 | -1.6% |

#### *2.3.2.5 Slippage*

Slippage occurs when the amount of land an owner enrolls in CRP is partially or wholly offset by additional land that is brought into production. This phenomenon also occurs with other land retirement programs. Strategic sod-busting, a similar term, occurs when a landowner that enrolls land into the CRP places marginal and/or highly erodible land in crop production. Both practices have the effect of reducing the benefits gained from retiring land under the CRP, and impairing cost effectiveness. Participants in CRP and non-participants can be the instigators of slippage.

Slippage has been identified as an undesirable effect of CRP since it may offset part of economic and environmental benefits (Roberts, 2002; Wu, 2000; Leathers and Harrington, 2000). In effect, there is less than a one-to-one correspondence between the land enrolled in CRP and the land under cultivation (Wu, 2000; Roberts and Bucholtz, 2002). The reduction of output supply and cultivated acreage is not proportional to the land set aside by CRP if either new non-cropland is converted to cropland or yields of the crops increase on non-retired land.

Slippage was foreseen as a potential problem from CRPs inception. Slippage had also been identified as a problem with the previous acreage reduction programs. Slippage estimates have varied substantially. Six studies of slippage were done using all or subsets of data from 1956 – 1984. As reported in Leathers and Harrington (2000), slippage rates from these earlier studies ranged from 0 percent for wheat in 1978 to 100 percent for corn in the same year. Love and Foster (1990) found slippage rates for wheat in the 29 – 37 percent range and for corn in the 48 – 58 percent range. Prior regional studies of the slippage on all cropland ranged from 30 – 55 percent.

There have also been several more recent studies of slippage. Wu (2000) estimated nationwide slippage to be 20 percent. He found slippage to be higher in the Corn Belt region (30 percent) and lower in the Lake States and Northern Plains regions (16 and 15 percent respectively). A reduction in overall water quality benefits due to slippage has been estimated at about 5 – 10 percent (Wu, 2000; Ribaudo, 1989). Goodwin and Smith (2000) estimate nationwide slippage at about 25 percent. They found that about 25 percent of the erosion reduction due to CRP had been offset by increased erosion that results from crop insurance, disaster relief and other income support programs. Since most of the other land retirement programs besides the CRP and WRP ended in 1992, it is possible to estimate the effects of CRP slippage alone. Slippage rates in southwestern Kansas in 1993 and 1994 were estimated at 28 and 41 percent, respectively. This compares with 57 percent from 1988-1992, when two other land reserve programs were active in southwestern Kansas (Leathers and Harrington, 2000).

The most recent study by Roberts and Bucholtz (2002) has indicated that prior slippage estimates may have been erroneous due to omitted variable bias. That is, earlier studies failed to account for variable land quality and other regional factors that influence CRP enrollment. After controlling for these factors, Roberts and Bucholtz found that up to 30 percent of slippage might be in the form of new hay plantings, causing a nominal change in erosion.

Types of Slippage

There are two types of slippage: production and acreage. CRP can affect both. Production slippage occurs when, in response to a decrease of planted acres due to enrollment in CRP, a farmer produces more intensely on the remaining land. This would affect not only the yield per acre but involve the application of more fertilizer and pesticide. There could be adverse environmental impacts on soil erosion, water quality and wildlife habitat from this supply response.

This type of slippage may also occur if the fallow period is shortened (Roberts and Bucholtz, 2002). As an example, suppose that a 100-acre farm has a rotation of two years cropland and eight years grassland. Twenty-five acres are assigned to crops while the other 75 acres are allocated to grassland during any particular year. Suppose that after the two years of crops the farmer enrolls 25 acres in the CRP, and continues with the same rotation on the remaining 75 acres. He then converts 18.75 acres of grassland to crops, which are going to be in crops for two years and then return to grassland. Although the CRP enrolled 25 acres, the net land set-aside from production is just 6.25 acres per year. Alternately, if the higher yield comes from improved technology or more intensive labor, there may not be adverse environmental impacts (Roberts and Bucholtz, 2002).

Acreage slippage occurs when, in response to a decrease in planted acres due to enrollment in CRP, a farmer converts non-cropland to cropland. This acreage slippage can involve the conversion of land by the CRP contract holder (Wu, 2000), or by non-enrolled operators, who want to fill the reduction in agricultural production, and take advantage of any increase in commodity price (Leathers and Harrington, 2000). Roberts and Bucholtz (2002) found this type of slippage to be approximately zero for major commodity crops but up to 30 percent for conversion of pastureland to hay plantings. The environmental damages of this substitution effects are mitigated somewhat through the conservation compliance and sodbuster provisions of the 1985 Food Security Act.

Roberts and Bucholtz (2002) found that acreage slippage was approximately zero for major commodity crops and up to 30 percent for the conversion of pastureland to hay plantings. They surmise that the largest category of slippage may be the conversion of fallow land to cropland.

Factors Other than CRP that Can Cause Slippage

In addition to CRP, there are other factors that may affect the slippage rate, including changes in crop prices relative to other farm outputs, efficiency of production, and technological progress. If crop prices increase, farmers have an incentive to cultivate additional land or to intensify cultivation on non-retired land. Since one of the outcomes can be the reduction in crop supply, CRP sometimes may have the effect of raising crop prices and providing an incentive to the farmer to crop more intensively his other land or to convert marginal land to crops.

Technological change and efficiency of production (Hoag et. al., 1993) are two factors that can have similar effects as slippage. Given new technology, farmers may increase yields by using inputs more effectively or at less cost, raising productivity. For example, as shown in Table 2.3-11, from 1960-1996 the geometric mean of annual growth rate of total factor productivity in U.S. agriculture was 2.00 percent. Part of this increment comes from the fact that yields from the crops increased at the rate of 1.86 percent, while total inputs were reduced by 0.35 percent during the same period. Increases in output due to technological change and efficiency of production do not necessarily cause an increase in erosion or runoff, as sod-busting does. In addition, this type of yield slippage may have positive economic impacts, by making a farm more competitive.

*Table 2.3-8. Annual Growth Rate in Total Factor Productivity, Crops, and Agricultural Inputs Indices, U.S. (1960-1996)*

| Average | Total Factor Productivity Growth | Total Crops Index | Intermediate Input Index | Capital Index | Labor Index | Land Index | Total Input Index |
|---|---|---|---|---|---|---|---|
| 1960-66 | 2.50% | 0.40% | 0.80% | 0.60% | -4.70% | -2.10% | -1.20% |
| 1966-69 | 2.90% | 2.70% | 1.10% | 2.40% | -4.80% | -1.40% | -1.00% |
| 1969-73 | 1.70% | 2.50% | 0.50% | 1.10% | -0.90% | -0.10% | 0.10% |
| 1973-79 | 0.70% | 3.10% | 3.00% | 2.90% | -1.60% | -0.80% | 1.30% |
| 1979-89 | 2.20% | 0.50% | -1.20% | -2.10% | -2.00% | -1.10% | -1.50% |
| 1989-96 | 2.00% | 2.00% | 1.40% | -1.70% | -1.30% | -0.20% | 0.20% |
| Geometric Mean*, 1960-1996 | 2.00% | 1.86% | 0.93% | -0.53% | -2.56% | -0.95% | -0.35% |

* The geometric mean is used to calculate an accurate average when there is compound growth occurring.
Source: Ball et. al., 2001

### *2.3.2.6 Societal Benefits and Costs of CRP*

There are environmental and economic benefits and costs of the CRP. Some of these benefits and costs affect the quantity and quality of goods and services received by society (e.g. recreational fishing water quality, air quality, the costs of cleaning sediment from drainage ditches, the cost of treating groundwater, etc.).

Some of these benefits and costs are transferred payments in which funds are shifted from one sector of the economy to another (Jaroszerwski, Poe and Boisvert, 2000; Smith, 2000; Osborn, 1997; Hughes et. al., 1995; Young and Osborn, 1990). Transfer payments do not directly result in changes in the quantity or quality of goods and services provided in society, since no new output is being created. Price support and CRP rental payments are transfers from the taxpayers to landowners. Typically, the costs and benefits of transfer payments cancel out. A $100 rental payment from the CCC to a landowner is a cost to the Government but a benefit to the landowner. One USDA analysis indicates that wheat, corn and soybean prices would rise 12, 15 and 13 percent respectively, compared with no CRP (Smith, 2000). From an economic stance, this cost is a transfer from consumers to producers and is a wash in cost-benefit calculation. There are social impacts, however, from this re-distribution of funds. For instance, higher food costs disproportionately impact low-income consumers who spend a higher percentage of their income on food than high-income consumers do. The impacts wrought by the spending of dollars in the Government sector versus the household sector are studied in economic impact studies, which examine the distribution of employment, sector income and household income. Economic impacts are addressed in a subsequent section.

It should be noted that some of the most comprehensive cost-benefit studies of the CRP have been done by the USDA-ERS, and include increases in food prices that may result from a decrease in the supply of cropland available for cultivation, and transfer costs (USDA-FSA, 1997b; Barbarika and Langly, 1992; Young and Osborn, 1990).

The costs of CRP are more easily quantified and monetized than the benefits. It is an easier task to estimate the costs that would be avoided of mostly marketed goods and the government payments made than it is to estimate the benefits of environmental goods, with the latter including items like improved water quality, restoration of wetland functions and endangered species habitat, and wildlife viewing. Non-market valuation techniques are typically used to estimate these benefits. These techniques include direct methods, such as contingent value, contingent choice and contingent behavior surveys, and indirect methods, such as averting expenditure and cost of production studies, and hedonic property and travel cost valuation models. The contingent valuation method, the direct method, which is the most commonly used, involves surveys of stakeholders and the public concerning hypothetical conditions. The indirect methods are based on observable market transactions (e.g. expenditures to treat polluted water, production costs, home sale prices, and travel costs to a recreational site). In both direct and indirect methods, a statistical model is run and the implicit or marginal price of an environmental quality attribute is estimated. Courts and peer review have alternately upheld the results of these studies as best estimates or criticized them for their bias or misspecification. Study methods employed are often restricted by time and funding availability. The result is that not all of the benefits of CRP have been quantified to date.

Since it has been difficult to quantify all of the benefits of CRP, non-market valuation and structural modeling techniques have been used to quantify, and often monetize what are thought to be the major ones and those whose improvements are listed as the CRP's primary objectives. USDA-FSA (1997b) monetizes the improvement to surface water quality but states the benefit of fertilizer and pesticide reduction in tons used. Classen, Hansen et al (2001) monetize the benefits of soil erosion reduction and wildlife habitat improvement, and indicate that other benefits not quantified in their analysis are increases in waterfowl populations, cleaner coastal and estuarine recreation areas, improved survival of threatened and endangered species, and improved quality of commercial fisheries. USDA-ERS (2000a and b) contains comprehensive lists of environmental benefits.

Several studies have not directly valued changes in all resources from CRP, but have modeled changes in net returns to farmers from changes in these resources. Ribaudo, Colacicco et al. (1990), Moorhead and Dangerfield (1996), and Goodwin and Smith (2001) estimate the tons of soil erosion reduction under CRP as well as income changes due to improved soil productivity and reduced fertilizer usage. De La Torre Ugarte et al. (1998) use the POLYSIS model of the economy, which includes demand, supply and environment modules, to estimate changes in net returns to farmers from changes in soil erosion, N and P runoff and leaching, nutrient availability, organic C, soil structure and pH, water-holding capacity and, and pesticide indicators.

More prevalent than comprehensive cost-benefit studies are CRP benefit studies. These include:

- Water quality improvements that benefit recreation, reduce dredging and water treatment costs and improve the productivity of commercial fisheries (Ribaudo, 1989);
- Improved soil productivity, groundwater supply, water and air quality, and wildlife habitat (Ribaudo and Colacicco, 1990);
- Improved freshwater recreation, pheasant hunting and wildlife viewing (Feather et al., 1999)
- Improved lake water recreation (Douglas and Johnson, 2001; Feather and Hellerstein, 1997);
- Increased 'social benefits' from CREP in New York (Jaroszerwski, Poe and Boisvert, 2000);
- Improved freshwater recreation, soil productivity, health, wildlife viewing and pheasant hunting (Claasen, Hansen et al., 2001); and
- Recreation water quality improvements.

In a comprehensive analysis of benefits, wildlife habitat improvements have been found to comprise the largest single category (USDA-FSA, 1997b; Hoag, 1999).

## Benefits and Costs of CRP

**Benefits**

- Decreased costs of surplus commodity production and storage
- Increased future supplies of timber
- Lower administrative costs for conservation compliance, sodbuster, swampbuster
- Improvement in groundwater quality
- Improve surface water quality
- Reduced irrigation pumping costs
- Higher farm income due to price increases
- Increase in farm wealth/asset base due to timber
- Protect soil productivity/food production asset base
- Reduce wind erosion/improve air quality
- Consumptive benefits of small and big game wildlife (=hunting, fishing, sporting clays)
- Improve groundwater quality
- Savings on groundwater pumping and treatment costs
- Aesthetic improvements
- Nonconsumptive benefits of wildlife (=viewing; camping, hiking, picnicking, nature study, photography, ecological value)
- Improved wildlife habitat.
- Decreased pesticide use
- Freshwater-based recreation
- Threatened and endangered species protection
- Reduced nutrient damages
- Reduced flooding damages
- Carbon sequestration
- Reduced dredging costs
- Cleaner coastal and estuarine recreation areas
- Improved quality of commercial fisheries
- Income stability
- Decreased need for credit
- Increased land values
- Increase in reservoir capacity from lower sedimentation

Sources: (Claasen, Hansen et al., 2001); (Hughes et al., 1995); (Vanderhoe, 1995); (Young and Osborn, 1990); (Ribaudo, Colacicco et al., 1990); (Ribaudo, 1989).

**Costs**

- Higher production costs from crop restructuring and a reduction of acreage over which to spread fixed production costs
- CRP administrative costs
- Costs to farmers and government to establish cover crops
- Technical assistance costs
- Increased consumer (domestic and foreign) food costs
- Rental cost payments
- Negative impacts on local farm economies from decreased demand for agricultural inputs, labor, crop storage and processing
- Increase in noxious weeds

Sources: (USDA-FSA, 1997b); (Hughes et al., 1995); (Young and Osborn, 1990).