USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Conservation Effects Assessment Project

March 2022

Conservation Practices on Cultivated Cropland

A Comparison of CEAP I and CEAP II Survey Data and Modeling

Cover Photo: Lynn Betts, NRCS. Conservation tillage system that leaves at least 30 percent of the soil covered after planting with last year's crop residue. North-central Iowa. Residue adequately controls erosion by both wind and water on this soil type. Photo ID NRCS IA99102

CEAP National Report: Conservation Practices on Cultivated Cropland

Executive Summary

The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) evaluates conservation trends and effects on cultivated cropland through the multiagency Conservation Effects Assessment Project (CEAP), a sampling and modeling approach using natural resource data and farmer surveys. The first set of farmer surveys was conducted in 2003–06 (CEAP I) with reports released from 2010 through 2014. Now, comparison data from farmer surveys conducted in 2013–16 (CEAP II) make it possible to estimate conservation adoption and effects between the CEAP survey periods.

The agricultural landscape is dynamic, shaped by policy, technology, and natural resource drivers among others, which together affect farmer decisions and conservation trends. Between the CEAP surveys, increased demand and higher prices for commodities encouraged production expansion in nearly all regions of the country. A warming climate, longer growing season, and advances in seed technology and higher yielding crop varieties drove cropping pattern shifts, most notably in the northern and southern plains, where corn and soybean production replaced wheat and other close-grown crops with lower average nutrient needs, and fallow periods.

The agricultural landscape continued to shift between the two survey periods. Demand for commodities increased, particularly corn and soybeans, and higher prices encouraged production expansion. A warming climate, longer growing season, and seed technology advances extended the northern boundaries of corn and soybean production, where they replaced crops such as wheat and other close-grown crops with significantly lower average nutrient needs and fallow periods.

During the decade:

- Farmers increasingly adopted advanced technology, including enhanced-efficiency fertilizers and variable-rate fertilization to improve efficiency and benefit rural economies and the environment.
- More efficient conservation tillage systems, particularly no-till, became the dominant form of tillage, reducing erosion and fuel use.
- Use of structural practices increased, largely in combination with conservation tillage as farmers integrated multiple conservation treatments to gain efficiencies.
- Conservation crop rotation and cover crop use increased, as did the use of high-biomass crops in rotation.
- Irrigators shifted toward more efficient pressure-based systems, and improved water management strategies decreased per-acre water application rates.

As a result, CEAP estimates:

- Average annual water (sheet and rill) and wind erosion dropped by 70 million and 94 million tons, respectively, and edge-of-field sediment loss declined by 74 million tons.
- Nearly 26 million additional acres of cultivated cropland were gaining soil carbon, and by CEAP II carbon gains on all cultivated cropland increased by over 8.8 million tons per year.
- Nitrogen and phosphorus losses through surface pathways declined by 3 and 6 percent, respectively. However, subsurface nitrogen and soluble phosphorus losses increased by 13 and 11 percent, respectively.
- Per-acre irrigation application rates dropped by 19 percent and national withdrawals by 7 million-acre-feet.
- Average annual fuel use dropped by 110 million gallons of diesel fuel equivalents, avoiding associated greenhouse gas emissions of nearly 1.2 million tons of carbon dioxide equivalents.

While gains were made, shifts in crops, cropping patterns, and tillage systems outpaced nutrient application research and guidance and industry capacity to deliver and apply nutrients efficiently. Consequently, subsurface losses of nitrogen and soluble phosphorus increased with the expansion of crops with higher nutrient demand and conservation tillage systems, which promote water infiltration and subsurface flow. Transitioning to conservation tillage systems, particularly no-till, requires nutrient method and form adjustments to incorporate nutrients that previously may have been tilled into the soil under conventional systems.

Recognizing the variability in conservation treatment needs within fields and addressing soil health and nutrient management as a system is critical to achieving the full benefits of advanced technology, tillage efficiency, and conservation measures. For example, in each CEAP survey period, a small proportion of acres accounted for most nutrient and sediment losses; in CEAP II, 73 percent of the subsurface nitrogen losses came from 28 percent of the acres, generally smaller, vulnerable areas within larger fields.

A systems approach to conservation recognizes in-field variability and the connectivity of natural resources, and that conservation measures designed to benefit one resource also may affect another, potentially negatively. For example, in a watershed in which soluble phosphorus is a resource concern, nutrient incorporation may be needed to reduce potential soluble losses, but it also may reduce the maximum soil carbon benefits of strict no-till. Conservation planning assesses the agri-environmental system to identify and develop workable solutions that fit the operation, the land, and the resource need in balance with local natural resource priorities.

Table of Contents

Tables

Figures

Boxes

CEAP National Report: Conservation Practices on Cultivated Cropland

INTRODUCTION

The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) evaluates conservation trends and effects on cultivated cropland through the multiagency Conservation Effects Assessment Project (CEAP), a sampling and modeling approach drawing on natural resource data and farmer surveys (appendix 1). The farmer surveys are conducted jointly by USDA's NRCS and National Agricultural Statistics Service (NASS). The first surveys were completed in 2003–06 (CEAP I), with basinwide reports released from 2010 through 2014. Now, comparison data from the second set of farmer surveys (2013–16; CEAP II) make it possible to evaluate change over a decade.

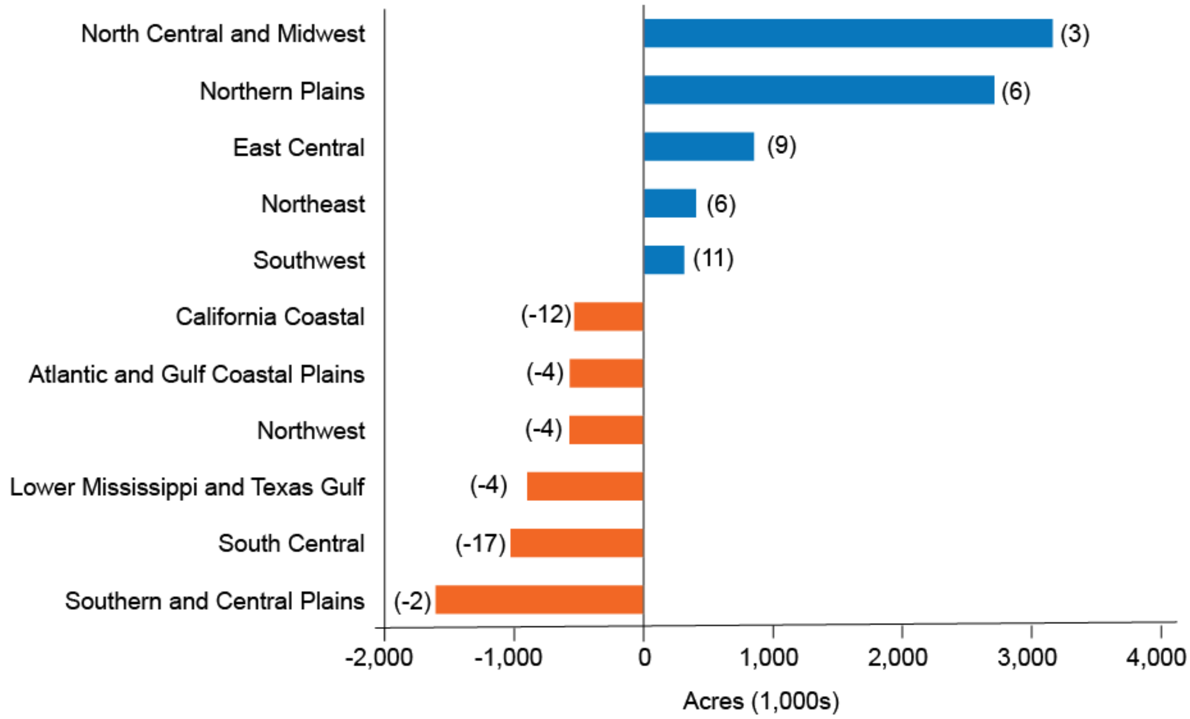
CEAP is intended to contribute to the science base for managing the agricultural landscape for environmental quality. Findings are intended to help guide conservation policy and program development and help conservationists, farmers, and ranchers in their conservation decisions. The purpose of this report is to present the CEAP I and CEAP II data on conservation practices applied on cultivated cropland at national and in some cases regional levels, estimates of the effects of these practices, and how conservation activity may have changed over the decade. The data reflect only the presence or absence of the practice; they do not indicate if the practice is pre-existing and maintained, reconstructed, or newly installed.

CEAP Production Regions

Estimates in this report are presented for 11 CEAP production regions, which reflect prevalent land use, cropping systems, climate, soil characteristics, and conservation practice use. The first CEAP reports (CEAP I) presented results by regions representing the major drainage basins in the United States (Water Resource Regions). The CEAP II regions reduce the variability in cropping systems, conservation and production practices, and resource concerns found in the CEAP I regions. The rules of analysis were unchanged between the CEAP survey periods, but the CEAP I sample points were reaggregated into the new regions presented in this report. For some regions with small amounts of cultivated cropland or where production systems and natural resource factors affect the opportunity or need for adoption of these practices, slight changes cannot be reliably estimated.

Over the decade between the two CEAP survey periods, there was a small net gain in cultivated cropland of more than 2 million acres, primarily coming from pastureland and cropland exiting the Conservation Reserve Program (CRP).[1] Five regions gained almost 7.5 million cultivated cropland acres, while six regions lost about 5.3 million acres combined (fig. 1). By CEAP II, three regions (North Central and Midwest, Southern and Central Plains, and Northern Plains) accounted for three-fourths of all U.S. cultivated cropland (fig. 2; appendix 2, table A-1).

Figure 1. Change in Cropland Acreage by Region, CEAP I to CEAP II



Note: Number in parentheses indicates acreage change as a percent of the region's CEAP I cultivated cropland level.

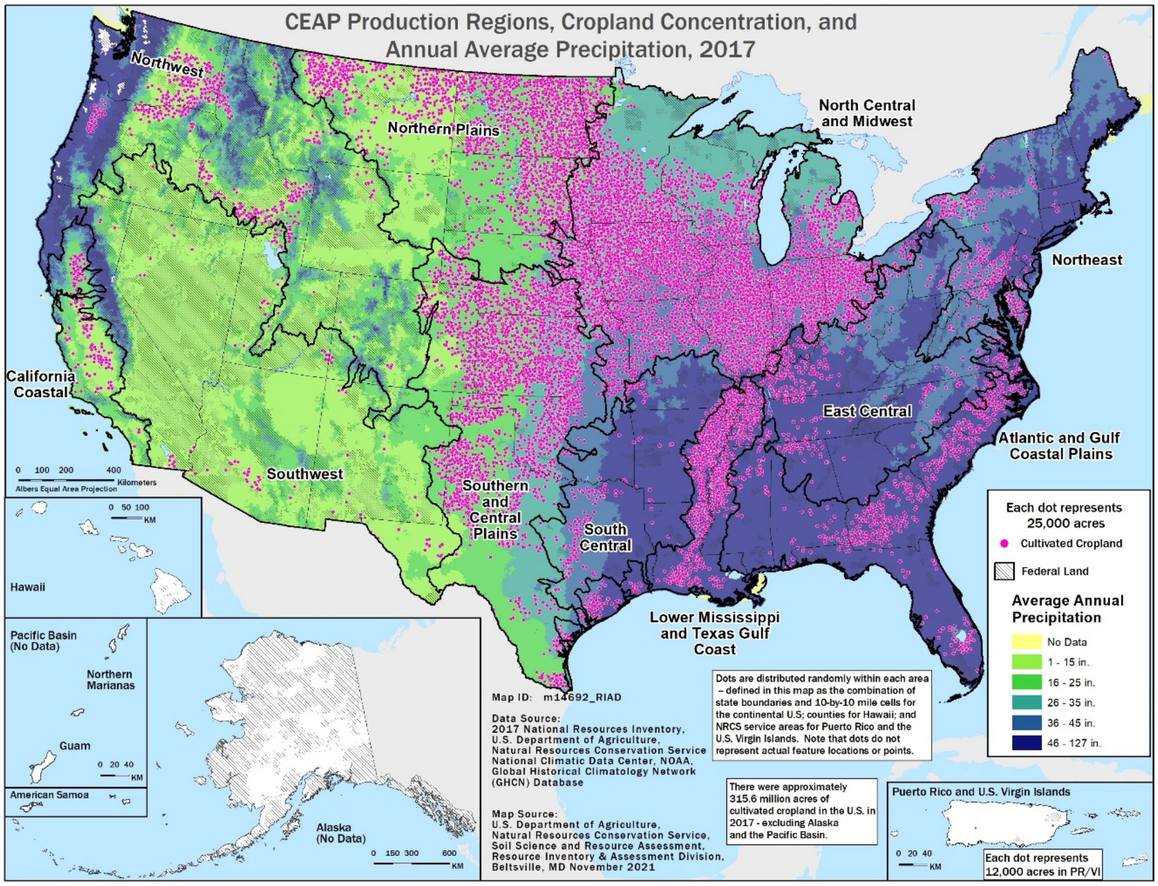
The following provides generalized overviews of production and natural resource factors for each CEAP region to give context for the trends presented in this report.

California Coastal: *Cultivated cropland accounts for 3.9 million acres, less than 10 percent of the region's total land area and about 1 percent of all cultivated cropland in the United States.* Cultivated cropland is concentrated in the level to gently rolling valleys, which have lower vulnerability to wind and water erosion. With its dry Mediterranean climate, water management and irrigation practices are higher priorities than erosion control within fields or at their edges. Production on cultivated cropland is dominated by high-value crops such as rice, fruits, and vegetables. Production practices, pest and disease control measures, and industry requirements for the fresh market reduce producers' ability to adopt conservation tillage on a continuous basis.

---

[1] See tables 6 and 7 of U.S. Department of Agriculture. 2020. *Summary Report: 2017 National Resources Inventory*, Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/nri/results/

Figure 2. CEAP Production Regions, Cropland Concentration, and Annual Average Precipitation



Note: The dot density shows concentrations of cultivated cropland within the region while the shading reflects the precipitation.

Southwest: *Cultivated cropland accounts for nearly 3.2 million acres, or less than 1 percent of the region's total land area and less than 1 percent of all cultivated cropland in the United States.* With an arid climate, water erosion vulnerability is low, while water management and irrigation practices are higher conservation priorities. Less than 10 percent of cultivated cropland acres have high or moderately high runoff risk when rains occur. Wind erosion is the primary erosion concern. High-tillage crops such as cotton, root crops, and vegetables along with land levelling and land shaping for irrigation limit adoption of continuous conservation tillage.

Northwest: *Cultivated cropland accounts for 13.4 million acres, but less than 5 percent of the region's total land area and about 4 percent of all cultivated cropland in the United States*. The region has a largely semiarid to arid climate that minimizes the need for water-induced erosion control. Wind erosion poses more of an erosion challenge. The significant increase in conservation tillage between the two CEAP survey periods is the primary wind-erosion-control measure. Wheat and other close-grown crops dominate cultivated cropland production and provide opportunities for the adoption of conservation tillage. Portions of the region where acreage is irrigated and root crops such as potatoes are produced have limited opportunities for continuous conservation tillage.

Northern Plains: *Cultivated cropland accounts for 51.1 million acres, or about 27 percent of the region's total land area and about 16 percent of all cultivated cropland in the United States.*

The region's semiarid to subhumid climate, coupled with the fact that only about a fourth of the acres have high or moderately high runoff risk, reduces need for extensive structural practice adoption. In contrast, 44 percent of acres have a high or moderately high wind erosion risk, but the dominance of close-grown crops and conservation tillage provides significant control.

Southern and Central Plains: *Cultivated cropland accounts for 62.7 million acres, or about 28 percent of the region's total land area and about 20 percent of all cultivated cropland in the United States*. With periods of seasonal drought and high-energy convective storms often producing high-intensity rainfall and flash floods, regional water quantity concerns need to be balanced with vegetated structural practices for wind and water erosion control. In the semiarid parts of the region, use of seasonal conservation tillage (e.g., crop rotations with small grains providing seasonal erosion control) is the primary wind erosion control method, while in the higher rainfall areas, structural conservation practice options are needed. The significant cotton acreage characterized by intense tillage, partially to control pests (e.g., boll weevil), reduces the viability of continuous conservation tillage in the southern part of the region. However, rotations with corn and small grains provide some seasonal tillage system flexibility. The northern part of the region is dominated by small grains conducive to conservation tillage adoption, although root crop (e.g., sugar beets) production here is also associated with intense tillage.

North Central and Midwest: *Cultivated cropland accounts for about 123.3 million acres, or about 44 percent of the region's total land area and about 39 percent of all cultivated cropland in the United States*. The region's high-rainfall climate and the intensity of agricultural production drives higher adoption of one or more structural practices and conservation tillage to address multiple resource concerns. The sloping landscapes in the region may require more than one structural practice supported by conservation tillage, while conservation tillage alone may be adequate to control erosion in the lower lying areas, which tend to be drained and more prone to subsurface losses. The size and concentration of agriculture in this region significantly influences many of the national trends in adoption of structural practices and conservation tillage adoption.

South Central: *Cultivated cropland accounts for 5.1 million acres, or less than 5 percent of the region's total land area and about 2 percent of all cultivated cropland in the United States*. The generally sloping landscapes and humid, high-rainfall climate drives adoption of one or more structural conservation measures to control runoff. Cotton production in the region also reduces the opportunities for conservation tillage, resulting in the need for more than one structural practice on many acres to control erosion and sediment loss.

Lower Mississippi and Texas Gulf Coast: *Cultivated cropland accounts for 20.9 million acres, or nearly one-third of the region's land area and about 7 percent of all cultivated cropland in the United States*. The humid and subtropical climate, nearly flat slopes with tile drainage, and rolling loess hills adjacent to floodplains create conditions for excessive sediment loss and the need for multiple structural practices and minimal tillage practices with high-residue crop rotations. The prevalence of intense-tillage cotton and rice production reduces conservation tillage opportunities and increases reliance on structural practices.

East Central: *Cultivated cropland accounts for over 10.2 million acres, or about 17 percent of the region's land area and about 3 percent of all cultivated cropland in the United States.* The humid climate with rolling topography often requires adoption of structural practices along with conservation tillage to control erosion and runoff. The high adoption of conservation tillage and particularly no-till reflect the dominance of corn-soybean-wheat rotations in the region.

Atlantic and Gulf Coastal Plains: *Cultivated cropland accounts for 13.8 million acres, just under 10 percent of the region's land area and about 4 percent of all cultivated cropland in the United States.* The humid, high-rainfall climate increases the need for edge-of-field structural practices to reduce losses on the two-thirds of acres with high to moderately high leaching risk, despite nearly level slopes. While less than 15 percent of acres have high or moderately high runoff risk, multiple structural practices generally are needed because of the high rainfall. The use of complex rotations with high-residue crops offset some effects associated with intense tillage systems on cotton and peanut production in the region, but structural practices are often necessary.

Northeast: *Cultivated cropland accounts for almost 7.6 million acres, just under 7 percent of the region's land area and about 2 percent of all cultivated cropland in the United States*. The northern part of the region has little cropland, and what is there is typically corn for silage and root and vegetable crops on hilly landscapes, which drives a need for multiple structural practices especially when conservation tillage is not used. The humid climate, more intense agriculture on hilly landscapes, and high proportion of acres receiving animal manures in the southern part of the region benefit from combinations of structural practices with conservation tillage.

A Changing Agricultural Landscape

Significant changes in agricultural management and production occurred over the decade in response to a variety of factors and provide additional context for the trends presented in this report. The changes are interrelated, manifesting in significant shifts in where crops are produced because of expanded growing seasons, advances in technology, and market signals. Moreover, the production environment continues to change; consider the current, historic drought conditions in the West and the continuing evolution of agri-environmental policies.

Farms and Ownership

The long-term shift toward larger, more specialized farms is part of a complex set of structural changes in agriculture. In the early 1980s, most cropland was operated by farms with less than 600 crop acres, today most cropland is on farms with at least 1,100 acres. Field crop operations increasingly grow just two or three crops.[2]

Specialization also separated crop and livestock production, which continued to shift toward larger, more geographically concentrated enterprises that produced no crops and relied on purchased feed. The geographic separation of livestock from cropland drove a nutrient imbalance between the two, reducing opportunities for manure nutrients to be used productively, and creating incentives for overapplication of manure nutrients as a waste disposal solution.[3,4]

[2] https://www.ers.usda.gov/publications/pub-details/?pubid=45110
[3] https://www.ers.usda.gov/publications/pub-details/?pubid=45110
[4] https://www.ers.usda.gov/publications/pub-details/?pubid=44294

Despite shifts toward larger, more specialized farms, family farms continue to dominate crop agriculture. Family farms as a group accounted for 98 percent of farms and 86 percent of production in 2019. Most family farms are small;[5] they operate almost one half of all farmland but account for only 22 percent of production. Large-scale family farms accounted for less than 3 percent of farms, 21 percent of farmland, but 44 percent of the value of production.[6]

While most of all U.S. farmland is owner-operated, more than half of cropland was rented in 2017, compared with just over 25 percent of pastureland. In general, rental activity is concentrated in grain production areas; cash grains such as rice, corn, soybeans, wheat, and cotton.[7] Most rented acres are owned by non-operator landlords, often with little connection to agriculture.

Cropping Patterns

Since the 1990s, U.S. farmers have been increasing corn and soybean acreage while decreasing acreage of other widely grown crops, particularly wheat. The Federal Agriculture Improvement and Reform (FAIR) Act of 1996 allowed farmers to change crops without loss of farm program eligibility, helping to ensure that crop acreage decisions would be based on market signals rather than farm program benefits. In the late 1990s, soybean acreage increased while wheat acreage decreased, reflecting changes in the relative profitability of these crops.[8]

The shift accelerated in the late 2000s as increasing demand for feed and fuel and a spike in export demand led to higher corn and soybean prices. Relative to wheat, corn prices were particularly high, peaking at about 90 percent of wheat in 2010–12. Soybean prices were also high relative to wheat during this period, peaking at 195 percent of wheat prices in 2009–10.

From 1992 to 2015, corn and soybeans increased from 41 percent to 54 percent of cultivated cropland nationally. Corn and soybean acreage increased in the western Corn Belt (Missouri, Iowa, Southwestern Minnesota, Eastern Nebraska, and Eastern South Dakota), the Great Plains (Texas, Oklahoma, Kansas, North Dakota, and Western South Dakota), the Northern and Northeastern states (Northwestern Minnesota, Wisconsin, Pennsylvania, and New York), and many parts of the South (fig. 3;pages 8 and 9 appendix 2, table A-2). Wheat acreage declined within traditional Corn Belt states (Ohio, Indiana, Illinois, Missouri, and Iowa) and along the eastern edge of the Great Plains (Texas, Oklahoma, Kansas, Nebraska, and the Dakotas), while increasing along the eastern seaboard and in some parts of Tennessee, Kentucky, and Alabama. Cotton production declined or was unchanged in all major cotton producing regions.

Prevailing Weather

Changes in temperature and precipitation altered growing conditions, making areas to the west and north of the traditional Corn Belt more favorable for corn and soybean production. In dryer regions, the moisture conservation benefits of conservation tillage (especially no-till) may have been important in expanding corn and soybean acreage. In the Great Plains and across the

[5] The Farm Typology developed by USDA's Economic Research Service identifies small family farms as those with less than $350,000 in gross cash farm income.
[6] https://www.ers.usda.gov/publications/pub-details/?pubid=100011
[7] https://www.ers.usda.gov/publications/pub-details/?pubid=74675
[8] Zulauf, Carl and Melissa R. Wright. 2001. "The Law of Unintended Consequences." *Choices*, Second Quarter: 20–24.

northern tier of states, growing seasons were 9 to 10 days longer, on average, during 1991–2012 than during 1901–60.[9] During similar time periods, in the eastern Great Plains, where lack of moisture has been a barrier to corn and soybean production, overall precipitation has increased by 10 to 20 percent. Further, the proportion of precipitation received in the heaviest 1 percent of precipitation events increased by 42 percent in the Northern Plains and by 24 percent in the Southern Plains.[10] The increase in precipitation intensity may increase runoff, making some of the additional moisture unavailable to crops as well as increasing the potential for loss of sediment and nutrients from farm fields.

Production Technology

Advances in plant breeding technology, pest management, and other management techniques have increased productivity and production efficiencies. For example:

- Continuous improvement in corn genetics have contributed to steady increases in corn yields.
- Shorter season corn varieties, which can be grown at higher latitudes and depend less on late-season moisture, helped expand corn production west and north.
- Drought-tolerant varieties reduced the risk of crop loss in mild drought conditions and have been most widely used in states that experience relatively frequent periods of mild to moderate drought.[11]
- The availability of herbicide tolerant (HT) corn and soybeans simplified weed control with reduced tillage, increasing the use of all types of conservation tillage.[12]

However, the rapid advances in crop genetics have outpaced research on fertilizer recommendations, creating a lag that will tend to slow the realization of the environmental benefits of these more efficient crop genetics.

The use of guidance systems on tractors, combines, and in other field operations has become more commonplace, accompanied by variable-rate fertilizer application technology that matches fertilizer rates to different soil zones and conditions within a field. Enhanced-efficiency fertilizers (EEF) include additives and formulations designed to control and better time the nutrient release of commercial fertilizers to meet crop demand and improve nutrient-use efficiency. The technology has largely been focused on nitrogen with the aim of reducing losses from ammonia volatilization and, after mineralization, to leaching, immobilization, and denitrification. These technologies make the farm operation more efficient in its fertilizer use and reduce potential losses.

---

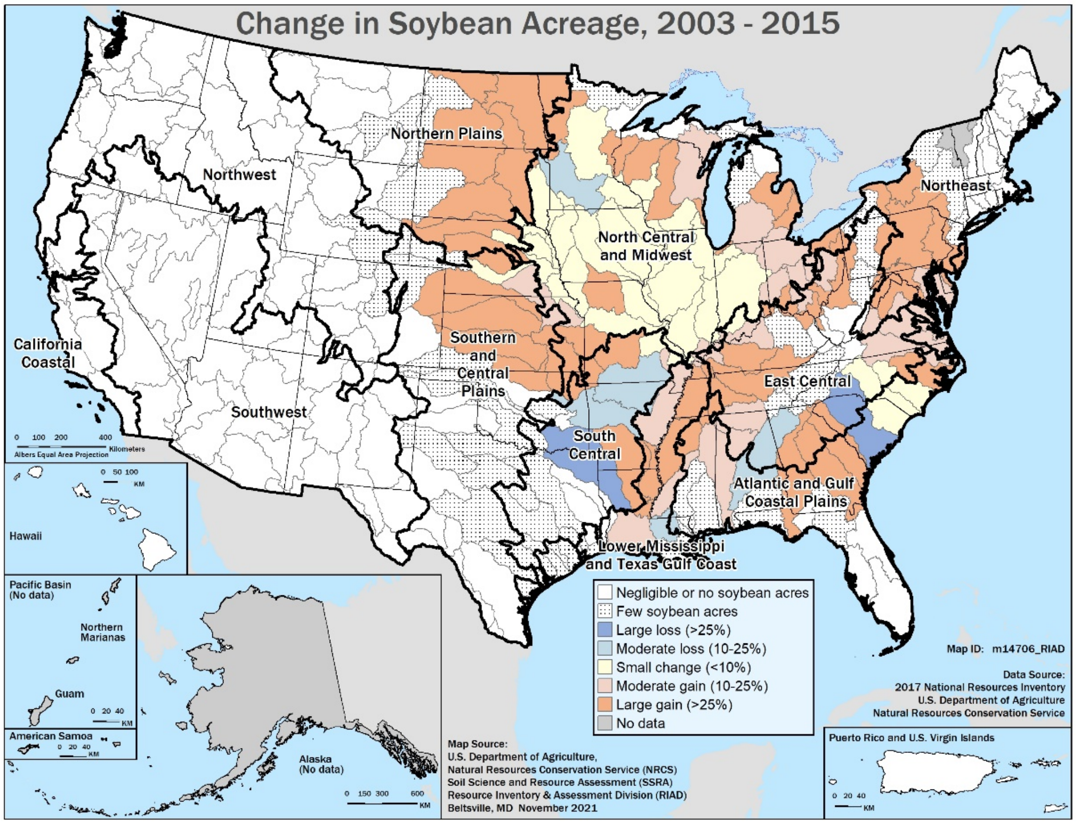
[9] Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, S. Doney, R. Feely, P. Hennon, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville, 2014: Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 19-67.

[10] Hayhoe, K., D.J. Wuebbles, D.R. Easterling, D.W. Fahey, S. Doherty, J. Kossin, W. Sweet, R. Vose, and M. Wehner, 2018: Our Changing Climate. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 72–144.

[11] McFadden, Jonathan, David Smith, Seth Wechsler, and Steven Wallander. 2019. “Development, Adoption, and Management of Drought-Tolerant Corn in the United States.” USDA Economic Research Service, Economic Information Bulletin EIB-204, November.

[12] Perry, Edward D., Gian Carlo Moschini, and David A. Hennessy. 2016. “Testing for Complementarity: Glyphosate Tolerant Soybeans and Conservation Tillage.” American Journal of Agricultural Economics 98 (3): 765–84.

Figure 3. Change in Acreage of Selected Crops by Region and 12-Digit Hydrologic Unit, 2003–15



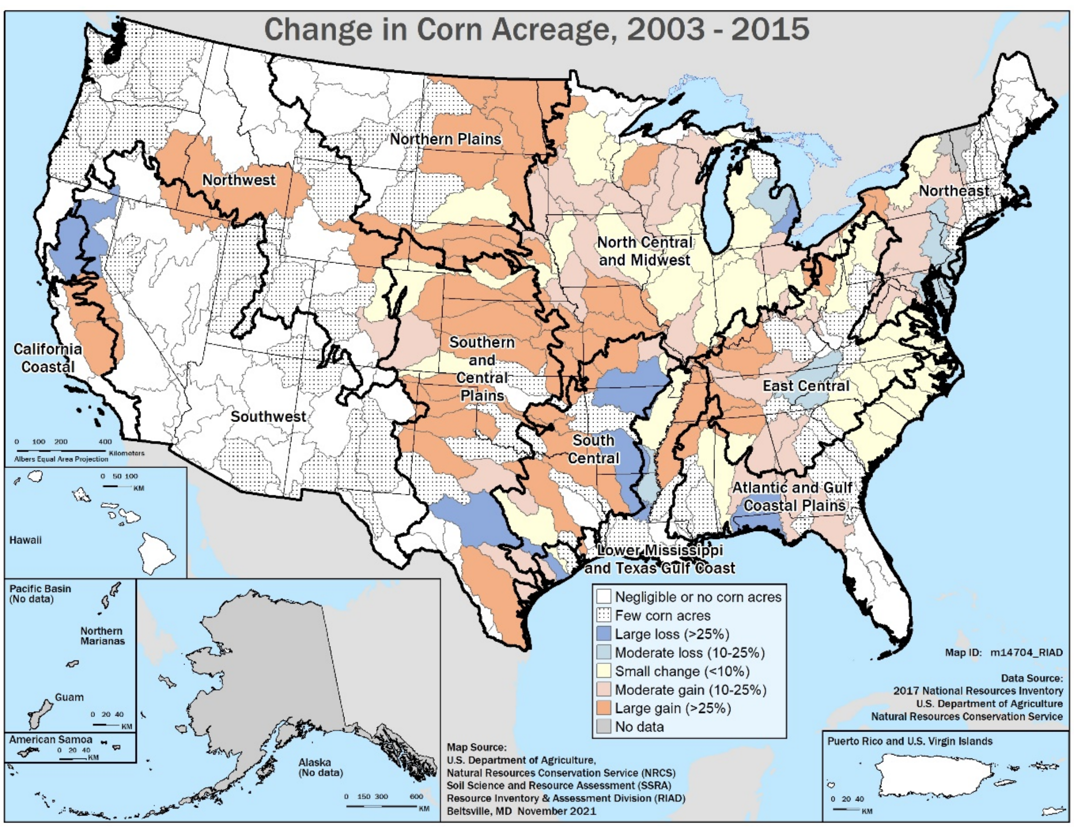
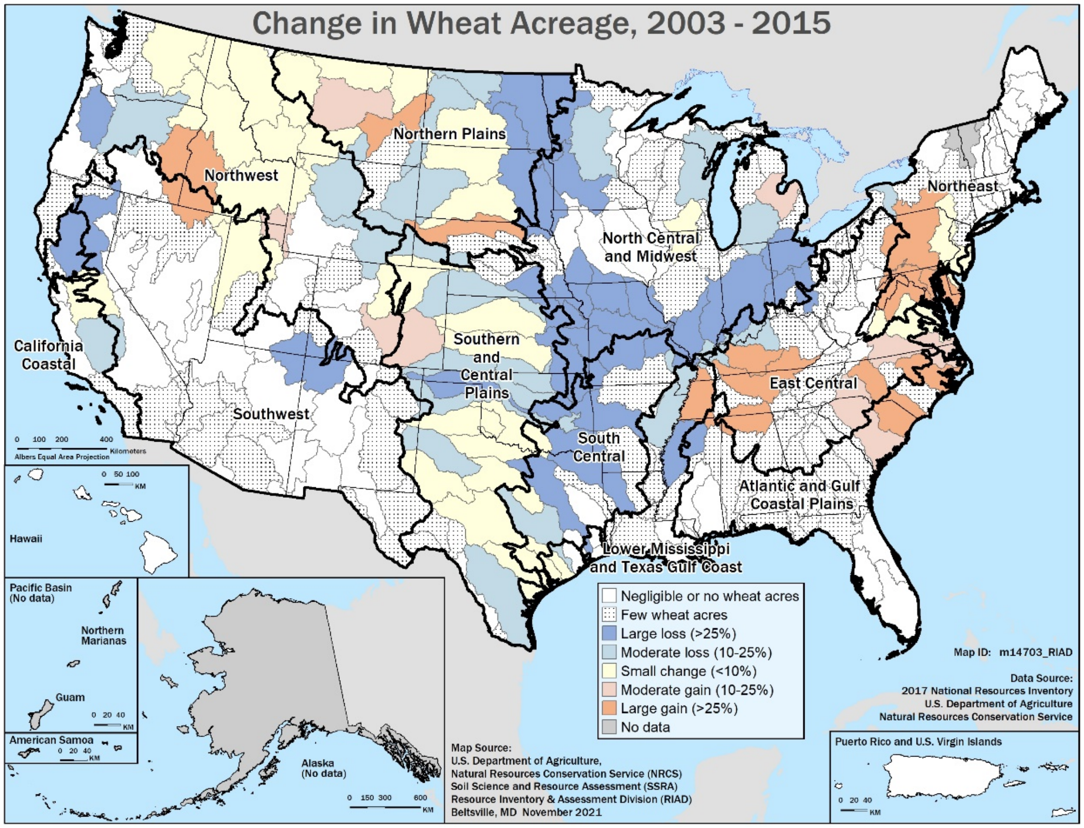
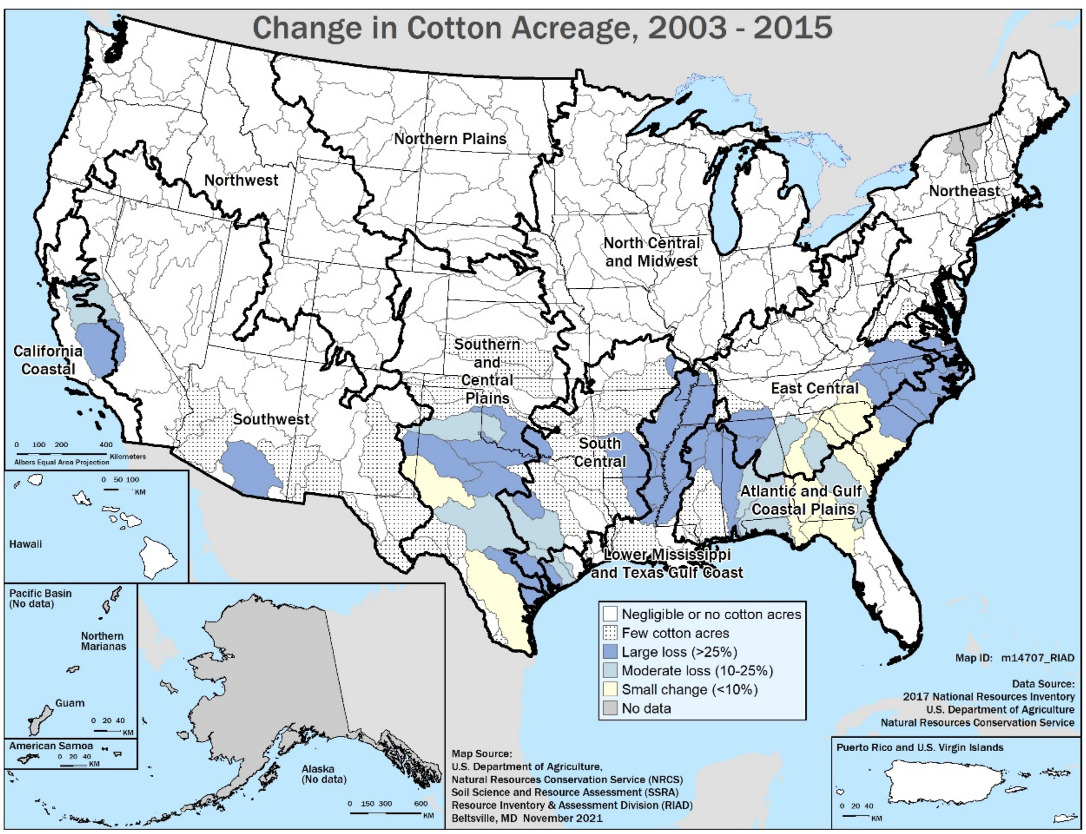


*Figure 3. Change in Acreage of Selected Crops by Region and 12-Digit Hydrologic Unit, 2003–15***—Cont.**





How Did the Use of Conservation Practices Change Between the CEAP Surveys?

In the decade between the CEAP surveys, adoption of structural practices and conservation tillage increased significantly, closely aligned with rising corn and soybean acreage. Conservation crop rotations were used on a majority of cultivated cropland, and the use of cover crops expanded. Irrigated cropland also increased, accompanied by efficiency gains that led to reduced water use. Nutrient management was challenged to keep pace with tillage and cropping changes and experienced some overall declines reflecting the complex interaction with conservation tillage systems.

Structural Practices and Conservation Tillage

Farmer adoption of structural practices (e.g., terraces, grassed waterways, see box 1, page 13) and conservation tillage, alone or in combination, increased by nearly 42 million acres nationwide between the two CEAP surveys. By CEAP II, one or more of these conservation practices were in place on over 81 percent of all cultivated cropland, up from 68 percent in CEAP I (table 1; appendix 2, table A-3). Acres without conservation tillage or structural practices declined significantly by 39.5 million acres to 19 percent of all cultivated cropland.

Table 1. Structural Practices, Conservation Tillage, and Both on Cultivated Cropland, CEAP I and CEAP II

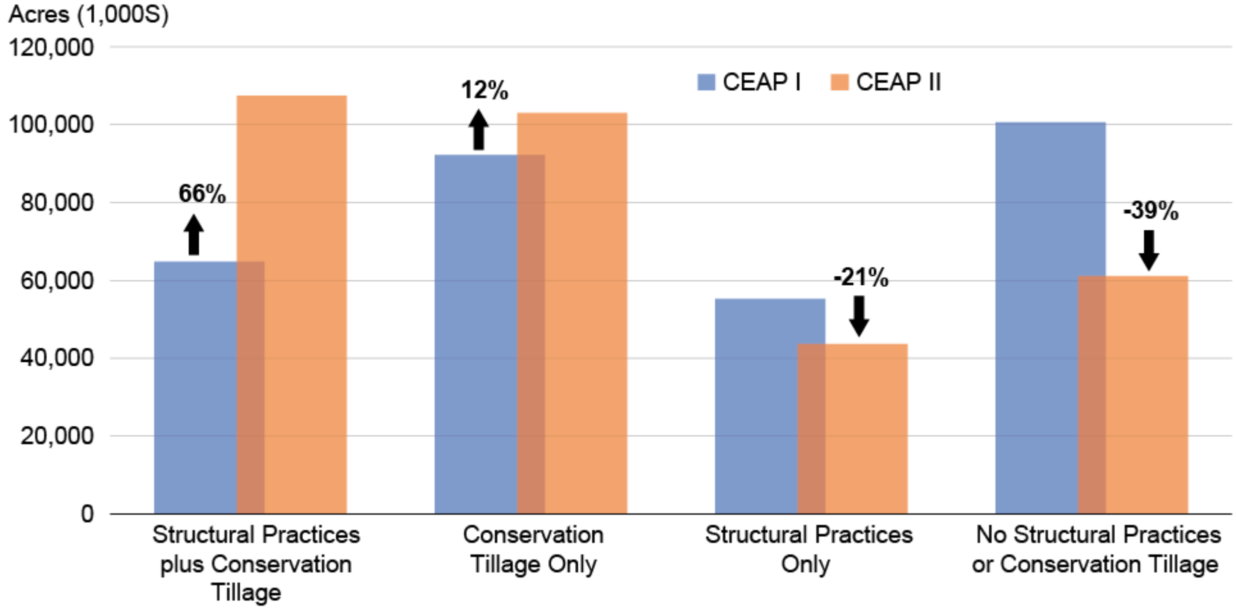
Treatment Group	CEAP I		CEAP II		CEAP II minus CEAP I *		Percent Change in Acres Relative to CEAP I
	Acres (1,000s)	Percent of Acres	Acres (1,000s)	Percent of Acres	Acres (1,000s)	Percent of Acres	
Structural Practices, Conservation Tillage, or Both	**212,414**	**68**	**254,155**	**81**	**41,742**	**13**	**20**
Structural Practices plus Conservation Tillage	*64,860*	*21*	*107,489*	*34*	*42,630*	***13***	***66***
Conservation Tillage Only	*92,265*	*29*	*103,042*	*33*	*10,778*	***3***	***12***
Structural Practices Only	*55,289*	*18*	*43,623*	*14*	*-11,666*	***-4***	***-21***
No Structural Practices or Conservation Tillage	**100,651**	**32**	**61,148**	**19**	**-39,503**	**-13**	**-39**
National	**313,065**	**100**	**315,303**	**100**	**2,238**		

** Ninety-five-percent confidence intervals were constructed for each survey period; overlap of the intervals was considered to indicate no difference between the means. Unless noted, values fall within the 95-percent confidence interval.*

Structural Practices plus Conservation Tillage

The greatest gains were made in the structural practices plus conservation tillage treatment group, evidence that farmers were increasingly integrating conservation management and structural treatments in a systems approach to improve results on their operations. By CEAP II, the combined practices had increased by 66 percent and were in place on over 107 million acres, or 34 percent of all cultivated cropland (fig. 4).

Figure 4. Cultivated Cropland by Treatment Group, CEAP I and CEAP II



Adoption of structural practices and conservation tillage was highly concentrated in the North Central and Midwest and the Southern and Central Plains regions, which together accounted for about 72 percent of the total increase (fig. 5). Nationally, structural practices integrated with conservation tillage increased by 13 percentage points over the decade.

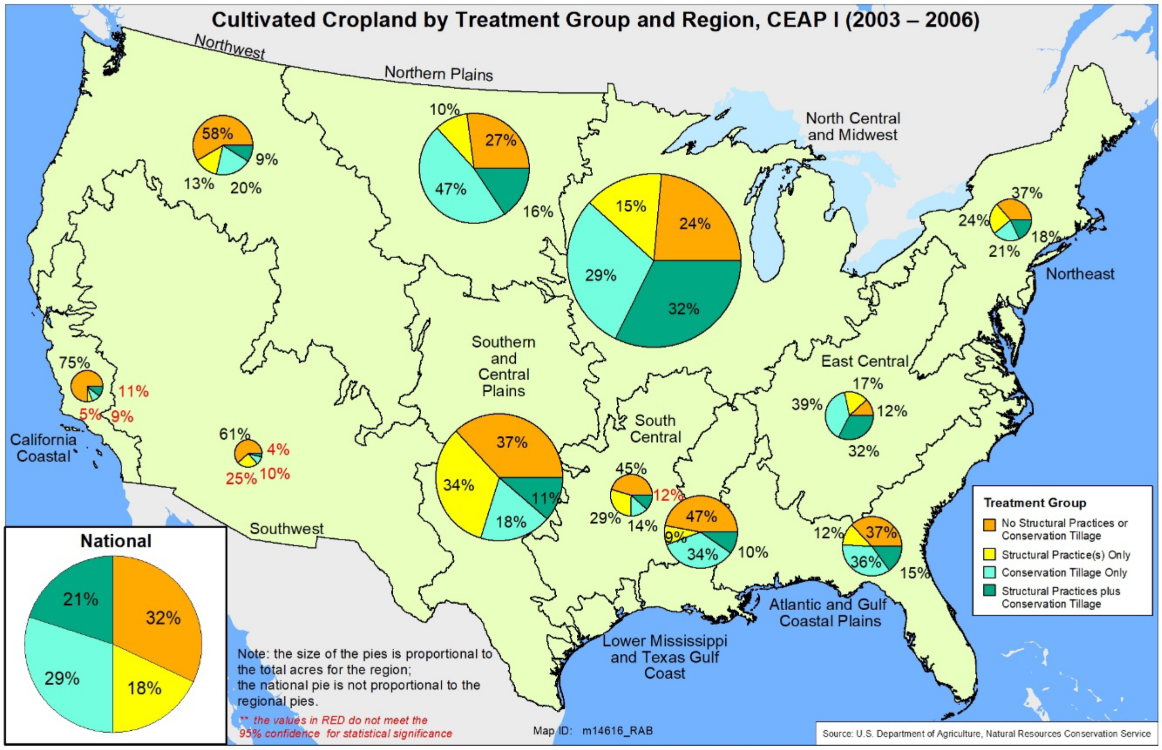
Structural Practices

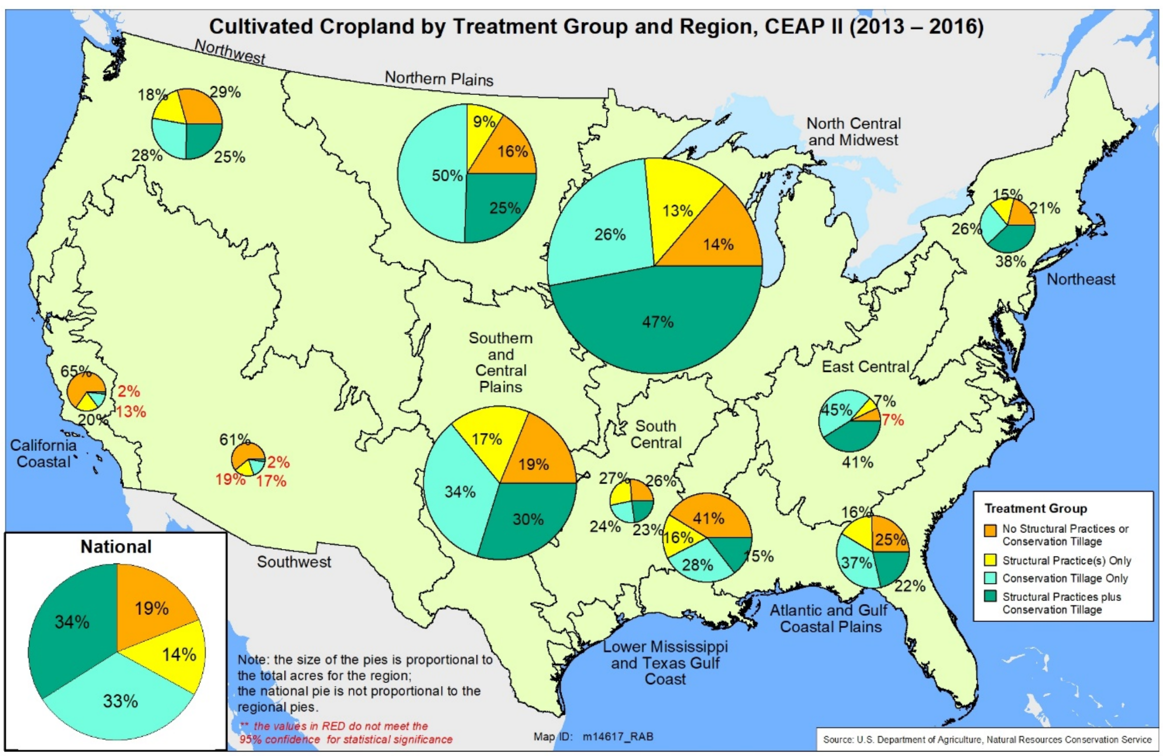
Between CEAP I and CEAP II, an additional 31 million acres were benefited by structural practices, largely in combination with conservation tillage as the use of structural practices alone declined by 11.7 million acres (see box 1, page 13). By CEAP II, nearly half of all cultivated cropland acres had one or more structural practices in place (table 2; appendix 2, table A-4).

Multiple structural practices accounted for 77 percent of the increase in adoption between CEAP I and CEAP II as farmers applied supporting practices in a systems approach to reduce soil erosion and related losses from cultivated cropland. More than half (56 percent) of the total national increase occurred in the North Central and Midwest region, where an additional 17.3 million acres benefited from application of one or more structural practices.

Of the five structural practice groups used on cultivated cropland (box 1), field borders (at least 30 feet wide) experienced the largest acreage gain between the two survey periods as well as the largest percent gain relative to CEAP I implementation levels (fig. 6). Overland flow and concentrated flow control practices, however, maintained the largest footprint in both survey periods, reflecting their long history as erosion-control tools on farm fields (see also appendix 2, table A-5).

Figure 5. Cultivated Cropland by Treatment Group and Region, CEAP I and CEAP II





Box 1. Structural Practice Groups and Types of Practices

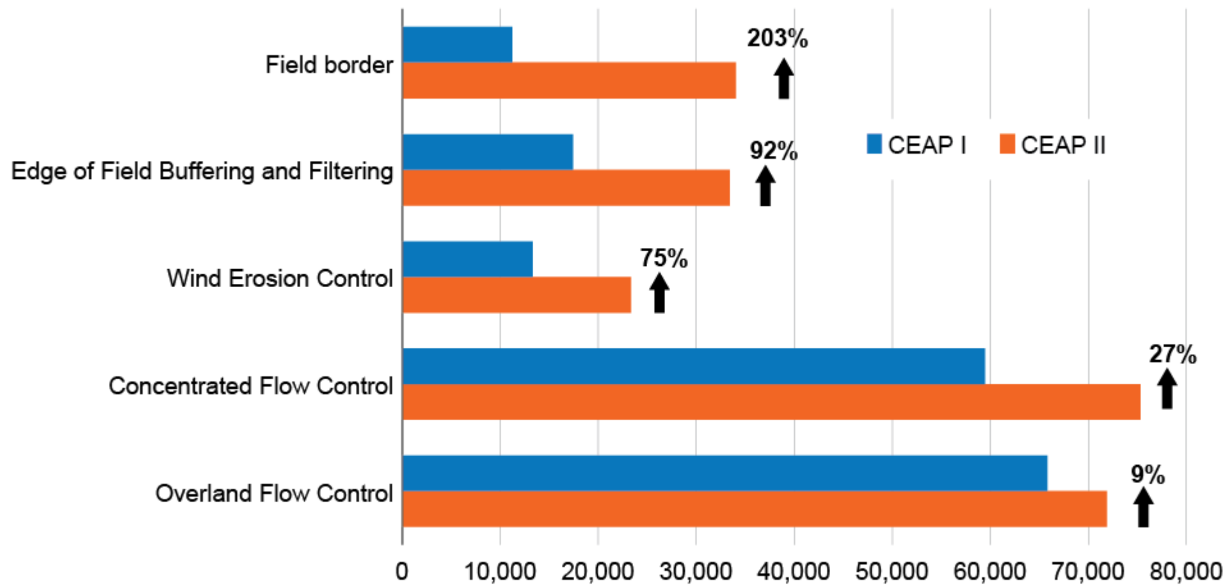
Five structural practice groups were established based on their primary conservation objective to facilitate evaluating change between the CEAP survey periods. The groups and example practices include:

- ***Field border***—Strips of permanent vegetation (grasses, legumes, forbs, or shrubs) established on one or more sides of a field
- ***Edge-of-field buffering and filtering***—Riparian forest buffers, riparian herbaceous buffers, filter strips, critical area planting
- ***Wind erosion control***—Windbreaks or shelterbelts, herbaceous wind barriers, hedgerow plantings
- ***Concentrated flow control***—Grassed waterways, grade stabilization structures, diversions, structures for water control
- ***Overland flow control***—Terraces, contour buffer strips, contour farming, stripcropping, in-field vegetative barrier.

Table 2. Structural Practice Adoption, CEAP I and CEAP II

Cultivated Cropland with:	CEAP I		CEAP II		CEAP II - CEAP I		
	Acres (1000s)	Percent	Acres (1000s)	Percent	Acres (1000s)	Percent	Percent Change in Acres Relative to CEAP I
One or More Structural Practices	**120,149**	**38**	**151,113**	**48**	**30,964**	**10**	**26**
One Type of Structural Practice	68,485	22	75,619	24	7,134	2	10
More than One Type of Structural Practice	51,664	17	75,494	24	23,830	7	46

Figure 6. Structural Practices by Group, CEAP I and CEAP II



Note: CEAP II bar notations reflect the percent increase in acreage relative to the CEAP I implementation level.

Conservation Tillage

The change in conservation tillage was particularly striking. Compared to conventional tillage, conservation tillage systems reduce soil disturbance, promote development of soil organic matter, reduce potential for compaction, and increase soil moisture holding capacity and infiltration, among other benefits. CEAP established five tillage classes based on average annual Soil Tillage Intensity Rating (STIR) values,[13] which were placed into two groups for analysis:

- **Conservation Tillage**
  - Reduced Tillage includes:
    - Continuous Mulch Tillage: All crops in the rotation are produced under tillage with STIR values for each crop between 20 and 80. Mulch tillage includes all forms of conservation tillage that are not considered no-till.
    - Seasonal No-Till: At least one crop is produced with no-till (STIR <20) and no crop in the rotation is conventionally tilled (STIR>80).
  - Continuous No-Till: All crops in the rotation are produced with tillage practices having STIR values <20.
- **Conventional Tillage**
  - Continuous Conventional Tillage: All crops in the rotation are conventionally tilled (STIR >80).
  - Seasonal Conventional Tillage: At least one crop in the rotation is conventionally tilled (STIR>80) and at least one crop is conservation tilled (STIR<80).

In the decade between the CEAP surveys, conservation tillage adoption increased by 53.4 million acres (table 3; appendix 2, table A-6). Eighty percent of this increase was in combination with structural practices (see also table 1, page 10). By CEAP II, conservation tillage had become the dominant form of tillage, used on over two-thirds of all cultivated cropland (67 percent). More than 41.5 million acres of the total increase was in continuous no-till, which reached 33 percent of all cultivated cropland acres by CEAP II (fig. 7). As a result, farmers were able to reduce annual average fuel consumption in tillage processes by 110 million gallons of diesel fuel equivalents and avoid the associated annual greenhouse gas emissions by nearly 1.2 million tons of carbon dioxide equivalents (CO_2-eq) by CEAP II (see box 2, page 16).

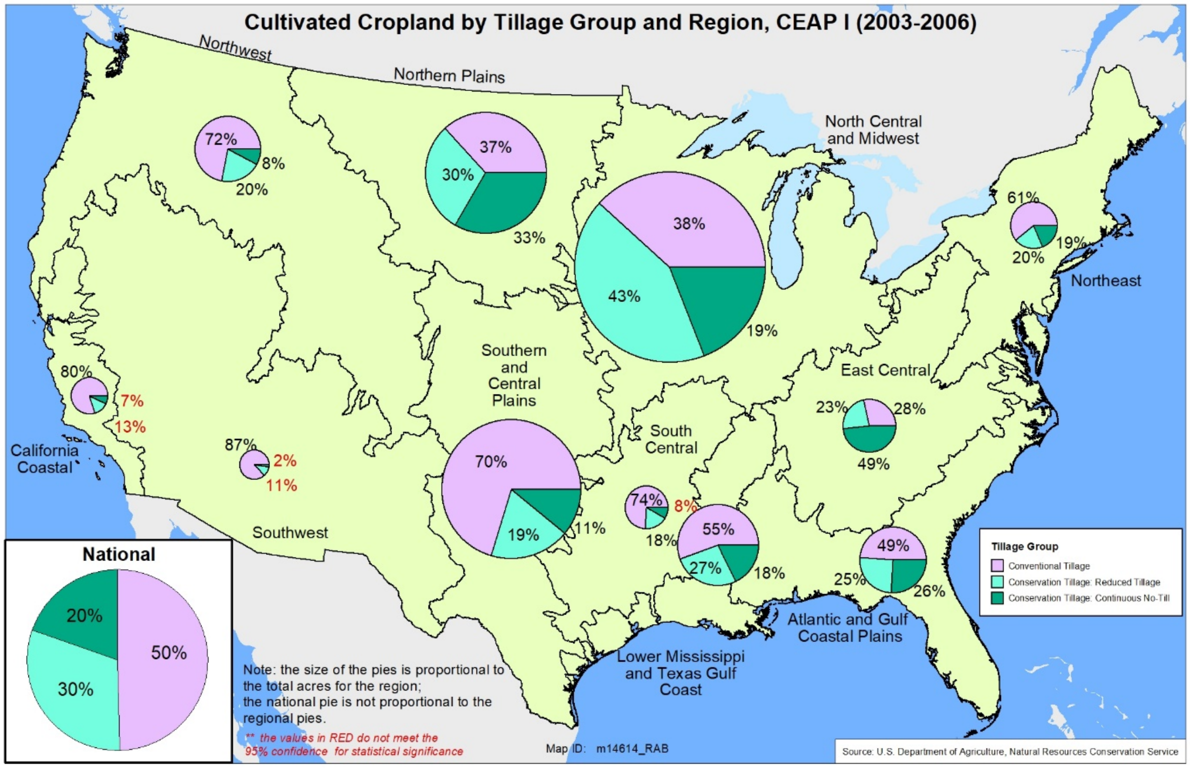
Table 3. Tillage Groups and Classes, CEAP I and CEAP II

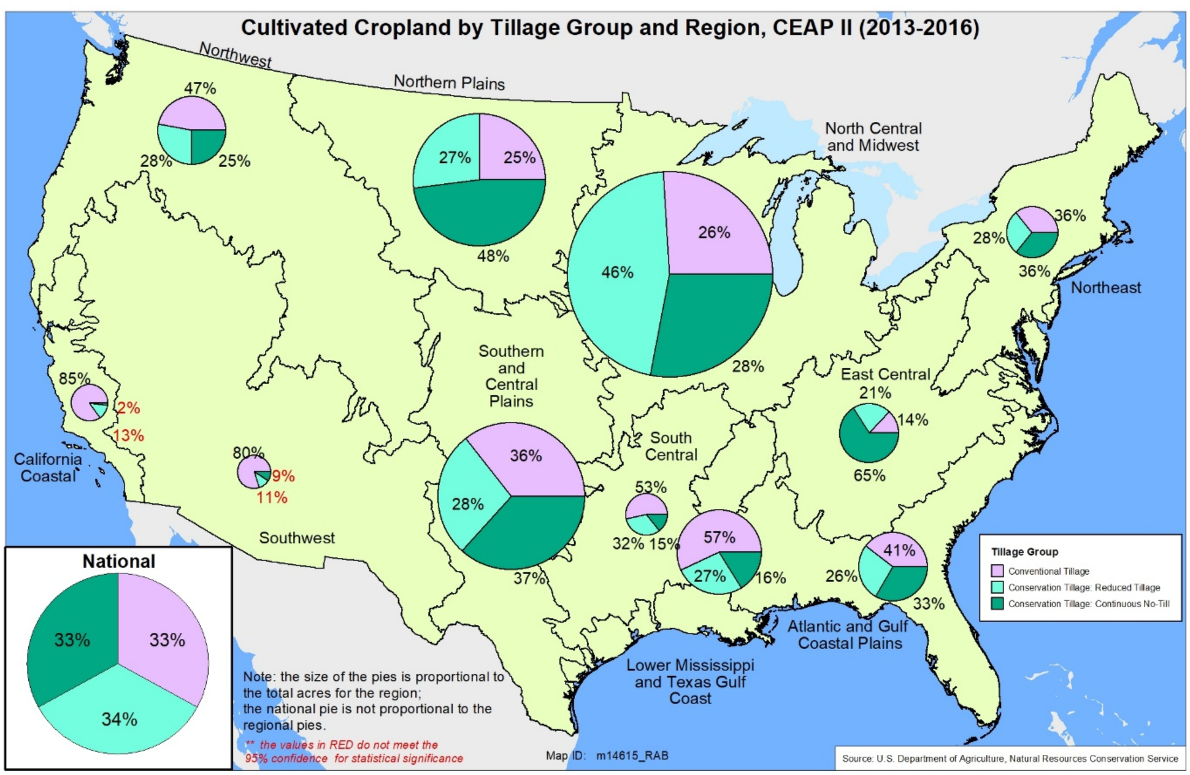
Tillage Group / Tillage Class	CEAP I		CEAP II		CEAP II minus CEAP I *		Percent Change in Acres Relative to CEAP I
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Acres (1,000s)	Percent	
Conservation Tillage	**157,124**	**50**	**210,532**	**67**	**53,408**	**17**	**34**
Continuous Mulch	*50,631*	*16*	*60,212*	*19*	*9,581*	*3*	19
Seasonal No Till	*44,941*	*14*	*47,211*	*15*	*2,271*	*1*	5
Continuous No-Till	*61,553*	*20*	*103,108*	*33*	*41,556*	*13*	68
Conventional Tillage	**155,941**	**50**	**104,771**	**33**	**-51,169**	**-17**	**-33**
Continuous Conventional	*62,922*	*20*	*42,052*	*13*	*-20,869*	*-7*	-33
Seasonal Conventional	*93,019*	*30*	*62,719*	*20*	*-30,300*	*-10*	-33

** Ninety-five-percent confidence intervals were constructed for each survey period; overlap of the intervals was considered to indicate no difference between the means. Unless noted, values meet the 95-percent confidence interval.*

[13] STIR is a function of the type, frequency, and depth of tillage and calculates soil disturbance intensity for each crop grown in a crop rotation. The higher the rating, the greater the soil disturbance and erosion potential.

Figure 7. Cultivated Cropland by Tillage Class, CEAP I and CEAP II





Box 2. Tillage Effects on Fuel Consumption and Greenhouse Gas Emissions

Among the many benefits of conservation tillage systems as compared to conventional tillage are the reductions in the number of field operations and associated soil disturbance, fuel consumption, and greenhouse gas emissions. Between CEAP I and CEAP II, cultivated cropland increased by over 2 million acres, conservation tillage systems increased by over 53 million acres, and conventional tillage systems declined by over 51 million acres. Correspondingly, fuel use grew in conservation tillage and dropped in conventional tillage. The upshot is that by CEAP II, farmers were cultivating slightly more cropland while using less fuel and producing fewer emissions; annual fuel consumption on all cultivated cropland declined by 110 million gallons of diesel fuel equivalents and annual emissions declined by nearly 1.2 million tons of carbon dioxide equivalents (CO_2-eq).

Fuel Use and Emissions by Tillage System, CEAP I to CEAP II

Tillage System	CEAP I (2003–06)		CEAP II (2013–16)		CEAP II minus CEAP I	
	Acres\ (Million)	Total Fuel Consumption (Million gallons Diesel equiv.)	Acres\ (Million)	Total Fuel Consumption (Million gallons Diesel equiv.)	Fuel Consumption (Million gallons Diesel equiv.)	Emissions Reductions (Million tons CO_2 equiv)**
Continuous Conventional	62.9	340.0	42.1	226.0	-114.0	-1.3
Seasonal Conventional *	93.0	328.0	62.7	226.0	-102.0	-1.1
Reduced Tillage	95.5	266.0	107.4	298.0	32.0	0.4
Continuous No Till	61.6	114.0	103.1	188.0	74.0	0.8
Total	**313.1**	**1,048.0**	**315.3**	**938.0**	**-110.0**	**-1.2**

** Seasonal conventional is presented separately here because of differences in fuel consumption compared to continuous conventional tillage.*

*** Based on 22.4 pounds of CO_2-eq per gallon of diesel fuel equivalents.*

Assuming uniform transition over the decade, the adoption of conservation tillage had an estimated cumulative effect of reducing:

- Fuel consumption by up to 600 million gallons of diesel fuel equivalents, enough to meet the annual electricity requirements of nearly 2.3 million average households in the United States.[14]
- Emissions by up to 6.6 million tons of CO_2-eq., enough to offset the annual CO_2-eq emissions of about 1.4 million passenger cars, or nearly all the passenger cars registered in the state of Louisiana.[15]
- Fuel costs borne by farmers by up to $1.8 billion.[16]

These effects, however, mask the significant difference between conservation tillage and continuous conventional tillage in terms of fuel use and emissions. If the nearly 273 million acres of cultivated cropland under conservation tillage and seasonal conventional systems in CEAP II had been under continuous conventional tillage, it would have required an additional 763 million gallons of diesel fuel equivalents per year, and that additional fuel would have had associated emissions of roughly 8.5 million tons of CO_2-eq. For context, the additional fuel is equal to the annual energy needed for over 2.8 million average households in the United States.[17] The associated CO_2-eq emissions is equal to that of 1.9 million passenger cars, or roughly all the passenger cars in the state of Colorado. [18]

---

[14] As calculated by converting the estimated diesel fuel equivalents reduced to kilowatt hours. According to the U.S. Energy Information Administration the average household electricity use is 10,649 kWh annually. https://www.eia.gov/energyexplained/units-and-calculators/energy-conversion-calculators.php

[15] Based on emissions from an average passenger vehicle, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator. Number of passenger vehicles as reported in 2015 according to data from the Federal Highway Administration. https://www.fhwa.dot.gov/policyinformation/statistics/2015/mv1.cfm

[16] Based on an average price of $2.94 per gallon for diesel fuel between 2003 and 2016, as reported by the U.S. Energy Information Administration. https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_a.htm

[17] As calculated by converting the estimated diesel fuel equivalents reduced to kilowatt hours. According to the U.S. Energy Information Administration the average household electricity use is 10,649 kWh annually. https://www.eia.gov/energyexplained/units-and-calculators/energy-conversion-calculators.php

[18] Based on emissions from an average passenger vehicle, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator. Number of passenger vehicles as reported in 2015 according to data from the Federal Highway Administration. https://www.fhwa.dot.gov/policyinformation/statistics/2015/mv1.cfm

And farmers would have faced between $1.8 billion and $3 billion in additional fuel costs.[19] Roughly 80 percent of that additional fuel need would have been concentrated in three regions—North Central and Midwest, Northern Plains, and Southern and Central Plains.

Estimated Annual Reduction in Fuel Use and Emissions by Conservation Tillage and Seasonal Conventional Tillage Systems as Compared to Continuous Conventional Tillage, CEAP II

Tillage Type	Cultivated Cropland		Total Fuel Consumption (Million gallons Diesel equiv.)	Average Fuel Use/Acre	Fuel Use Avoided (Million gallons Diesel equiv.)*	Emissions Avoided (Million tons CO2 equiv) **
	Acres (Millions)	Acres (Percent				
Continuous Conventional	42.1	13.4	226.0	5.4	-	-
Seasonal Conventional	62.7	19.9	226.0	3.6	112.6	1.3
Reduced Tillage	107.4	34.1	298.0	5.5	282.0	3.2
Continuous No Till	103.1	32.7	188.0	1.8	368.7	4.1
Total	**315.3**	**100.0**	**938.0**	**16.3**	**763.3**	**8.5**

** Potential annual reduction in fuel consumption as compared to a continuous conventional tillage system with STIR >80.*
*** Based on 22.4 pounds of CO_2-eq per gallon of diesel fuel equivalents.*

The Southern and Central Plains, characterized by winter wheat and other close-grown small grains, accounted for 40 percent of the total increase in conservation tillage adoption. The North Central and Midwest region (dominated by corn and soybean production) accounted for another 31 percent. Nationally, conservation tillage adoption increased by 17 percentage points between the survey periods. That gain was exceeded in four regions, with the Southern and Central Plains region being twice the national average.

Structural Practices and Conservation Tillage on Vulnerable Cropland

The cultivated cropland most vulnerable to excessive soil erosion (Highly Erodible Land [HEL]) and runoff (high and moderately high Soil Vulnerability Index [SVI] runoff) account for about 27 percent and 29 percent of all cultivated cropland, respectively (box 3). Conservation adoption on these acres emphasized structural practices in combination with conservation tillage. In addition, these vulnerable acres received a slightly higher proportion of treatment compared to their less vulnerable counterparts. By CEAP II, structural practices or conservation tillage, or both, were in place on 85 percent of HEL cultivated cropland and on over 90 percent of cultivated cropland with high or moderately high runoff vulnerability, as compared to 81 percent for all cultivated cropland.

Highly Erodible Land—The 1985 Farm Bill introduced policy to encourage conservation on cropland deemed to be the most susceptible to excessive erosion (Highly Erodible Land [HEL]) by linking farm program eligibility to implementation of soil conservation measures. Between CEAP I and CEAP II, adoption of structural practices plus conservation tillage on HEL increased by 13.9 million acres (63 percent) (table 4, fig. 8; appendix 2, table A-7). Use of conservation tillage without structural practices also increased by nearly 6.8 million acres (32 percent), while use of structural practices alone declined by 4.9 million acres (35 percent). Adoption of these practices increased by 12 percentage points over the decade, despite a 7.4-million-acre increase in HEL under cultivation.

[19] Based on average prices of $3.9 per gallon for diesel fuel in 2013 and $2.4 per gallon in 2016, as reported by the U.S. Energy Information Administration. https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_a.htm

Box 3. Soil Vulnerability Indexes

NRCS developed Soil Vulnerability Indexes (SVI) in the 2000s to support conservation planning through rigorous assessment of soil vulnerability to the forces of water (runoff, leaching) and wind. SVI uses current information on soil properties as well as other aspects of vulnerability such as slope and drainage. Four ratings (low, moderate, moderately high, and high) are used to categorize a soil's potential vulnerability. The index is regionally relative; for example a high runoff rating in an arid region would not have the same conservation need as a high runoff rating in a humid region. Examining cropland by potential vulnerability offers an important tool for identifying conservation needs and supporting conservation planning from the field to regional and national scales.

Between the CEAP surveys, cultivated cropland with moderately high and high runoff vulnerability increased by nearly 11 million acres. For cultivated cropland vulnerable to leaching, the only increase was in low vulnerability acres at nearly 12.5 million acres although it remained the smallest rating category. Cultivated cropland with moderately high wind vulnerability increased by 4 million acres, while the rest of the rating categories declined.

Across the three vulnerability indexes, wind and runoff vulnerability have a similar distribution of acres among the rating categories, with most acres having low vulnerability and least acres having high vulnerability. The distribution for leaching vulnerability is nearly the opposite with most acres having a moderate or high rating. In CEAP II, nearly 30 percent of cultivated cropland had high vulnerability to leaching as compared to 11 percent for runoff vulnerability and 1 percent for wind vulnerability.

Cultivated Cropland by Soil Vulnerability Index Type and Rating, CEAP I and CEAP II

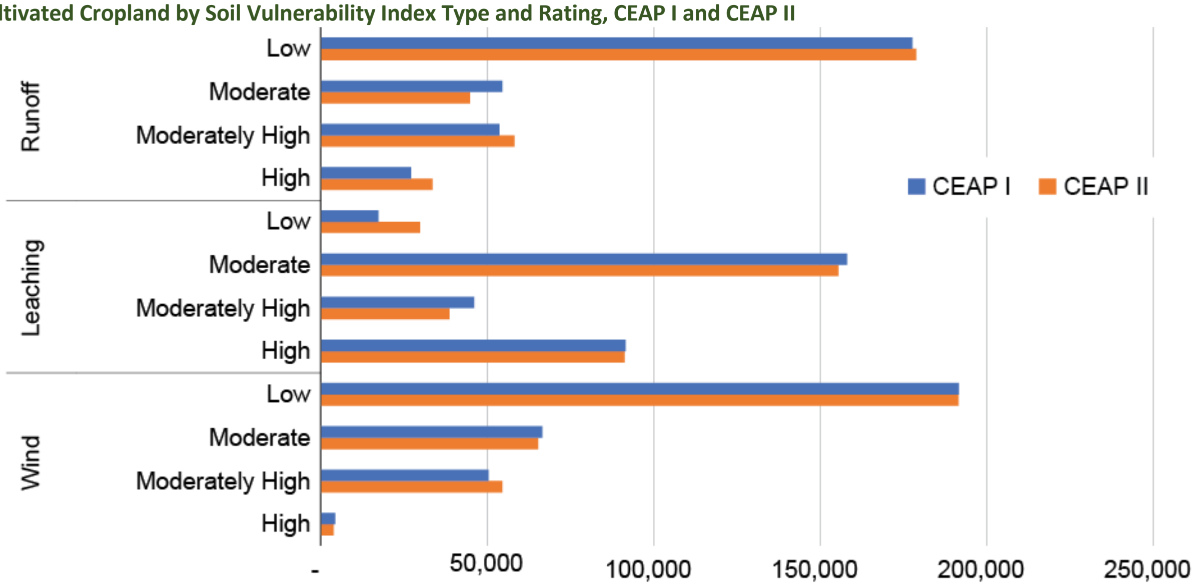
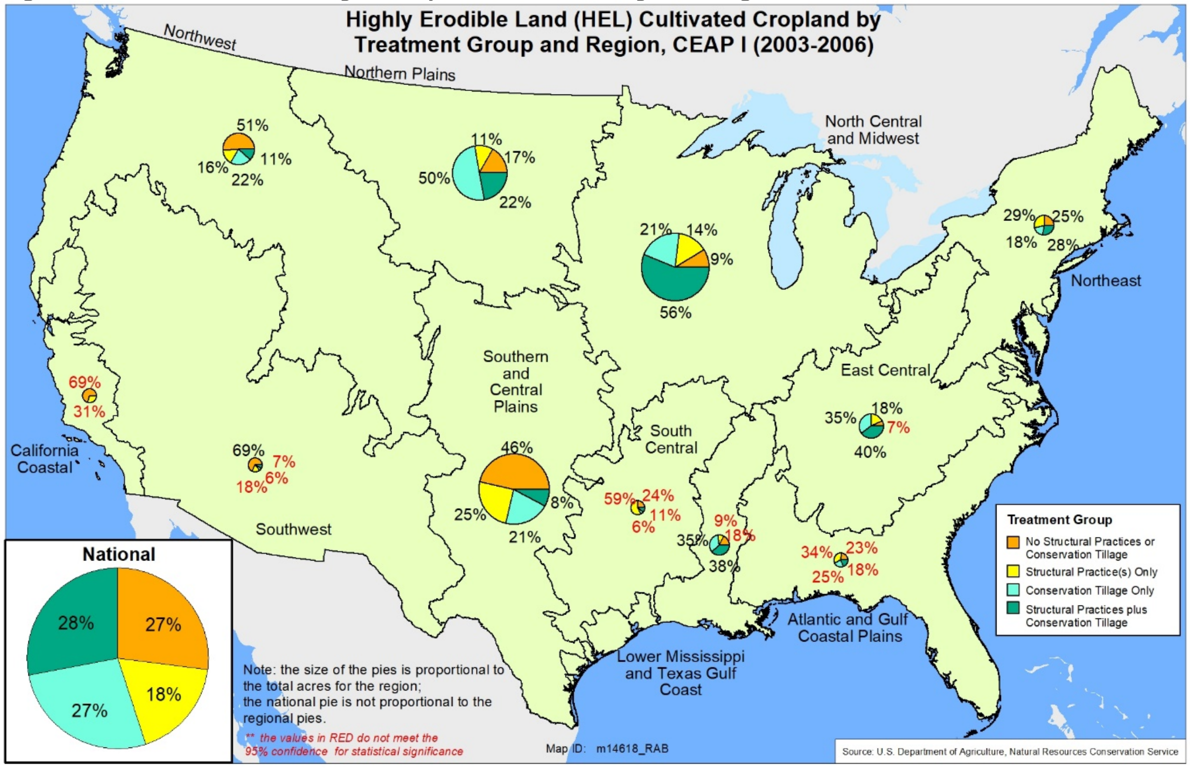
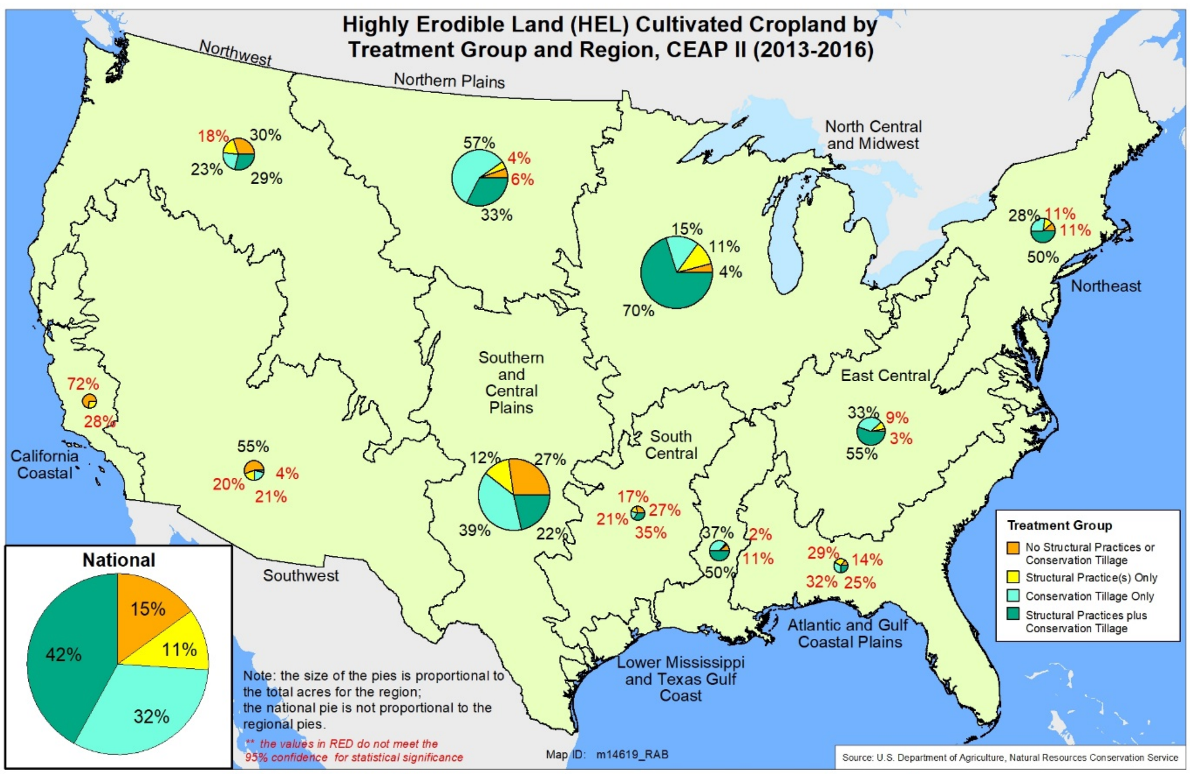


Table 4. Highly Erodible Cropland by Treatment Group, CEAP I and CEAP II

Treatment Group	CEAP I		CEAP II		CEAP II - CEAP I		
	Acres (1000s)	Percent HEL	Acres (1000s)	Percent HEL	Acres (1000s)	Percent HEL	Percent Acres Relative to CEAP I
Structural Practices, Conservation Tillage, or Both	**57,262**	**73**	**72,985**	**85**	**15,722**	**12**	27
Structural Practices plus Conservation Tillage	*21,971*	*28*	*35,862*	*42*	*13,891*	*14*	*63*
Conservation Tillage Only	*21,164*	*27*	*27,926*	*33*	*6,762*	*6*	*32*
Structural Practices Only	*14,127*	*18*	*9,197*	*11*	*-4,930*	*-7*	*-35*
No Structural Practice(s) or Conservation Tillage	**21,155**	**27**	**12,800**	**15**	**-8,355**	**-12**	-39
National	**78,417**	**100**	**85,785**	**100**	**7,367**		9

Figure 8. HEL Cultivated Cropland by Treatment Group and Region, CEAP I and CEAP II



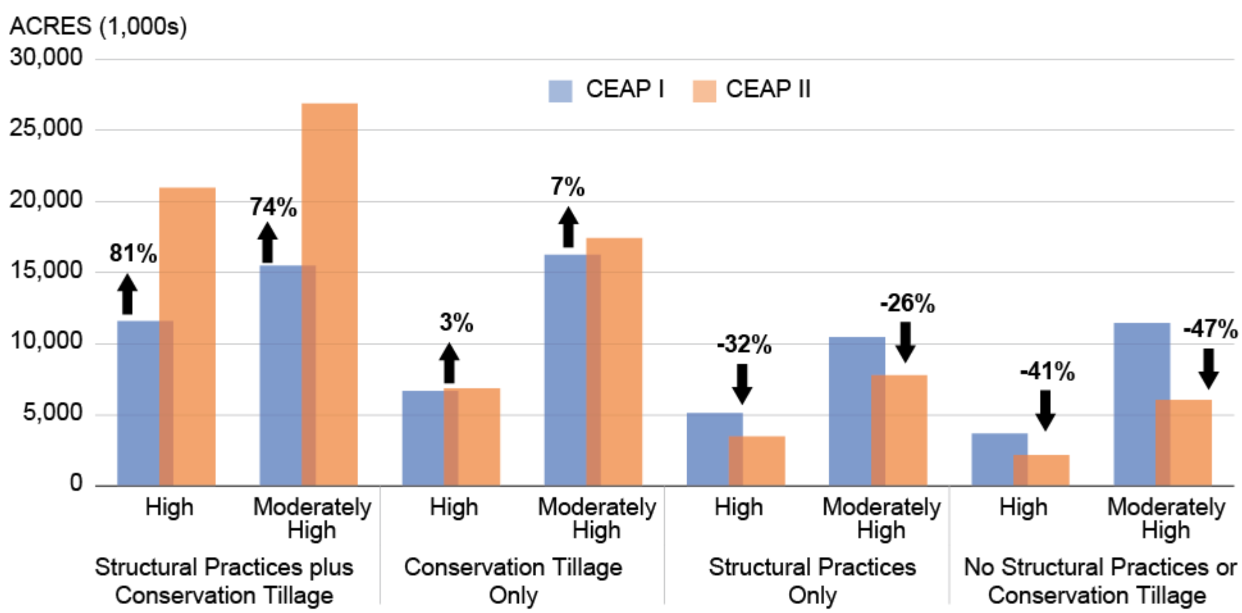


Cropland Vulnerable to Runoff—On the cultivated cropland most vulnerable to runoff (high and moderately high SVI runoff categories), adoption of structural practices plus conservation tillage increased by a combined 20.8 million acres between the CEAP surveys (table 5; appendix 2, table A-8). By CEAP II, the combined practices on high and moderately high vulnerability acres increased by 81 and 74 percent, respectively (fig. 9). Use of conservation tillage alone increased by a small amount, about 1.3 million acres. Adoption of structural practices alone declined by 4.4 million acres.

Table 5. Cultivated Cropland with High and Moderately High Runoff (SVI) Ratings by Treatment Group, CEAP I and CEAP II

Treatment Group	CEAP I		CEAP II		CEAP II - CEAP I		
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Percent of Acres Relative to CEAP I
Structural Practices, Conservation Tillage, or Both							
High	**23,453**	**86**	**31,340**	**93**	**7,887**	**7**	**34**
Moderately High	**42,250**	**79**	**52,114**	**90**	**9,864**	**11**	**23**
Structural Practices plus Conservation Tillage							
High	*11,605*	*43*	*20,974*	*63*	*9,370*	*20*	81
Moderately High	*15,497*	*29*	*26,898*	*46*	*11,401*	*17*	74
Conservation Tillage Only							
High	*6,706*	*25*	*6,877*	*21*	*171*	*-4*	3
Moderately High	*16,268*	*30*	*17,436*	*30*	*1,169*	*0*	7
Structural Practices Only							
High	*5,143*	*19*	*3,489*	*10*	*-1,654*	*-9*	-32
Moderately High	*10,485*	*20*	*7,779*	*13*	*-2,706*	*-6*	-26
No Structural Practices or Conservation Tillage							
High	**3,692**	**14**	**2,192**	**7**	**-1,500**	**-7**	**-41**
Moderately High	**11,471**	**21**	**6,051**	**10**	**-5,420**	**-11**	**-47**
National							
High	**27,145**	**9**	**33,532**	**11**	**6,387**	**2**	**24**
Moderately High	**53,721**	**17**	**58,165**	**18**	**4,444**	**1**	**8**

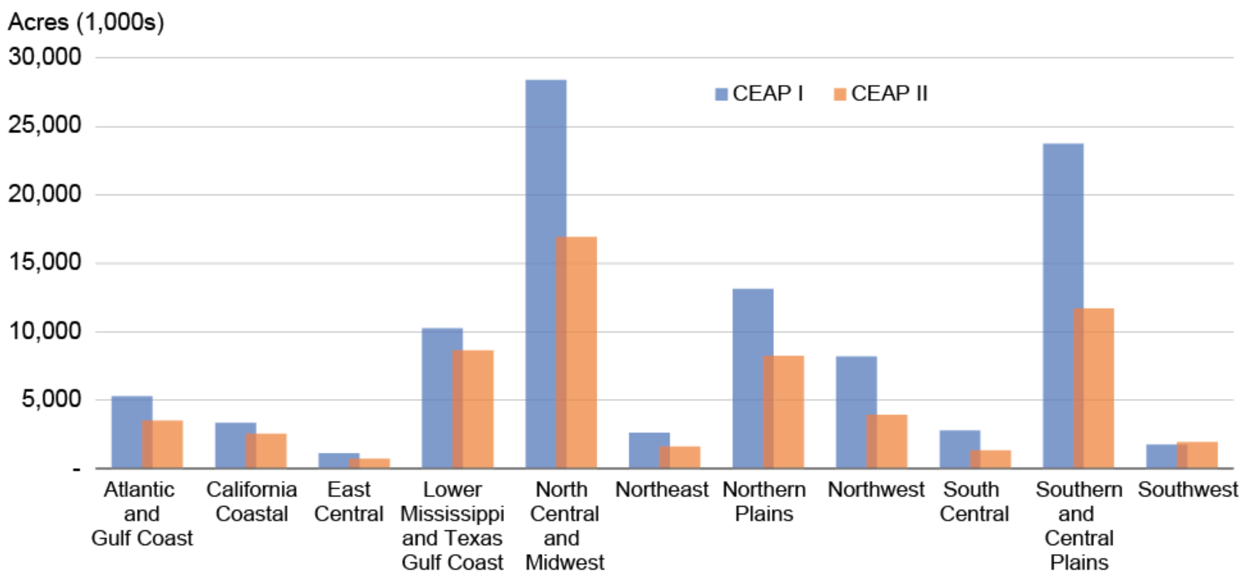
Figure 9. Cultivated Cropland with High and Moderately High SVI Runoff Rating by Treatment Group, CEAP I and CEAP II



Cultivated Cropland with No Structural Practices or Conservation Tillage

As of CEAP II, some 61.1 million acres (19 percent) of cultivated cropland had neither structural practices nor conservation tillage in place, down from 100.7 million acres (39 percent) in CEAP I (fig. 10). Four regions (North Central and Midwest, Southern and Central Plains, Northern Plains, and Lower Mississippi and Texas Gulf Coast) accounted for 74 percent of the cultivated cropland without structural practices or conservation tillage.

Figure 10. Cultivated Cropland with No Structural Practices or Conservation Tillage by Region, CEAP I and CEAP II



Conservation needs may be low on the acres without structural practices or conservation tillage, or addressed through other measures (such as rotations or cover crops). However, treatment may be particularly important on untreated acres highly vulnerable to erosion and/or runoff, or where high rainfall intensifies potential soil losses. For example, of the total acreage lacking structural practices or conservation tillage, 12.8 million acres were HEL and 8.2 million acres had high or moderately high vulnerability to runoff (table 6).

Table 6. Cultivated Cropland with No Structural Practices or Conservation Tillage, CEAP I and CEAP II

Cultivated Cropland Group	CEAP I		CEAP II		CEAP II minus CEAP I		Percent Change in Acres Relative to CEAP I
	Acres (1,000s)	Percent Acres	Acres (1,000s)	Percent Acres	Acres (1,000s)	Percent Acres	
All Cultivated Cropland	**100,651**	**32**	**61,148**	**19**	**-39,503**	**-13**	**-39**
Highly Erodible Land	21,155	27	12,800	15	-8,355	-12	-39
Percent of All Acres with No Structural Practices or Conservation Tillage	*21*		*21*				
High and Moderately High Runoff Vulnerability	15,163	19	8,243	9	-6,920	-10	-46
Percent of All Acres with No Structural Practices or Conservation Tillage	*15*		*13*				

Conservation Crop Rotations and Cover Crops

Conservation crop rotations and cover crops have a common goal of reducing erosion through covering or protecting the soil. A conservation crop rotation is a planned sequence of crops grown on the same field over a period of time to achieve a conservation purpose, such as reducing erosion or improving soil organic matter content. Cover crops are generally a grass, small grain, or legume planted specifically to provide vegetative cover during the non-growing season. Including cover crops, perennials, and winter annuals in a crop rotation provides year-round soil cover, and a variety of benefits such as promoting soil structure, taking up nutrients that may otherwise be lost, and enhancing habitat for wildlife, including pollinators. Some cropping systems and environments, however, are less conducive to the use of cover crops in rotation, for example in arid or semiarid environments where additional water may be needed to maintain productivity or where growing seasons are short. Technologies such as interseeding before harvest can help to overcome challenges to late-season establishment of cover crops in colder climates.

Conservation Crop Rotations

By CEAP II, nearly 70 percent of cultivated cropland acres had conservation crop rotations, up from 66 percent in CEAP I, including 28 percent of all cultivated cropland acres having high-biomass conservation crop rotations (table 7; appendix 2, table A-9). For this report, conservation crop rotations had to meet a biomass index score of 1.5 or higher; rotations with a biomass index of 2.0 or higher were identified as high-biomass conservation crop rotations. [20] As expected, high-biomass conservation crop rotations are concentrated in rotations with hay—84 percent of acres with hay in the rotation had high-biomass crop rotations—but only 16 percent of acres with continuous row crop rotations were high-biomass conservation crop rotations.

About 31 percent of cultivated cropland acres (96.2 million acres) did not have a conservation crop rotation in CEAP II. These acres, however, are not equally distributed among the four major crop rotation groups. Only 11 percent of rotations that included hay were not in a conservation crop rotation. In contrast, 51 percent of rotations with only close-grown crops were not in a conservation crop rotation. While only 27 percent of rotations that included only continuous row crops were not in a conservation crop rotation, that group accounted for over half of the total acres without conservation crop rotations.

Of the 96 million acres without conservation crop rotations, 40 percent included an idle or fallow year, which contributes little or no biomass to the rotation. These years were planned resting periods to allow the soil to build up water or nutrient reserves or were idled because of external conditions such as poor weather, natural disasters, or economic hardship. Ninety-eight percent of rotations that included only close-grown crops and 69 percent of rotations that included hay had an idle or fallow year in the rotation.

---

[20] The biomass index assigns a score to each crop in a rotation based on the level of biomass produced (high, moderately high, moderately low, low, and idle/fallow), and then averages these scores over the rotation to produce a single score.

Table 7. Cultivated Cropland by Crop Rotation Group, CEAP II

Crop Rotation Group	Cultivated Cropland		With Conservation Crop Rotations				Without Conservation Crop Rotations			
			All*		High-Biomass**		All		With Idle or Fallow in One or More Rotation Years	
	Acres (1,000)	Percent	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Acres (1,000s)	Percent
Hay With Other Crops	20,787	7	18,459	89	17,503	84	2,328	11	1,599	69
Close-grown Crops, No Hay or Row Crops	47,289	15	23,077	49	20,287	43	24,212	51	23,631	98
Row and Close-grown Crops, No Hay	65,719	21	44,689	68	19,650	30	21,030	32	8,517	41
Continuous Row Crops	181,509	58	132,865	73	29,223	16	48,644	27	4,183	9
All Cultivated Cropland	315,303	100	219,136	70	86,708	28	96,167	31	37,986	40

** Acres with a crop rotation biomass index score greater than or equal to 1.5.*
*** Acres with a crop rotation biomass index score greater than or equal to 2.0.*

All production regions except for the Northwest, South Central, and Southern and Central Plains experienced an increase in conservation crop rotations between the CEAP surveys (fig. 11). Specifically:

- Use of high biomass conservation crop rotations increased in all but four regions—Northern Plains, Northwest, South Central, and Southern and Central Plains.
- Four regions—North Central and Midwest, Northeast, East Central, and South Central—exceeded the national average of nearly 70 percent of cultivated cropland acres in conservation crop rotations. The latter three also had 40 percent or more of their cultivated cropland in high-biomass conservation crop rotations.
- Three regions—California Coastal, Northern Plains, and Southern and Central Plains—were below the CEAP II national average but still had more than half of their regional cultivated cropland in conservation crop rotations.
- Half or fewer of the cultivated cropland acres in four regions—Atlantic and Gulf Coastal Plains, Southwest, Lower Mississippi and Texas Gulf Coast, and Northwest—were in conservation crop rotations.

Conservation crop rotations used in combination with conservation tillage can provide even better protection against runoff and soil loss. Nearly half of all cultivated cropland acres have combinations of conservation tillage and conservation crop rotations and another 21 percent have conservation crop rotations but are conventionally tilled (fig 12).

Continuous row crops accounted for most cultivated cropland acres and most acres with conservation crop rotations and conservation tillage (55 percent). Cultivated cropland with continuous close-grown crops had the lowest percent of acres with conservation crop rotations and conservation tillage (29 percent). The most common close-grown crop rotations were corn and wheat, soybean and wheat, corn and soybean and wheat, rice and soybean, and wheat and sorghum. Not surprisingly, hay with other crops in rotation, while the smallest share of cultivated cropland (7 percent), had most acres meeting the definition of conservation crop rotation (88 percent) (table 8).

Figure 11. Percent of Cultivated Cropland with Conservation Crop Rotations by Biomass Index (BI) Level and Region, CEAP I and CEAP II

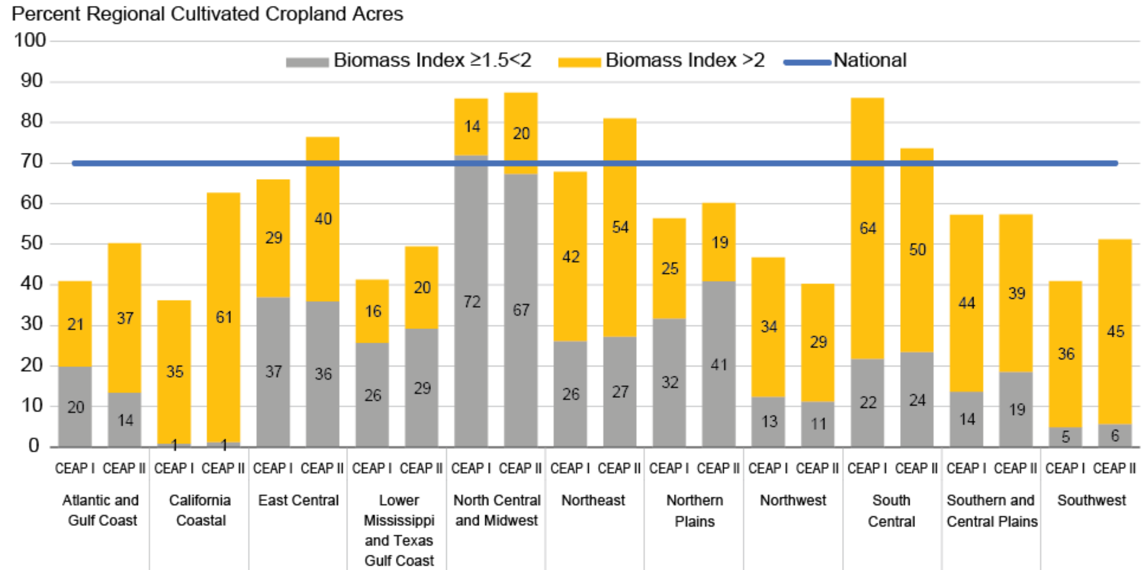


Figure 12. Cultivated Cropland by Combinations of Conservation Crop Rotations and Tillage, CEAP II

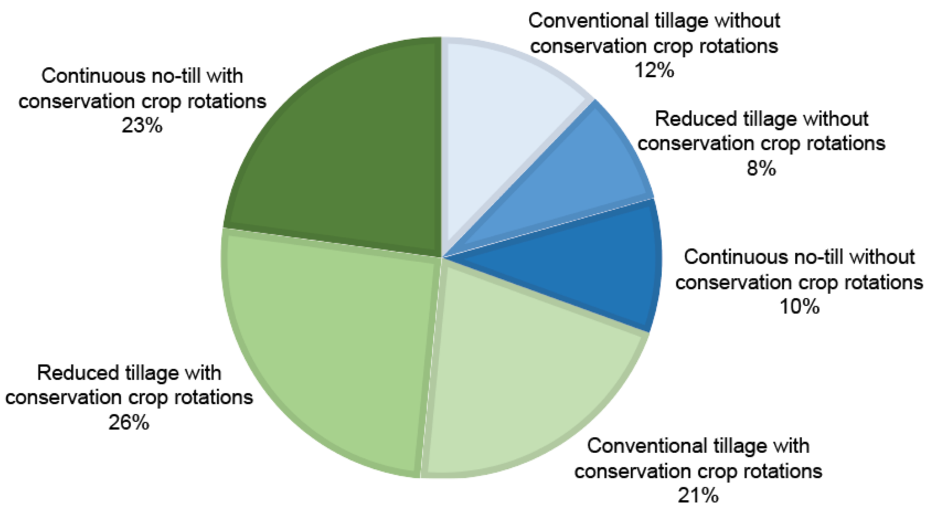


Table 8. Cultivated Cropland by Crop Rotation Group and Tillage Group, CEAP II

Crop Rotation Group	Cultivated Cropland	Tillage Group					
		Conventional Tillage		Reduced Tillage		Continuous No-Till	
		Conservation Crop Rotation Status					
		With	*Without*	*With*	*Without*	*With*	*Without*
	Acres (1,000s)	Percent Crop Rotation Group Acres					
Hay with other crops	20,787	45.3	3.9	22.6	2.6	20.8	4.8
Continuous Close-grown crops, no hay or row crops	47,289	19.6	17.1	12.7	11.5	16.5	22.7
Row and close-grown crops, no hay	65,719	22.4	11.9	18.7	8.8	26.8	11.4
Continuous Row crops, no close-grown crops or hay	181,509	18.1	12.0	31.9	8.2	23.2	6.6
National	**315,303**	**21.0**	**12.2**	**25.6**	**8.4**	**22.8**	**9.9**

Cover Crops

Between CEAP I and CEAP II, farmers' use of cover crops increased from slightly over 2 million acres to nearly 19 million acres, yet cover crops were still used on only about 6 percent of total cultivated cropland in CEAP II. Cover crop adoption between the two surveys was highly concentrated in three regions—Atlantic and Gulf Coastal Plains, North Central and Midwest, and Northern Plains—where 70 percent of the increase occurred (fig. 13).

Cover crops were more prevalent among continuous row crop rotations, which accounted for 58 percent of cultivated cropland acres but 68 percent of the acres with cover crops in one or more years of the rotation (table 9). In CEAP II, about 7 percent of continuous row crop acres included cover crops.

Nearly all acres with cover crops—94 percent—also had conservation crop rotations, in part due to the biomass contribution of the cover crops (table 10). About 84 percent of the acres with cover crops had high-biomass conservation crop rotations, which included high-biomass crops such as hay (other than small-grain hay), grasses, grass seed, and wild rice. About 1.1 million acres that included cover crops in the rotation did not meet the biomass index threshold (i.e., biomass index of 1.5 or greater) to be designated as a conservation crop rotation.

Figure 13. Cultivated Cropland with Cover Crops, CEAP I and CEAP II

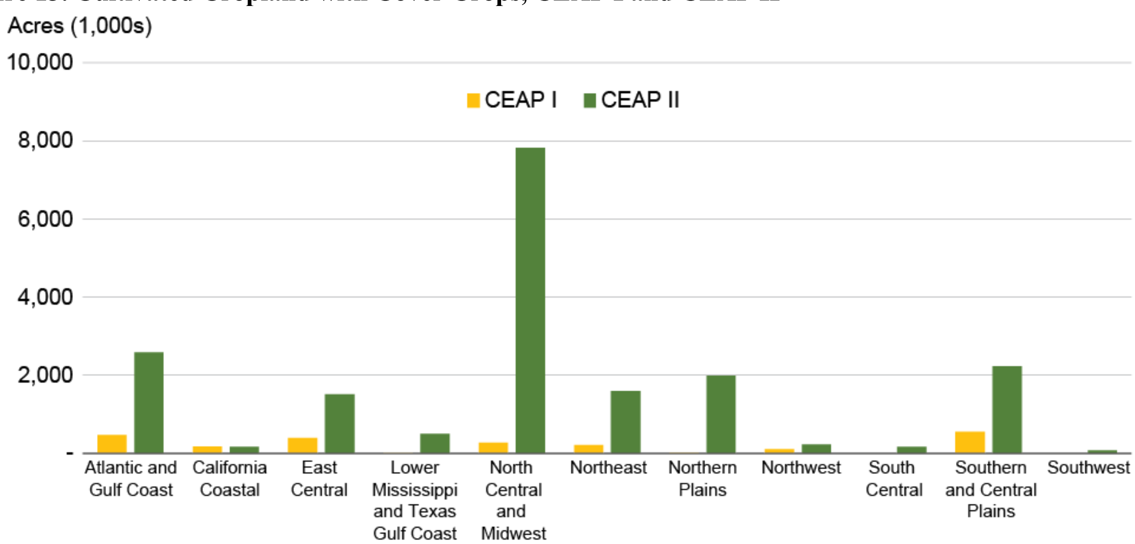


Table 9. Use of Cover Crops in Major Crop Rotation Groups, CEAP II

Crop Rotation Group	Cultivated Cropland	Cover Crops	Average Crop Years with Cover Crops*	Group Acres with Cover Crops	Group Share of All Cover Crops
	Acres (1,000s)		Percent		
National	**315,303**	**18,900**	**56**	**6.0**	**100.0**
Hay with Other Crops	20,787	1,409	44	6.8	7.5
Continuous Close-grown Crops, No Hay or Row Crops	47,289	654	45	1.4	3.5
Row and Close-grown Crops, No Hay	65,719	3,996	47	6.1	21.1
Continuous Row Crops	181,509	12,840	61	7.0	67.9

** For sample points with rotations that included cover crops, the number of years in the rotation that had cover crops was divided by the number of years in the full rotation. This proportion was then averaged over all the sample points with cover crops and reported here as an average percentage.*

Table 10. Cover Crops and Conservation Crop Rotations by Major Crop Rotation Group, CEAP II

Crop Rotation Group	Cultivated Cropland with Cover Crops	Cover Crop Acres with Conservation Crop Rotation	Cover Crop Acres with High-Biomass Conservation Crop Rotation
	Acres (1,000s)	Percent	Percent
National	18,900	94.2	83.8
Hay with Other Crops	1,409	94.0	90.7
Close-grown Crops, No Hay or Row Crops	654	83.6	77.0
Row and Close-grown Crops, No Hay	3,996	93.1	78.9
Row crops, No Close-grown Crops or Hay	12,840	95.1	84.9

About 6 percent of cultivated cropland acres included cover crops in one or more years of the rotation in CEAP II. Cover crop use in the Northeast, Atlantic and Gulf Coastal Plains, and East Central regions was substantially higher than the national average, accounting for 30 percent of acres with cover crops in the rotation while accounting for only 10 percent of all cultivated cropland acres (table 11).

Table 11. Cover Crop Use by Region, CEAP II

Production Region	Cultivated Cropland	Cover Crops	Regional Cultivated Cropland	Regional Acres with Cover Crops	Regional Share of All Cover Crop Acres
	Acres (1,000s)		Percent		
National	**315,303**	**18,900**	**100**	**6**	**100**
Atlantic and Gulf Coastal Plains	13,825	2,587	4	19	14
California Coastal	3,913	169	1	4	1
East Central	10,166	1,511	3	15	8
Lower Mississippi and Texas Gulf Coast	20,916	506	7	2	3
North Central and Midwest	123,296	7,815	39	6	41
Northeast	7,597	1,611	2	21	9
Northern Plains	51,130	1,995	16	4	11
Northwest	13,438	227	4	2	1
South Central	5,107	170	2	3	1
Southern and Central Plains	62,732	2,231	20	4	12
Southwest	3,183	77	1	2	0

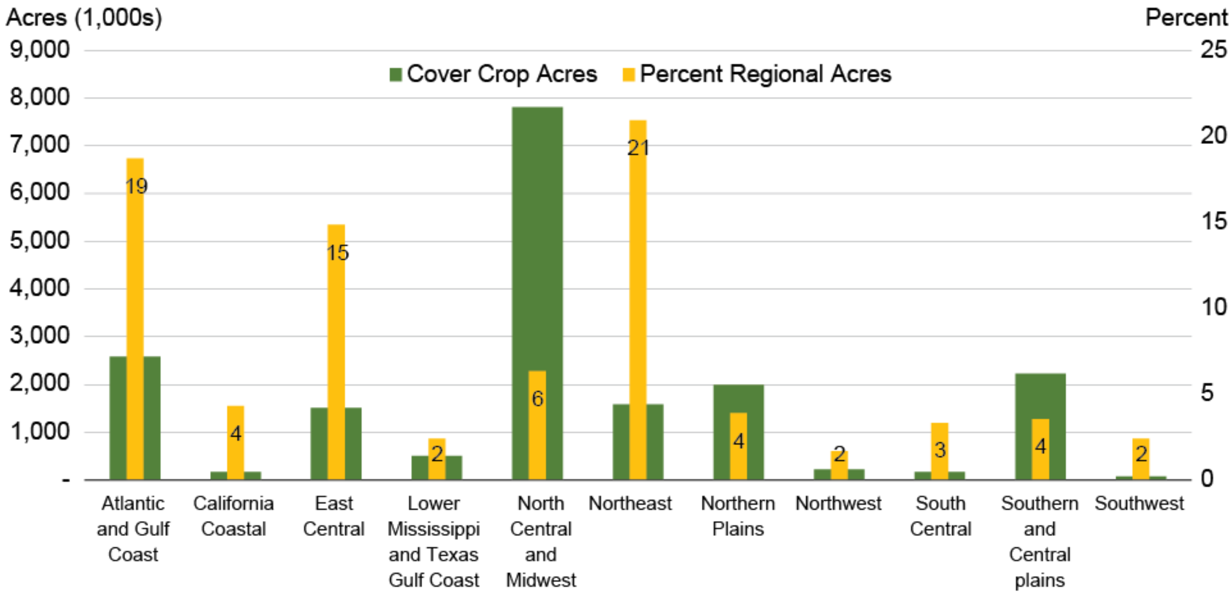
Cover crop use in the North Central and Midwest region was close to the national average with about 6.3 percent of cultivated cropland with cover crops in rotation, although that region accounted for 41 percent of all cultivated cropland acres with cover crops nationally (fig 14). All other regions were below the national average. Humid and subhumid production regions generally have adequate precipitation and infiltration to replenish soil water used by cover crops. The low use of cover crops in certain production regions (California Coastal, Lower Mississippi and Texas Gulf Coast, Northwest, South Central, and Southwest) reflects the arid or semi-arid conditions or water intensive production systems (e.g., rice) where additional water is needed to maintain productivity.[21, 22, 23]

[21] Eash, L., Berrada, A.F., Russell, K. and Fonte, S.J., 2021. Cover Crop Impacts on Water Dynamics and Yields in Dryland Wheat Systems on the Colorado Plateau. Agronomy, 11(6), p.1102.

[22] Nielsen, D.C., Lyon, D.J., Hergert, G.W., Higgins, R.K., Calderón, F.J. and Vigil, M.F., 2015. Cover crop mixtures do not use water differently than single-species plantings. Agronomy Journal, 107(3), pp.1025-1038.

[23] Unger, P.W. and Vigil, M.F., 1998. Cover crop effects on soil water relationships. Journal of Soil and Water Conservation, 53(3), pp. 200-206.

Figure 14. Cover Crop Use on Cultivated Cropland by Region, CEAP II



Irrigation

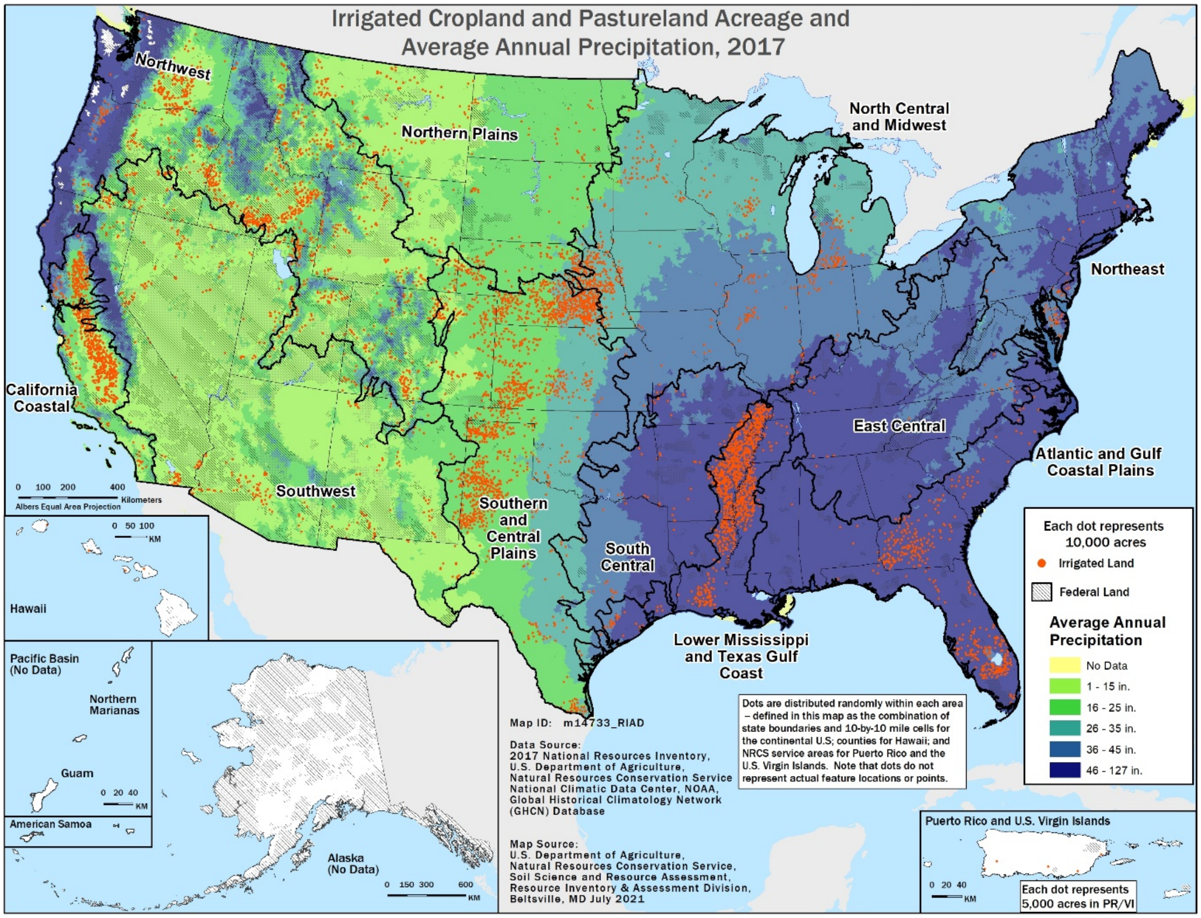
About 49.7 million cropland acres were irrigated by CEAP II, an increase of 4.9 million acres (11 percent) over the CEAP I level (table 12). Irrigated acres are concentrated where the practice is either required for production because of low precipitation, where it enables more profitable crops, where water supplies are available, and where producers view the capital expense as a sound production investment (fig. 15). Over two-thirds of irrigated acreage is in three regions—Southern and Central Plains (34 percent), Lower Mississippi and Texas Gulf Coast (23 percent), and North Central and Midwest (10 percent).

Table 12. Total Cropland, Irrigated Cropland, and Change in Irrigated Acres, CEAP I and CEAP II, Nationally and by Region

Geographic Area	CEAP I			CEAP II			Change in Acres	
	Total Cropland Acres *(1,000s)*	Irrigated Cropland Acres *(1,000s)*	Percent Irrigated	Total Cropland Acres *(1,000s)*	Irrigated Cropland Acres *(1,000s)*	Percent Irrigated	*(1,000s)*	*Percent*
National	**313,065**	**44,802**	**14**	**315,303**	**49,711**	**16**	**4,909**	**11**
Southern and Central Plains	64,337	15,564	24	62,732	16,778	27	1,214	8
Lower Mississippi and Texas Gulf Coast	21,816	8,970	41	20,916	11,651	56	2,681	30
North Central and Midwest	120,134	3,857	3	123,296	5,218	4	1,362	35
Northwest	14,010	5,156	37	13,438	4,554	34	-603	-12
California Coastal	4,447	3,775	85	3,913	3,193	82	-583	-15
Atlantic and Gulf Coastal Plains	14,395	2,127	15	13,825	2,902	21	775	36
Southwest	2,870	2,366	82	3,183	2,571	81	205	9
Northern Plains	48,420	1,776	4	51,130	1,762	3	-14	-1
South Central	6,135	930	15	5,107	672	13	-259	-28
East Central	9,312	195	2	10,166	233	2	38	19
Northeast	7,190	85	1	7,597	177	2	92	109

* Regions in table sorted by declining CEAP II irrigated cropland acres.

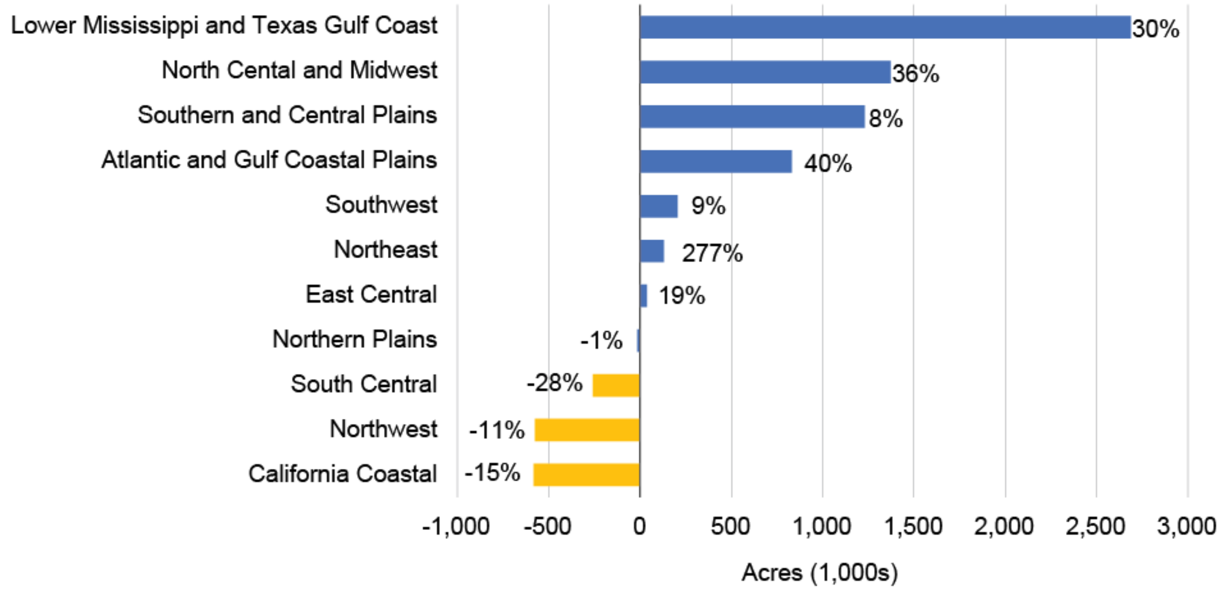
Figure 15. Acres of Irrigation on Cropland and Pastureland, 2017



Change in irrigated cropland between the CEAP surveys varied by region. There were increases in seven regions but declines in four—the Northern Plains, South Central, California Coastal, and Northwest. The greatest increase in irrigated cropland occurred in the Lower Mississippi and Texas Gulf Coast with over 2.6 million additional irrigated acres (fig. 16). Although the Northeast more than doubled irrigated acres between the CEAP surveys, it still has the fewest total irrigated acres (table 12, above). The Atlantic and Gulf Coastal Plains, North Central and Midwest, and Lower Mississippi and Texas Gulf Coast all increased irrigated area by 30 percent or more from CEAP I levels.

Irrigation intensity is greatest in areas with low rainfall in the growing season, or where crops require either additional water or water at a different time than normal precipitation. Irrigation is employed on 82 percent of the cropland acres in the California Coastal region and on 81 percent in the Southwest region, both characterized by low rainfall. In the more humid Lower Mississippi and Texas Gulf Coast region, about 56 percent of the cropland is irrigated due to the crops grown (rice is 100-percent irrigated), low soil water holding capacity, and precipitation timing (table 12, above).

Figure 16. Change in Irrigated Cropland by Region, CEAP I to CEAP II

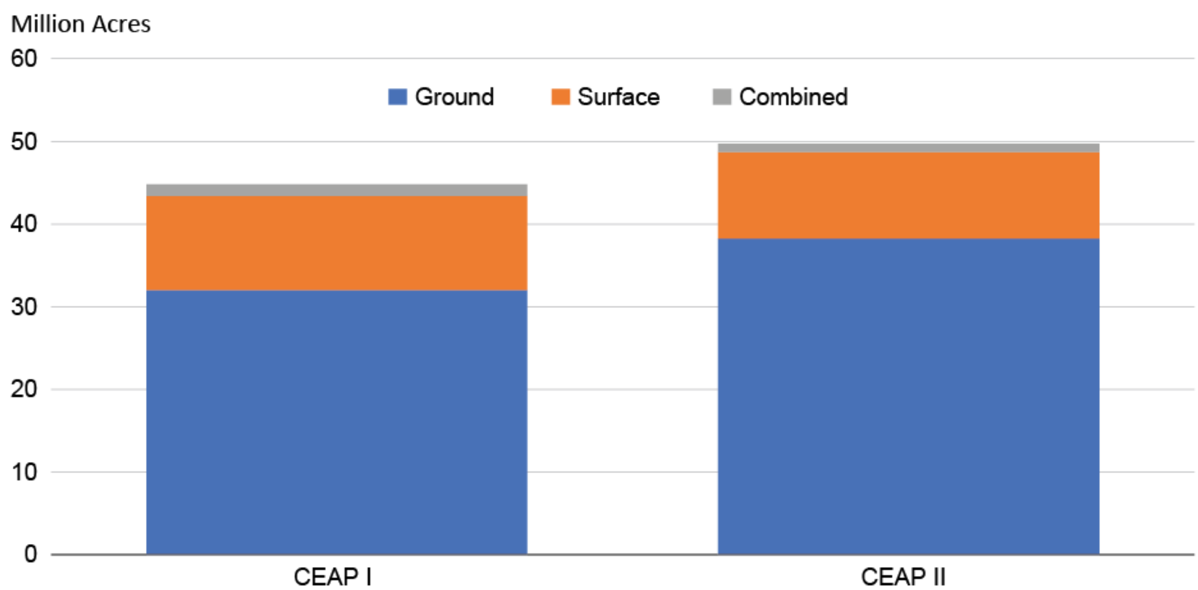


Note: Number at the end of each bar reflects the percent change in irrigated acreage relative to CEAP I levels.

Water Sources

In CEAP II, about 77 percent of irrigated cropland acres were served by groundwater, 21 percent by surface water, and the remaining 2 percent by the combined sources (fig. 17). Use of groundwater increased by about 6 percent (over 6 million acres), and use of surface water and combined sources declined by 4 percent (more than 900,000 acres) and 1 percent (400,000 acres), respectively, relative to CEAP I levels. While surface water sources are more susceptible to drought shortages, groundwater sources may be challenged by aquifer declines and exhaustion of the resource.

Figure 17. Sources of Water for Irrigated Cropland, CEAP I and CEAP II



Surface water was the predominant irrigation water source in the western United States (California Coastal, Northwest, and Southwest regions) and the East Central region, while groundwater sources dominated in the remaining seven regions. However, groundwater is an important and growing share of irrigation water supplies in the western regions. In the Southwest region, groundwater-supplied acres increased by 20 percentage points (18 points from groundwater and 2 points from combined sources)—from 24 percent in CEAP I to 42 percent by CEAP II. In the Northwest region groundwater-supplied acres increased by 14 percentage points while surface water acres decreased by a similar share. The California Coastal region's dependence on groundwater grew by 11 percentage points, while surface-only irrigated acres decreased by only 1 percentage point (fig. 18)

Application Methods

In the period between CEAP I and CEAP II there was a national shift toward irrigation pressure application systems, increasing 12 percentage points to 66 percent, and accounting for 8.7 million acres. Most regions primarily use pressure systems, while three regions (California Coastal, South Central, and Lower Mississippi and Texas Gulf Coast) primarily use gravity application methods. The East Central and Northeast regions depend wholly on pressure-based systems (fig. 19).

Between the two survey periods, every region except the South Central maintained or increased the share of irrigated cropland served by pressure systems. Use of pressure systems in the Atlantic and Gulf Coastal Plains region increased by 25 percentage points (1.3 million acres), in the Northwest and Southwest regions by 19 percentage points (over 400,000 and 500,000 acres, respectively), and in the California Coastal and Southern and Central Plains regions by 15 percentage points (400,000 acres and 3.4 million acres, respectively). The South Central region's decline in pressure systems was consistent with the overall irrigated cropland decline of 259,000 acres in the region.

Nationally, low-pressure center pivot systems were the most prevalent in CEAP I and CEAP II, and the share of irrigated cropland area served by these systems increased from 30 percent to 37 percent (13.4 to 18.6 million acres) (fig. 20). Center pivot technology in its various forms (low-pressure spray, impact sprinklers, and on- or near-ground emitters) increased from 47 percent of irrigated cropland acres in CEAP I to 54 percent of cropland acres in CEAP II. The most used gravity irrigation technology was poly-pipe, which increased to 13 percent of cropped acres in CEAP II, up from 8 percent in CEAP I. Poly-pipe systems are extensively used in the Lower Mississippi and Texas Gulf Coast and South Central regions. The only other gravity distribution system with a double-digit share was an open discharge system from a well, pipeline, gate, or valve with 10 percent of acres in CEAP II, down from 12 percent in CEAP I.

The regions that rely on pressure systems were increasingly using low-pressure spray center pivots (fig. 21). In the East Central region, the most common irrigation technology in CEAP II was hand-move sprinklers, which are not suitable for all crops. In the Northeast the most common irrigation technology in CEAP II was big gun sprinklers, which are relatively low-cost and are versatile across crops and terrain, but not as efficient as other pressure options.

Figure 18. Water Sources for Irrigated Cropland, Nationally and by Region, CEAP I and CEAP II

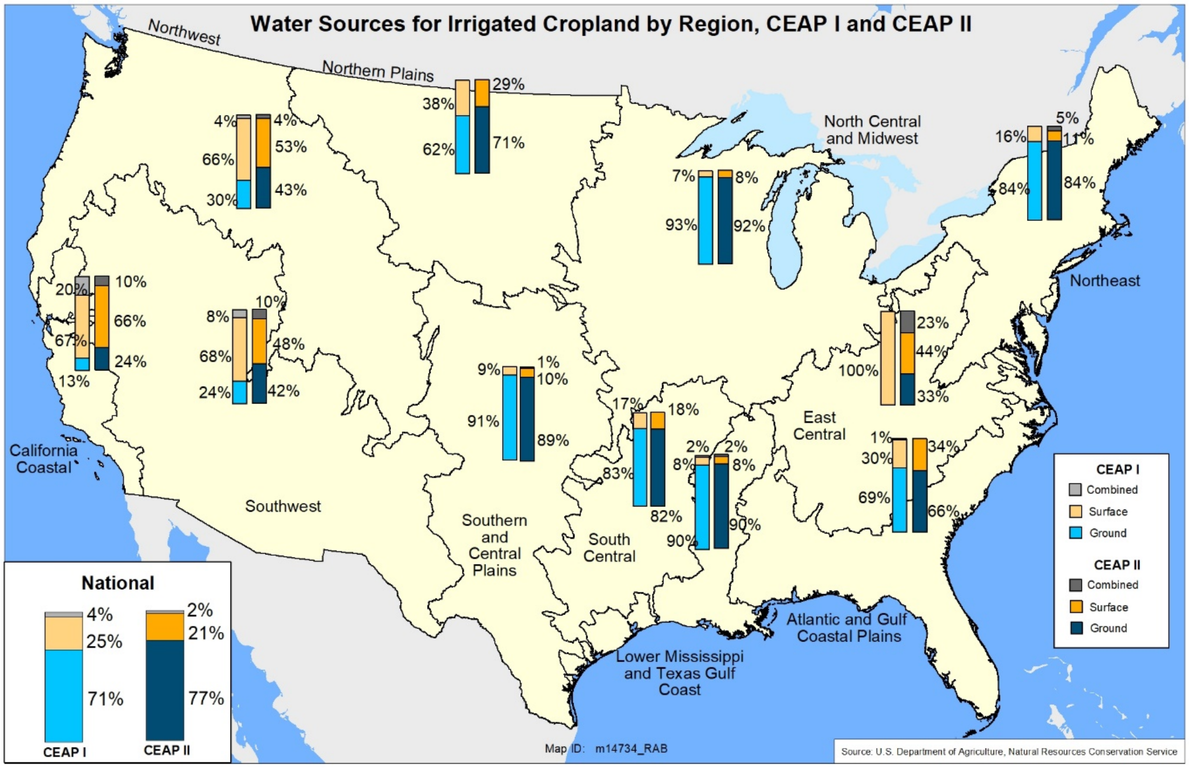


Figure 19. Irrigation Water Application Technology, Nationally and by Region, CEAP I and CEAP II

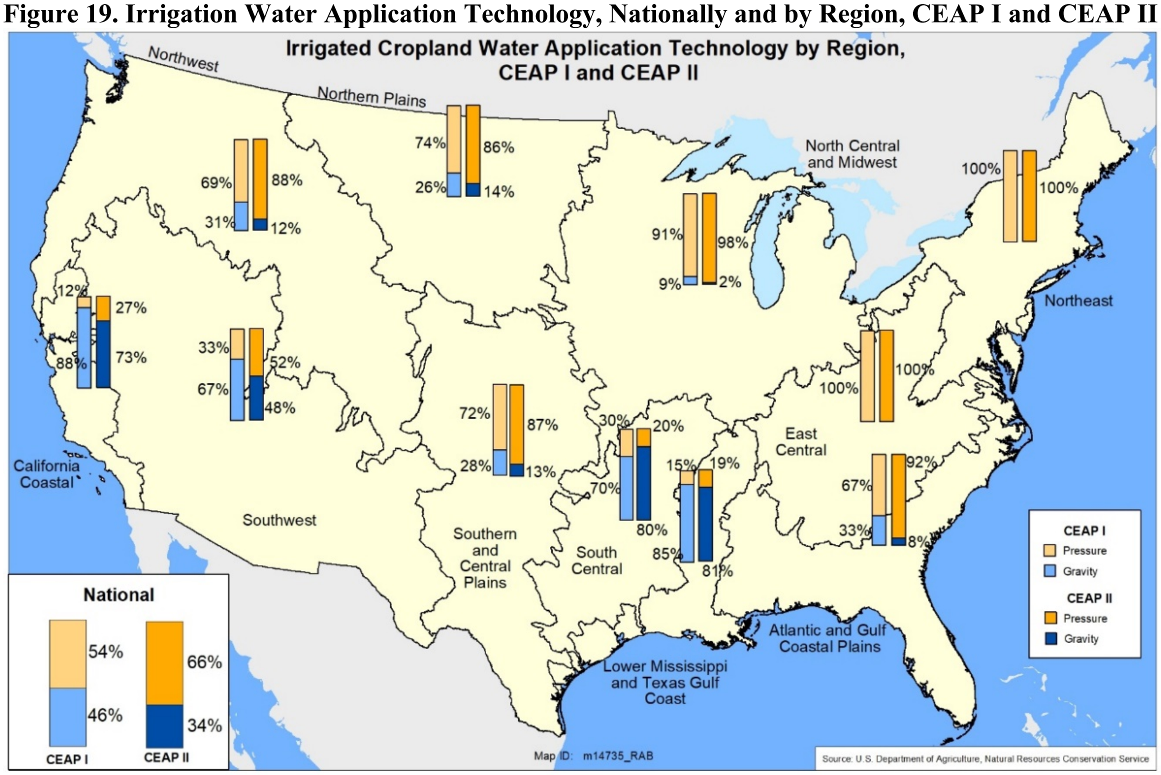
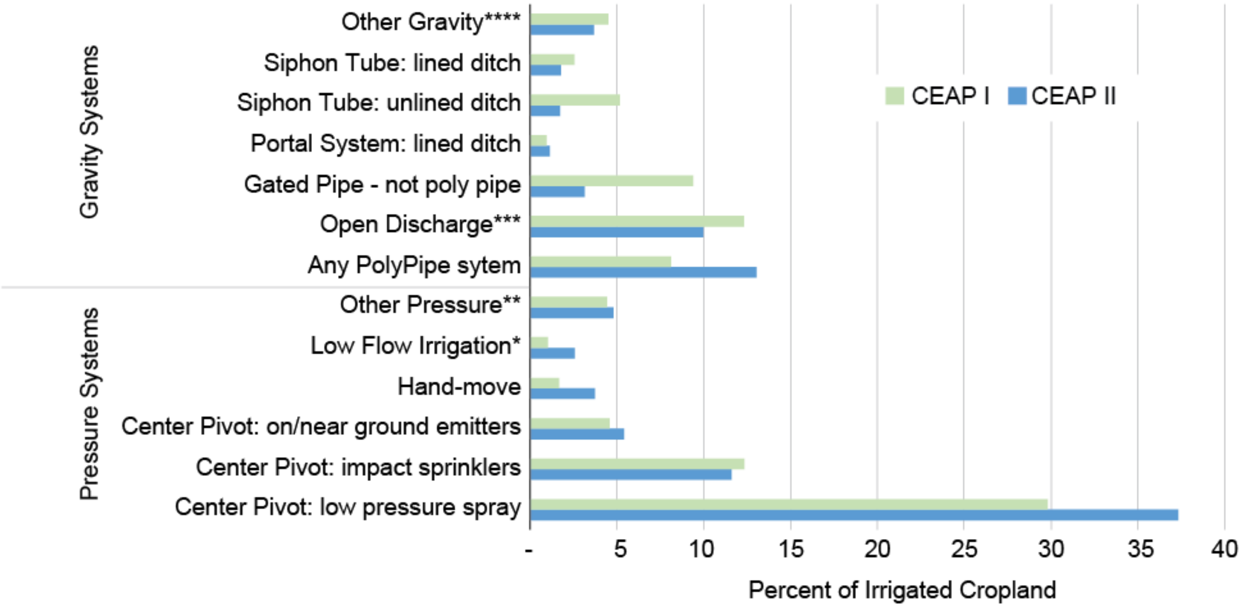
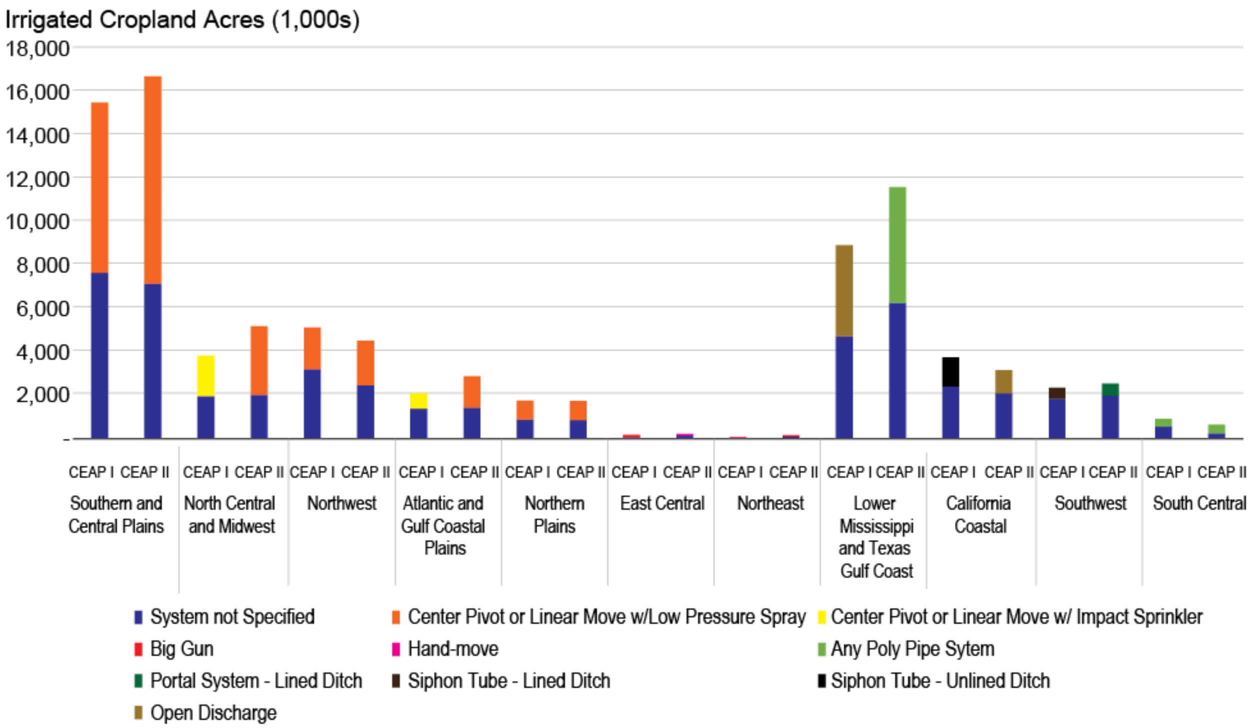


Figure 20. National Irrigation Water Application Systems on Cropland, CEAP I and CEAP II



* Low-Flow irrigation includes drip, trickle, and micro-sprinklers
**Other pressure includes side roll or wheel move, solid or permanent and big gun each with less than 2 percent of acres.
*** Open discharge is water flowing from a pipe, well, gate, or valve with no flow control.
****Other gravity includes subirrigation, portal system from a lined ditch, and improved gated pipe (surge flow or cablegation) each with no more than 1 percent of acres.

Figure 21. Most Prevalent Regional Irrigation Water Application Systems on Cropland, CEAP I and CEAP II



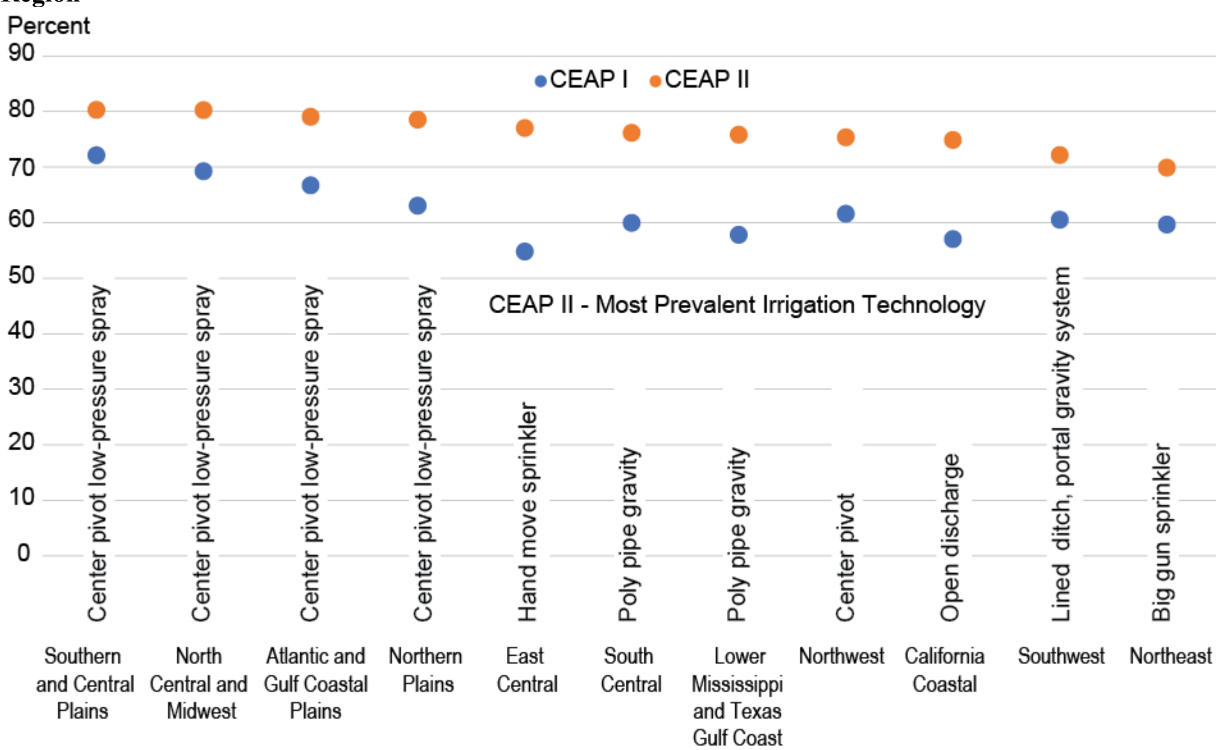
Application Efficiency

Irrigation water efficiency is a measure of water inputs to production outputs and was estimated by calculating the Virtual Irrigation System Efficiency (VISE).[24] The higher the VISE score, the more efficient the system. VISE is not a measured efficiency but is calculated from information obtained from a farmer survey on the physical distribution system, water source and conveyance method, and irrigator decisions on timing and amounts. Soil properties based on the field soil type from National Resources Inventory (NRI) points were also considered in the efficiency score.

The average VISE score increased from 62 percent to 76 percent from CEAP I to CEAP II. The 14-point (23-percent) improvement implies that irrigators needing to provide 12 inches of water to meet plant consumptive needs could reduce water application by 3.6 inches or almost 20 percent. This potential reduction in water applied translates directly into reduced pumping costs for groundwater and reduced surface water diversions to maintain the same acreage.

All regions increased their irrigation efficiencies between CEAP I and CEAP II (fig. 22). In CEAP II, the Southern and Central Plains and North Central and Midwest regions had the highest efficiency scores at 80 percent and the Northeast had the lowest at 70 percent. The

Figure 22. VISE Efficiency Scores in CEAP I and CEAP II and Most Prevalent Technology in CEAP II, by Region

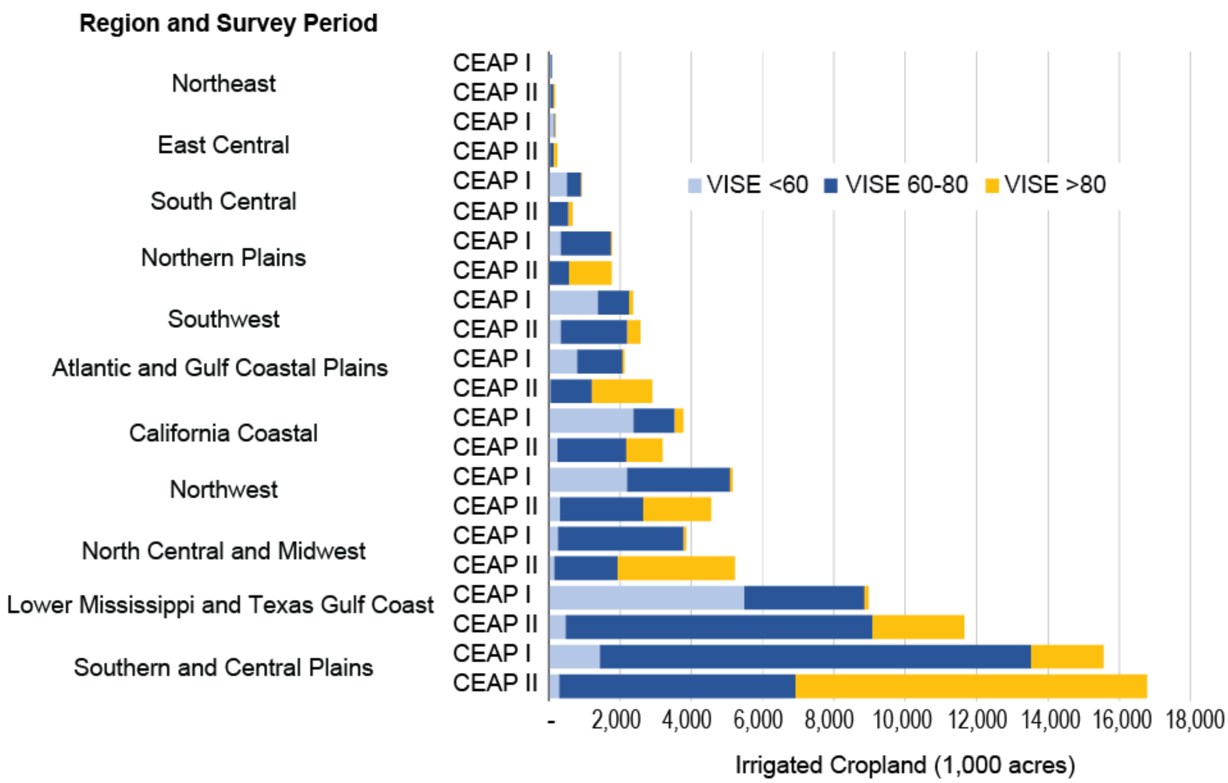


[24] Because the calculation process considers the delivery loss inherent in 19 water application technologies, runoff from the field (technology and management based) and deep percolation (soils, technology and management based), there can be a wide range of estimated VISE efficiency scores within an individual application technology as well as across technologies.

greatest gain in average score was in the East Central region from 55 percent in CEAP I to 77 percent in CEAP II, in large part due to the shift to hand-move sprinklers. The smallest efficiency gains were the 8-percent increase in the Southern and Central Plains (low-pressure center pivot sprinklers in both periods) and the 10-percent increase in the Northeast (big gun sprinkler in both periods). The four regions with the highest estimated efficiency scores all relied on low-pressure center pivots as the most prevalent irrigation application technology.

Nationally, there was about a 30-percent decline in acres with lower VISE scores and about a 40 percent increase in acres with higher VISE scores. This pattern was repeated in all production regions (fig. 23). The shift may have been technology based or management based, or by adding irrigated acres on better suited soils, or more likely a combination of all efficiency drivers.

Figure 23. Irrigated Acreage Distribution of VISE Efficiencies by VISE Grouping and Region, CEAP I and CEAP II



Application Amount

Total irrigation water applications on cropland declined nationally and in most regions despite the increase in irrigated acres. In CEAP I the average irrigation water application was 19.2 inches per acre, declining to 15.6 inches per acre in CEAP II (table 13). Total irrigation water applications declined 10 percent (from 71.7 million acre-feet to 64.6 million acre-feet), even though irrigated acres increased by 11 percent (4.9 million acres).

Nationally, the average per-acre decline in water application was about 3.6 inches with the Lower Mississippi and Texas Gulf Coast region having the greatest decline at 5.5 inches. Only one region, the Northeast, increased average water application per acre *and* total water applied from CEAP I to CEAP II; three regions (Southwest, North Central and Midwest, and Atlantic and Gulf Coastal Plains), despite having less water applied per acre, gained enough irrigated acres to increase total water applications as well. Two regions, Lower Mississippi and Texas Gulf Coast and Atlantic and Gulf Coastal Plains, recorded more than 20-percent declines in per-acre water applications. In the South Central region, total water applications declined by over 30 percent, due in large part to the nearly 30-percent decline in cultivated cropland acres.

Table 13. Irrigation Water Applications, Total Water Applied, and Change in Water Applications, CEAP I to CEAP II, by Region

Geographic Area	CEAP I		CEAP II		Change CEAP I to CEAP II		Change from CEAP I	
	Average Water Applied	**Total Water Applied**	**Average Water Applied**	**Total Water Applied**	**Average Water Applied**	**Total Water Applied**	**Average Water Applied**	**Total Water Applied**
	Inches/ acre	***1000 acre-feet***	***Inches/ acre***	***1000 acre-feet***	***Inches/ acre***	***1000 acre-feet***	***Percent***	***Percent***
National	**19.2**	**71,683**	**15.6**	**64,624**	**-3.6**	**-7,060**	**-19**	**-10**
Region*								
Southern & Central Plains	15.7	20,363	14	19,575	-1.7	-788	-11	-4
Lower Mississippi & Texas Gulf Coast	23	17,193	17.5	16,991	-5.5	-202	-24	-2
California Coastal	40.6	12,773	36.2	9,631	-4.4	-3,141	-11	-25
Northwest	21.7	9,325	18.2	6,907	-3.5	-2,418	-16	-26
Southwest	28	5,521	25.9	5,548	-2.1	28	-8	0
North Central & Midwest	6.2	1,993	5.1	2,218	-1.1	225	-18	10
Northern Plains	13	1,924	10.5	1,542	-2.5	-382	-19	-21
South Central	20.5	1,589	19.5	1,091	-1	-498	-5	-31
Atlantic & Gulf Coastal Plains	5.3	940	4.2	1,016	-1.1	76	-21	11
East Central	4.4	72	3.7	72	-0.7	0	-16	0
Northeast	2.9	20	3.5	52	0.6	31	21	900

** Regions in table sorted by declining CEAP II total water application amounts.*

Nutrient Management

Nitrogen is essential for protein formation, and plants take up more of this nutrient than any other. The second most required nutrient is phosphorus, essential for plants to use and store energy. Some crops, such as corn, have high nitrogen demands, while others such as soybeans meet their nitrogen demand through a process called biological nitrogen fixation.

Practices to manage nutrients include application rate, timing, method, and form or source. There are many ways to combine these four components to maintain or enhance production and minimize potential losses. Climate, soil, cropping system, and tillage influence the options available to farmers (box 4).

Box 4. Advances in Nutrient Technology

Precision guidance systems allow for improved placement of nutrients and the ability to apply nutrients to actively growing crops. Together, variable-rate technologies in combination with enhanced-efficiency fertilizers (EEFs) can better match nutrient application rates to the differing needs of unique soil types within a field and their production potential, and reduce the impact of early application by extending the release of nutrients and, for some forms, by reducing volatile losses.

Use of variable rate technology more than quadrupled between CEAP I and CEAP II. Gains were concentrated in the North Central and Midwest region, accounting for 55 percent of the total increase. Only two regions, South Central and Southwest, experienced small declines over the time period.

Variable Rate Technology Adoption by Region, CEAP I and CEAP II

Geographic Scope	CEAP I		CEAP II		CEAP II minus CEAP I	
	Acres (1,000s)	Percent Acres	Acres (1,000s)	Percent Acres	Acres (1,000s)	Percent Acres
National	**12,567**	**4**	**51,215**	**16**	**38,648**	**12**
Region						
Atlantic and Gulf Coastal Plains	515	4	2,632	19	2,117	15
California Coastal	192	5	296	8	104	3
East Central	277	3	1,038	10	761	7
Lower Mississippi and Texas Gulf Coast	493	3	3,885	19	3,392	16
North Central and Midwest	6,023	5	27,632	22	21,610	17
Northeast	160	2	426	6	266	3
Northern Plains	1,849	4	7,575	15	5,726	11
Northwest	1,022	8	2,302	17	1,280	10
South Central	335	6	330	6	-5	1
Southern and Central Plains	1,597	3	5,034	8	3,437	5
Southwest	104	4	66	2	-38	-1

Between the survey periods, use of EEFs increased by over 6-fold and were in use on over one-fourth of all cultivated cropland by CEAP II. All regions showed gains in EEF use, with the North Central and Midwest accounting for 55 percent of the total increase.

Enhanced-Efficiency Fertilizer Adoption by Region, CEAP I and CEAP II

Geographic Scope	CEAP I		CEAP II		CEAP II minus CEAP I	
	Acres (1,000s)	Percent Acres	Acres (1,000s)	Percent Acres	Acres (1,000s)	Percent Acres
National	**11,734**	**4**	**74,146**	**26**	**64,412**	**22**
Region						
Atlantic and Gulf Coastal Plains	327	2	2,356	19	2,029	17
California Coastal	130	4	352	10	222	7
East Central	353	4	2,215	23	1,862	19
Lower Mississippi and Texas Gulf Coast	983	6	4,629	28	3,646	23
North Central and Midwest	8,301	7	44,139	38	35,838	31
Northeast	353	5	2,754	39	2,401	34
Northern Plains	355	1	8,334	17	7,978	16
Northwest	154	1	1,871	15	1,717	13
South Central	118	2	741	16	623	14
Southern and Central Plains	642	1	6,505	12	5,863	11
Southwest	17	1	249	9	232	8

Rate

Nutrient application rates vary by crop and take into consideration all sources of essential nutrients. Cultivated cropland acres on which a soil test was taken within the last 5 years increased slightly over the decade, from 56 percent to 60 percent. Where manure was applied, soil testing rates were at 77 percent (box 5). However, nutrient application rates on manured acres still were substantially higher than rates on acres receiving only commercial fertilizers, perhaps related to a lag in manure testing.

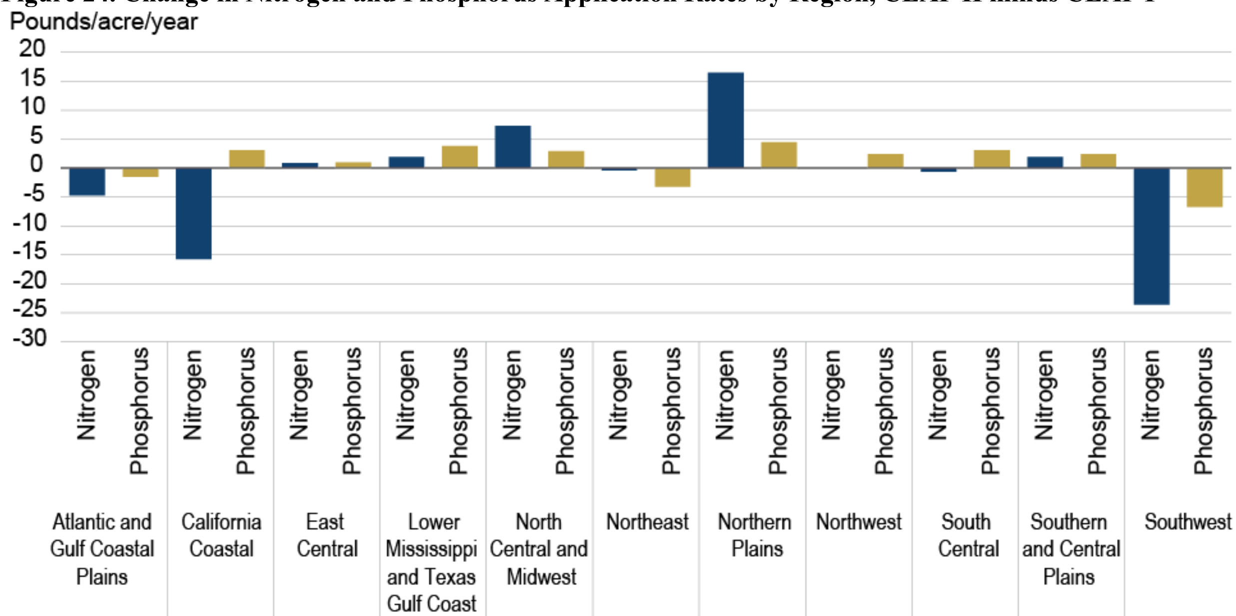
Nationally, application rates of nitrogen and phosphorus from all sources increased between the CEAP surveys (table 14). Average nitrogen rates increased by 7 percent, from 73 to 78.5 lbs/a/y. The largest increase occurred in the Northern Plains region at 16.6 lbs/a/y, over three times the national average increase. The North Central and Midwest was the only other region with a rate increase above the national average. The expansion of corn production in these two regions drove the need for more nitrogen (fig. 24).

Phosphorus application rates increased by 15 percent, from 16.2 to 18.6 lbs/a/y. Five regions had rate increases above the national average increase of 2.4 lbs/a/y. The largest rate increase occurred in the Northern Plains region at 4.5 lbs/a/y.

Table 14. Nutrients Applied on Cultivated Cropland, CEAP I and CEAP II

Nutrient	CEAP I			CEAP II			CEAP II minus CEAP I		
	Acres Receiving (1,000s)	Tons Applied (1,000s)	Rate (lbs/a/y)	Acres Receiving (1,000s)	Tons Applied (1,000s)	Rate (lbs/a/y)	Acres Receiving (1,000s)	Tons Applied (1,000s)	Rate (lbs/a/y)
Nitrogen	294,384	11,433	73	294,069	12,263	78.5	-315	830	5.2
Phosphorus	268,472	2,538	16.2	278,859	2,930	18.6	10,387	392	2.4

Figure 24. Change in Nitrogen and Phosphorus Application Rates by Region, CEAP II minus CEAP I



Box 5. Soil Testing for Nutrient Management

Testing soils for nitrate nitrogen, phosphorus, organic matter, potassium, pH, and soluble salts content provides essential information for developing a sound nutrient management strategy and determining appropriate nutrient application rates to promote healthy plant growth and minimize potential for nutrient losses. Between the CEAP surveys, the share of cultivated cropland acres having had a soil test within the previous 5 years increased from 56 to 60 percent.

Soil Testing on Cultivated Cropland, CEAP I and CEAP II

Cultivated Cropland with Soil Test within Previous 5 Years by Nutrient Type	CEAP I		CEAP II		CEAP II minus CEAP I	
	Acres (1,000s)	Acres Percent	Acres (1,000s)	Acres Percent	Acres (1,000s)	Acres Percent
Cultivated Cropland Acres with Soil Test	174,086	56	189,222	60	15,136	4
Commercial N and P and/or Manure	171,626	57	187,332	62	15,706	5
Commercial N and P Only	*154,143*	*56*	*163,679*	*60*	*9,536*	*4*
Manure with/without Commercial N and P	*17,483*	*65*	*23,653*	*77*	*6,169*	*12*
No Commercial N or P Applied	2,460	20	1,890	14	-570	-5

Cultivated cropland acres receiving manure (with or without commercial fertilizers) were tested more frequently than those receiving commercial fertilizers only. In CEAP II, 77 percent of manured acres had recent soil tests, compared to 60 percent of acres receiving commercial fertilizer only.

Between CEAP I and CEAP II, soil testing rates on acres receiving only commercial fertilizer increased by 4 percentage points, from 56 percent in CEAP I to 60 percent in CEAP II. In contrast, soil testing on acres receiving manure increased by 12 percentage points, suggesting growing awareness of the importance of soil testing when using manure nutrients. However, the use of manure testing to understand manure nutrient content lagged at only 48 percent in CEAP II. Consequently, over half the acres receiving manure lacked information to establish appropriate application rates to ensure meeting crop needs, while minimizing potential for losses or soil phosphorus accumulation.

Most regions increased the number of cultivated cropland acres with recent soil tests in CEAP II. In the California Coastal, Northeast, and Northwest regions, soil testing increased by 13 percentage points or more. The South Central region was alone in experiencing a reduction in acres with a recent soil test. Six regions had soil testing rates higher than the national average (60 percent). The South Central, Southern and Central Plains, Southwest, and Lower Mississippi and Texas Gulf Coast were the only regions with soil testing rates below 50 percent of their regional cultivated cropland acres.

Soil Testing* on Cultivated Cropland by Region, CEAP I and CEAP II

Geographic Scope	CEAP I		CEAP II		CEAP II minus CEAP I	
	Acres (1,000s)	Acres Percent	Acres (1,000s)	Acres Percent	Acres (1,000s)	Acres Percent
National	**174,086**	**56**	**189,222**	**60**	**15,136**	**4**
Region						
Atlantic and Gulf Coastal Plains	11,262	78	10,793	78	-469	<1
California Coastal	1,768	40	2,127	54	359	15
East Central	5,698	61	6,258	62	560	0
Lower Mississippi and Texas Gulf Coast	9,548	44	9,476	45	-71	2
North Central and Midwest	78,583	65	85,025	69	6,442	4
Northeast	4,097	57	5,308	70	1,211	13
Northern Plains	26,106	54	31,276	61	5,170	7
Northwest	7,748	55	9,636	72	1,888	16
South Central	2,252	37	1,638	32	-614	-5
Southern and Central Plains	26,052	40	26,353	42	301	2
Southwest	972	34	1,332	42	360	8

** Soil test within the previous 5 years*

Method

Nutrients are applied to fields in a variety of ways but can be divided between those that place the nutrient on the soil surface and those that incorporate nutrients beneath the soil surface. Knifing, injection, and other incorporation methods place nutrients in the root zone for growing plants, which also reduces potential for nutrient loss via wind and rain. There are many reasons that drive decisions on application method from the nutrient source (some manures are more difficult to incorporate) to application timing (incorporating nutrients into a growing crop is more difficult).

Between the two CEAP surveys, there was a clear trend away from nutrient incorporation on cultivated cropland, and as a result increased opportunity for losses from fields. By CEAP II, 50 percent of nitrogen applied and 20 percent of phosphorus applied were not incorporated (table 15; appendix 2, tables A-10 and A-11). The acreage on which all nutrient applications were incorporated declined for nitrogen (by 29 percent) and phosphorus (by 24 percent). In contrast, the acres where none of the nutrient applications were incorporated increased for nitrogen (by 41 percent) and phosphorus (by 46 percent).

All regions experienced a similar pattern of a decrease in all applications incorporated and an increase in applications with no incorporation for both nutrients (fig. 25). Three regions—North Central and Midwest, Northern Plains, and Southern and Central Plains—accounted for 90 percent of the change in tons of nitrogen applied without incorporation. The North Central and Midwest region alone accounted for nearly half of the change in tons of phosphorus applied without incorporation.

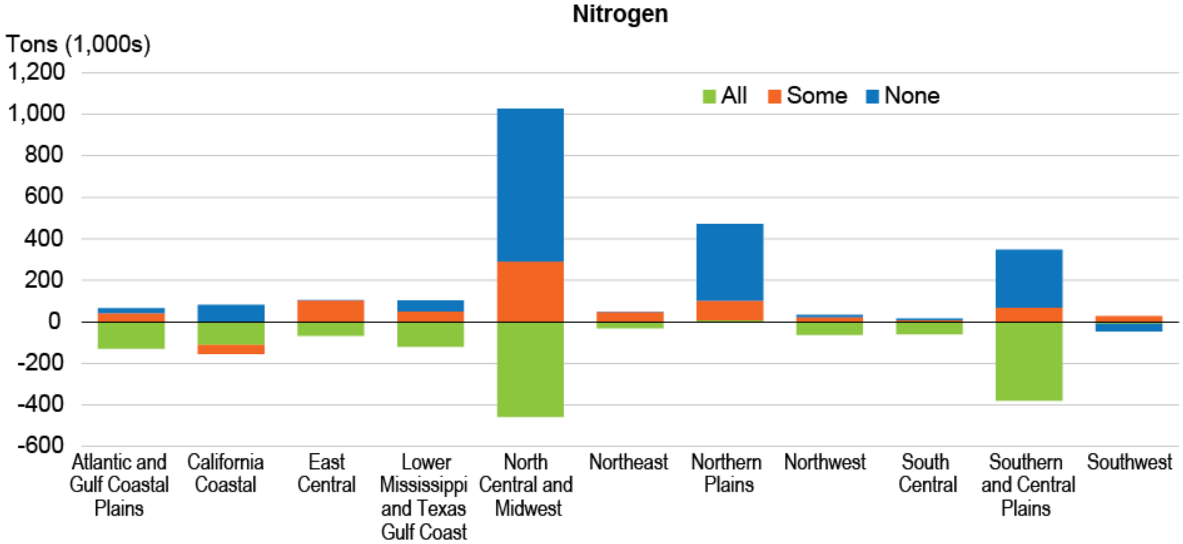
Table 15. Cultivated Cropland with Nutrients Applied by Type and Incorporation, CEAP I and CEAP II

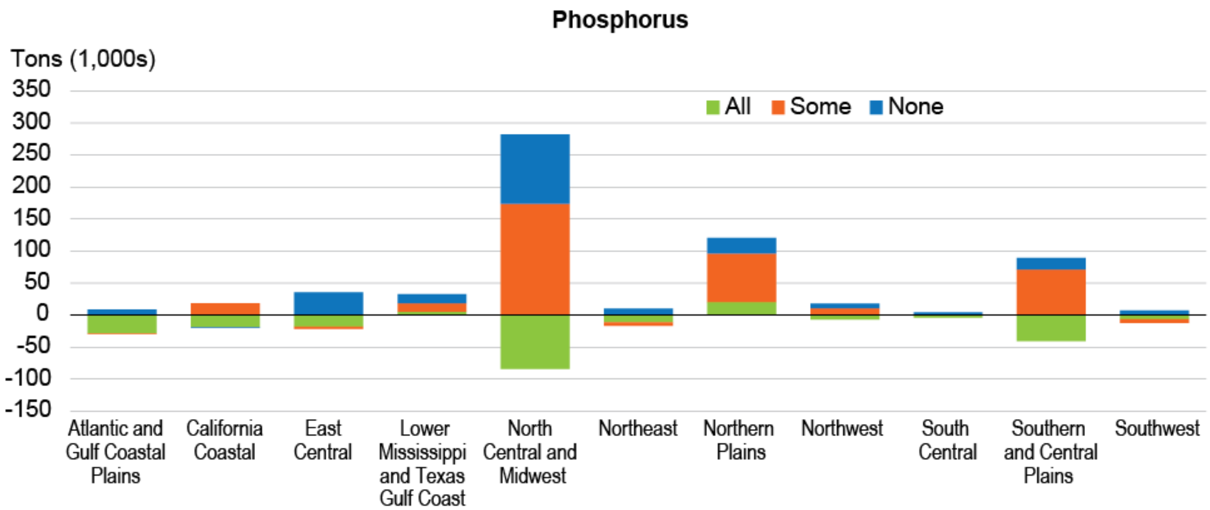
Incorporation Status	CEAP I				CEAP II				CEAP II minus CEAP I			
	Acres (1,000s)	**Percent**	**Tons (1,000s)**	**Percent**	**Acres (1,000s)**	**Percent**	**Tons (1,000s)**	**Percent**	**Acres (1,000s)**	**Percent Relative to CEAP I**	**Tons (1,000s)**	**Percent Relative to CEAP I**
Nitrogen												
Application Acres	**294,384**		**11,433**		**294,069**		**12,263**		**-315**		**830**	**7**
All Incorporated	152,265	52	5,275	46	107,423	37	3,864	32	-44,842	-29	-1,411	-27
Some Incorporated	101,346	34	1,513	13	129,018	44	2,223	18	27,672	27	710	47
None Incorporated	40,773	14	4,645	41	57,628	20	6,176	50	16,855	41	1,531	33
Phosphorus												
Application Acres	**268,472**		**2,538**		**278,859**		**2,930**		**10,387**	**4**	**393**	**15**
All Incorporated	133,376	50	1,116	44	100,995	36	923	32	-32,381	-24	-193	-17
Some Incorporated	99,392	37	1,070	42	125,593	45	1,418	48	26,201	26	348	33
None Incorporated	35,704	13	352	14	52,270	19	589	20	16,567	46	237	67

Timing

Nutrients may be applied before planting (*pre-plant*), at the time of planting (*at-plant*), or following the emergence of the crop (*post-plant*). In general, nutrient uptake rates are highest from early to mid-growing season, which is why *at-plant* and *post-plant* applications together account for the largest share of applications. *Post-plant* applications occur when crops are actively growing and have the greatest nutrient needs; however, incorporation is complicated by the potential for plant damage. *Pre-plant* application avoids the challenge of applying fertilizer, particularly manure, to a growing crop, but leaves nutrients exposed for a longer time before uptake, increasing opportunities for losses.

Figure 25. Change in Incorporation Extent and Region, CEAP II minus CEAP I



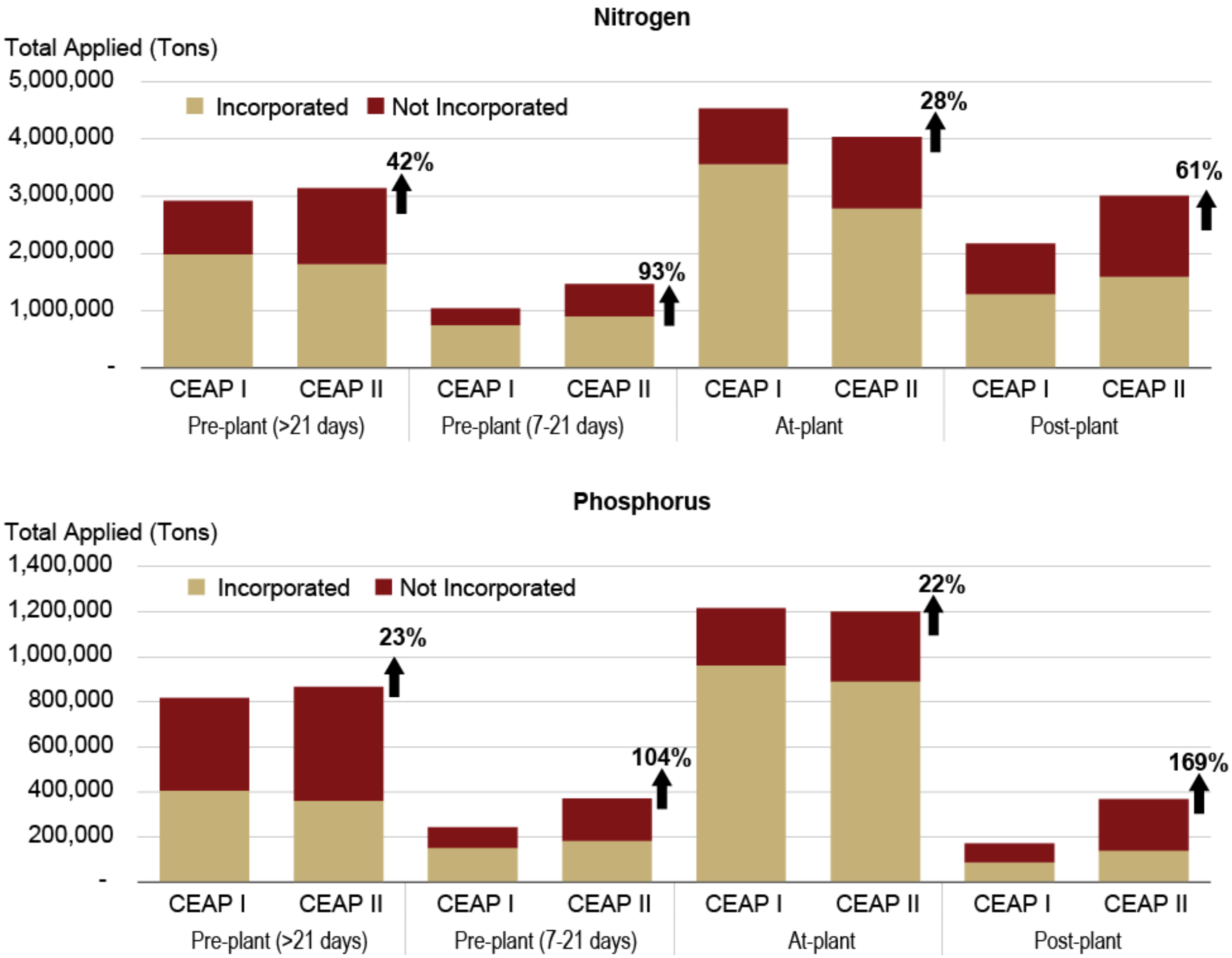


Pre-plant (>21 days) applications that were not incorporated increased while incorporated applications declined. By CEAP II, the increases in the unincorporated pre-plant load were 392,000 tons for nitrogen and 95,000 tons for phosphorus, while incorporated loads dropped by 172,000 tons for nitrogen and 46,000 tons for phosphorus.

Most nitrogen and phosphorus applications are *at plant* (application within 7 days of planting), although there was a net decline in tons applied between the two CEAP surveys. Nitrogen applied *at plant* and incorporated declined by 22 percent, while applications not incorporated increased by 28 percent relative to CEAP I levels. Phosphorus applied *at plant* and incorporated declined by 7 percent, and applications not incorporated increased by 22 percent relative to CEAP I levels (fig. 26; appendix 2, tables A-12 and A-13).

The nutrients applied during the other three timing periods increased by nearly 1.5 million tons of nitrogen and 372,000 tons of phosphorus. Most of the increase occurred *post-plant* and as unincorporated applications of nitrogen and phosphorus, 61-percent and 169-percent increases from CEAP I levels, respectively.

Figure 26. Total Applied Nutrients by Timing and Incorporation, CEAP I and CEAP II



Note: The increase in the unincorporated load relative to CEAP I levels is shown as a percent above the CEAP II values for each application timing.

Technology advances, such as nitrogen inhibitors and precision guidance systems, increase timing options; despite this, incorporation is still essential to reduce loss risk. Between the CEAP survey periods, enhanced-efficiency fertilizers were used on an additional 64 million acres by CEAP II or 26 percent of cultivated cropland (see also box 4, page 36). Farmers also increased the use of variable rate technology (VRT), using it on an additional 38.6 million acres or 17 percent of all cultivated cropland by CEAP II.

Manure Application Trends

Between CEAP I and CEAP II, acres receiving manure nutrients increased substantially, reflecting the continuing increase and consolidation in the sector. The significant increase in the purchase of manure nutrients signaled a departure from viewing manure simply as a waste-disposal problem. While soil testing increased and manured acres had substantially higher testing rates, increased application rates and load-to-loss disparities indicate continuing challenges. Manure nutrients can be more mobile than commercial mineral nutrients as they may be less dense and more soluble, although the fraction of manure nutrients in organic form may release over time through mineralization. A combination of proper rates, timing, and application methods is necessary to manage losses from all sources to meet defined threshold levels.

Cultivated cropland receiving manure increased by 14 percent to nearly 31 million acres in CEAP II, roughly 10 percent of all cultivated cropland (table 16). Between CEAP I and CEAP II, acres receiving only manure nutrients increased by 28 percent (908,000 acres) and acres receiving manure and commercial fertilizer increased by 12 percent (2.8 million acres). In both surveys, acres receiving manure had higher nitrogen and phosphorus application rates than those receiving only commercial fertilizer—over 71 and 90 percent higher, respectively, in CEAP II.

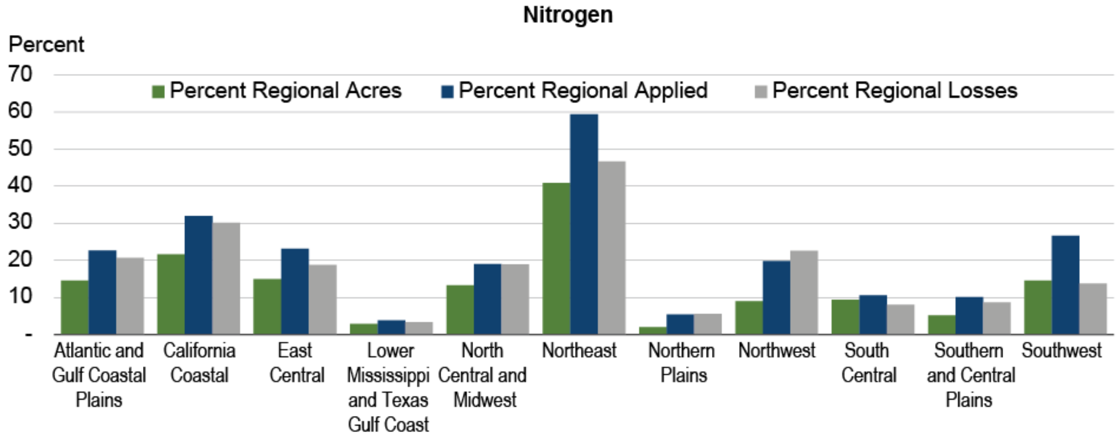
Table 16. Average Annual Nutrient Application Rates—Manured and Commercial Only

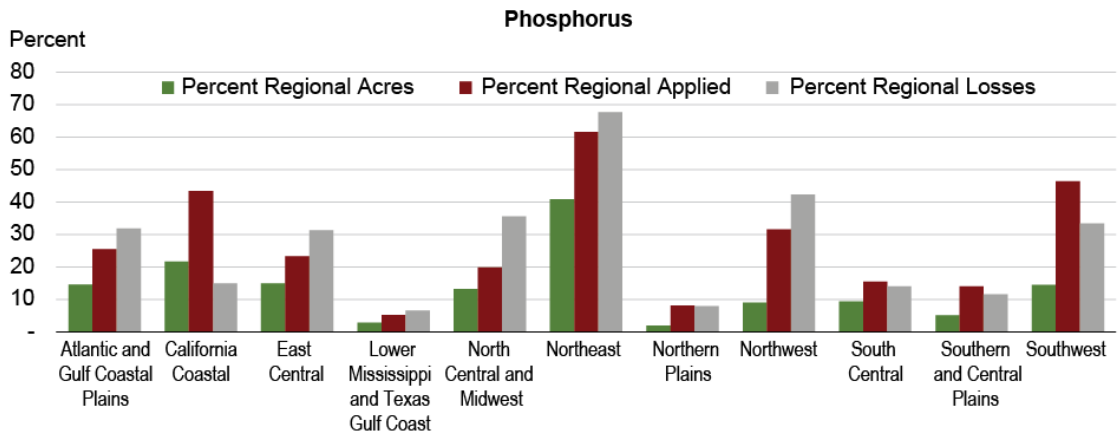
Nutrient Source	Cultivated Cropland			Nitrogen Application Rate			Phosphorus Application Rate		
	CEAP I	CEAP II	CEAP II minus CEAP I	CEAP I	CEAP II	CEAP II minus CEAP I	CEAP I	CEAP II	CEAP II minus CEAP I
	Acres (1,000s)			Pounds/acre/year					
Manure Acres (with or without Commercial)	27,013	30,727	3,713	136	140	5	39	38	-1
Manure Only Acres	*3,241*	*4,150*	*908*	*112*	*110*	*-2*	*42*	*40*	*-2*
Manure w/ Commercial	*23,772*	*26,577*	*2,805*	*139*	*145*	*5*	*39*	*38*	*-1*
Commercial Nitrogen without Manure	267,371	263,343	-4,028	76	82	6			
Commercial Phosphorus without Manure	241,459	248,132	6,673				18	20	2

The top three regions for receiving manure were the North Central and Midwest at 16.3 million acres, the Southern and Central Plains with 3.2 million acres, and the Northeast with 3.1 million acres. While manured acres are a minor portion of the total acres in the North Central and Midwest (13 percent) and Southern and Central Plains (5 percent) regions, they make up 41 percent of the cultivated cropland acres in the Northeast.

Because of higher application rates, manured acres received a disproportionate share of the total nutrients applied in every region (fig. 27). Overall, the proportion of nitrogen losses equaled or were below the applied load in 10 regions, while for phosphorus losses that was the case in only five regions. In the North Central and Midwest region, the 13 percent of regional acres that received manure accounted for 19 percent of the total applied nitrogen and 20 percent of the total applied phosphorus, while nitrogen and phosphorus losses on these acres were 19 percent and 36 percent of the total regional losses, respectively. In the Northeast, the 41 percent of acres that received manure accounted for 59 percent of total applied nitrogen and 62 percent of the total applied phosphorus. While nitrogen losses were less than the applied load, they still made up nearly half (47 percent) of the regional nitrogen losses; phosphorus losses at 68 percent exceed the applied phosphorus load, making manure management one of the highest regional priorities. The contrast in percent load and percent loss illustrates the regional challenges in managing manure nutrients, particularly with respect to its commercial counterpart.

Figure 27. Nitrogen and Phosphorus Applied Load and Losses from Cultivated Cropland Receiving Manure Nutrients, CEAP II





Acres receiving manure and commercial fertilizer have nutrient application rates nearly twice that of acres receiving only commercial fertilizers, and almost a third higher than acres receiving manure alone. In seven regions, commercial nitrogen accounts for 40 percent or more of the total nitrogen applied on manured acres (fig. 28). Overall phosphorus application rates are lower, but commercial phosphorus still accounts for 20 percent or more of the total phosphorus applied in six regions. The use of manure testing to understand nutrient content was done on only 48 percent of the manured cropland in CEAP II; consequently, over half the acres receiving manure lacked adequate information to establish appropriate application rates for crop needs, while minimizing potential for losses or soil phosphorus accumulation. It is unclear why operators may apply additional commercial fertilizer, which may not be necessary for crop production, constitutes an additional production cost, and may increase potential loss risks. This suggests there is a need to better understand manure nutrient content and availability for plant growth.

Between the CEAP surveys, winter application of manure declined, largely the portion that was not incorporated, and reduced the amount of manure nutrients exposed to potential losses in that season. Applications in the other three seasons—but particularly in spring and fall—increased (fig. 29). Most of the total load is applied in spring and fall before and after the active growing periods of most crops, when incorporation is critical to ensure that applied nutrients remain in place.

Figure 28. Nitrogen and Phosphorus Applied to Manured Acres by Source and Region, CEAP II

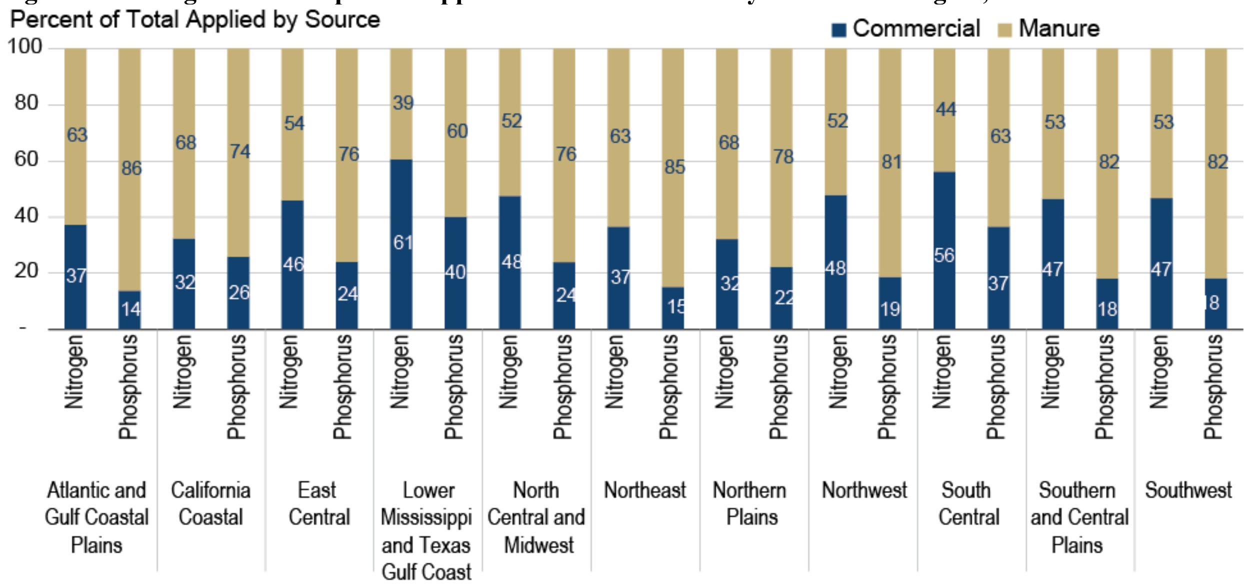
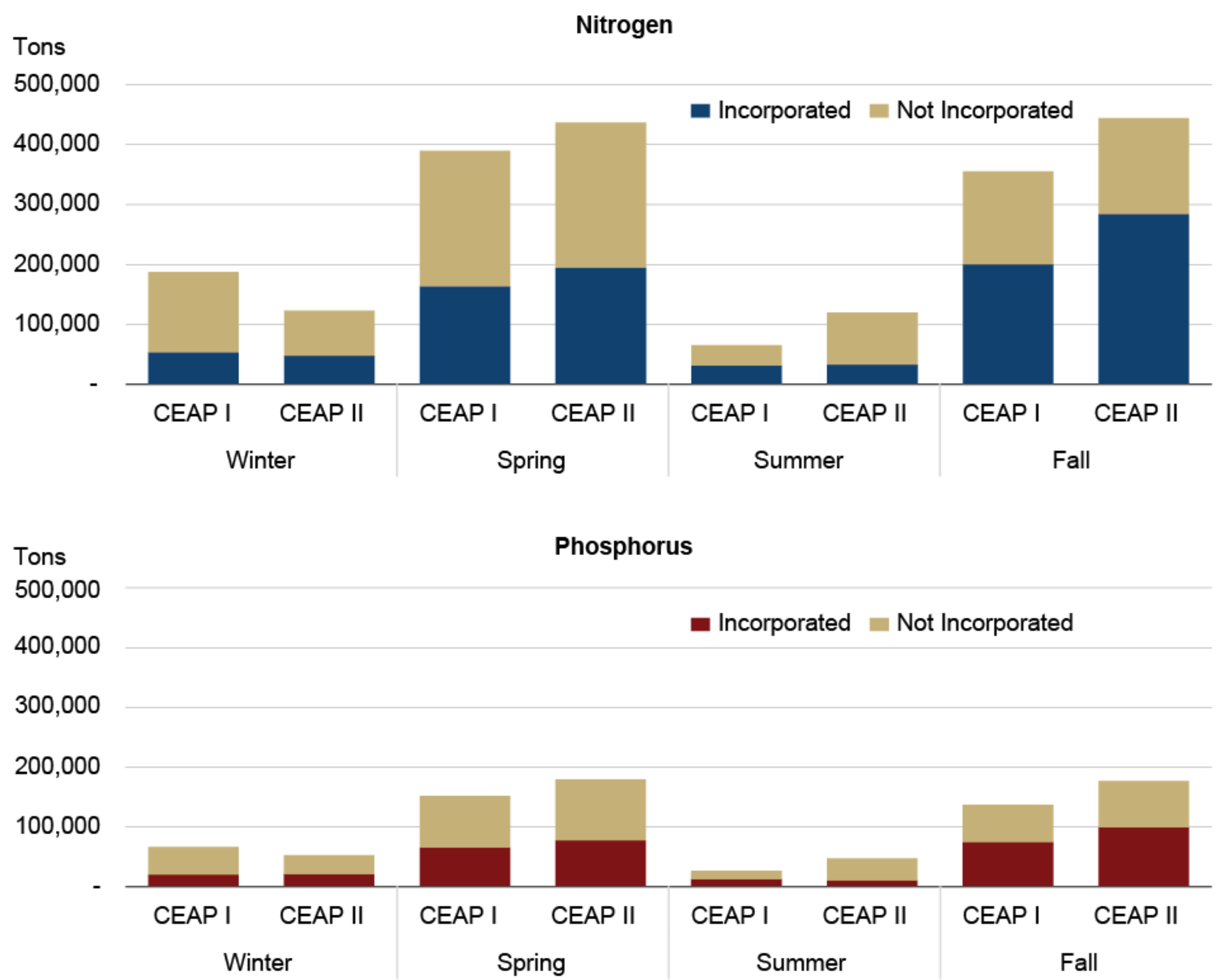


Figure 29. Seasonal Application of Manure Nutrients by Method, CEAP I and CEAP II



Spring is generally the wettest season, increasing the potential for nutrient losses. The total spring load increased by 12 percent for nitrogen and 18 percent for phosphorus, and while the incorporated applications increased, led by increases in dairy and swine manure injection, so also did applications that were not incorporated. Fall applications also increased as did the incorporated portion, particularly for nitrogen.

While the summer load and its unincorporated portion increased, applications are on actively growing crops, which have lower loss potential even when broadcast without incorporation. U.S. poultry production expanded over the 2011–20 period, as producers sought to meet increased demand.[25] The increased use of poultry manure (a solid form) with limited incorporation options may explain some of the notable increase in unincorporated manure.

There was a significant change in the marketing and acceptance of manure as a nutrient source between the CEAP survey periods, suggesting continuing opportunities for improving the use of the resource. The most notable shift was the nearly threefold increase in acres applying purchased manure. While manure applied on operations where it was produced still accounted for most manured acres, that segment declined by 13 percent (2.5 million acres). Acres on which users were compensated to receive and apply manure increased by nearly 900,000 acres (131 percent), indicating that livestock producers continue to seek ways to get manure on more acres (table 17).

Table 17. Cultivated Cropland with Manure Applied, by Source, CEAP I and CEAP II

Source of Manure	**CEAP I**	**CEAP II**	**CEAP II - CEAP I**	**Percent Change Relative to CEAP I**
	Acres (1,000s)			
On Operation	19,350	16,889	-2,460	-13
Off Operation	7,664	13,837	6,173	81
No Cost	*4,453*	*2,759*	*-1,694*	*-38*
Compensated	*676*	*1,564*	*888*	*131*
Purchased	*2,535*	*9,514*	*6,979*	*275*
Total	**27,013**	**30,727**	**3,713**	**14**

[25] https://www.ers.usda.gov/topics/animal-products/poultry-eggs/sector-at-a-glance/

How Did Conservation Adoption Affect Resource Concerns?

Between the CEAP surveys, adoption of soil-conserving practices had a positive effect on multiple cultivated cropland conditions—reducing erosion, increasing soil carbon, reducing losses of sediment, and restricting some nutrient loss pathways. Loss thresholds were established for each of these resource concerns to present an estimated conservation condition, assess potential treatment needs, and provide context for potential future loss reductions.[26] The thresholds do not reflect or suggest conservation-related policy standards, and do not indicate that any specific natural resource targets would be achieved if thresholds were met (e.g., water quality standards). Meeting a threshold is not a static condition, as cultivated cropland may experience periodic losses above or below a threshold under extreme conditions, such as prolonged intense rainfall or drought.

Cultivated cropland meeting loss thresholds for erosion, sediment, surface nitrogen, and sediment-transported phosphorus increased or remained stable, but declined for subsurface nitrogen and soluble phosphorus between CEAP I and CEAP II. In both surveys, most of the sediment, nitrogen, and phosphorus losses came from a small number of cultivated cropland acres that exceeded specific loss thresholds. CEAP provides estimates of edge-of-field losses through surface and subsurface pathways;[27] however, the estimates do not suggest a particular fate of transported materials (e.g., to water) or potential impact.

Erosion

Controlling soil erosion from water and wind is essential to maintaining soil health and productivity and has been a longstanding conservation objective. Too much erosion on farm fields creates challenges for sustaining soil productivity, while windborne soil or sediment leaving a field can generate negative offsite impacts. Forms of water erosion on farm fields include sheet and rill, ephemeral gully, and classic gully. Sheet and rill erosion is generally a resource concern in higher rainfall areas and on steeper slopes. Wind erosion is primarily a resource concern in arid and semiarid regions, although it can also be a problem in wetter regions or on certain organic soils. Conservation practices such as conservation tillage, conservation crop rotations, cover crops, and structural practices all help control erosion. In regions with low rainfall, vegetative structural wind erosion control practices are constrained as they compete with crops for limited water supplies.

The concept of soil loss tolerance is used to aid in understanding the potential effects of soil erosion on soil productivity. The soil loss tolerance rate—"T"—reflects the estimate of annual soil loss that can occur and still permit crop productivity to be sustained economically and indefinitely on a given soil. The T value varies by soil, with deeper, uniform soils having higher

---

[26] Threshold levels were derived through a series of forums with technical experts and refined by further examination of model output to establish thresholds that were agronomically feasible and could be achieved with existing production and conservation technology. Criteria used to establish these thresholds were refined for CEAP II, so the CEAP I findings reported here will differ from those found in previous CEAP I reports.

[27] Subsurface loss estimates include natural lateral drainage, deep drainage, and tile and ditch drains.

T values than shallow or previously eroded soils. Examining erosion levels relative to their T value provides one way to assess whether fields are stable or declining.

Sheet and Rill Erosion

Between CEAP I and CEAP II, average annual sheet and rill erosion on cultivated cropland dropped by over 76 million tons per year, a 13-percent reduction relative to CEAP I (table 18). Rates declined from 1.9 tons per acre per year (t/a/y) to 1.7 tons t/a/y over the decade.

In CEAP I and CEAP II, most cultivated cropland acres met the threshold (soil T) at 89 percent and 90 percent, respectively. As a result of the increase in conservation tillage and structural practices, cultivated cropland meeting the threshold increased by over 6.5 million acres and cultivated cropland exceeding the threshold dropped by 4.3 million acres, 12 percent from CEAP I levels (table 18; appendix 2, table A-14).

Total sheet and rill erosion on cultivated cropland meeting the threshold dropped by 30.6 million tons, an 11-percent reduction from CEAP I levels. Erosion on acres exceeding T dropped by 45.8 million tons, a 14-percent reduction from CEAP I levels. Most erosion continued to come from the acres exceeding T; 55 percent of total sheet and rill erosion in both surveys came from cultivated cropland eroding at rates above T although these acres accounted for only 11 and 10 percent of acres in CEAP I and CEAP II, respectively.

Table 18. Sheet and Rill Erosion by Threshold, CEAP I and CEAP II

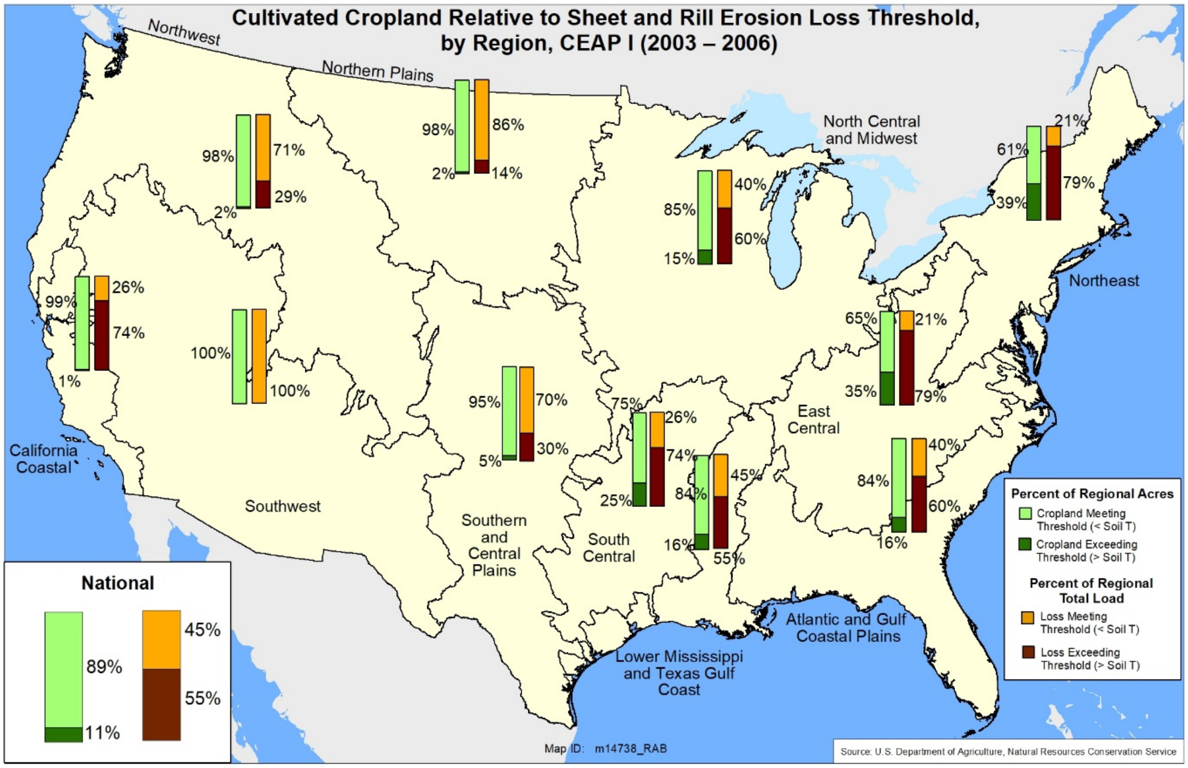
	CEAP I				CEAP II				CEAP II minus CEAP I			
	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent Relative to CEAP I	Tons (1,000s)	Percent Relative to CEAP I
Total	313,065	100	598,623	100	315,303	100	522,263	100	2,238	1	-76,360	-13
Meeting Threshold	277,546	89	266,834	45	284,132	90	236,252	45	6,586	2	-30,583	-11
Exceeding Threshold	35,519	11	331,789	55	31,171	10	286,012	55	-4,348	-12	-45,777	-14

The North Central and Midwest region, with nearly 40 percent of all cultivated cropland, accounted for over 50 percent of the total sheet and rill erosion in CEAP II. The East Central, Lower Mississippi and Texas Gulf Coast, and Southern and Central Plains had the next highest loads, and together accounted for 28 percent of total sheet and rill erosion (fig. 30).

Between the surveys, the national average sheet and rill erosion rate on all cultivated cropland dropped by 0.2 t/a/y. The Northeast region experienced the largest reduction at 1 t/a/y, and rate reductions in the North Central and Midwest and Southern and Central Plains regions were the same as the national average. The East Central and South Central regions with their generally sloping landscapes and humid, high rainfall climate had the highest average sheet and rill erosion rates in CEAP II at 4.1 t/a/y.

Rainfall and inherent soil runoff vulnerability are the primary forces driving sheet and rill erosion on cultivated cropland (box 6, page 50). Over 77 percent of the cultivated cropland with sheet and rill erosion exceeding the threshold receives average annual rainfall of 35 inches or more, and most of those acres have moderately high or high vulnerability to runoff (table 19).

Figure 30. Sheet and Rill Erosion on Cultivated Cropland Relative to Threshold, CEAP I and CEAP II



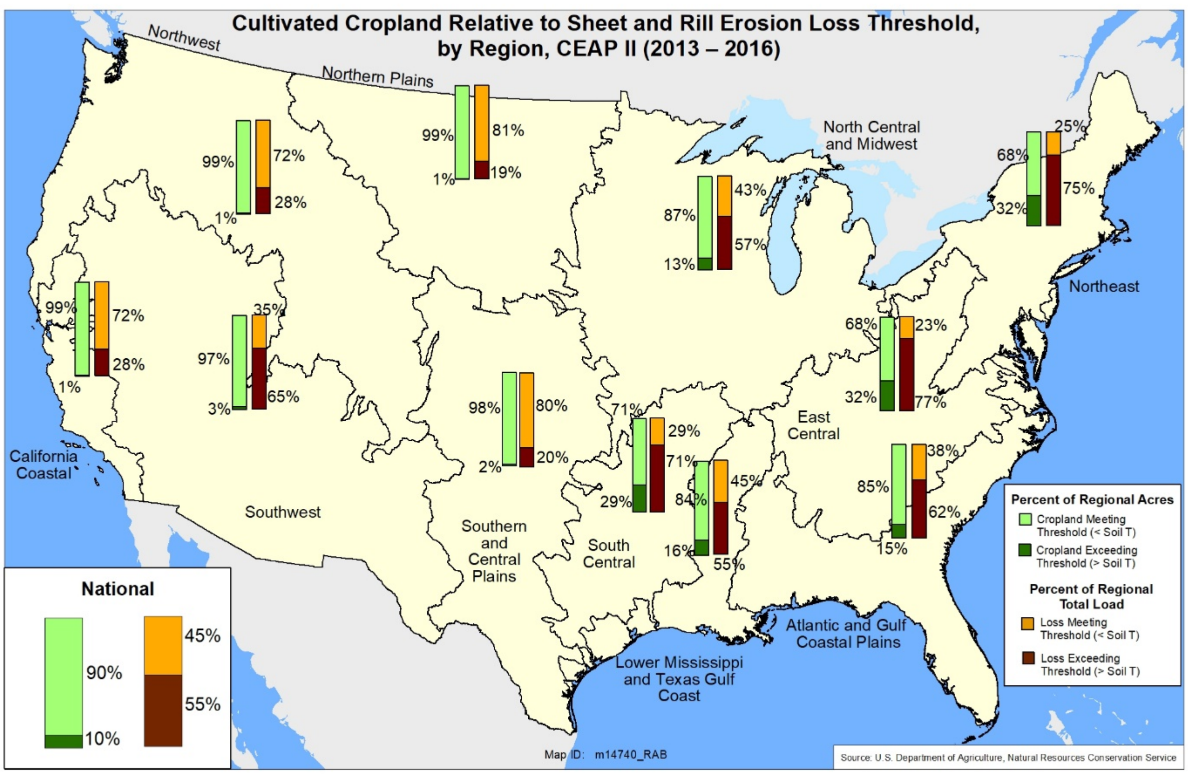
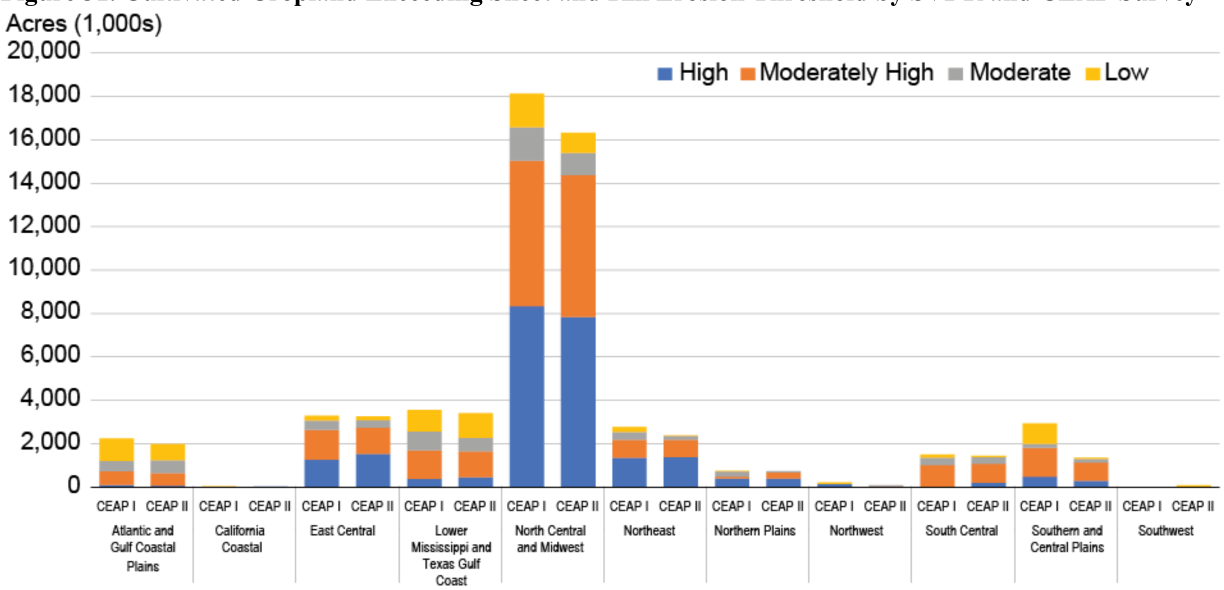


Table 19. Cultivated Cropland with Sheet and Rill Erosion above T by Soil Vulnerability Runoff and Rainfall, CEAP II

SVI Runoff Rating	Average Annual Rainfall									
	≤ 15 inches		> 15 and ≤ 25 inches		> 25 and ≤ 35 inches		> 35 and ≤ 45 inches		> 45 inches	
	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI
Low	0	-	0	-	465	1	474	1	2,283	9
Moderate	0	-	192	2	328	5	1,011	9	1,757	12
Moderately High	0	-	374	4	2,492	17	5,472	31	4,027	46
High	0	-	536	11	2,717	28	6,221	48	2,823	71
National	**0**	**-**	**1,101**	**1**	**6,002**	**8**	**13,178**	**16**	**10,890**	21

Between the CEAP surveys, cultivated cropland exceeding the sheet and rill threshold decreased overall and in all vulnerability categories (fig. 31). However, most acres exceeding the threshold remained in the high and moderately high vulnerability categories; 79 percent in CEAP II. While most regions experienced a decline in high vulnerability acres exceeding the threshold, the South Central and East Central regions experienced an increase. In three regions (East Central, Northeast, and South Central), more than 20 percent of the regional cultivated cropland acres exceed the sheet and rill threshold due to a mix of factors related to topography, annual rainfall, and cropping systems.

Figure 31. Cultivated Cropland Exceeding Sheet and Rill Erosion Threshold by SVI-R and CEAP Survey



Wind Erosion

Between the two CEAP surveys, wind erosion dropped by nearly 94 million tons per year by CEAP II, a 16-percent reduction relative to CEAP I. Rates dropped from an annual average of 1.9 t/a/y to 1.6 t/a/y.

Most cultivated cropland acres met the wind erosion threshold (soil T) at 88 percent in CEAP I and 90 percent in CEAP II. Cultivated cropland meeting the wind erosion threshold increased by

Box 6. Controlling Erosion on Highly Erodible Land (HEL)

Between the CEAP surveys, major gains were made in controlling erosion on highly erodible land (HEL) cropland. Gains in conservation tillage and structural practices on HEL helped to reduce losses, despite the overall increase in cultivation of HEL-designated cropland.

Sheet and rill erosion on HEL was reduced by over 39 million tons, 52 percent of the total sheet and rill erosion reduction despite an increase in cultivation of 4.3 million acres. The average sheet and rill erosion rate on HEL dropped from 6.8 t/a/y to 5.1 t/a/y. Despite these gains, in CEAP II, HEL acres still accounted for 40 percent of total sheet and rill erosion while accounting for only 13 percent of the acres.

Of the 41 million acres designated HEL for sheet and rill erosion in CEAP II, 40 percent were eroding above the tolerance rate (T), down from 55 percent in CEAP I. The North Central and Midwest region alone accounted for 63 percent of HEL acres eroding above T and 63 percent of the load from HEL. In CEAP II, four regions (Lower Mississippi and Texas Gulf, East Central, Atlantic and Gulf Coastal Plains, and South Central regions) had over 50 percent of their respective regional HEL acres eroding above T; these regions have high concentrations of low-residue crops (e.g., cotton and soybeans) and higher rainfall. Average soil slopes on HEL cropland in the East Central region are among the highest of all regions.

Highly Erodible Cultivated Cropland Vulnerable to Sheet and Rill Erosion, CEAP I and CEAP II

	CEAP I			CEAP II			CEAP II minus CEAP I		
	HEL	NHEL	Total	HEL	NHEL	Total	HEL	NHEL	Total
Acres (1,000s)	37,017	276,048	313,065	41,392	273,911	315,303	4,375	-2,137	2,238
Tons (1,000s)	250,734	347,889	598,623	211,319	310,944	522,263	-39,415	-36,945	-76,360
Rate (t/a/y)	6.8	1.3	1.9	5.1	1.1	1.7	-1.7	-0.1	-0.3
Percent Cultivated Cropland Acres	12	88		13	87		1.3	-1.3	
Percent Tons Erosion	42	58		40	60		-1.4	1.4	

Losses on highly erodible land (HEL) cropland susceptible to wind erosion were reduced by nearly 22 million tons by CEAP II, despite a 2.7-million-acre increase in cultivated acreage. The average wind erosion rate on HEL dropped from 5.3 t/a/y to 4.5 t/a/y. More remains to be done; although HEL cultivated cropland accounted for 14 percent of the acres, it generated 41 percent of wind erosion in CEAP II.

Of the 45.7 million acres designated HEL for wind erosion in CEAP II, 27 percent were eroding above the tolerance rate (T), down from 37 percent in CEAP I. The Southern and Central Plains region alone accounted for 68 percent of HEL acres eroding above T and 79 percent of the load from HEL. In CEAP II, two of the regions that are most susceptible to wind erosion (Southern and Central Plains and Southwest regions) had over a third of their respective regional HEL acres eroding above T.

Highly Erodible Cultivated Cropland Vulnerable to Wind Erosion, CEAP I and CEAP II

	CEAP I			CEAP II			CEAP II minus CEAP I		
	HEL	NHEL	Total	HEL	NHEL	Total	HEL	NHEL	Total
Acres (1,000s)	42,908	270,156	313,065	45,665	269,638	315,303	2,757	-518	2,238
Tons (1,000s)	228,677	374,928	603,605	206,914	302,826	509,740	-21,763	-72,102	-93,865
Rate (t/a/y)	5.3	1.4	1.9	4.5	1.1	1.6	-0.8	-0.3	-0.3
Percent Cultivated Cropland Acres	14	86		14	86		0.8	-0.8	
Percent Tons Erosion	38	62		41	59		2.7	-2.7	

nearly 10 million acres between the surveys, while acres exceeding the threshold dropped by 7.6 million acres, 20 percent from CEAP I levels (table 20; appendix 2, table A-15).

Table 20. Wind Erosion by Threshold, CEAP I and CEAP II

	CEAP I				CEAP II				CEAP II minus CEAP I			
	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent Relative to CEAP I	Tons (1,000s)	Percent Relative to CEAP I
Total	313,065	100	603,605	100	315,303	100	509,740	100	2,238	1	-93,865	-16
Meeting Threshold	274,431	88	258,919	43	284,309	90	197,904	39	9,878	4	-61,015	-24
Exceeding Threshold	38,634	12	344,686	57	30,994	10	311,836	61	-7,640	-20	-32,850	-10

Most of the total reduction in tons of wind erosion on cultivated cropland came from acres meeting the threshold, which dropped by 61 million tons, or 65 percent of the total. Wind erosion from cultivated cropland exceeding the threshold dropped by 32.8 million tons (35 percent of the total). By CEAP II, cultivated cropland with wind erosion exceeding the threshold accounted for only 10 percent of acres in CEAP II, but generated 61 percent of the total wind erosion load (fig. 32).

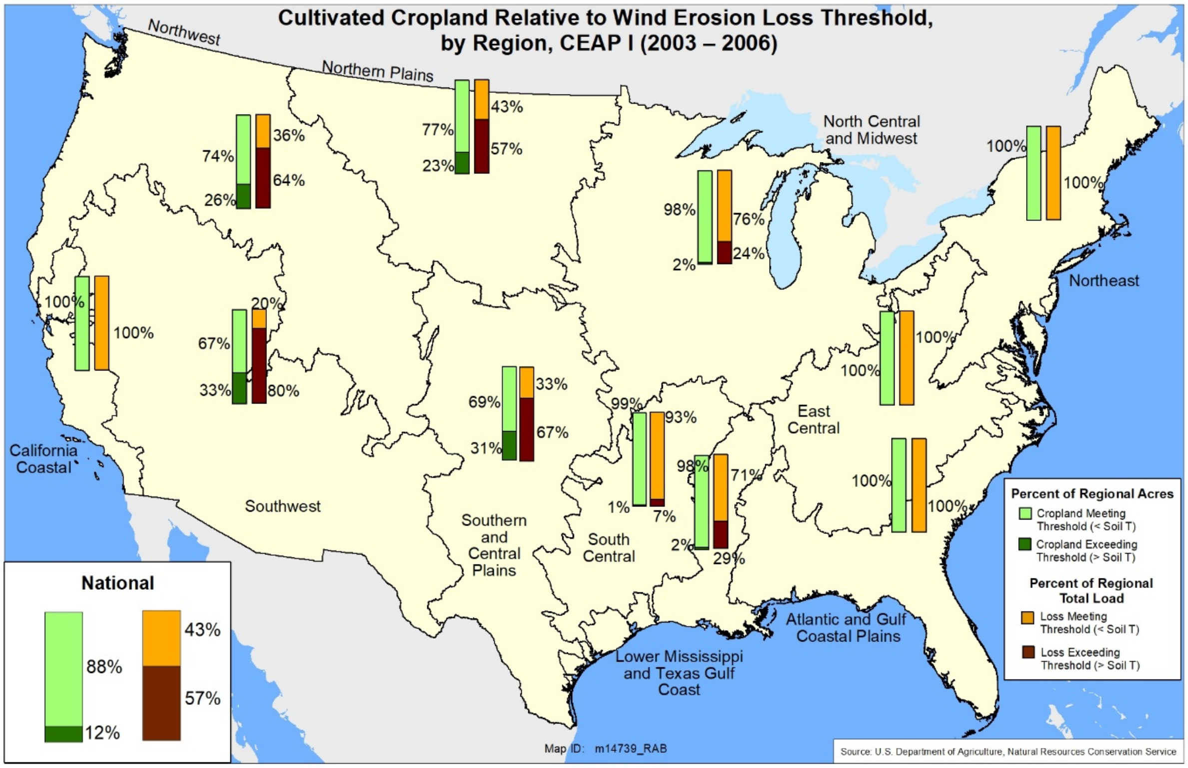
The primary regions with wind erosion concerns are the Northern Plains, Northwest, Southern and Central Plains, and Southwest. Of these, the Northern Plains and Southern and Central Plains regions account for 36 percent of total cultivated cropland acres but 77 percent of total wind erosion in CEAP II.

Between the surveys, the national average wind erosion rate on all cultivated cropland dropped by 0.3 t/a/y. The Southwest region experienced the largest reduction at 2.4 t/a/y, and rate reductions in the Northwest and Southern and Central Plains regions were greater than the national average, at 0.8 and 0.7 t/a/y, respectively. Despite declines, the Northern Plains, Northwest, Southern and Central Plains, and Southwest still had the highest average wind erosion rates in CEAP II.

Inherent wind vulnerability and arid/semiarid conditions are the primary forces driving wind erosion on cultivated cropland. Nearly 81 percent of the cultivated cropland with wind erosion exceeding the threshold receives less than 25 inches of rainfall annually, and most of those acres have moderately high or high wind vulnerability (table 21).

Between the CEAP surveys, cultivated cropland exceeding the wind threshold decreased overall and in all vulnerability categories (fig. 33). However, most exceeding acres remained in the moderately high and moderate vulnerability categories; 84 percent in CEAP II. While most regions experienced a decline in moderately high vulnerability acres exceeding the threshold, the Northern Plains and North Central and Midwest regions experienced an increase. In three regions (Northern Plains, Southern and Central Plains, and Southwest), more than 20 percent of the regional cultivated cropland acres exceeded the wind threshold due to a mix of factors related to climate and cropping systems.

Figure 32. Wind Erosion on Cultivated Cropland Relative to Threshold, CEAP I and CEAP II



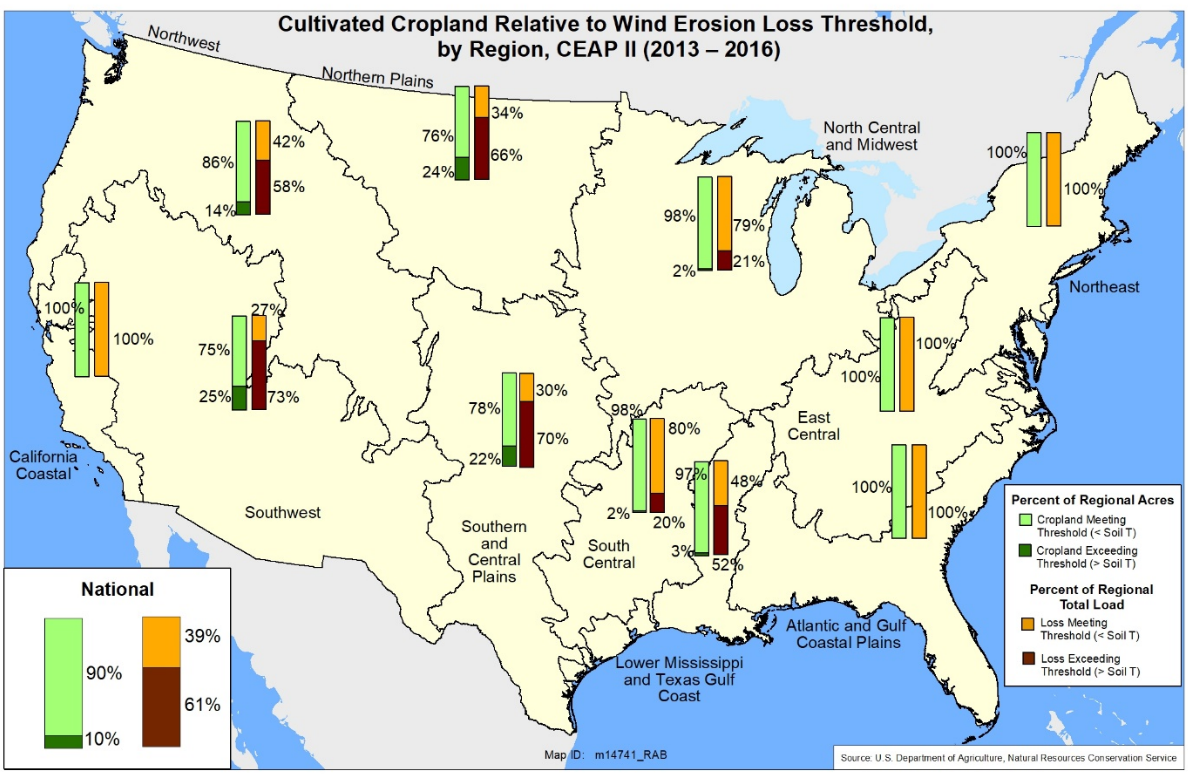
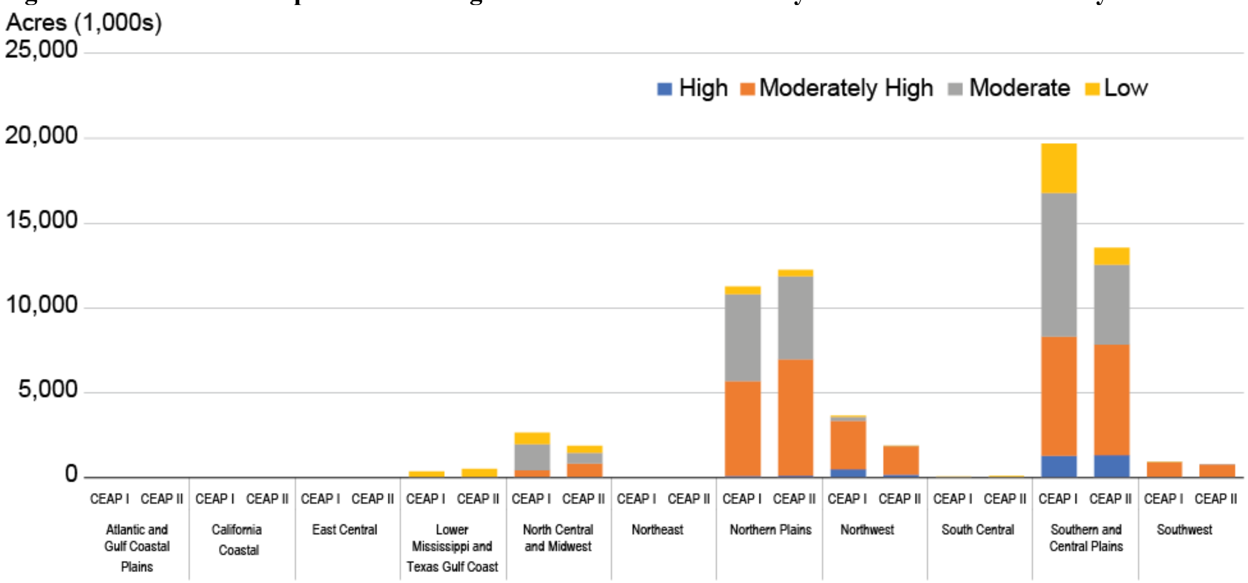


Table 21. Cultivated Cropland with Wind Erosion above T by Soil Vulnerability Wind and Rainfall, CEAP II

SVI Wind Rating	Average Annual Rainfall									
	≤ 15 inches		> 15 and ≤ 25 inches		> 25 and ≤ 35 inches		> 35 and ≤ 45 inches		> 45 inches	
	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI
Low	0	0	0	0	1,721	3	632	1	59	0
Moderate	24	7	8,915	17	1,303	11	0	-	0	-
Moderately High	3,797	17	10,708	39	2,155	41	0	-	0	-
High	276	39	1,366	54	37	19	0	-	0	-
National	**4,097**	18	**20,989**	25	**5,217**	7	**632**	1	**59**	0

Figure 33. Cultivated Cropland Exceeding Wind Erosion Threshold by SVI-W and CEAP Survey



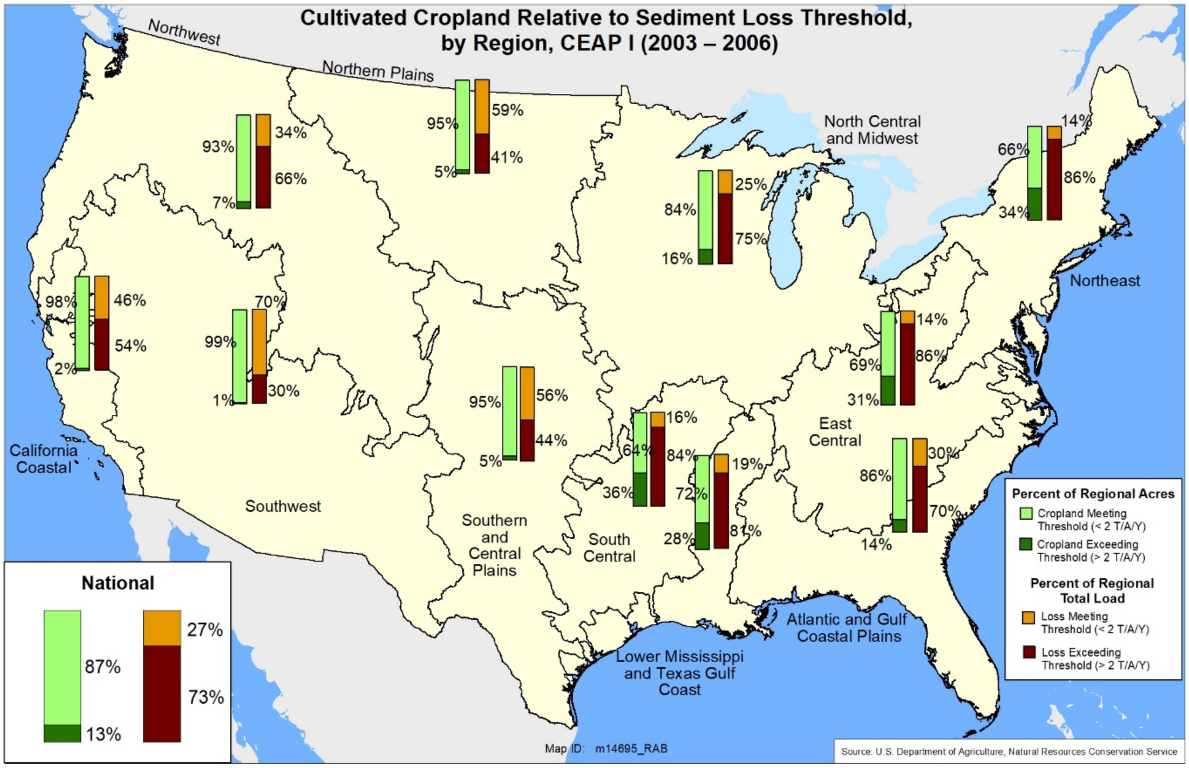
Sediment

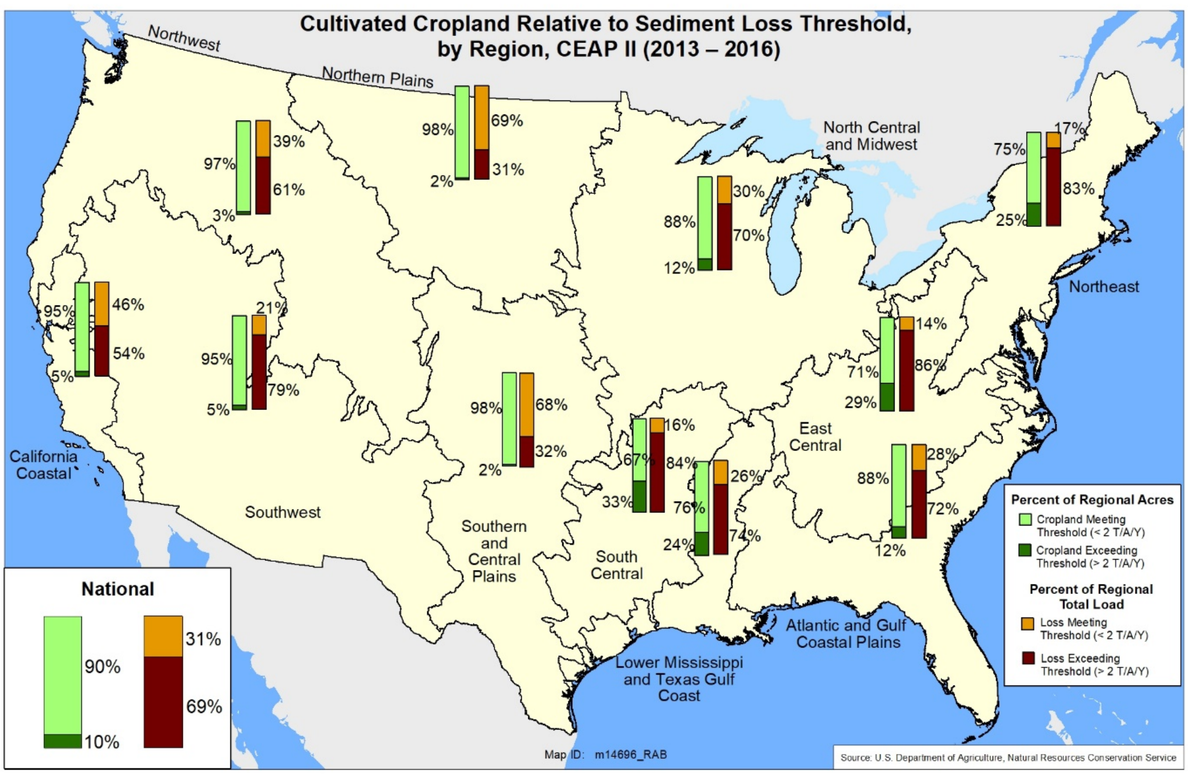
Between CEAP I and CEAP II, total sediment losses dropped by 74 million tons (22 percent), as farmers applied conservation measures on cultivated cropland and moved acres to higher sediment management levels. Three regions (North Central and Midwest, Lower Mississippi and Texas Gulf Coast, and Southern and Central Plains) accounted for 77 percent of the total reduction. However, these three regions plus the East Central still accounted for 76 percent of the total sediment load in CEAP II (fig. 34).

Average sediment loss on cultivated cropland dropped from 1.1 tons per acre per year to 0.9 t/a/y. The Northeast region experienced the largest reduction at 0.7 t/a/y, and rate reductions in the Lower Mississippi and Texas Gulf Coast and North Central and Midwest regions also exceeded the national average. The East Central and South Central regions—with their generally sloping landscapes and humid, high rainfall climate—had the highest average sediment loss rates in CEAP II at 2.4 and 2.6 t/a/y, respectively.

In both surveys, most cultivated cropland acres met the sediment threshold (2 t/a/y)—88 percent in CEAP I and 91 percent in CEAP II (table 22). As cultivated cropland meeting the threshold increased by 11 million acres over the decade, sediment loss on these acres declined by nearly 12.7 million tons.

Figure 34. Cultivated Cropland and Sediment Load Relative to Sediment Threshold (Acres and Tons), CEAP I and CEAP II





Cultivated cropland exceeding the sediment threshold dropped by nearly 9 million acres, from 12 percent to 9 percent between CEAP I and CEAP II. The associated sediment load declined by 61.5 million tons, or 83 percent of the total reduction. However, cultivated cropland exceeding the sediment threshold remains the largest source, with 9 percent of the acres delivering 68 percent of the total sediment load in CEAP II (table 22; appendix 2, table A-16).

Table 22. Sediment Loss by Threshold, CEAP I and CEAP II

	CEAP I				CEAP II				CEAP II minus CEAP I			
	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent Relative to CEAP I	Tons (1,000s)	Percent Relative to CEAP I
Total	313,065	100	337,635	100	315,303	100	263,455	100	2,238	1	-74,181	-22
Meeting Threshold	274,952	88	95,946	28	285,968	91	83,218	32	11,016	4	-12,728	-13
Exceeding Threshold	38,113	12	241,689	72	29,335	9	180,237	68	-8,778	-23	-61,452	-25

By CEAP II, three regions (North Central and Midwest, East Central, and Lower Mississippi and Texas Gulf Coast) accounted for 74 percent of the total acres exceeding the sediment threshold and 73 percent of the associated sediment losses.

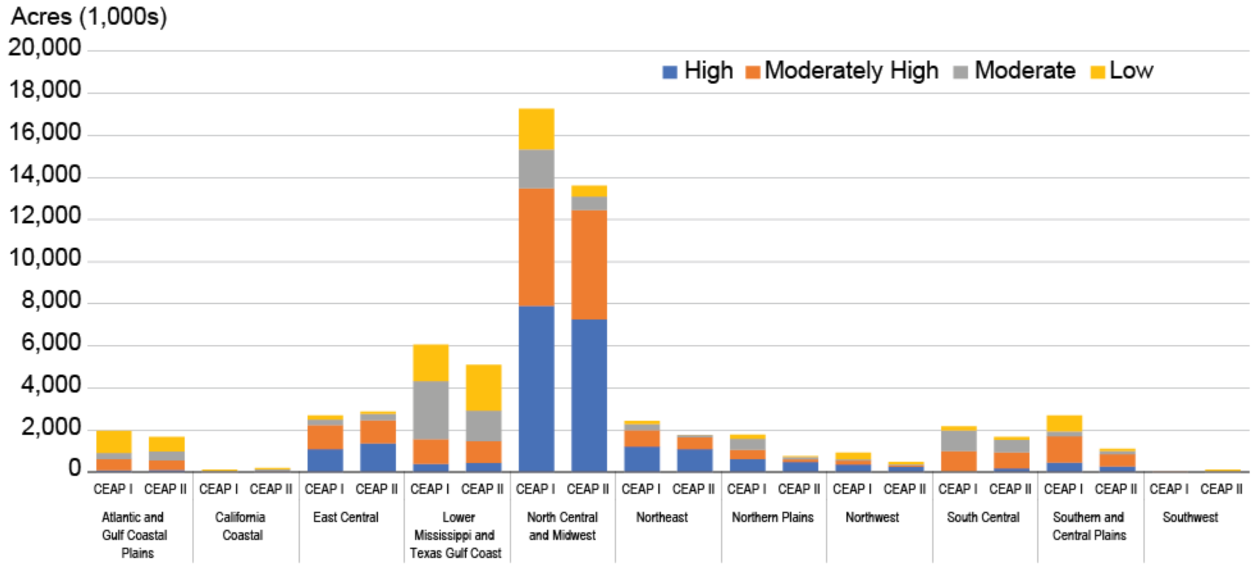
Rainfall and inherent soil runoff vulnerability are the primary forces driving sediment loss from cultivated cropland (see also box 3, page 18). Of the 29.3 million cultivated cropland acres exceeding the sediment threshold in CEAP II, 22.2 million (76 percent) were in areas with more than 35 inches of annual rainfall, and 15.2 million acres (69 percent) had moderately high and high runoff vulnerability (table 23). Of all cultivated cropland acres with high runoff vulnerability and more than 45 inches of rain annually (3.9 million acres), 65 percent (2.5 million acres) exceeded the sediment loss threshold.

Table 23. Cultivated Cropland Exceeding the Sediment Threshold by Soil Vulnerability Index Runoff and Rainfall, CEAP II

SVI Runoff Rating	Average Annual Rainfall									
	≤ 15 inches		> 15 and ≤ 25 inches		> 25 and ≤ 35 inches		> 35 and ≤ 45 inches		> 45 inches	
	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI
Low	11	0	124	0	344	1	407	1	3,181	13
Moderate	60	2	152	2	296	4	913	8	2,487	17
Moderately High	36	0	201	2	2,498	17	3,749	22	3,401	39
High	21	1	785	16	2,595	27	5,507	42	2,566	65
National	**128**	**1**	**1,262**	**2**	**5,733**	**8**	**10,576**	**13**	**11,636**	**22**

Between the CEAP surveys, cultivated cropland exceeding the sediment loss threshold decreased overall and in all vulnerability categories (fig. 35). However, most acres exceeding the threshold remained in the high and moderately high vulnerability categories; 73 percent in CEAP II. All regions experienced a decline in moderately high vulnerability acres exceeding the threshold, while only five regions experienced declines in all vulnerability categories (North Central and Midwest, Northern Plains, Northeast, Northwest, and Southern and Central Plains). Four regions (East Central, Lower Mississippi and Texas Gulf Coast, Northeast, and South Central) had more than 20 percent of their regional cultivated cropland acres exceed the sediment threshold due to a mix of factors related to climate and cropping systems.

Figure 35. Cultivated Cropland Exceeding the Sediment Threshold by Region and SVI-R, CEAP I and CEAP II



Surface Nitrogen

Surface losses of nitrogen declined slightly between CEAP I and CEAP II, with only 11 percent of cultivated cropland acres exceeding the threshold of 15 pounds per acre per year (lbs/a/y) in both surveys (table 24; appendix 2, table A-17). In CEAP II, the 11 percent of acres exceeding the threshold generated 48 percent of the total surface nitrogen loss. The majority (65 percent) of the acres meeting the surface loss threshold were losing less than 5 lbs/a/y, helping to offset the per-acre increase in losses on acres exceeding the threshold and resulting in the net reduction in surface nitrogen loss.

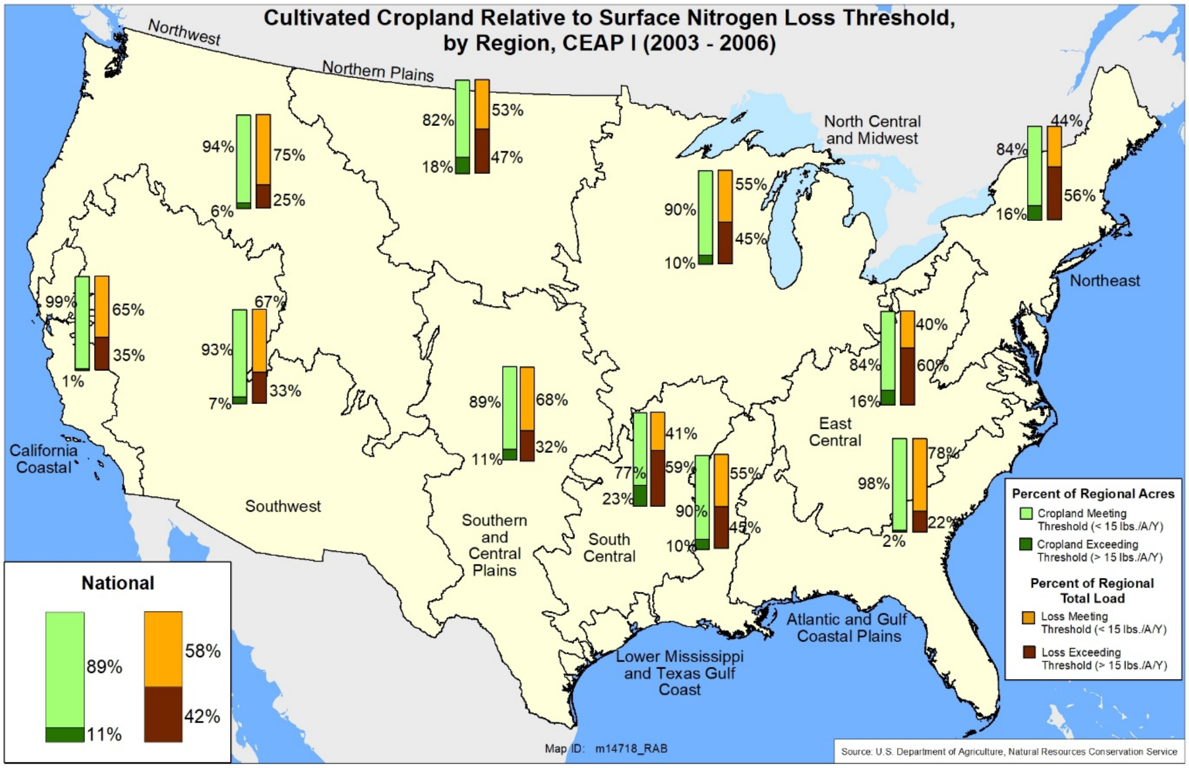
Table 24. Surface Nitrogen Loss by Threshold, CEAP I and CEAP II

	CEAP I				CEAP II				CEAP II minus CEAP I			
	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent Relative to CEAP I	Tons (1,000s)	Percent Relative to CEAP I
Total	313,065	100	1,073	100	315,303	100	1,038	100	2,238	1	-35	-3
Meeting Threshold	277,981	89	621	58	281,357	89	541	52	3,376	1	-80	-13
Exceeding Threshold	35,084	11	452	42	33,946	11	497	48	-1,138	-3	45	10

While most regions experienced a decline in cultivated cropland exceeding the surface loss threshold, the Northern Plains experienced an increase of more than 2.8 million such acres. Two regions (North Central and Midwest and Southern and Central Plains) accounted for a 4-million-acre decline in cultivated cropland exceeding the surface nitrogen loss threshold (fig. 36).

Rainfall and inherent soil runoff vulnerability are the primary forces driving surface nitrogen loss from cultivated cropland. Of the 33.9 million cultivated cropland acres exceeding the surface nitrogen loss threshold in CEAP II, most were in areas receiving between 15 and 25 inches of rainfall annually (table 25). Some 18.8 million (55 percent) were in areas receiving more than 25 inches of rainfall, down from 62 percent in CEAP I, while cultivated cropland receiving less than

Figure 36. Cultivated Cropland Relative to Surface Nitrogen Loss Threshold (Acres and Tons), CEAP I and CEAP II



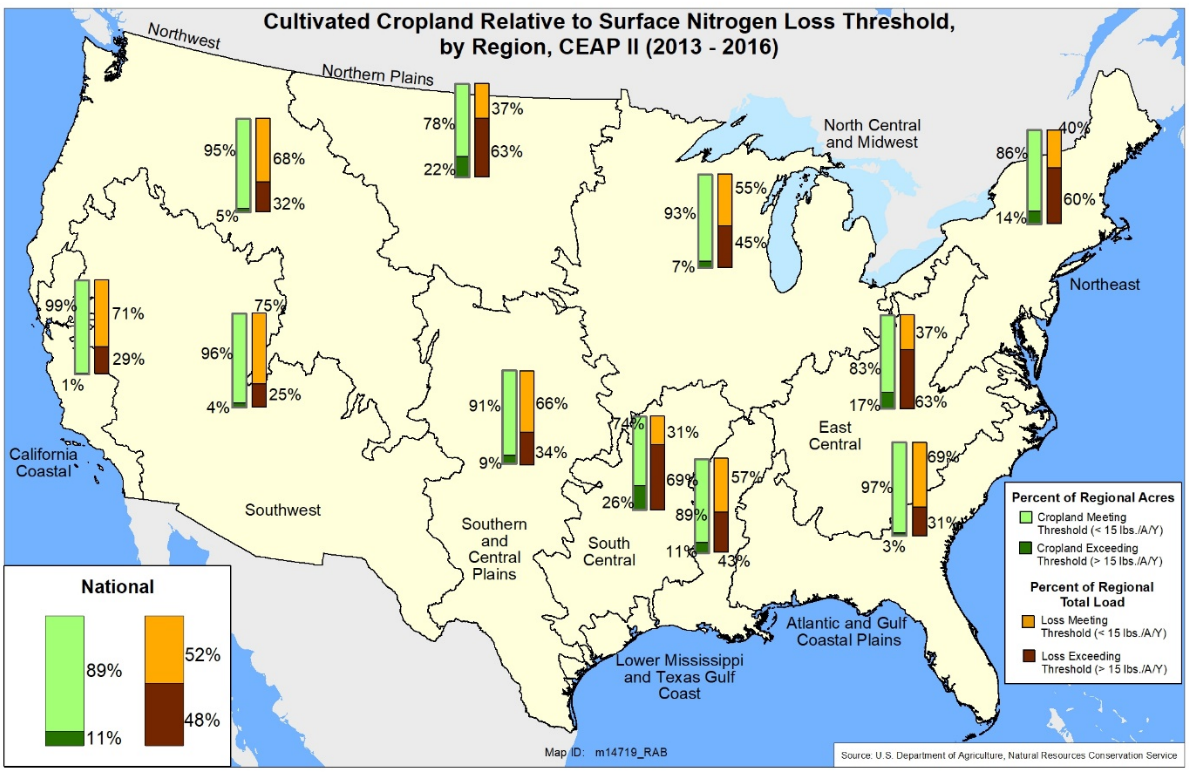


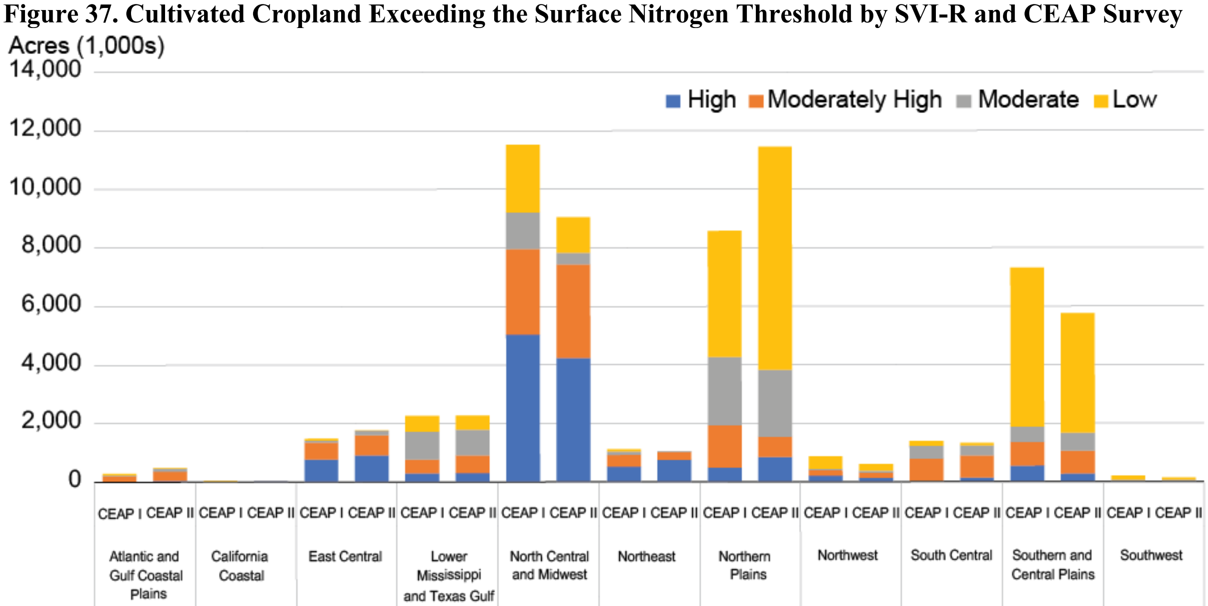
Table 25. Cultivated Cropland Exceeding Surface Nitrogen Threshold by SVI Runoff and Rainfall, CEAP II

SVI Runoff Rating	Average Annual Rainfall									
	≤ 15 inches		> 15 and ≤ 25 inches		> 25 and ≤ 35 inches		> 35 and ≤ 45 inches		> 45 inches	
	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI
Low	1,132	11	9,273	16	2,561	6	380	1	521	2
Moderate	140	6	2,448	26	667	9	674	6	930	6
Moderately High	294	4	855	9	1,998	14	2,165	12	2,175	25
High	8	0	1,025	21	1,883	20	3,161	24	1,656	42
National	**1,574**	**7**	**13,601**	**16**	**7,108**	**10**	**6,380**	**8**	**5,282**	**10**

25 inches of rainfall and exceeding the surface nitrogen loss threshold increased by 15 percent. Of all cultivated cropland acres with a high SVI-R and receiving more than 45 inches of rain annually, 42 percent (1.7 million acres) exceeded the surface nitrogen threshold, reflecting the difficulty in managing losses under these conditions.

Cultivated cropland exceeding the surface nitrogen threshold declined overall and in most regions between CEAP I and CEAP II (fig. 37). Exceeding acres with high or moderately high runoff vulnerability declined in all but the East Central, Northern Plains, Northeast, and South Central. In the Northern Plains, the largest increase was in low vulnerability acres exceeding the surface nitrogen loss threshold, reflecting the increase in nutrient application rates and decline in nutrient incorporation in the region. In two regions (Northern Plains and South Central) more than 20 percent of the regional cultivated cropland acres exceeded the surface nitrogen threshold due to a mix of factors related to climate and cropping systems.

Figure 37. Cultivated Cropland Exceeding the Surface Nitrogen Threshold by SVI-R and CEAP Survey



Sediment-Transported Phosphorus

Sediment-transported phosphorus losses dropped by 14,000 tons between CEAP I and CEAP II, as cultivated cropland acreage exceeding the loss threshold (greater than 3 lbs/a/y) decreased by nearly 1.6 million acres (table 26; appendix 2, table A-18). The edge-of-field phosphorus losses on acres exceeding the threshold, however, stayed relatively level, suggesting increases in per-acre losses. By CEAP II, the 11 percent of acres exceeding the threshold accounted for 61 percent of the total sediment-transported loss. The 89 percent of acres meeting the threshold had a 14-percent reduction in losses over the decade despite an increase of 3.8 million acres.

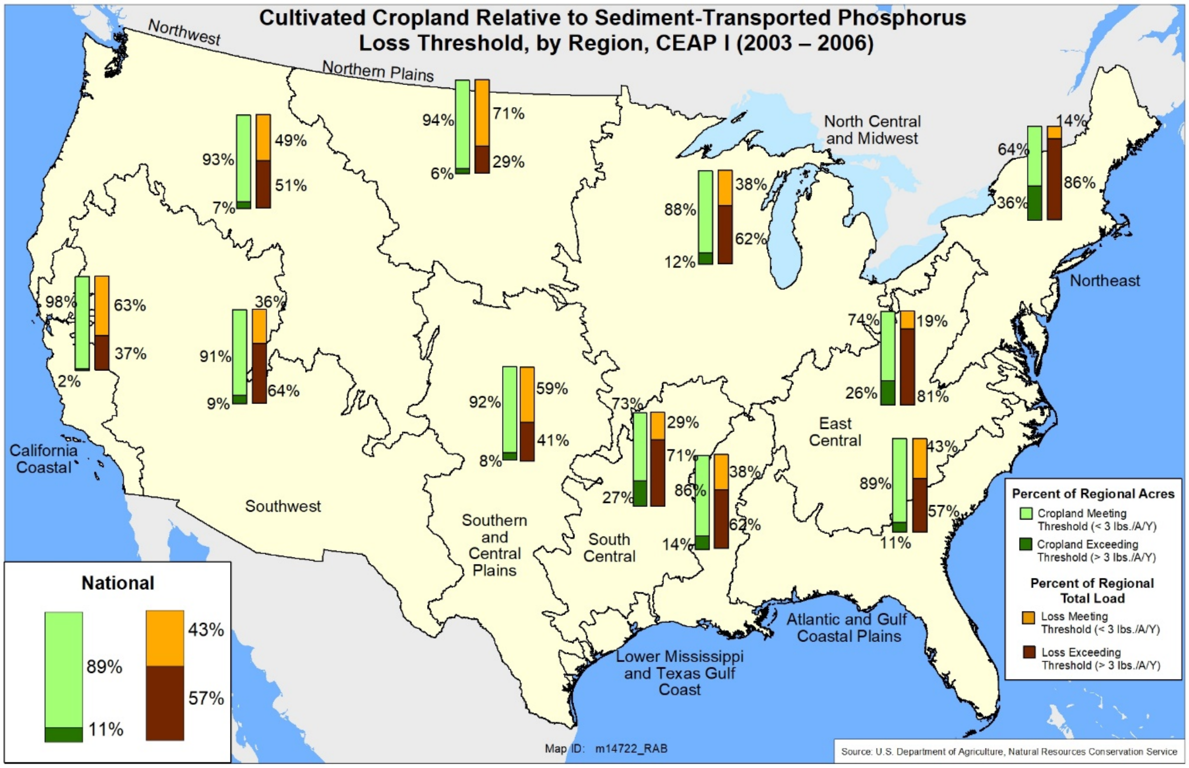
Table 26. Sediment-Transported Phosphorus Loss by Threshold, CEAP I and CEAP II

	CEAP I				CEAP II				CEAP II minus CEAP I			
	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent Relative to CEAP I	Tons (1,000s)	Percent Relative to CEAP I
Total	313,065	100	227	100	315,303	100	213	100	2,238	1	-14	-6
Meeting Threshold	277,854	89	97	43	281,673	89	83	39	3,819	1	-13	-14
Exceeding Threshold	35,211	11	130	57	33,630	11	129	61	-1,581	-4	-1	-1

Most regions experienced a decline in acres exceeding the sediment-transported phosphorus threshold; the Northern Plains was a notable exception with an increase of 2 million acres. The Southern and Central Plains region had the largest decline in cultivated cropland exceeding the threshold, at 1.7 million acres. The region also experienced a net decline in cultivated cropland over the decade. The North Central and Midwest region experienced the largest increase in cultivated cropland meeting the threshold, gaining 4.2 million acres between the survey periods (fig. 38).

Rainfall and inherent soil runoff vulnerability are the primary forces driving sediment-transported phosphorus loss from cultivated cropland. Of the 33.6 million cultivated cropland acres exceeding the loss threshold in CEAP II, most were in areas receiving more than 25 inches of rainfall annually, nearly 26 million acres (77 percent) and of these most were in high and moderately high vulnerability categories (65 percent) (table 27). Unexpected is the number of low-runoff-vulnerability acres exceeding the threshold (33 percent of all cultivated cropland with low runoff vulnerability), suggesting the effects of increased nutrient application rates and reduction in nutrient incorporation. Of all cultivated cropland acres with a high SVI-R and receiving more than 45 inches of rain annually, 55 percent (2.1 million acres) exceeded the sediment-transported phosphorus threshold, reflecting the difficulty in managing losses under these wet conditions.

Figure 38. Cultivated Cropland Relative to Sediment-Transported Phosphorus Loss Threshold (Acres and Tons), CEAP I and CEAP II



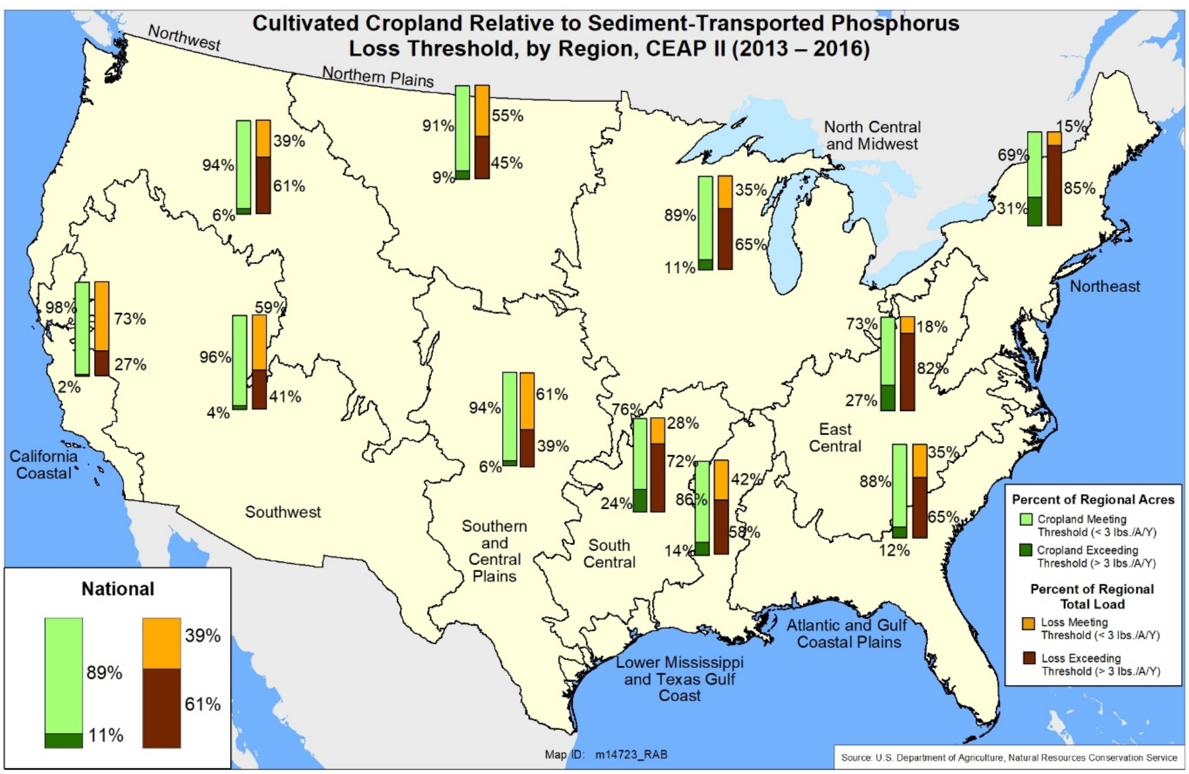
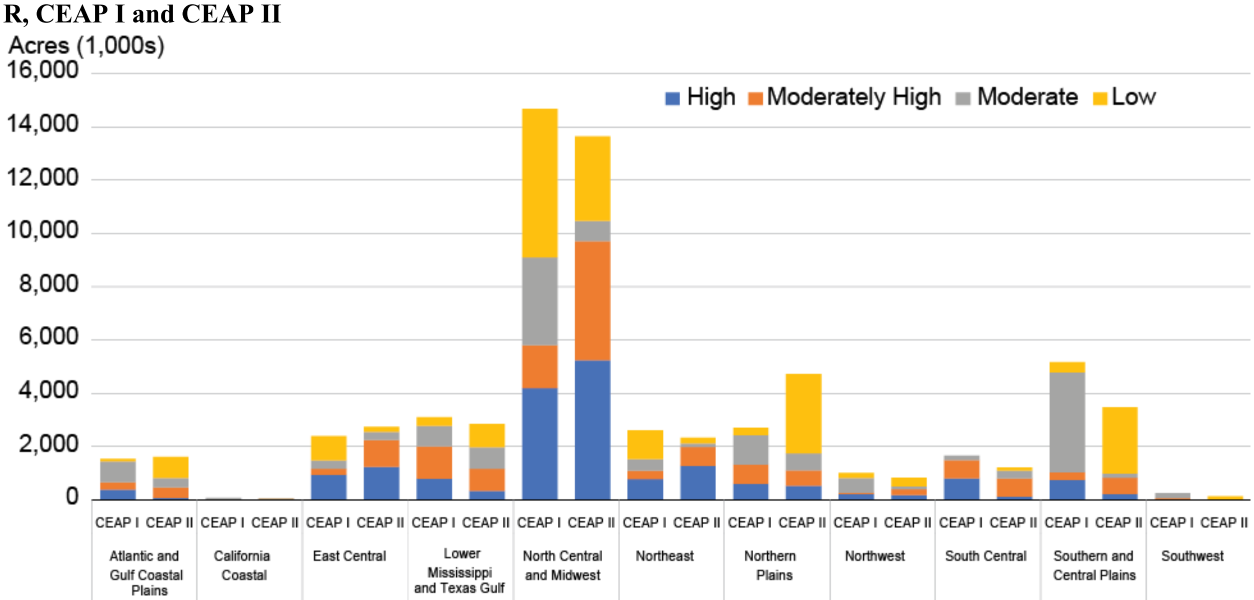


Table 27. Cultivated Cropland Exceeding Sediment-Transported Phosphorus Threshold by SVI Runoff and Rainfall, CEAP II

SVI Runoff Rating	Average Annual Rainfall									
	≤ 15 inches		> 15 and ≤ 25 inches		> 25 and ≤ 35 inches		> 35 and ≤ 45 inches		> 45 inches	
	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI
Low	833	8	4,227	7	2,160	5	2,152	5	1,929	8
Moderate	25	1	734	8	449	6	791	7	1,559	11
Moderately High	399	5	635	6	2,572	18	2,946	17	2,949	33
High	38	2	775	16	2,158	23	4,104	31	2,195	55
National	**1,295**	**6**	**6,372**	**8**	**7,339**	**10**	**9,992**	**12**	**8,633**	**16**

Cultivated cropland exceeding the sediment-transported phosphorus threshold declined overall and in most regions between CEAP I and CEAP II (fig. 39). Nationally, acres exceeding the threshold with high runoff vulnerability remained relatively stable, acres with moderately high and low vulnerability increased significantly, and acres with moderate vulnerability declined. The Northern Plains and Southern Plains regions each had a significant increase in low-vulnerability acres exceeding the sediment-transported phosphorus loss threshold, reflecting the increase in nutrient application rates and decline in nutrient incorporation in those regions. In three regions (East Central, Northeast, and South Central) more than 20 percent of the regional cultivated cropland acres exceeded the sediment-transported phosphorus threshold due to a mix of factors related to climate and cropping systems. While most regions followed the national pattern, there were exceptions, notably the North Central and Midwest region, which had an increase in high vulnerability acres (over 1 million acres) and a decrease in low vulnerability acres (2.4 million acres) exceeding the threshold.

Figure 39. Cultivated Cropland Exceeding Sediment-Transported Phosphorus Threshold by Region and SVI-R, CEAP I and CEAP II



Subsurface Nitrogen

Although most acres met the subsurface nitrogen threshold in both survey periods, subsurface nitrogen losses increased by 420,000 tons between CEAP I and CEAP II (table 28; appendix 2, table A-19). Conservation tillage systems reduced the risk of nitrogen loss through surface pathways and increased infiltration for subsurface flow, while the increase in surface application of fertilizer promoted surface conversion to soluble nitrogen and movement through the soil profile. Cultivated cropland exceeding the subsurface loss threshold (greater than 25 lbs/a/y) increased by over 14 million acres (19 percent), while acres meeting the threshold declined by almost 12 million acres (5 percent). Losses from acres exceeding the threshold increased by 442,000 tons, resulting in losses 20 percent higher than the CEAP I level and only slightly offset by the decline in losses from acres meeting the threshold.

Table 28. Subsurface Nitrogen Loss by Threshold, CEAP I and CEAP II

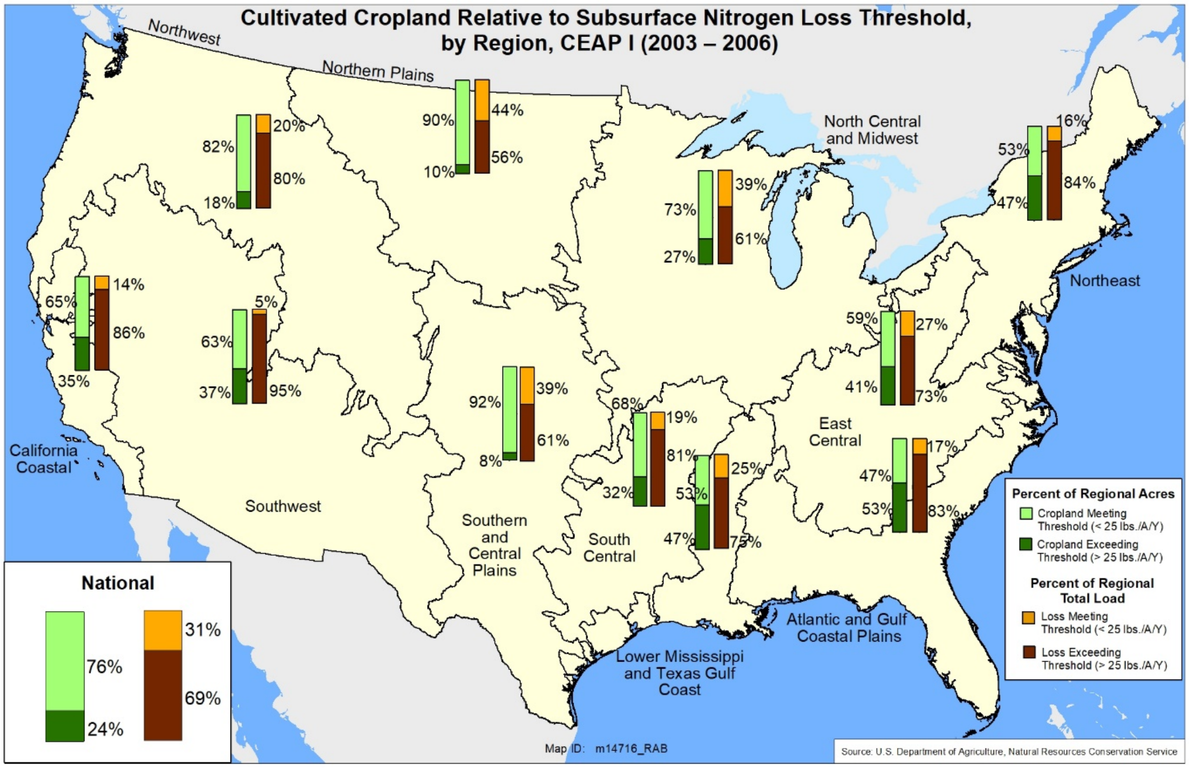
	CEAP I				CEAP II				CEAP II minus CEAP I			
	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent Relative to CEAP I	Tons (1,000s)	Percent Relative to CEAP I
Total	313,065	100	3,130	100	315,303	100	3,550	100	2,238	1	420	13
Meeting Threshold	238,286	76	971	31	226,389	72	949	27	-11,897	-5	-22	-2
Exceeding Threshold	74,779	24	2,159	69	88,914	28	2,601	73	14,135	19	442	20

By CEAP II, 28 percent of cultivated cropland acres exceeded the subsurface nitrogen loss threshold and accounted for 73 percent of the total subsurface nitrogen losses (fig. 40). About half of the acres that met the subsurface threshold were losing less than 13 lbs/a/y. Timing nutrient applications with crop demand and incorporating applications are particularly critical practices as there are few edge-of-field options for trapping subsurface flow. In addition, without attention to timing and incorporation, increased rates may even lead to reduced yields as increased losses reduce nutrient-use efficiencies.

The North Central and Midwest and the Northern Plains regions accounted for 76 percent of the total increase in acres exceeding the subsurface loss threshold, each having individual increases of over 5 million acres. In the Northern Plains region, that increase more than doubled the acres exceeding the threshold. In the larger North Central and Midwest region, 31 percent of cultivated cropland exceeded the subsurface nitrogen loss threshold in CEAP II, an increase of 17 percent from CEAP I levels (fig. 40).

Rainfall and inherent soil leaching vulnerability are the primary forces driving subsurface nitrogen loss from cultivated cropland. Of the 88.9 million cultivated cropland acres exceeding the loss threshold in CEAP II, nearly 55 million acres (62 percent) were in areas receiving more than 35 inches of rainfall annually. Of these acres, 60 percent were in high and moderately high leaching vulnerability categories (table 29). Across all rainfall categories, most of the acres exceeding the threshold were in the high (39 percent) or moderate (35 percent) leaching vulnerability categories. Of all cultivated cropland acres with a high SVI-L and receiving more than 45 inches of rain annually, 57 percent (7.3 million acres) exceeded the subsurface nitrogen threshold, reflecting the difficulty in managing subsurface losses under high rainfall conditions.

Figure 40. Cultivated Cropland Relative to Subsurface Nitrogen Loss Threshold (Acres and Tons), CEAP II



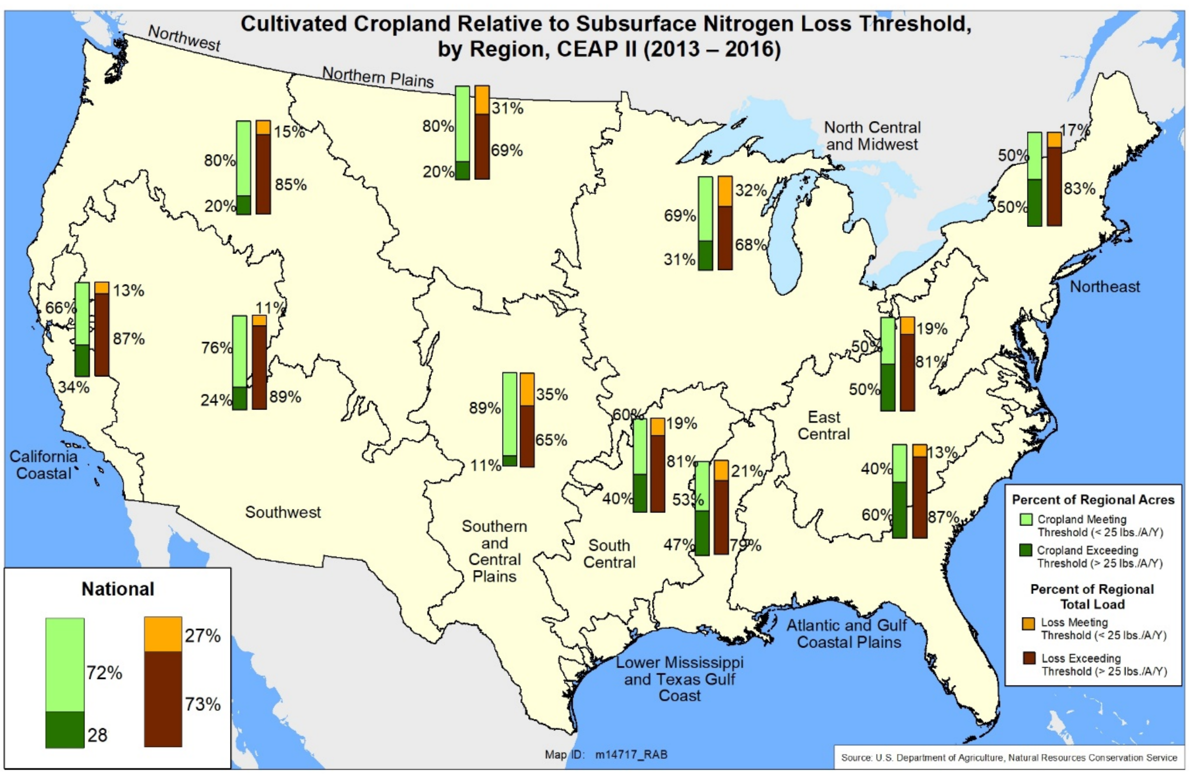
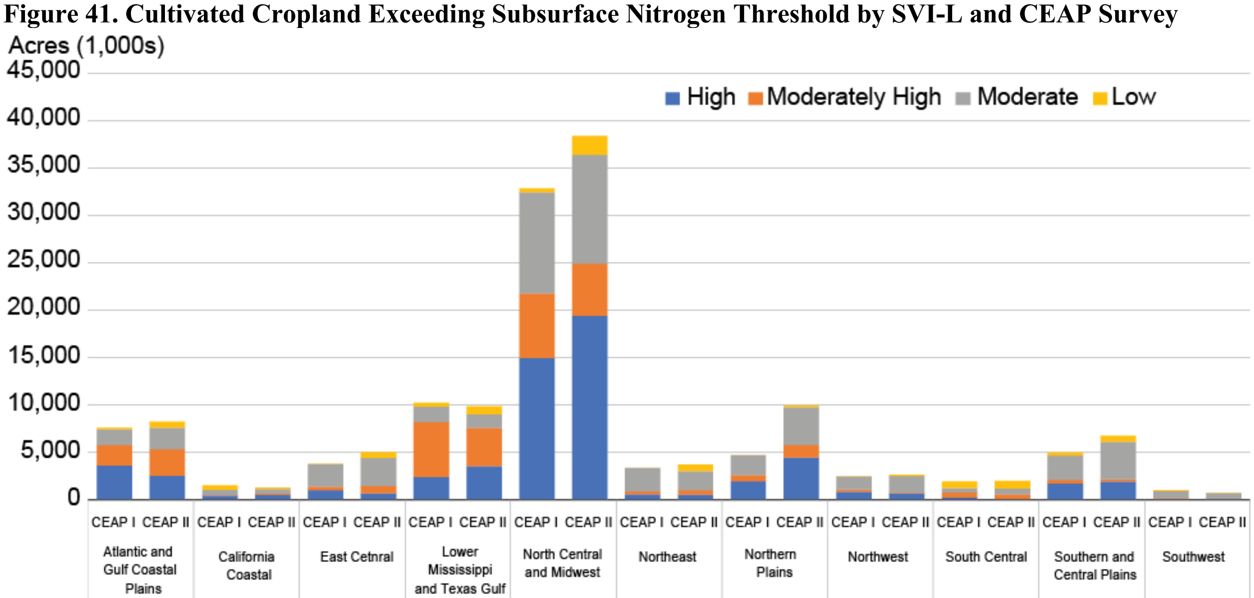


Table 29. Cultivated Cropland Exceeding Subsurface Nitrogen Threshold by SVI Leaching (SVI-L) and Rainfall, CEAP II

SVI Leaching Rating	Average Annual Rainfall									
	≤ 15 inches		> 15 and ≤ 25 inches		> 25 and ≤ 35 inches		> 35 and ≤ 45 inches		> 45 inches	
	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI
Low	186	9	463	12	1,469	20	2,321	22	2,303	39
Moderate	2,551	15	6,289	12	5,264	14	9,290	30	8,082	47
Moderately High	110	21	1,229	23	1,367	30	4,701	41	8,412	51
High	826	30	5,687	29	8,574	34	12,462	41	7,326	57
National	**3,673**	**16**	**13,669**	**17**	**16,675**	**23**	**28,775**	**35**	**26,123**	**50**

Cultivated cropland exceeding the subsurface nitrogen threshold increased overall and in most regions between CEAP I and CEAP II (fig. 41). Acres exceeding the threshold with high, moderate, and low leaching vulnerability increased, while there was a slight decline in moderately high acres. The North Central and Midwest and Northern Plains regions each had a significant increase in high vulnerability acres exceeding the surface nitrogen loss threshold. The Southwest was the only region with a decline in acres exceeding the threshold in all vulnerability categories. In nine regions more than 20 percent of the regional cultivated cropland acres exceeded the subsurface nitrogen threshold reflecting the decline in nutrient management that occurred between the surveys and the difficulties in controlling subsurface flow.

Figure 41. Cultivated Cropland Exceeding Subsurface Nitrogen Threshold by SVI-L and CEAP Survey



Soluble Phosphorus

Soluble phosphorus losses increased by 7,200 tons (11 percent) between the survey periods (table 30; appendix 2, table A-20). Cultivated cropland exceeding the soluble phosphorus loss threshold (greater than 0.5 lbs/a/y) increased by 11.4 million acres (16 percent) while acres meeting the threshold declined by 9.2 million acres (4 percent). Phosphorus losses from acres exceeding the threshold increased by 6,600 tons, or 15 percent from CEAP I levels, and increased slightly on acres meeting the threshold. By CEAP II, 27 percent of cultivated cropland acres exceeded the threshold and accounted for 73 percent of the total soluble phosphorus losses. The probability of meeting the soluble loss threshold is increased with incorporation of applied nutrients, which becomes more important as rates increase.

Table 30. Soluble Phosphorus Loss by Threshold, CEAP I and CEAP II

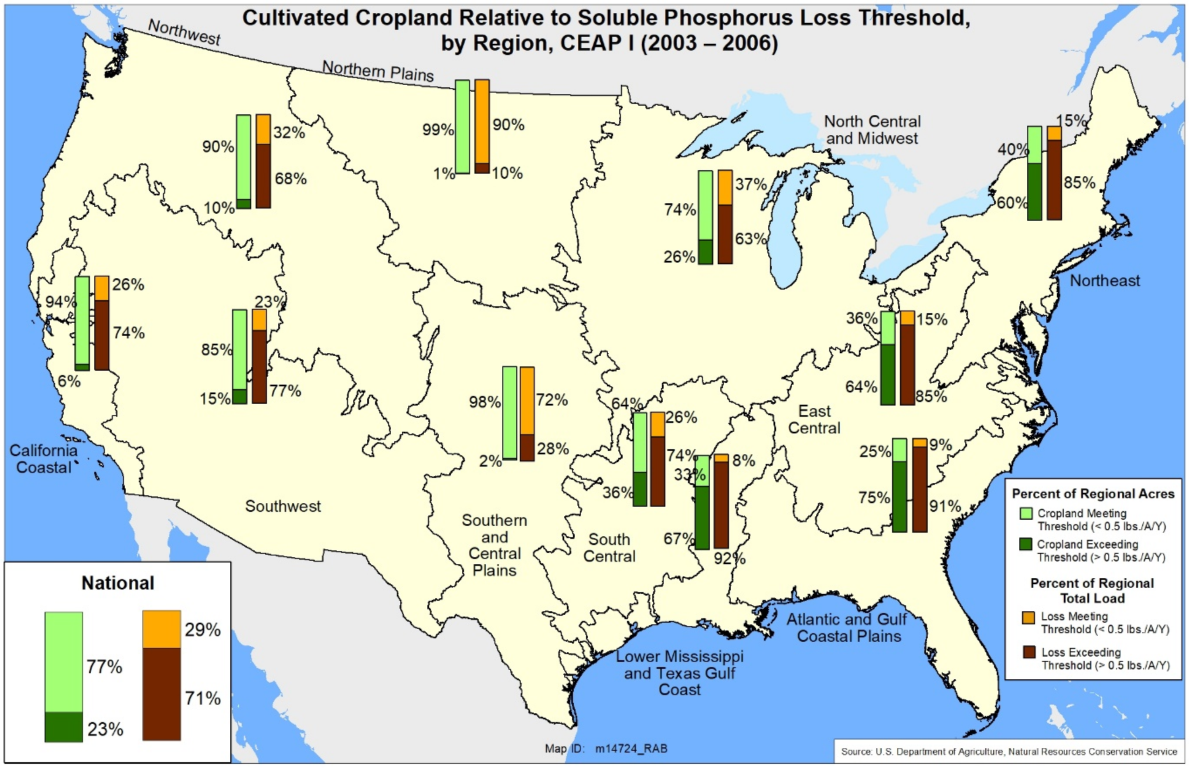
	CEAP I				CEAP II				CEAP II minus CEAP I			
	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Acres (1,000s)	Percent Relative to CEAP I	Tons (1,000s)	Percent Relative to CEAP I
Total	313,065	100	63	100	315,303	100	70	100	2,238	1	7.2	11
Meeting Threshold	240,156	77	18	29	230,942	73	19	27	-9,214	-4	0.6	3
Exceeding Threshold	72,909	23	45	71	84,361	27	51	73	11,452	16	6.6	15

Most regions experienced an increase in acres exceeding the soluble phosphorus loss threshold. The North Central and Midwest region had an increase of nearly 9 million acres exceeding the threshold by CEAP II, more than twice that of the other gaining regions. The Northern Plains gained nearly 2.5 million acres meeting the threshold, while most regions lost acres in that category (fig. 42).

Rainfall and inherent soil runoff vulnerability are the primary forces driving soluble phosphorus loss from cultivated cropland. Of the 84.4 million cultivated cropland acres exceeding the loss threshold in CEAP II, most were in areas receiving 35 inches or more of rainfall annually—nearly 74 million acres (88 percent)—and of these nearly 50 percent had low runoff vulnerability (table 31). Across all rainfall categories, about half of the acres exceeding the threshold (41.7 million acres) had low runoff vulnerability. Of all cultivated cropland acres with a high SVI-R and receiving more than 45 inches of rain annually, 79 percent (3.1 million acres) exceeded the soluble phosphorus threshold, reflecting the difficulty in managing soluble losses under high rainfall conditions.

Cultivated cropland exceeding the soluble phosphorus threshold increased overall and in most regions between CEAP I and CEAP II (fig. 43). Acres exceeding the threshold with high, moderately high, and low runoff vulnerability increased, while there was a slight decline in moderate vulnerability acres. The North Central and Midwest had a significant increase in high vulnerability acres exceeding the threshold and was joined by the Lower Mississippi and Texas Gulf Coast in a substantial increase in low vulnerability acres exceeding the threshold. In six regions more than 20 percent of the regional cultivated cropland acres exceeded the soluble phosphorus threshold reflecting the decline in nutrient management that occurred between the surveys and the challenges in controlling soluble flow.

Figure 42. Cultivated Cropland Relative to Soluble Phosphorus Loss Threshold (Acres and Tons), CEAP I and CEAP II



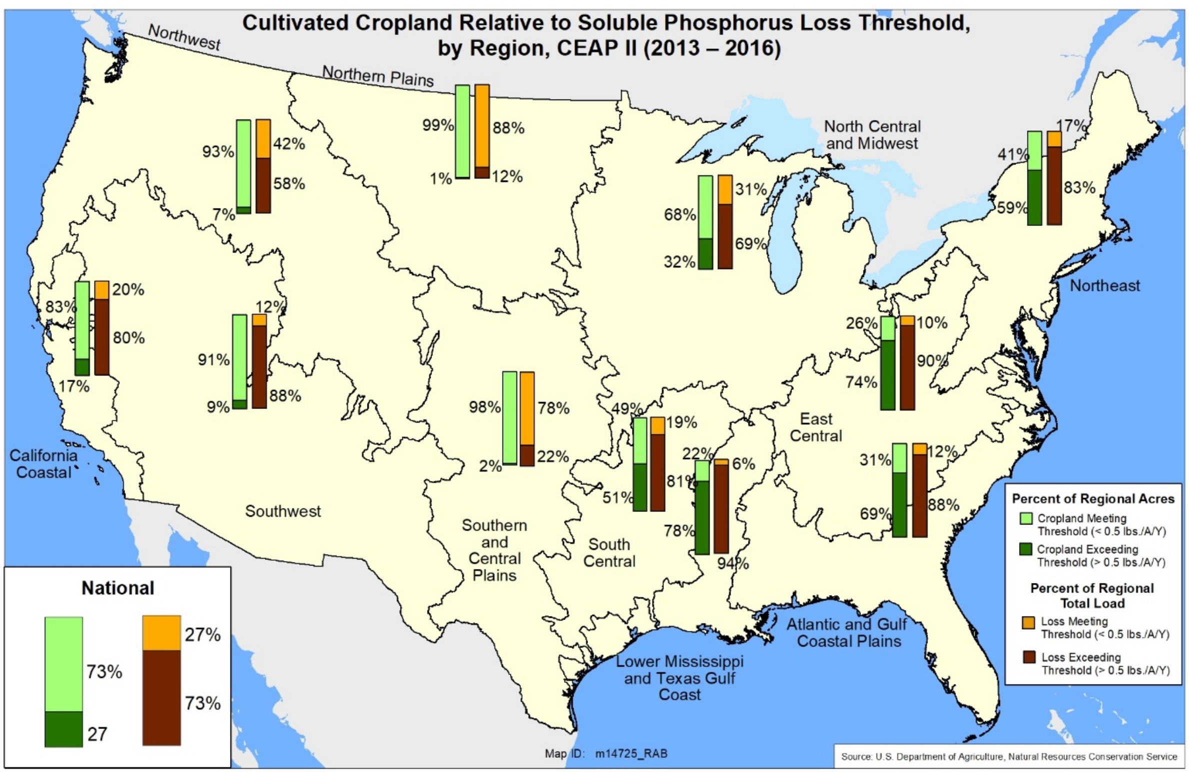
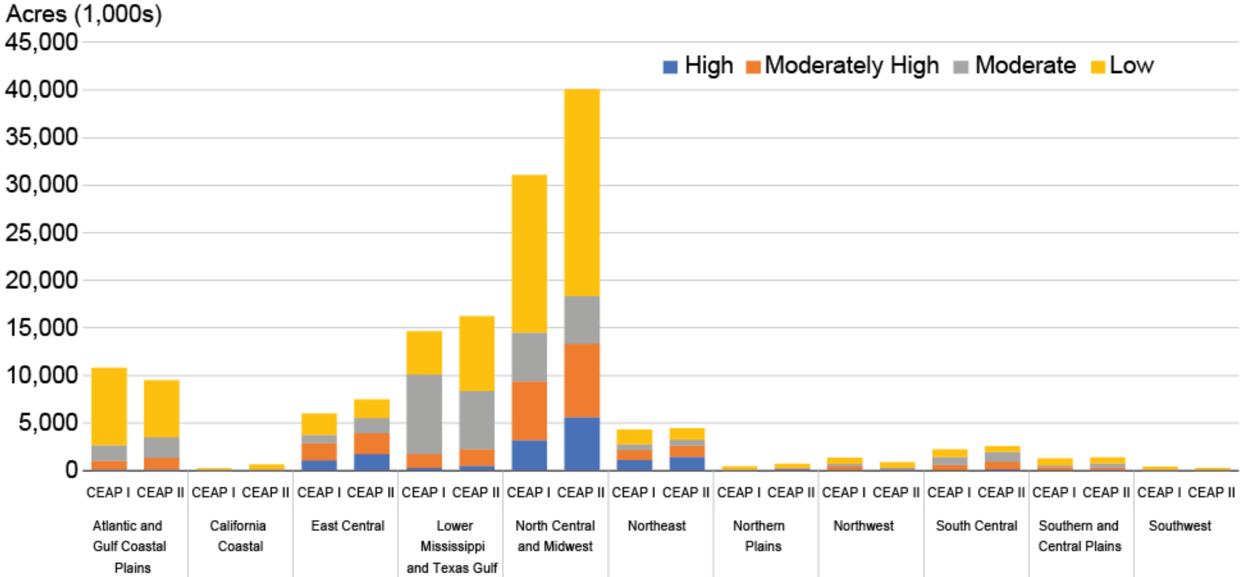


Table 31. Cultivated Cropland Exceeding Soluble Phosphorus Threshold by SVI Runoff and Rainfall, CEAP II

SVI Runoff Rating	Average Annual Rainfall									
	≤ 15 inches		> 15 and ≤ 25 inches		> 25 and ≤ 35 inches		> 35 and ≤ 45 inches		> 45 inches	
	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI
Low	345	3	1,022	2	4,664	11	17,768	43	17,953	71
Moderate	85	4	38	0	870	12	4,834	42	11,335	78
Moderately High	92	1	120	1	1,863	13	6,505	37	6,838	77
High	38	2	198	4	1,034	11	5,619	43	3,141	79
National	**560**	**2**	**1,377**	**2**	**8,431**	**11**	**34,725**	**42**	**39,267**	75

Figure 43. Cultivated Cropland Exceeding Soluble Phosphorus Threshold by Region and SVI-R, CEAP I and CEAP II



Soil Carbon

Between the CEAP surveys, soil carbon gains on all cultivated cropland increased by over 8.8 million tons per year because of soil-conserving measures applied by farmers. By CEAP II, cultivated cropland meeting the soil carbon threshold (gaining or maintaining soil carbon) increased by 3.4 million acres; cultivated cropland gaining carbon increased by 25.7 million acres and cultivated cropland maintaining soil carbon declined by 22.3 million acres. Cultivated cropland exceeding the threshold (losing carbon) declined slightly (1.2 million acres) (fig. 44).

Average soil carbon change on all cultivated cropland increased from 144 to 192 lbs/a/y (33 percent). On the nearly 19 million acres where cover crops were part of the rotation in CEAP II, rates of carbon gain were nearly 30 percent above the average gain on cultivated cropland where cover crops were not in use (box 7, page 69).

Most regions had soil carbon gains between the two survey periods (fig. 45). Three regions, led by the Southern and Central Plains, accounted for 75 percent of the total increase. These regions also experienced significant increases in conservation tillage between the two CEAP surveys.

Figure 44. Cultivated Cropland by Carbon Trend, CEAP I and CEAP II

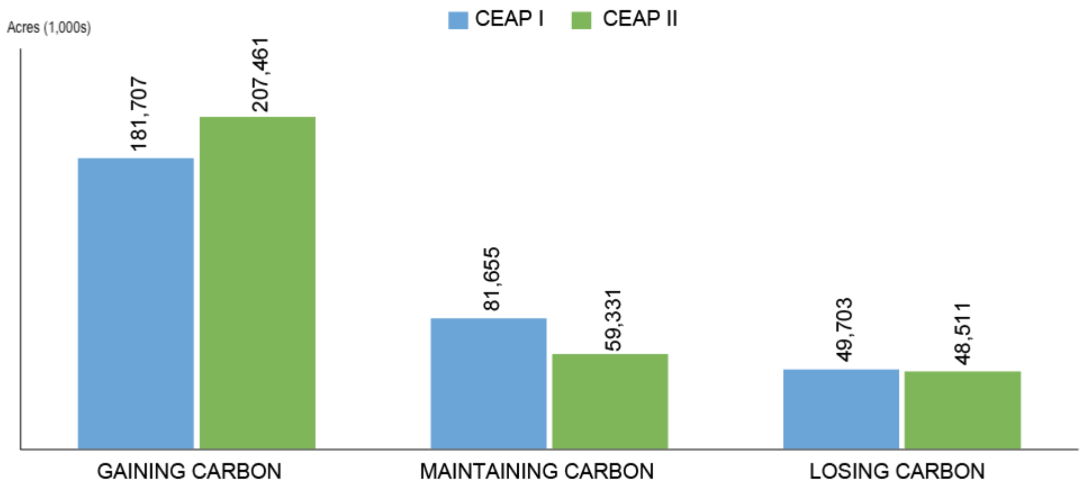
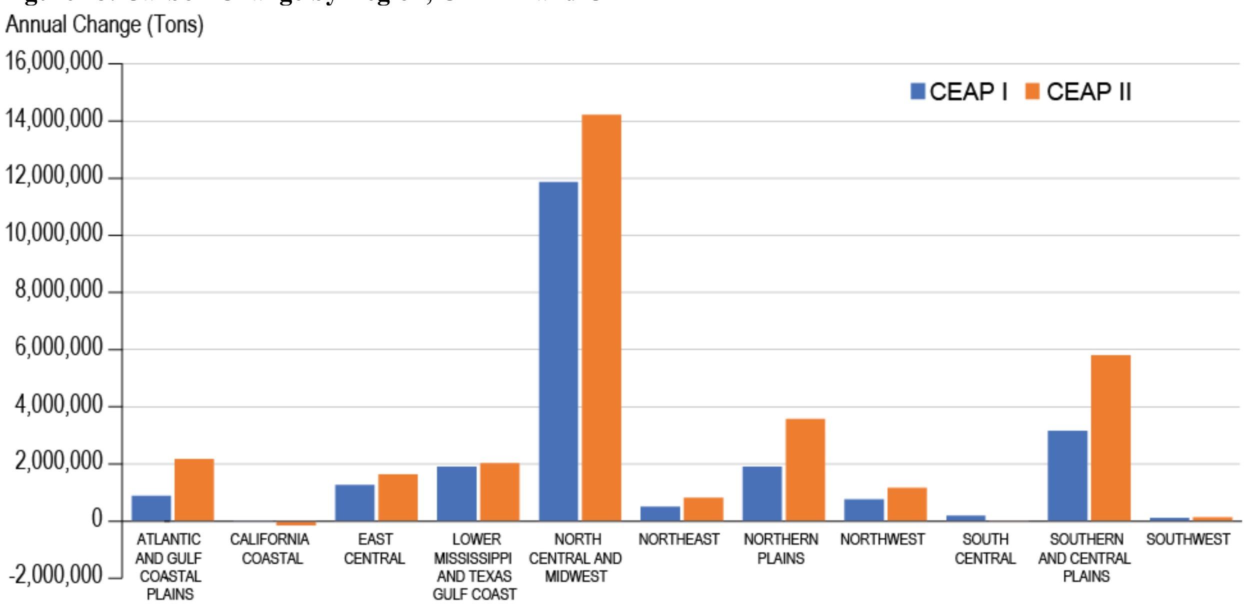


Figure 45. Carbon Change by Region, CEAP I and CEAP II



As expected, most soils gaining carbon are under continuous no-till or reduced tillage, 41 and 37 percent respectively. However, more than 22 percent of acres under conventional tillage also gained carbon, demonstrating that there are strategies that work for all tillage classes (fig. 46). Nevertheless, nearly 60 percent of all acres losing carbon are conventionally tilled and could benefit from additional conservation.

Multiple management and natural resource factors affect soil carbon storage. Inherent soil vulnerability to erosion and runoff losses, low-residue cropping systems, and nutrient management strategies that limit plant growth all can contribute to soils not maintaining or gaining soil carbon. Of the 48.5 million cultivated cropland acres exceeding the carbon threshold in CEAP II, over one-third were receiving between 15 and 25 inches of rainfall annually, and of these most had low runoff vulnerability (table 32). Across all rainfall categories, about 60 percent of the exceeding acres (28.9 million acres) had low runoff vulnerability, up from 57 percent in CEAP I. Of all cultivated cropland acres with a high SVI-R and receiving more than 45 inches of rain annually, only 15 percent exceeded the carbon threshold, suggesting that while rainfall and inherent vulnerability may affect soil carbon, other factors could have more influence.

Three regions—North Central and Midwest, Northern Plains, and Lower Mississippi and Texas Gulf Coast—drove the increase in cultivated cropland with low runoff vulnerability and exceeding the carbon threshold between the survey periods (fig. 47; appendix 2, table A-21).

Box 7. Cover Crop Benefits

The estimated benefits on cultivated cropland with cover crops in CEAP II was compared to simulated losses with the cover crops removed from the rotation. With cover crops, the losses of sediment were reduced by 17 percent, total nitrogen by 17 percent, and total phosphorus by 9 percent. Annual change in soil carbon increased by 30 percent.

Effects of Cover Crops on Selected Benefits

Benefit Summary	With Cover Crop	Without Cover Crop	Cover Crop Benefit	
	Tons/Year			Percent
Sediment Loss	13,244,520	15,987,435	-2,742,915	-17
Total Nitrogen Loss	316,390	379,708	-63,318	-17
Surface Nitrogen Loss	42,720	46,535	-3,815	-8
Subsurface Nitrogen Loss	273,570	333,173	-59,503	-17
Total Phosphorus Loss	16,582	18,284	-1,702	-9
Soluble Phosphorus Loss	4,519	4,758	-239	-5
Soil Carbon Gain	2,808,210	2,164,961	645,248	30

Farmers weigh the trade-offs in cover crop management decisions to achieve their objectives. For example, terminating a cover crop with intense tillage may diminish its benefits for erosion reduction or soil condition. Conversely, cover crop residues left to degrade naturally on the soil surface may contribute to an increase in soluble nitrogen or phosphorus losses. In arid and semiarid regions, competition for water between cover and cash crops may affect adoption. Cover crop adoption over the decade between the two surveys was highly concentrated in three regions—Atlantic and Gulf Coastal Plains, North Central and Midwest, and Northern Plains—where 70 percent of the increase occurred.

Figure 46. Carbon Trends by Tillage Class, CEAP II

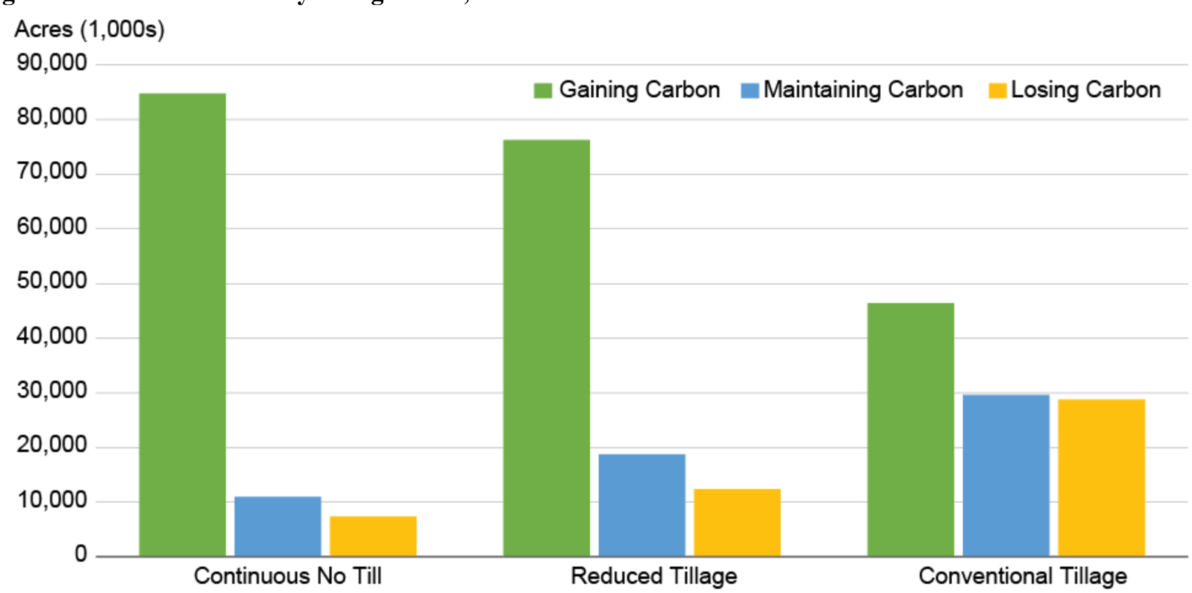
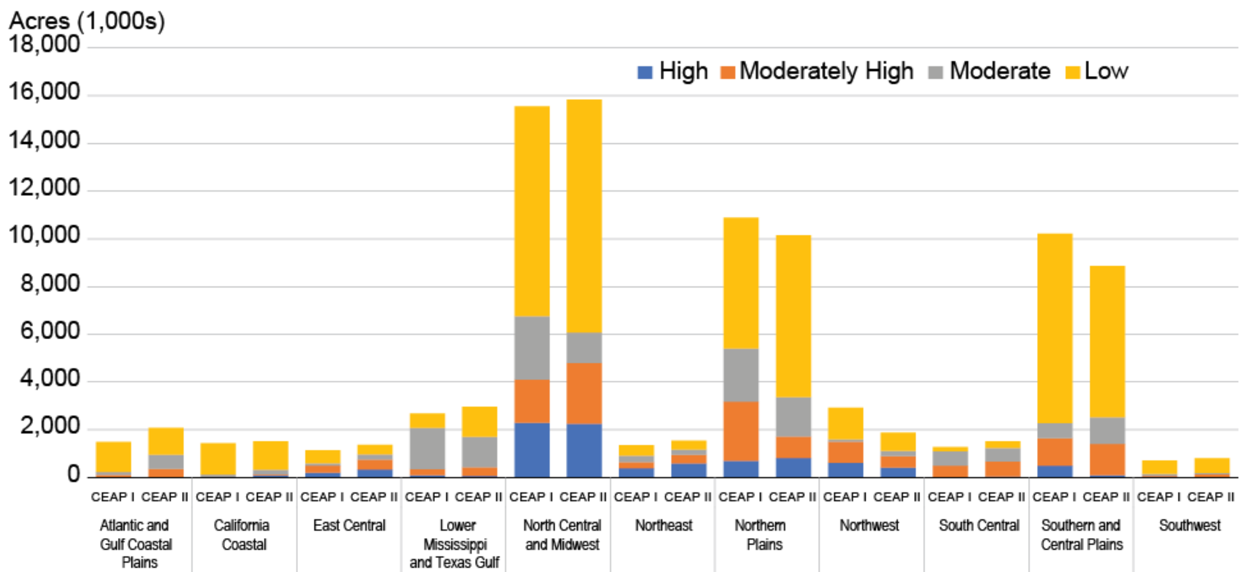


Table 32. Cultivated Cropland Exceeding the Soil Carbon Threshold by SVI Runoff and Rainfall, CEAP II

SVI Runoff Rating	Average Annual Rainfall									
	≤ 15 inches		> 15 and ≤ 25 inches		> 25 and ≤ 35 inches		> 35 and ≤ 45 inches		> 45 inches	
	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI	Acres (1,000s)	Percent of SVI
Low	2,042	19	12,301	21	6,140	14	5,189	13	3,219	13
Moderate	373	15	2,008	22	1,310	18	1,738	15	1,888	13
Moderately High	767	10	1,445	15	2,026	14	1,710	10	1,564	18
High	406	19	932	19	823	9	2,046	16	584	15
National	**3,588**	**16**	**16,686**	**20**	**10,299**	**14**	**10,683**	**13**	**7,255**	**14**

Figure 47. Cultivated Cropland Exceeding the Carbon Threshold by Region and SVI-R, CEAP I and CEAP II



Managing cultivated cropland for soil carbon is a complex process and requires a systems approach to avoid negatively affecting other natural resources. For example, while soils gaining carbon have lower nitrogen losses than those maintaining or losing carbon, there can still be significant nitrogen loss. Soils gaining carbon with a low level of nitrogen management lose more nitrogen than soils losing carbon but with a high level of management (table 33). Improving soil health and increasing carbon storage in balance with sound nutrient management can help to prevent unintended consequences.

Table 33. Nitrogen and Phosphorus Loss by Carbon Trend and Nutrient Management Level

Nutrient Management Level	Carbon Trend					
	Gaining (>100 lbs/a/y)		Maintaining		Losing (<-100 lbs/a/y)	
	Nitrogen	Phosphorus	Nitrogen	Phosphorus	Nitrogen	Phosphorus
	lbs/a/y					
Low	47	4.8	76	5.8	105	7.6
Moderate	23	1.7	38	2.9	61	6
Moderately High	21	1.1	33	1.5	59	3.7
High	15	1	19	1.3	36	3.2

Resource Concerns Summary

Conservation measures adopted by farmers between CEAP I and CEAP II helped to reduce field losses of erosion, sediment, surface nitrogen, sediment-transported phosphorus, and soil carbon. Correspondingly, the acres exceeding thresholds for those resource concerns declined as well (table 34). However, for subsurface nitrogen and soluble phosphorus losses, acres exceeding loss thresholds increased between the survey periods. These losses were driven by changes in nutrient management practices and related to changes in cropping patterns. Over one-fourth of the Nation's cultivated cropland exceeded thresholds for subsurface nitrogen and soluble phosphorus losses.

Table 34. Cultivated Cropland Exceeding Resource Concern Thresholds by Survey

Resource Concern (Loss Threshold)	CEAP I		CEAP II		CEAP II minus CEAP I	
	Acres (1,000s)	Percent of Acres	Acres (1,000s)	Percent of Acres	Acres (1,000s)	Percent of Acres Relative to CEAP I
Sheet & Rill Erosion (>T)	35,519	11	31,171	10	-4,348	-12
Wind Erosion (>T)	38,634	12	30,994	10	-7,640	-20
Sediment (>2 t/a/y)	38,113	12	29,335	9	-8,778	-23
Surface Nitrogen (>15 lbs/a/y)	35,084	11	33,946	11	-1,138	-3
Sediment-Transported Phosphorus (>3lbs/a/y)	35,211	11	33,630	11	-1,581	-4
Subsurface Nitrogen (>25 lbs/a/y)	74,779	24	88,914	28	14,135	19
Soluble Phosphorus (>0.5 lbs/a/y)	72,909	23	84,361	27	11,452	16
Soil Carbon (Maintaining/Losing)	49,703	16	48,511	15	-1,192	-2

The acres exceeding thresholds are not additive, and a single field or a single acre may exceed more than one threshold. For example, an acre exceeding the sheet and rill erosion threshold may also exceed the sediment loss threshold. Similarly, opportunities remain where conservation measures are in place but the pressures on the land require more comprehensive treatment. For example, regions with intense rainfall, steeper slopes, or prevalence of low residue, intensive cropping systems often require additional conservation practices to meet loss thresholds.

Acres exceeding the thresholds were not evenly distributed, reflecting regional differences in climate, soils, production practices, and crops, among others. Cultivated cropland exceeding the wind threshold, for example, was concentrated in several western regions with arid and semiarid conditions. Water-driven resource concerns such as subsurface nitrogen losses were concentrated in regions with high rainfall and flatter terrain. Regional treatment priorities can be informed by the percentage of regional acres exceeding resource concern thresholds (table 35). For example, in the Northeast region, where nearly 50 percent of cultivated cropland exceeded the subsurface nitrogen threshold and nearly 60 percent of the acres exceeded the soluble phosphorus threshold, nutrient management would be a priority.

In most cases, cultivated cropland acres needing treatment to meet a resource concern threshold are not contiguous but exist as isolated areas within larger fields—for example, soils vulnerable to leaching within a field (box 8). Making progress begins with a field-scale resource assessment and conservation planning to design workable solutions in balance with an operator's economic and environmental objectives. Solutions may include targeted conservation practices within a systems approach, higher end technology, or some combination of these and other tools.

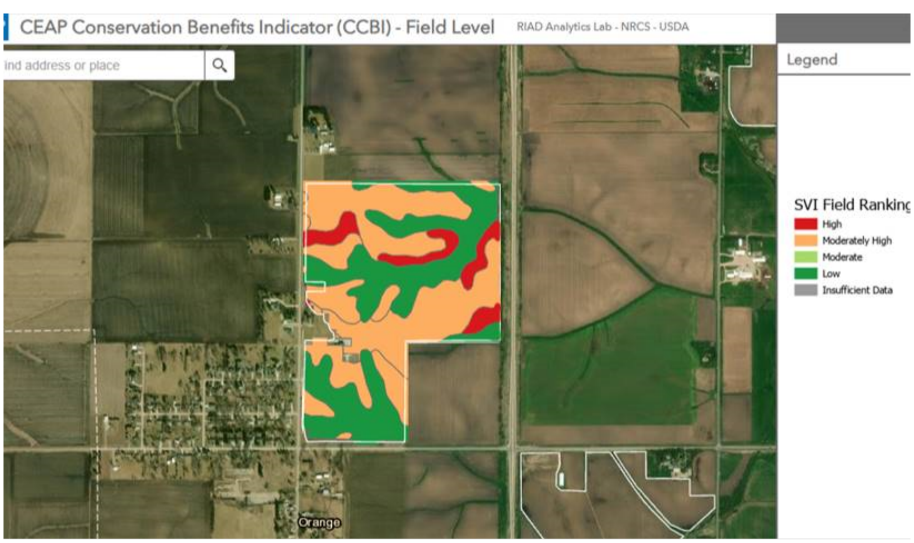
Table 35. Percent Regional Acres Exceeding by Threshold, CEAP II *

Region	Wind Erosion	Sheet & Rill Erosion	Sediment	Surface Nitrogen	Sediment Transported Phosphorus	Subsurface Nitrogen	Soluble Phosphorus	Carbon
Atlantic and Gulf Coastal Plains	0.0	14.5	12.0	3.5	11.6	59.7	68.9	15.1
California Coastal	0.0	1.0	5.1	1.3	1.6	33.5	17.0	38.7
East Central	0.0	32.0	28.2	17.4	27.0	49.7	73.6	13.6
Lower Mississippi and Texas Gulf	2.6	16.3	24.4	10.9	13.6	47.3	77.6	14.2
North Central and Midwest	1.5	13.2	11.0	7.3	11.1	31.1	32.5	12.8
Northeast	0.0	31.5	23.2	13.8	30.7	49.6	58.9	20.3
Northern Plains	24.0	1.5	1.5	22.4	9.3	19.5	1.5	19.8
Northwest	13.9	0.6	3.5	4.5	6.2	20.0	6.5	13.9
South Central	2.1	28.5	32.6	26.0	23.9	40.0	50.6	29.6
Southern and Central Plains	21.6	2.2	1.8	9.2	5.5	10.8	2.2	14.1
Southwest	25.2	2.8	3.8	4.5	4.3	24.0	9.2	25.2
National	**9.8**	**9.9**	**9.3**	**10.8**	**10.7**	**28.2**	**26.8**	**15.4**

** The highlighted cells indicate a regional percentage above the national average*

Box 8. Treatment Needs at the Field Level

Within a given farm field, measures needed to meet resource concern thresholds vary, reflecting the diversity of soils and vulnerabilities and highlighting the need for comprehensive conservation planning and integration of modern technologies such as precision agriculture to address needs more efficiently. The acres exceeding surface or subsurface loss thresholds are generally scattered, manifested as small, vulnerable inclusions in a larger field. The figure below shows a typical Midwestern field with a combination of soils with low, moderate, and high vulnerability to runoff. In most cases, eliminating cultivation on high and moderately high-risk soils embedded in a field is unrealistic, operationally and economically. Variable rate technology (VRT) allows precision application of nitrogen or other inputs based on variations in the soil or the crop offering one method for treating fields with multiple vulnerability zones. Where high risk acres are contiguous, at field edges or corners, conversion to less intensive uses may prove economically effective. Irrespective of approach, addressing vulnerable soils and their needs depends on conservation planning and targeting within the field to develop workable subfield treatments that minimize potential losses.



HOW DID SEDIMENT AND NUTRIENT MANAGEMENT CHANGE?

Cultivated cropland acres were categorized by the level of sediment, nitrogen, and phosphorus management being applied to allow comparison of conservation treatment between the two CEAP survey periods. Combinations of soils, climate, and crop rotations are a few factors that may affect the management level needed to maintain the resource. In general, higher levels of management are needed as annual rainfall and soil vulnerability increase.

Cultivated cropland acres were placed into one of four management levels—high, moderately high, moderate, and low—that consider the agricultural system in its entirety and the interactions and potential effects of operational and conservation activities on the land. The criteria are based on an Avoid, Control, and Trap approach to reducing sediment losses, and a Rate, Method, and Timing approach to reducing nutrient losses from cultivated cropland (appendix 3). This systems approach uses a mix of conservation practices tailored to the resource concern to minimize loss potential and optimize agricultural inputs for productivity. As management levels increase, more supporting practices are included.

The level of sediment, nitrogen, and phosphorus management on cultivated cropland changed over the decade between the CEAP surveys, reflecting the shifts in conservation treatment. The increase in conservation tillage and structural practices had a positive effect, most notably in sediment management, but also in nitrogen and phosphorus management where some gains were made in moderately high management levels. In contrast, the decline in nutrient management practices, particularly increased application rates and incorporation declines, drove large drops in high levels of management for nitrogen and phosphorus and corresponding increases in low levels of management of both.

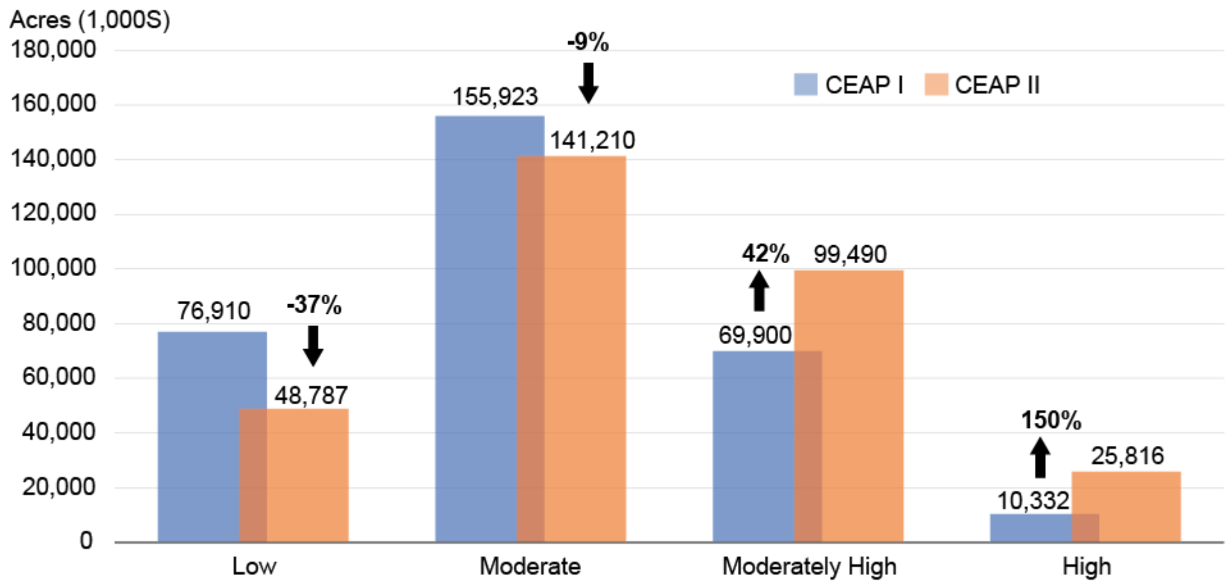
Sediment

Cultivated cropland with moderately high and high sediment management increased by 45 million acres, from 25 percent of acres in CEAP I to 40 percent of acres in CEAP II, reflecting farmers' increased adoption of conservation tillage and structural practices (table 36; appendix 2, table A-22). By CEAP II, acres with high sediment management had increased by 150 percent and acres with moderately high sediment management increased by 42 percent, while those in moderate and low levels declined by 43 million acres (18 percent) as more cultivated cropland moved to higher sediment management levels (fig. 48). Despite a 9-percent decline in acres with moderate management levels and a 37-percent decline in acres with low management levels, some 60 percent of cultivated cropland remained under moderate or low management for sediment control.

Table 36. Sediment Management Levels on Cultivated Cropland, CEAP I and CEAP II

Management Level	CEAP I		CEAP II		CEAP II minus CEAP I		Percent Change in Acres from CEAP I
	Acres (1000)	Percent	Acres (1000)	Percent	Acres (1000)	Percent	
National	**313,065**		**315,303**		**2,238**		1
High	10,332	3	25,816	8	15,484	5	150
Moderately High	69,900	22	99,490	32	29,590	10	42
Moderate	155,923	50	141,210	45	-14,713	-5	-9
Low	76,910	25	48,787	15	-28,123	-10	-37

Figure 48. Cultivated Cropland by Sediment Management Level, CEAP I and CEAP II

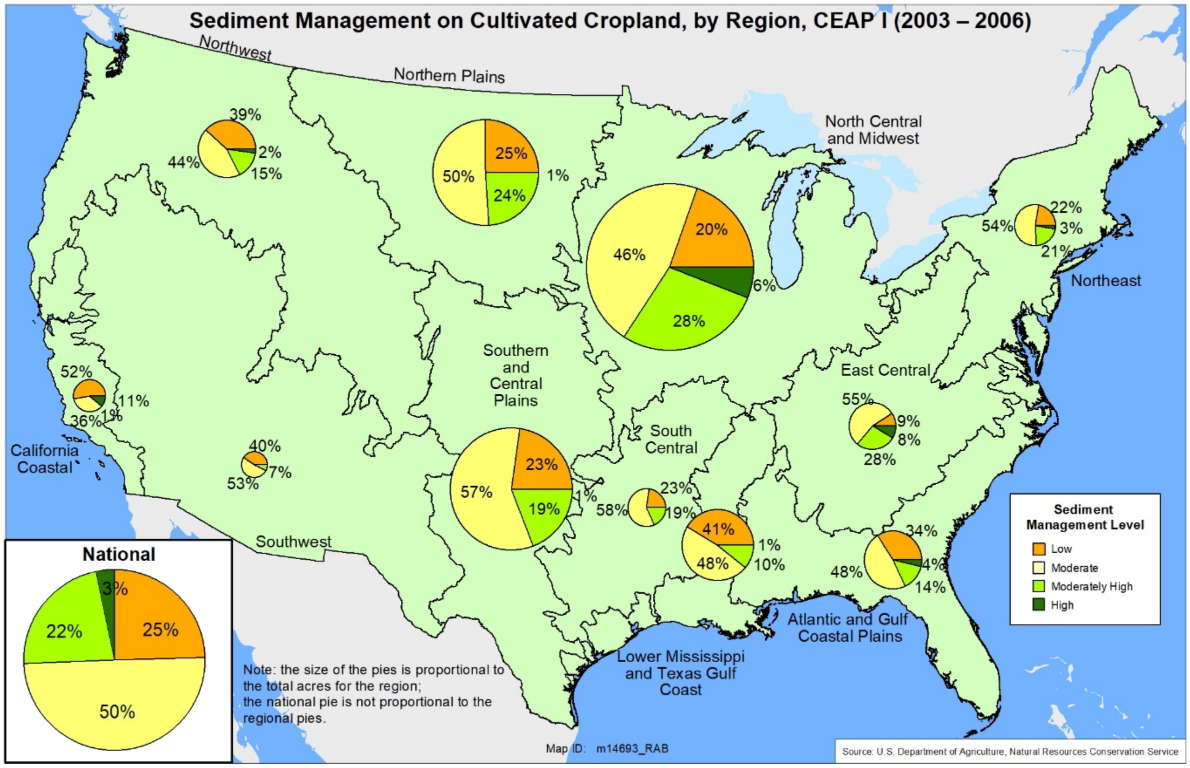


Production regions generally followed the national trend, with most showing increases in moderately high and high sediment management and declines in moderate and low management levels. Gains were concentrated in two regions—North Central and Midwest and Southern and Central Plains (fig. 49). Together these regions accounted for three-fourths of the total increase in cultivated cropland with moderately high and high levels of sediment management (33.7 million acres).

Sediment Management by Tillage System

The increase in conservation tillage and particularly in continuous no-till drove the increases in sediment management levels experienced between CEAP I and CEAP II. Cultivated cropland under reduced tillage and continuous no-till increased by 53 million acres; 83 percent of this increased acreage was in high and moderately high levels of sediment management. Continuous no-till with high sediment management increased by over 9 million acres (239 percent) (table 37). Conventional tillage experienced declines in all but the moderately high management category, aligning with the general loss of acres under that form of tillage (fig. 50).

Figure 49. Sediment Management Levels on Cultivated Cropland by Region, CEAP I and CEAP II



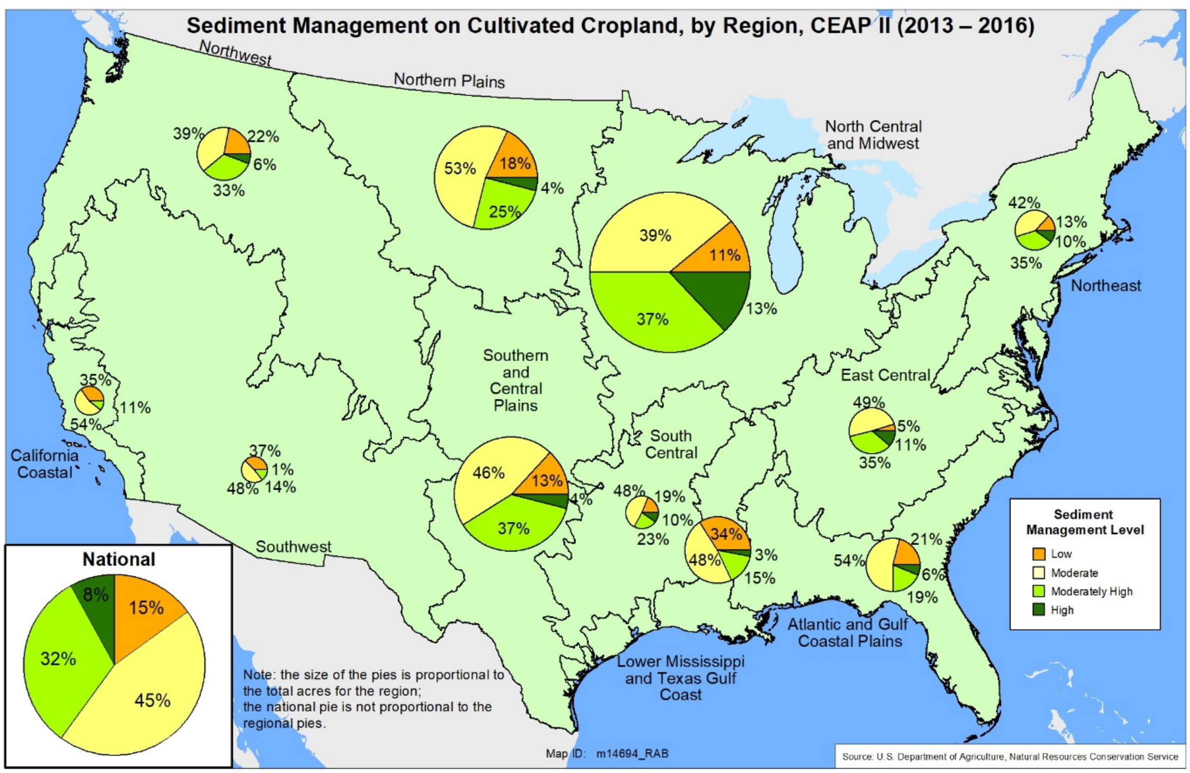
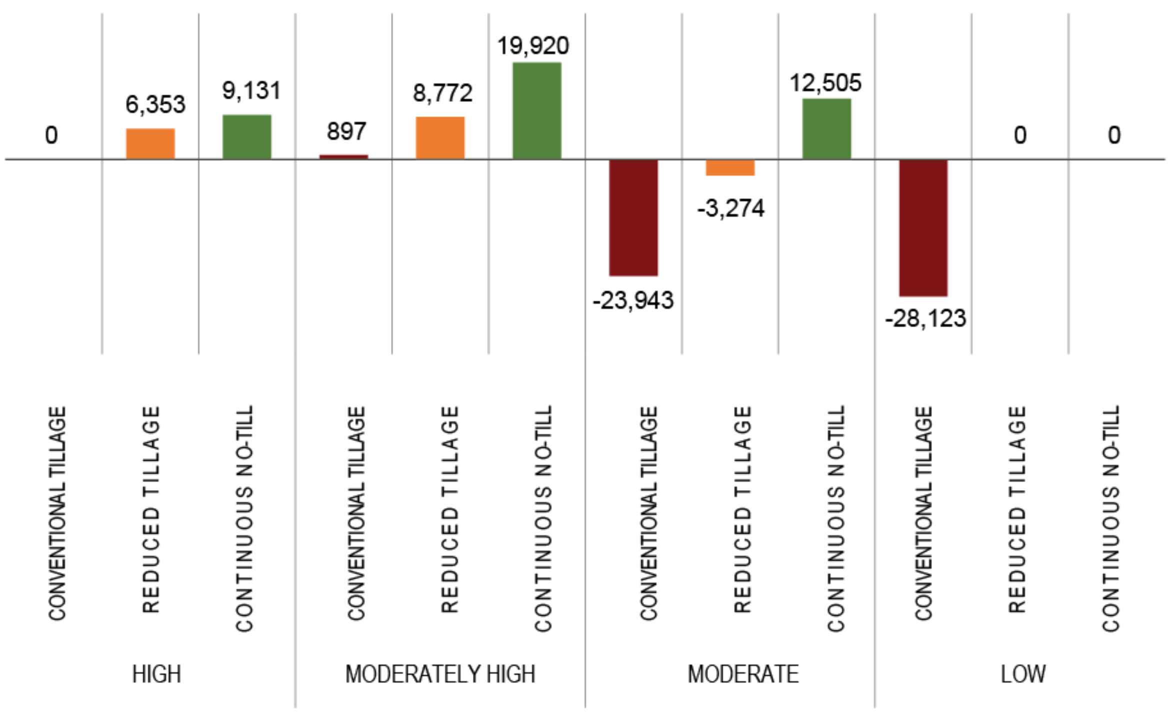


Table 37. Sediment Management on Cultivated Cropland by Tillage System and CEAP Survey

Tillage System / Sediment Management Level	CEAP I		CEAP II		CEAP II minus CEAP I		Percent Change in Acres from CEAP I
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Acres (1,000s)	Percent	
Conventional Tillage	**155,941**	**50**	**104,771**	**33**	**-51,170**	**-17**	**-33**
High	0	0	0	0	0	0	0
Moderately High	3,005	2	3,902	4	897	2	30
Moderate	76,026	49	52,082	50	-23,943	1	-31
Low	76,910	49	48,787	47	-28,123	-3	-37
Reduced Tillage	**95,572**	**31**	**107,423**	**34**	**11,851**	**4**	**12**
High	6,515	7	12,868	12	6,353	5	98
Moderately High	39,240	41	48,013	45	8,772	4	22
Moderate	49,817	52	46,543	43	-3,274	-9	-7
Low	0	0	0	0	0	0	0
Continuous No-Till	**61,553**	**20**	**103,108**	**33**	**41,555**	**13**	**68**
High	3,817	6	12,948	13	9,131	6	239
Moderately High	27,655	45	47,575	46	19,920	1	72
Moderate	30,081	49	42,585	41	12,505	-8	42
Low	0	0	0	0	0	0	0
National	**313,065**		**315,303**		**2,238**		**1**
High	10,332	3	25,816	8	15,484	5	150
Moderately High	69,900	22	99,490	32	29,589	9	42
Moderate	155,924	50	141,210	45	-14,712	-5	-9
Low	76,910	25	48,787	15	-28,123	-9	-37

Figure 50. Cultivated Cropland by Sediment Management Level and Tillage System, CEAP II minus CEAP I



Sediment Management on Vulnerable Acres

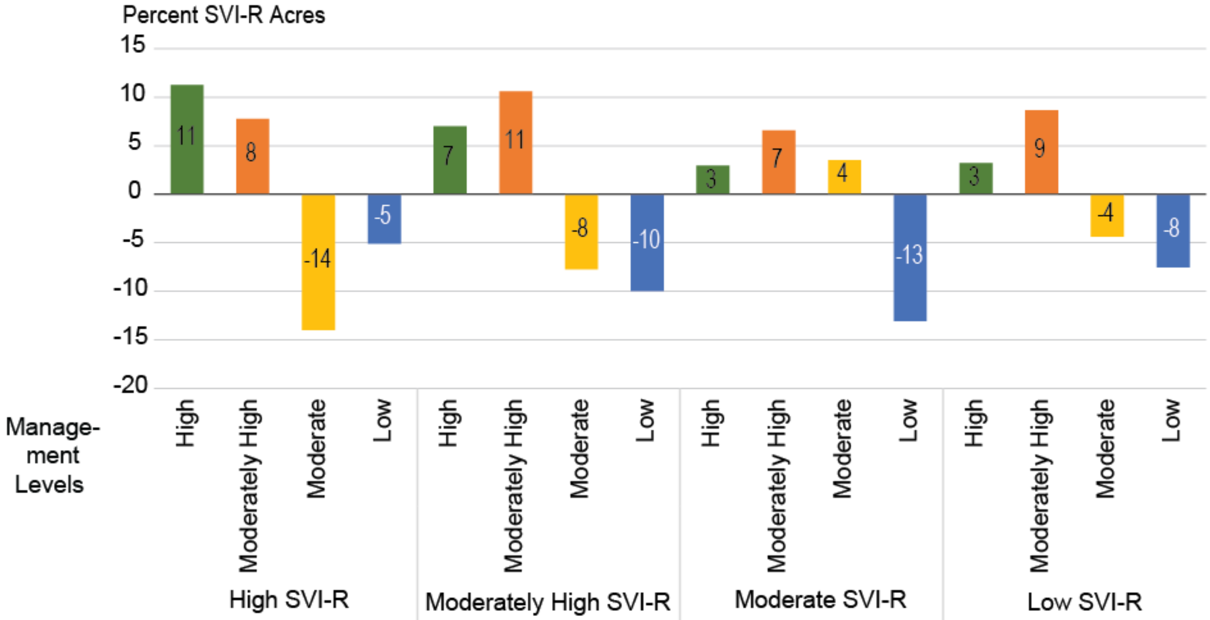
Between CEAP I and CEAP II, sediment management on cultivated cropland with high and moderately high vulnerability to runoff (soil vulnerability index runoff [SVI-R]) increased, reflecting the consistent movement into higher management levels (table 38; appendix 2, table A-25). High and moderately high sediment management on high vulnerability acres increased by 9.5 million acres and by 11.8 million acres on cultivated cropland with moderately high runoff vulnerability.

Table 38. Sediment Management Levels by Soil Vulnerability Index Runoff (SVI-R), CEAP I and CEAP II

Sediment Management Level	SVI R Rating								
	High		Moderately High		Moderate		Low		National
	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)
CEAP I									
High	2,516	9	2,169	4	1,401	3	4,245	2	10,332
Moderately High	10,674	39	16,714	31	9,815	18	32,697	18	69,900
Moderate	11,368	42	25,638	48	26,419	48	92,498	52	155,923
Low	2,587	10	9,200	17	16,899	31	48,225	27	76,910
National	**27,145**	**9**	**53,721**	**17**	**54,534**	**17**	**177,665**	**57**	**313,065**
CEAP II									
High	6,884	21	6,438	11	2,477	6	10,018	6	25,816
Moderately High	15,793	47	24,266	42	11,003	25	48,429	27	99,490
Moderate	9,363	28	23,277	40	23,269	52	85,300	48	141,210
Low	1,492	4	4,184	7	8,033	18	35,079	20	48,787
National	**33,532**	**11**	**58,165**	**18**	**44,781**	**14**	**178,825**	**57**	**315,303**
CEAP II minus CEAP I									
High	4,367	11	4,269	7	1,076	3	5,773	3	15,484
Moderately High	5,119	8	7,552	11	1,187	7	15,732	9	29,590
Moderate	-2,005	-14	-2,361	-8	-3,149	4	-7,198	-4	-14,713
Low	-1,094	-5	-5,016	-10	-8,866	-13	-13,147	-8	-28,123
National	**6,387**	**2**	**4,444**	**1**	**-9,753**	**-3**	**1,161**	**0**	**2,238**
Change Relative to CEAP I									
High	4,367	174	4,269	197	1,076	77	5,773	136	15,484
Moderately High	5,119	48	7,552	45	1,187	12	15,732	48	29,590
Moderate	-2,005	-18	-2,361	-9	-3,149	-12	-7,198	-8	-14,713
Low	-1,094	-42	-5,016	-55	-8,866	-52	-13,147	-27	-28,123
National	**6,387**	**24**	**4,444**	**8**	**-9,753**	**-18**	**1,161**	**1**	**2,238**

While high and moderately high sediment management levels increased in all vulnerability ratings, the largest percentage increases were in the higher runoff vulnerability classes (high and moderately high SVI-R) (fig. 51). Low sediment management was the reverse, declining in all runoff vulnerability classes and reflecting the adoption of conservation tillage and structural practices designed to control erosion and runoff.

Figure 51. Change in Sediment Management on Cultivated Cropland by SVI-R, CEAP II minus CEAP I



Nitrogen

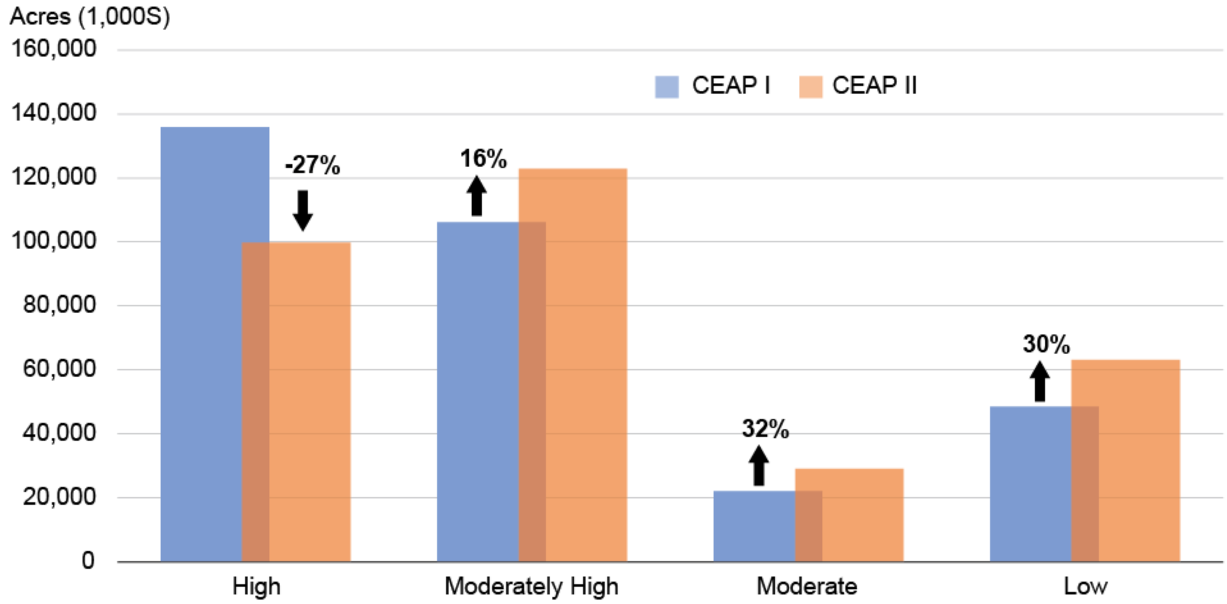
Between CEAP I and CEAP II, cultivated cropland with high nitrogen management declined by over 36 million acres (27 percent), while acres with moderately high nitrogen management increased by nearly 17 million acres (16 percent) (table 39; appendix 2, table A-23). By CEAP II, cultivated cropland with moderately high nitrogen management had become the dominant management class on cultivated cropland.

In contrast, cultivated cropland with moderate and low nitrogen management increased by nearly 21.7 million acres, reflecting the decline in nutrient management practices between the surveys (fig. 52). In CEAP II, over 70 percent of cultivated cropland was under high or moderately high nitrogen management, down from 77 percent in CEAP I.

Table 39. Nitrogen Management Levels on Cultivated Cropland, CEAP I and CEAP II

Nitrogen Management Level	CEAP I		CEAP II		CEAP II minus CEAP I		Percent Change in Acres from CEAP I
	Acres (1000)	Percent	Acres (1000)	Percent	Acres (1000)	Percent	
National	**313,065**		**315,303**		2,238		1
High	136,007	43	99,850	32	-36,158	-12	-27
Moderately High	106,224	34	122,954	39	16,730	5	16
Moderate	22,213	7	29,220	9	7,008	2	32
Low	48,620	16	63,279	20	14,659	5	30

Figure 52. Cultivated Cropland by Nitrogen Management Level, CEAP I and CEAP II



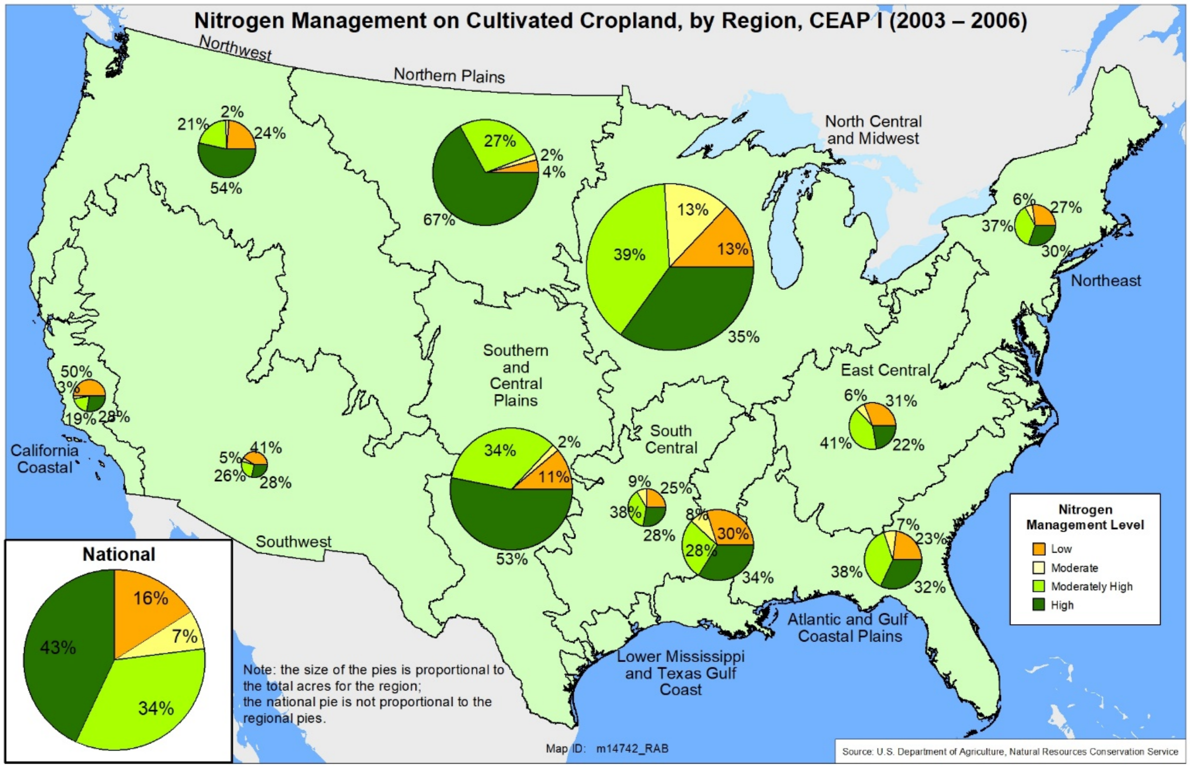
Production regions generally followed the national trends. All but the Southwest region experienced declines in high nitrogen management, and nine regions experienced gains in moderately high management. Three regions—North Central and Midwest, Northern Plains, and Southern and Central Plains—had the largest declines in high nitrogen management at nearly 31 million acres, accounting for 86 percent of the total nationwide decline between the survey periods. Losses in eight regions were 25 percent or more of the acres in their high nitrogen management level in CEAP I. The Northern Plains and Southern and Central Plains led the gains in moderately high nitrogen management, accounting for 73 percent of the total increase (fig. 53).

Nitrogen Management by Tillage System

The decline in nitrogen management between the CEAP surveys is concentrated in the conventional and reduced tillage systems. The overall decline in high management levels came from declines in conventionally tilled and reduced till acres, only partially offset by a slight increase in high management in continuous no-till (table 40). While continuous no-till with high nitrogen management increased by nearly 6 million acres, high management was a smaller share of the tillage class in CEAP II as compared to CEAP I, 29 to 39 percent respectively. In contrast, half (26.6 million acres) of the increase in conservation tillage systems (reduced tillage and continuous no till) was in low and moderate nitrogen management levels.

Conventional tillage experienced declines in every nitrogen management level, reflecting the general exodus of acres under that form of tillage (fig. 54). Reduced tillage had a decline in high nitrogen management (nearly 9 million acres) but increases in moderately high, moderate, and low management. Continuous no-till increased in every nitrogen management level, but like reduced tillage the largest increases were in moderately high and low nitrogen management, accounting for 75 percent of the total increase.

Figure 53. Nitrogen Management Levels on Cultivated Cropland, CEAP I and CEAP II



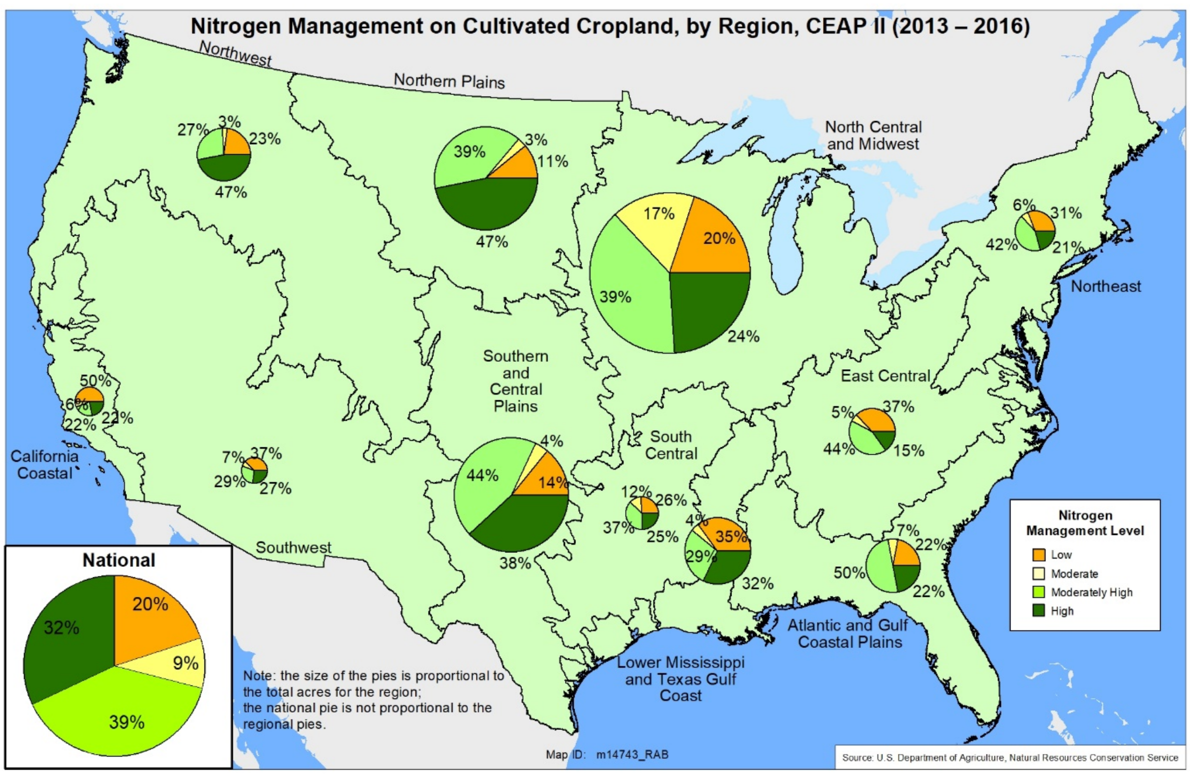
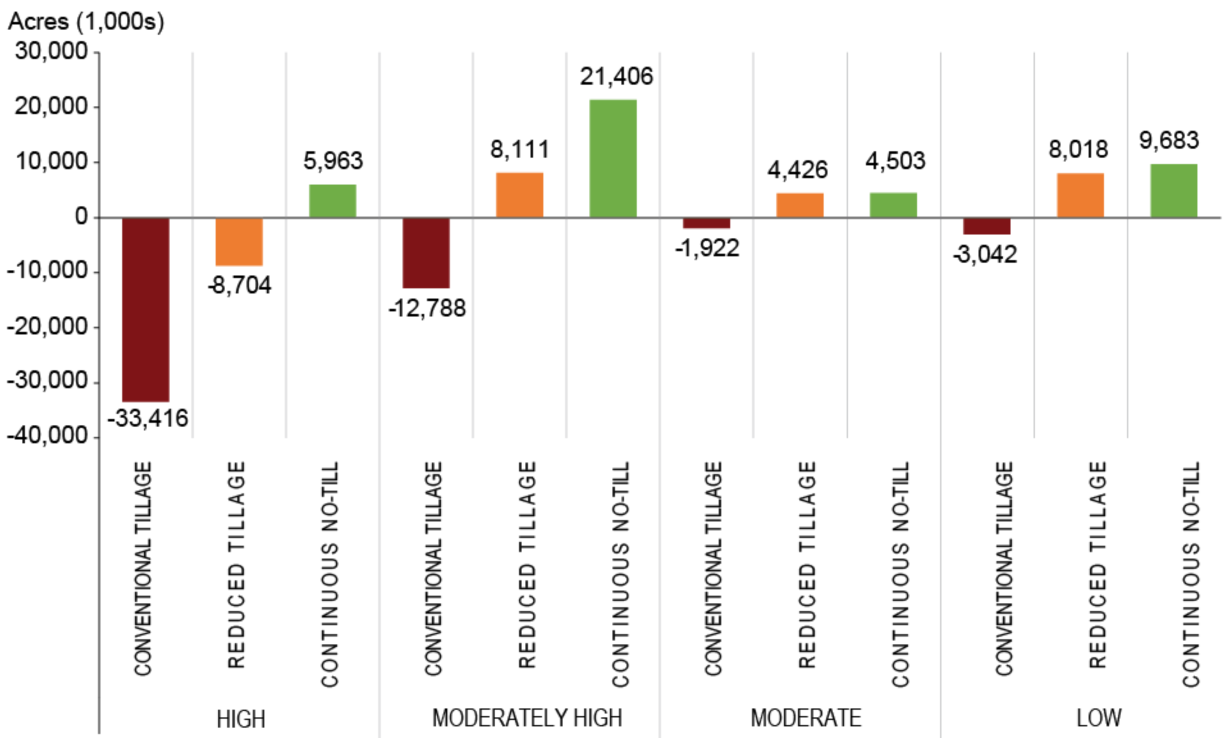


Table 40. Nitrogen Management on Cultivated Cropland by Tillage System and CEAP Survey

Tillage System / Nitrogen Management Level	CEAP I		CEAP II		CEAP II minus CEAP I		Percent Change in Acres from CEAP I
	Acres (1000)	Percent	Acres (1000)	Percent	Acres (1000)	Percent	
Conventional Tillage	**155,941**	**50**	**104,771**	**33**	**-51,169**	**-17**	**-33**
High	69,647	45	36,231	35	-33,416	-10	-48
Moderately High	48,703	31	35,915	34	-12,788	3	-26
Moderate	9,504	6	7,582	7	-1,922	1	-20
Low	28,086	18	25,044	24	-3,042	6	-11
Reduced Tillage	**95,572**	**31**	**107,423**	**34**	**11,852**	**4**	**12**
High	42,482	44	33,778	31	-8,704	-13	-20
Moderately High	31,939	33	40,050	37	8,111	4	25
Moderate	8,128	9	12,554	12	4,426	3	54
Low	13,023	14	21,041	20	8,018	6	62
Continuous No-Till	**61,553**	**20**	**103,108**	**33**	**41,556**	**13**	**68**
High	23,878	39	29,841	29	5,963	-10	25
Moderately High	25,583	42	46,989	46	21,406	4	84
Moderate	4,581	7	9,084	9	4,503	1	98
Low	7,512	12	17,195	17	9,683	4	129
National	**313,065**		**315,303**		**2,238**		**1**
High	136,007	43	99,850	32	-36,157	-12	-27
Moderately High	106,225	34	122,954	39	16,729	5	16
Moderate	22,213	7	29,220	9	7,007	2	32
Low	48,621	16	63,280	20	14,659	5	30

Figure 54. Nitrogen Management Level by Tillage System, CEAP II minus CEAP I



The downward shifts in nitrogen management levels reflect the decline in incorporation of applied nitrogen. Conversion to no-till and reduced tillage systems requires nutrient management changes. Incorporation techniques such as injection, knifing, or banding are needed, and these techniques may also require a different nutrient form. For example, no-till may not be an option with existing equipment and solid forms of manure because some level of incorporation is required.

Nitrogen Management on Vulnerable Acres

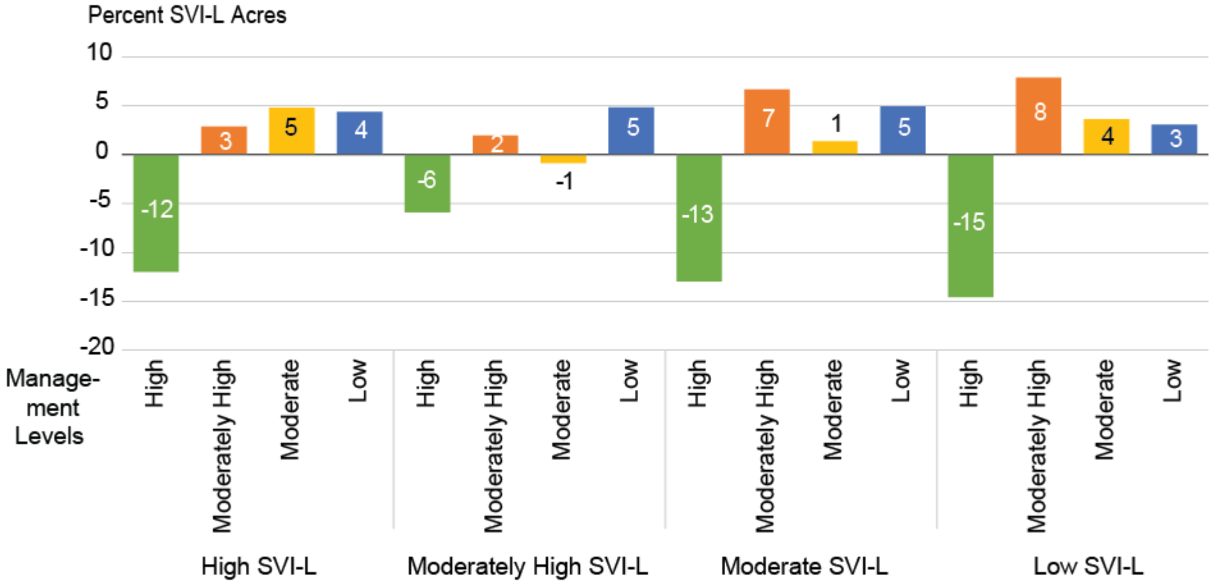
Cultivated cropland with high and moderately high soil vulnerability index ratings for leaching (SVI-L) needs more intensive nitrogen management to reduce the potential for nitrogen losses. Between the survey periods, the extent of cultivated cropland with high vulnerability (high SVI-L) changed little (less than 1 percent), while acres with moderately high vulnerability (moderately high SVI-L) declined by 16 percent. By CEAP II, 41 percent of cultivated cropland was in these two vulnerability classes (table 41; appendix 2, table A-26).

Between the surveys, high nitrogen management on high and moderately high SVI-L acres declined by over 16 million acres; a nearly 30-percent reduction for each vulnerability group from CEAP I levels. In contrast, cultivated cropland in the riskiest combination of high and moderately high SVI-L and low nitrogen management increased by over 4 million acres, and most (86 percent) was high SVI-L acres. By CEAP II, 67 percent of high and moderately high vulnerability cropland were under high or moderately high levels of nitrogen management, down from 75 percent in CEAP I. Between the two surveys, higher levels of nitrogen management declined on the most vulnerable acres while lower levels of nitrogen management increased (fig. 55).

Table 41. Nitrogen Management Levels by Soil Vulnerability Index Leaching, CEAP I and CEAP II

Nitrogen Management Level	SVI-L Rating								
	High		Moderately High		Moderate		Low		National
	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)
CEAP I									
High	37,561	41	17,459	38	73,169	46	7,819	45	136,007
Moderately High	31,637	35	16,160	35	52,543	33	5,884	34	106,224
Moderate	7,394	8	4,687	10	9,151	6	981	6	22,213
Low	14,921	16	7,749	17	23,282	15	2,668	15	48,620
National	**91,513**	**29**	**46,055**	**15**	**158,145**	**51**	**17,351**	**6**	**313,065**
CEAP II									
High	26,523	29	12,399	32	51,809	33	9,118	31	99,850
Moderately High	34,158	37	14,348	37	61,970	40	12,477	42	122,954
Moderate	11,733	13	3,605	9	11,116	7	2,767	9	29,220
Low	18,867	21	8,381	22	30,520	20	5,512	18	63,279
National	**91,281**	**29**	**38,732**	**12**	**155,416**	**49**	**29,874**	**9**	**315,303**
CEAP II minus CEAP I									
High	-11,037	-12	-5,060	-6	-21,359	-13	1,299	-15	-36,158
Moderately High	2,521	3	-1,812	2	9,427	7	6,594	8	16,730
Moderate	4,339	5	-1,082	-1	1,965	1	1,786	4	7,008
Low	3,945	4	631	5	7,238	5	2,844	3	14,659
National	**-232**	0	**-7,323**	**-2**	**-2,729**	**-1**	**12,522**	4	**2,238**
Change relative to CEAP I Levels									
High	-11,037	-29	-5,060	-29	-21,359	-29	1,299	17	-36,158
Moderately High	2,521	8	-1,812	-11	9,427	18	6,594	112	16,730
Moderate	4,339	59	-1,082	-23	1,965	21	1,786	182	7,008
Low	3,945	26	631	8	7,238	31	2,844	107	14,659
National	**-232**	**<1**	**-7,323**	**-16**	**-2,729**	**-2**	**12,522**	**72**	**2,238**

Figure 55. Change in Nitrogen Management on Cultivated Cropland by SVI-L, CEAP II minus CEAP I



Phosphorus

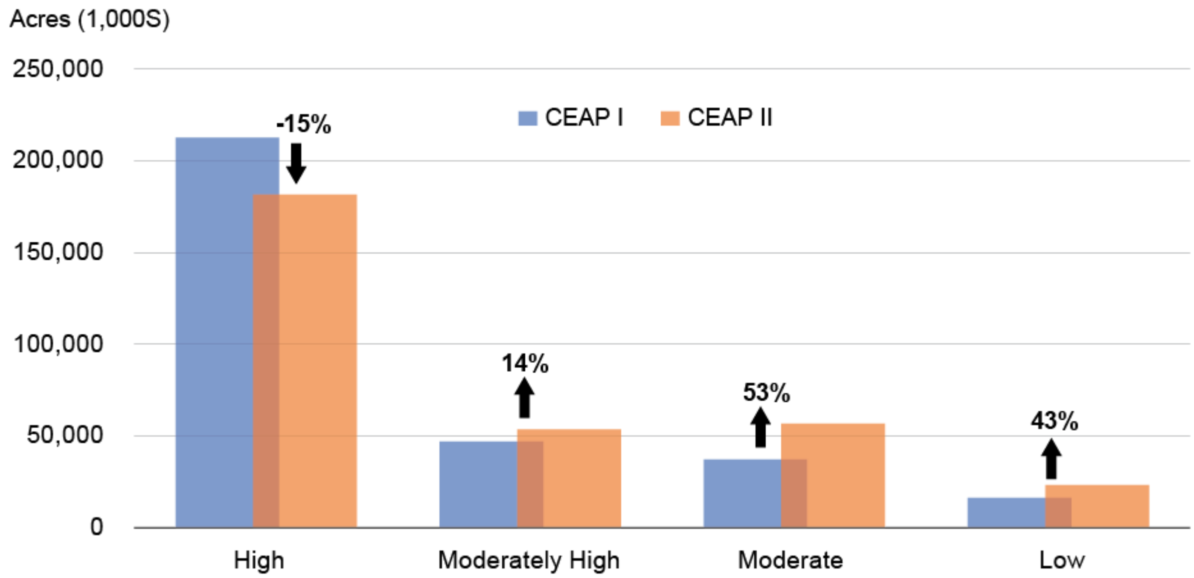
Between CEAP I and CEAP II, cultivated cropland with high phosphorus management declined by nearly 31 million acres, while moderately high management increased by 6.5 million acres; together there was a net loss in the higher management levels of 24.5 million acres (table 42; appendix 2, table A-24). In contrast, cultivated cropland with moderate and low phosphorus management increased by 26.7 million acres. While most cultivated cropland (75 percent) remained in high and moderately high phosphorus management in CEAP II, it was down from 83 percent in CEAP I, reflecting the overall decline in nutrient management practices between the surveys.

By CEAP II, cultivated cropland with high phosphorus management decreased by 15 percent from CEAP I levels. Acres in the remaining three management levels increased between 14 and 53 percent (fig. 56).

Table 42. Phosphorus Management Levels on Cultivated Cropland, CEAP I and CEAP II

Management Level	CEAP I		CEAP II		CEAP II minus CEAP I		Percent Change in Acres from CEAP I
	Acres (1000)	Percent	Acres (1000)	Percent	Acres (1000)	Percent	
National	**313,065**		**315,303**		**2,238**		1
High	212,703	68	181,711	58	-30,992	-10	-15
Moderately High	47,086	15	53,549	17	6,463	2	14
Moderate	37,130	12	56,902	18	19,772	6	53
Low	16,146	5	23,140	7	6,994	2	43

Figure 56. Cultivated Cropland by Phosphorus Management Level, CEAP I and CEAP II



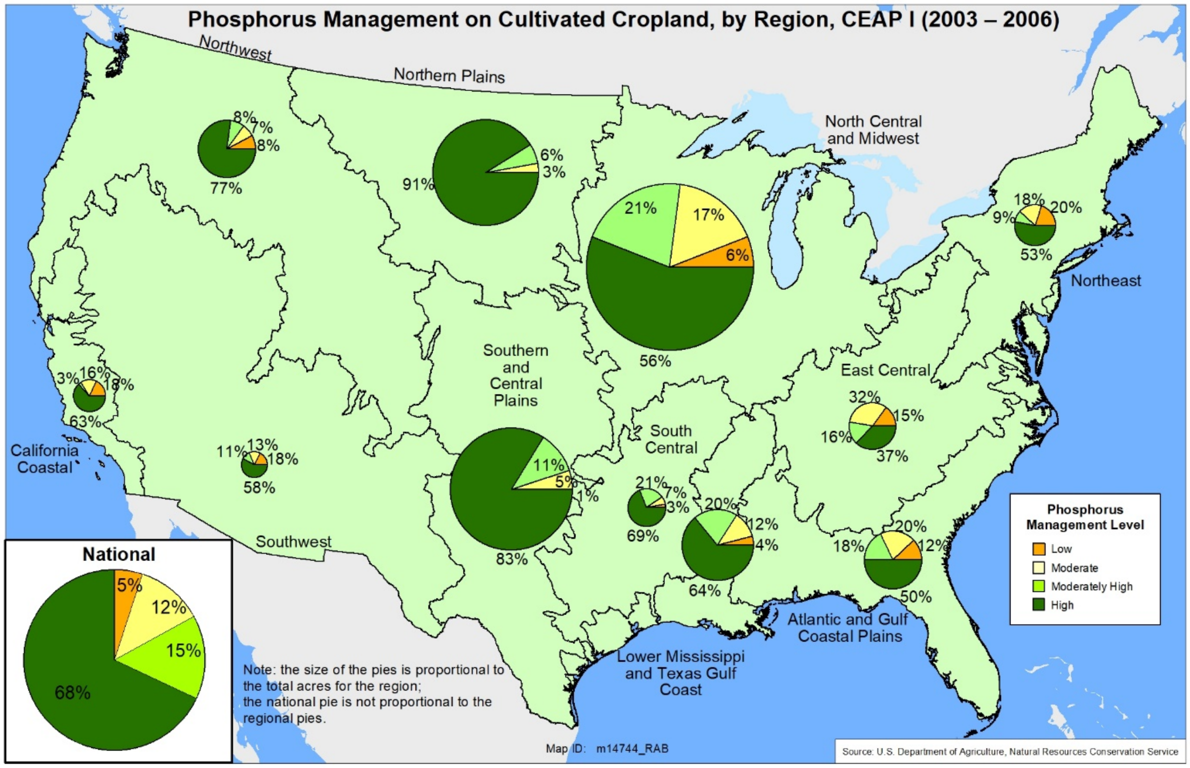
While six regions each had more than 1 million acres exit from high management, two regions—North Central and Midwest and Southern and Central Plains—accounted for most of the loss (fig. 57). Together these regions accounted for 65 percent of the total decline in cultivated cropland with a high level of phosphorus management (23.1 million acres) and 65 percent of the total increase in cultivated cropland with low phosphorus management (4.5 million acres).

Phosphorus Management by Tillage System

The changes in tillage between the CEAP surveys are reflected in the changes in phosphorus management levels on cultivated cropland. The overall decline in high management levels came from declines in conventional tillage and reduced till acres, only partially offset by the increase in high management in continuous no-till (table 43). While continuous no-till with high phosphorus management increased by 18.1 million acres, it occupied a smaller share of the tillage class in CEAP II as compared to CEAP I, dropping from 59 percent to 53 percent between the two surveys. In contrast, nearly 54 percent (28.7 million acres) of the increase in conservation tillage systems (reduced tillage and continuous no-till) was in low and moderate nitrogen management levels.

Conventionally tilled acres experienced declines in every phosphorus management level, reflecting the general exodus of acres under that form of tillage (fig. 58). Phosphorus management levels improved on nearly 12 million reduced tillage acres as the decline in high phosphorus management (4.1 million acres) was offset by large gains in moderate (8.4 million acres), moderately high (6.4 million acres), and low (4.3 million acres) management levels. Continuous no-till increased by over 41.5 million acres and in every phosphorus management level, but unlike reduced tillage the largest increase was in high phosphorus management (18.2 million acres), accounting for 44 percent of the total.

Figure 57. Phosphorus Management on Cultivated Cropland by Region, CEAP I and CEAP II



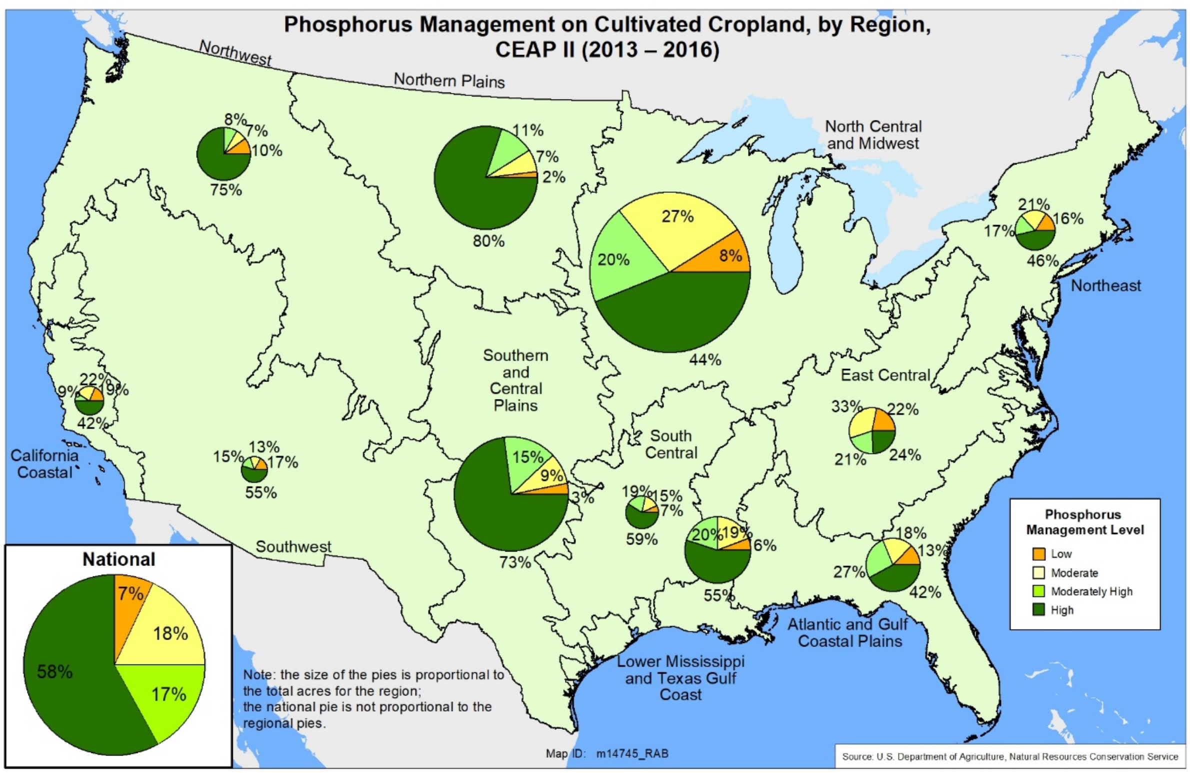
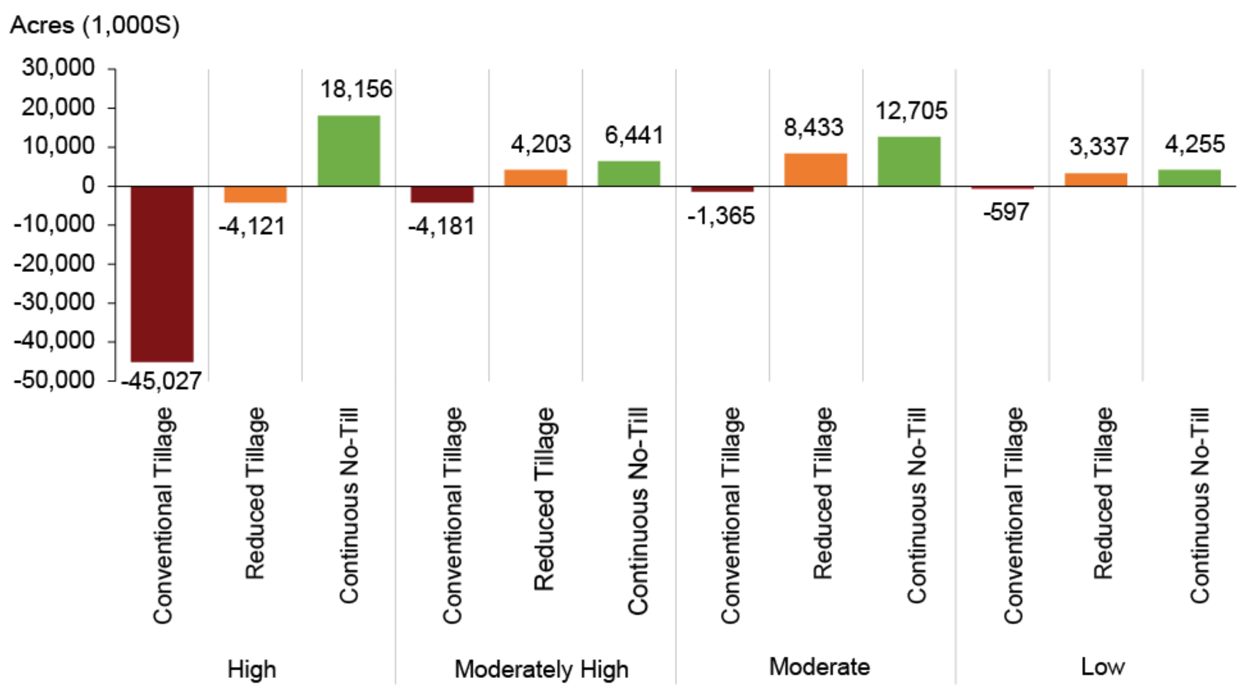


Table 43. Phosphorus Management on Cultivated Cropland by Tillage System and CEAP Survey

Tillage System / Phosphorus Management Level	CEAP I		CEAP II		CEAP II minus CEAP I		Percent Change in Acres from CEAP I
	Acres (1000)	Percent	Acres (1000)	Percent	Acres (1000)	Percent	
Conventional Tillage	**155,941**	**50**	**104,771**	**33**	**-51,170**	**-17**	**-33**
High	112,525	72	67,498	64	-45,027	-8	-40
Moderately High	18,463	12	14,282	14	-4,181	2	-23
Moderate	15,194	10	13,828	13	-1,365	3	-9
Low	9,759	6	9,162	9	-597	2	-6
Reduced Tillage	**95,572**	**31**	**107,423**	**34**	**11,851**	**4**	**12**
High	63,827	67	59,706	56	-4,121	-11	-6
Moderately High	15,022	16	19,225	18	4,203	2	28
Moderate	12,900	13	21,333	20	8,433	6	65
Low	3,823	4	7,160	7	3,337	3	87
Continuous No Till	**61,553**	**20**	**103,108**	**33**	**41,555**	**13**	**68**
High	36,351	59	54,507	53	18,156	-6	50
Moderately High	13,601	22	20,042	19	6,441	-3	47
Moderate	9,036	15	21,741	21	12,705	6	141
Low	2,564	4	6,819	7	4,255	2	166
National	**313,065**		**315,303**		**2,238**		
High	212,703	68	181,711	58	-30,992	-10	-15
Moderately High	47,086	15	53,549	17	6,463	2	14
Moderate	37,130	12	56,902	18	19,773	6	53
Low	16,146	5	23,141	7	6,995	2	43

Figure 58. Cultivated Cropland by Phosphorus Management Level and Tillage System, CEAP II minus CEAP I



Phosphorus Management on Vulnerable Acres

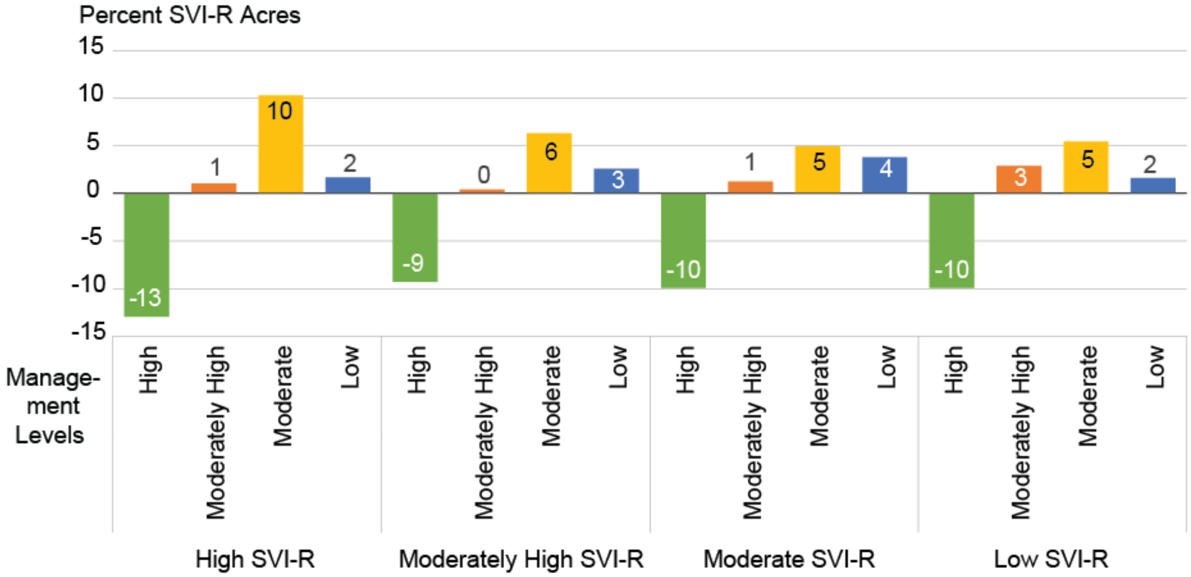
Cultivated cropland with high and moderately high soil vulnerability index ratings for runoff (SVI-R) need more intensive management to reduce the potential for phosphorus losses. Between the survey periods, the extent of cultivated cropland with high vulnerability (high SVI-R) increased by 6.4 million acres (24 percent from CEAP I levels) and acres with moderately high vulnerability (moderately high SVI-R) increased by 4.4 million acres (8 percent from CEAP I levels) (table 44; appendix 2, table A-27). By CEAP II, 29 percent of cultivated cropland were in these two high vulnerability classes.

Between the surveys, high phosphorus management on high and moderately high SVI-R acres declined by nearly 3 million acres (3- and 7-percent reductions from CEAP I levels, respectively). In contrast, cultivated cropland in the riskiest combination of high and moderately high SVI-R and low phosphorus management increased by over 2.7 million acres. By CEAP II, 69 percent of high and moderately high vulnerability acres were under high or moderately high levels of phosphorus management, down from 79 percent in CEAP I. Between the two surveys, higher levels of phosphorus management declined on the most vulnerable acres while lower levels of phosphorus management increased (fig. 59).

Table 44. Phosphorus Management on Cultivated Cropland by Soil Vulnerability Index Runoff (SVI-R) Rating, CEAP I and CEAP II

Phosphorus Management Level	SVI R Rating								National
	High		Moderately High		Moderate		Low		
	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)	Percent SVI Acres	Acres (1,000s)
CEAP I									
High	16,656	61	35,159	65	37,269	68	123,619	70	212,703
Moderately High	3,997	15	7,980	15	9,043	17	26,066	15	47,086
Moderate	4,601	17	7,454	14	6,224	11	18,851	11	37,130
Low	1,890	7	3,128	6	1,999	4	9,129	5	16,146
National	**27,145**	**9**	**53,721**	**17**	**54,534**	**17**	**177,665**	**57**	**313,065**
CEAP II									
High	16,227	48	32,670	56	26,158	58	106,657	60	181,711
Moderately High	5,286	16	8,869	15	7,975	18	31,420	18	53,549
Moderate	9,125	27	11,750	20	7,319	16	28,710	16	56,902
Low	2,895	9	4,877	8	3,330	7	12,039	7	23,140
National	**33,532**	**11**	**58,165**	**18**	**44,781**	**14**	**178,825**	**57**	**315,303**
CEAP II minus CEAP I									
High	-429	-13	-2,489	-9	-11,111	-10	-16,962	-10	-30,992
Moderately High	1,288	1	889	0	-1,068	1	5,354	3	6,463
Moderate	4,523	10	4,295	6	1,095	5	9,859	5	19,773
Low	1,005	2	1,749	3	1,331	4	2,910	2	6,994
National	**6,387**	**2**	**4,444**	**1**	**-9,753**	**-3**	**1,161**	**0**	**2,238**
Change Relative to CEAP I									
High	-429	-3	-2,489	-7	-11,111	-30	-16,962	-14	-30,992
Moderately High	1,288	32	889	11	-1,068	-12	5,354	21	6,463
Moderate	4,523	98	4,295	58	1,095	18	9,859	52	19,773
Low	1,005	53	1,749	56	1,331	67	2,910	32	6,994
National	**6,387**	**24**	**4,444**	**8**	**-9,753**	**-18**	**1,161**	**1**	**2,238**

Figure 59. Change in Phosphorus Management on Cultivated Cropland by SVI-R, CEAP II minus CEAP I



HOW DID THE CONSERVATION CONDITION IN THE CEAP SURVEYS COMPARE TO ALTERNATIVE TREATMENT LEVELS?

Alternative treatment levels were created to simulate the potential benefits from additional conservation and the possible tradeoffs in crop productivity or through unintended effects on related resource concerns. The estimated loss reductions associated with alternative treatment levels were modeled for all cultivated cropland acres irrespective of conservation treatment need. Estimates for treating all acres may overstate potential benefits since they include additional reductions from acres meeting resource concern thresholds, which would be unlikely to receive additional conservation treatment, or the benefit of additional conservation would be small. However, comparison of the alternative treatment levels with CEAP I and CEAP II conservation conditions provide valuable context for understanding existing conservation benefits.

The Erosion Control (EC) and Nutrient Management (NM) treatment levels simulate parts of a comprehensive plan that addresses the natural resource concerns of the agricultural system. The EC is primarily the addition of structural practices designed to control and trap losses from cropped fields, while the NM addresses nutrient application method, form, timing, and a 10-percent reduction in application rate and is designed to avoid excess surface and subsurface nutrient losses.[28] The Erosion Control and Nutrient Management (ENM) level combines these two treatments to simulate a comprehensive plan with improvements to structural conservation practices and nutrient management. The ENM is also modeled with only 85 percent of the nutrient form being applied (ENM85) plus timing and incorporation adjustments and runoff control to improve nutrient-use efficiency.

While the EC treatment level would control runoff and reduce surface losses that benefit yield, it would also encourage infiltration, which can increase subsurface nitrogen losses. Under the NM treatment level, the lack of runoff control could increase surface nitrogen, sediment, and total phosphorus losses. Without the EC runoff control, the NM rate reduction would fail to achieve its purpose of reducing nutrient losses and could negatively affect yield. Thus, the ENM treatment level reflects how EC runoff control would support NM reduced nutrient application rates, contributing to production and conservation of soil and nutrient inputs. The treatment levels demonstrate the benefits of a systems approach that considers multiple resource concerns in a conservation treatment.

Erosion Control and Nutrient Management (ENM)

Under ENM, structural and nutrient management practices are combined to address all applicable resource concerns while maintaining or enhancing productivity as compared to NM alone. At the ENM treatment level, all regions would have 87 percent or more of their cultivated cropland meeting the thresholds for sediment, wind erosion, surface nitrogen, and total phosphorus resource concerns (table 45).[29]

---

[28] At a 10-percent reduction, productivity is maintained on most soils while demonstrating the effects of improved use efficiency that is provided through rate reductions in combination with improved timing and application methods, particularly in precision agriculture systems.

[29] Wind erosion control under ENM reflects the application of structural wind erosion control practices on the most susceptible acres, however, these are not widely adopted in the most wind-erosion-prone regions where water supply challenges the use

Table 45. Estimated Percent of Cultivated Cropland Acres Meeting Resource Concern Thresholds under ENM, by Region

Geographic Area	Resource Concern							
	Sediment	Sheet and Rill	Wind **	Surface N	Subsurface N	Total P	Soluble P	Soil Carbon
National ENM	**97**	**93**	**100**	**99**	**77**	**97**	**79**	**87**
Region	**Percent Regional Acres**							
Atlantic and Gulf Coastal Plains	97	91	100	99	47	94	39	83
California Coastal	99	100	100	100	74	98	86	60
East Central	91	75	100	97	60	89	39	87
Lower Mississippi and Texas Gulf Coast	91	86	100	98	64	87	26	87
North Central and Midwest	97	90	100	99	75	97	78	88
Northeast	95	81	100	99	57	88	49	82
Northern Plains	100	100	100	100	83	100	99	86
Northwest	99	100	100	100	85	99	95	91
South Central	88	80	100	94	65	89	55	72
Southern and Central Plains	100	99	100	100	92	100	99	92
Southwest	97	97	100	100	79	97	94	82

** The highlighted cells indicate a regional percentage equal to or above the national average.*
*** Wind erosion control under ENM reflects the application of structural wind erosion control practices on the most susceptible acres, however, these are not widely adopted in the most wind-erosion prone regions where water supply challenges the use of vegetative structural practices. CEAP survey data indicate that only 2 percent of acres had structural wind erosion control practices applied, highlighting the need for alternative wind erosion control methods*

Subsurface nitrogen and soluble phosphorus losses are the most challenging to control, even under ENM. While surface losses can be trapped by edge-of-field practices (e.g., filter strips and buffers), there are fewer trapping options for subsurface and soluble losses. Treating the cropped areas with nutrient management and improved runoff control has limitations, especially in higher rainfall regions and with the economic and social priorities for food, feed, fiber, and fuel from cropland. Enhanced-efficiency fertilizers and precision agriculture with variable-rate technology can help, along with improved timing of nutrient applications. In some cases, however, practices such as drainage water management, establishment of wetlands or retention basins, or other measures may be needed to prevent losses.

The percentage of cultivated cropland acres meeting the various thresholds under ENM would vary more widely by region for sheet and rill erosion, subsurface nitrogen, soluble phosphorus, and soil carbon. In the East Central, South Central, and Northeast regions—with higher proportions of rolling to hilly landscapes under cultivation and rainfall above 35 inches—each would have 80 percent or less of cultivated cropland meeting the sheet and rill erosion threshold under ENM.

---

of vegetative structural practices. CEAP survey data indicate that only 2 percent of acres had structural wind erosion control practices applied, highlighting the need for alternative wind erosion control methods.

For subsurface nitrogen, seven regions would be below the national average of 77 percent and three regions (Atlantic and Gulf Coastal Plains, East Central, and Northeast) would have 60 percent or fewer acres meeting the threshold. Six regions would be below the national average of cultivated cropland meeting the soluble phosphorus threshold of 79 percent. The Lower Mississippi and Texas Gulf Coastal Plains was the most challenged, with its humid, subtropical climate, tile drainage, and rolling hills adjacent to flood plains.

Acres not meeting thresholds under the substantial conservation modeled in ENM are typically on the most vulnerable landscapes and may need additional conservation such as cover crops or other changes to the rotation, possibly including perennials, to meet thresholds.

Comparing Change in Cultivated Cropland Conservation Treatment Levels in CEAP Surveys

Cultivated cropland acres were categorized by conservation treatment levels to allow comparisons of change between the two CEAP surveys. The treatment levels were based on the number of resource concerns where established loss thresholds were being met. At the high treatment level, thresholds were met for all eight resource concerns (sheet and rill erosion, wind erosion, sediment, surface nitrogen, subsurface nitrogen, total phosphorus, soluble phosphorus, and soil carbon). At the moderate treatment level, thresholds were met for five to seven of the resource concerns, and at the low treatment level, thresholds were met for four or fewer resource concerns.

Between the two CEAP surveys, there was no change in the percentage of cultivated cropland in each of the treatment levels nationally (table 46), although the mix of resource concern thresholds being met could have shifted in some regions. For example, more acres were meeting erosion and sediment thresholds in CEAP II, offsetting a decline in acres meeting subsurface nitrogen and soluble phosphorus thresholds. At the regional scale, there were a few significant changes, most notably in the Northwest, Southwest, and Southern and Central Plains, where cultivated cropland with high treatment levels increased by 9 to 14 percent.

Eight regions had declines in cultivated cropland meeting high treatment levels from CEAP I to CEAP II, likely due to a loss in meeting certain nutrient management thresholds. The South Central region dropped from 30 percent to 21 percent of acres in high treatment and increased from 26 percent to 30 percent in low treatment levels. The East Central region dropped from 19 percent to 11 percent of acres in high treatment levels, and the Lower Mississippi and Texas Gulf Coast had the fewest acres in high treatment, dropping from 11 percent to 9 percent between the CEAP surveys. Meeting the high treatment level was challenging in these higher rainfall regions.

Except for the Northeast, South Central, and Northwest, most regions had little change in the percentage of acres with low treatment levels. Most regions showed an increase in the moderate treatment level, with seven regions experiencing an increase. Notably, the Northwest and Southern and Central Plains had high treatment levels on over 60 percent of cultivated cropland by CEAP II. The Northern Plains followed at 56 percent but had declined relative to CEAP I levels.

Table 46. Cultivated Cropland by Conservation Treatment Level, CEAP I and CEAP II

Geographic Scope	Conservation Treatment Level					
	High		Moderate		Low	
	CEAP I	CEAP II	CEAP I	CEAP II	CEAP I	CEAP II
	Percent					
National	**43**	**43**	**47**	**47**	**10**	**10**
Region						
Atlantic and Gulf Coastal Plains	15	13	70	73	15	13
California Coastal	45	40	52	58	3	2
East Central	19	11	56	63	25	26
Lower Mississippi and Texas Gulf Coast	13	9	68	72	19	18
North Central and Midwest	43	40	47	51	10	9
Northeast	15	15	55	63	30	22
Northern Plains	58	56	38	36	5	8
Northwest	47	61	47	36	6	3
South Central	30	21	44	49	26	30
Southern and Central Plains	55	64	40	32	5	4
Southwest	31	44	64	50	6	5

** The highlighted cells indicate that CEAP II values are higher than CEAP I.*

Comprehensive conservation systems that address all applicable resource concerns can achieve significant control of potential losses from farm fields (table 47). The 43 percent of cultivated cropland acres with high treatment met thresholds for all eight resource concerns, while the 10 percent of acres at low treatment met none. Moderate levels of treatment met all but subsurface nitrogen and soluble phosphorus thresholds. In fact, the subsurface nitrogen losses of 33 lbs/a/y losses were very near that of low treatment (39 lbs/a/y). Soluble phosphorus had an average of 0.6 lbs/a/y, just barely over the threshold. Both resource concerns, however, had the lowest national performance under the ENM treatment at only 77 and 79 percent, respectively, indicating the difficulty in controlling these loss pathways.

Table 47. Losses on Cultivated Cropland by Treatment Level and Resource Concern, CEAP II

Treatment Level	Percent Cultivated Cropland Acres		Sediment	Subsurface N	Surface N	Total P	Soluble P	Water Erosion	Wind Erosion	Soil Carbon
	CEAP I	CEAP II	tons	lbs	lbs	lbs	lbs	tons	tons	lbs
			unit / per acre / per year							
High	43	43	0.2	7.2	3.0	0.5	0.1	0.7	0.9	322.1
Moderate	47	47	0.5	33.1	5.9	1.7	0.6	1.3	1.8	161.7
Low	10	10	5.1	39.7	25.8	8.2	1.2	7.5	4.0	-174.1
Loss Threshold (ac/yr)			***2***	***25***	***15***	***3***	***0.5***	***Soil T***	***Soil T***	***Gain or Maintain***

** The highlighted cells indicate that loss meets the threshold for that resource concern.*

Erosion Control and Nutrient Management Treatment (ENM) Effects by Treatment Need

Simulations that applied ENM to cultivated cropland needing conservation treatment show the benefits of conservation systems that address all applicable resource concerns. In CEAP II, over 30 million acres (10 percent) of cultivated cropland were in the low conservation treatment level (meeting thresholds for four or fewer resource concerns) and thus considered high-need acres. Moderate-need acres (those meeting thresholds for five to seven resource concerns) accounted for another 148.8 million acres (47 percent).

Treating high-need acres to the ENM level would reduce sediment loss by 44 percent, largely through runoff control, which would also reduce surface nitrogen losses by 28 percent and total phosphorus losses by 29 percent. As expected, however, this treatment level would reduce subsurface nitrogen and soluble phosphorus losses by only 3 and 4 percent, respectively (table 48).

Table 48. Estimated Loss Reduction from CEAP II Baseline, by Loss Type and Treatment Level

Loss Type	CEAP II Baseline Loss	Treatment Level		
		High Need Acres	High-and Moderate-Need Acres	All Acres
	Tons	Percent Reduction		
Sediment	263,455	44	61	67
Wind Erosion	509,740	22	72	93
Sheet and Rill Erosion	522,263	17	23	24
Surface Nitrogen	1,038	28	60	74
Subsurface Nitrogen	3,550	3	19	21
Total Phosphorus	283	29	52	58
Soluble Phosphorus	70	4	13	15
Soil Carbon	31,381	4	3	0
Acres in category (1,000s)		***30,073***	***178,855***	***315,303***

Treating the high- and moderate-need acres to the ENM level would reduce most losses to levels near what could be achieved if all acres were treated. For some resource concerns (i.e., sheet and rill erosion, subsurface nitrogen, soluble phosphorus, carbon), however, reductions would be relatively small. In addition, because the low-need acres (high conservation treatment level) meet all resource concern loss thresholds, increased treatment can risk affecting productivity. Both results highlight the need for additional measures beyond ENM to increase control of subsurface nitrogen and soluble phosphorus losses.

The reduction in nutrient application rates and attention to application timing and method supported by erosion-control practices would result in significant loss reductions in the high-treatment-needs acres (table 49). Sediment, wind erosion, surface nitrogen, total phosphorus, and soil carbon would all improve by more than 50 percent. Sheet and rill erosion would be reduced by nearly 3 t/a/y—a 39-percent reduction—while the two most difficult resource concerns to control, losses of subsurface nitrogen and soluble phosphorus, would be reduced by 16 and 15 percent, respectively. In addition, estimated average yields of the five most prevalent crops were negligibly affected in this treatment simulation. The high-needs acres would see a slight but not significant increase in production, while the other treatment groups would experience very small decreases.

Notably, ENM treatment would result in a significant reduction in nitrogen and phosphorus applications, producing an associated economic benefit for the farm. Treating the high-need acres would reduce nitrogen applied by nearly 16 lbs/a/y and phosphorus by over 5 lbs/a/y. Likewise, treating moderate-need acres would reduce nitrogen applied by over 14 lbs/a/y and phosphorus by over 4 lbs/a/y. The focused treatment of high- and moderate-needs acres within a crop field highlight the economic and environmental opportunities of comprehensive conservation planning and precision conservation.

Table 49. Estimated Effects of ENM Treatment on Cultivated Cropland by Resource Concern and Treatment Need

Resource Concerns	Treatment Need								
	High Need			Moderate Need			Low Need		
	CEAP II Baseline	As Treated	Change from CEAP II	CEAP II Baseline	As Treated	Change from CEAP II	CEAP II Baseline	As Treated	Change from CEAP II
	unit/ac/yr		Percent	unit/ac/yr		Percent	unit/ac/yr		Percent
Sediment (tons)	5.1	1.2	-76	0.5	0.2	-55	0.2	0.1	-50
Sheet and Rill Erosion (tons)	7.5	4.6	-39	1.3	1.1	-15	0.7	0.7	-6
Wind Erosion (tons)	4.0	0.2	-95	1.8	0.1	-93	0.9	0.1	-89
Surface Nitrogen (lbs.)	25.8	6.5	-75	5.9	1.5	-74	3.0	0.9	-71
Subsurface Nitrogen (lbs.)	39.8	33.3	-16	33.1	25.2	-24	7.2	6.3	-12
Total Phosphorus (lbs.)	8.2	2.6	-68	1.7	0.8	-52	0.5	0.3	-49
Soluble Phosphorus (lbs.)	1.2	1.0	-15	0.6	0.5	-15	0.1	0.1	-17
Soil Carbon (tons)	-174.2	-82.0	-53	161.7	154.7	-4	322.2	308.7	-4
Estimated Input Effect (lbs/a/y)									
Nitrogen Applied (lbs.)	92.7	76.7	-17	89.0	74.5	-16	63.4	58.7	-7
Phosphorus Applied (lbs.)	24.2	18.6	-23	21.3	17.0	-20	15.1	14.0	-7
Estimated Yield Effect (bu/a/y)									
Corn (Grain)	158.3	158.8	0.3	159.5	158.1	-0.9	158.3	155.8	-1.6
Cotton	912.9	914.0	0.1	888.9	877.7	-1.3	896.8	883.2	-1.5
Durum & Spring Wheat	54.9	54.9	0.1	53.1	52.7	-0.7	48.7	48.6	-0.2
Soybeans	43.8	43.9	0.2	42.9	42.6	-0.8	43.9	43.5	-0.7
Winter Wheat	59.8	60.2	0.7	56.7	55.5	-2.1	42.3	42.2	-0.1

How Did Conservation in CEAP I and CEAP II Compare to ENM?

The conservation measures in place by CEAP II delivered progress toward the simulated ENM treatment level for most resource concerns (table 50). By CEAP II, sediment and sheet and rill erosion losses were at 80 and 84 percent of the simulated ENM treatment level, both with increases over the decade. While surface and subsurface nitrogen and sediment-transported phosphorus were at 61, 67, and 65 percent of their respective ENM treatment levels, subsurface nitrogen losses had increased since CEAP I. In CEAP II, soluble phosphorus losses were at 54 percent of ENM treatment level, down significantly from CEAP I. Wind erosion, while only at 42 percent of its ENM treatment level, nevertheless had the greatest progress toward ENM between the two CEAP surveys.

Table 50. Progress toward ENM by Resource Concern, CEAP I and CEAP II

Resource Concern	Treatment Level				CEAP II minus CEAP I	Change in Tons Relative to CEAP I	Progress toward ENM		
	No Practice (NP)	Erosion Control and Nutrient Management (ENM)	CEAP I	CEAP II			CEAP I	CEAP II	CEAP II minus CEAP I
	Average Annual Tons (1,000s)					Percent			
Sheet & Rill Erosion (Losses)	1,197,255	398,231	598,623	522,263	76,360	13	75	84	9
Wind Erosion (Losses)	848,310	37,024	603,605	509,740	93,865	16	30	42	12
Sediment (Losses)	946,467	87,834	337,635	263,455	74,181	22	71	80	11
Surface N (Losses)	2,218	272	1,073	1,038	-35	-3	59	61	2
Subsurface N (Losses)	5,095	2,803	3,130	3,550	420	13	86	67	-18
Total P (Losses)	592	118	290	283	-7	-2	64	65	1
Soluble Phosphorus (Losses)	83	59	63	70	7	11	85	54	-31
Soil Carbon (Gains)	6,823	31,320	22,519	31,381	8,862	39	64	100	36

Erosion and Sediment

With the increase in conservation tillage, structural practices, cover crops, and high-biomass conservation crop rotations between the CEAP surveys, there was significant progress toward ENM for sheet and rill erosion, wind erosion, and sediment. In CEAP II, annual sheet and rill erosion was about 84 percent of ENM, up from 75 percent in CEAP I (fig. 60). Sediment was at 80 percent of ENM in CEAP II, up from 71 percent in CEAP I. Although progress for wind erosion was only 42 percent of ENM in CEAP II, it was up from 30 percent in CEAP I. The lower performance level reflects that much of the current toolbox for wind erosion control depends on vegetative practices that are typically less well suited to the most wind-erosion-prone areas of the Nation.

Two regions—North Central and Midwest and Southern and Central Plains—were above the average national progress toward the sheet and rill ENM, at 90 percent and 86 percent, respectively. The Northern Plains region led progress toward the wind erosion ENM at 58 percent, 16 percentage points above the national average. Progress toward the sediment ENM mirrored sheet and rill erosion, with the North Central and Midwest and Southern and Central Plains regions being above the national average, at 86 percent and 81 percent respectively (fig. 61).

Figure 60. Erosion and Sediment Progress Toward ENM, CEAP I and CEAP II

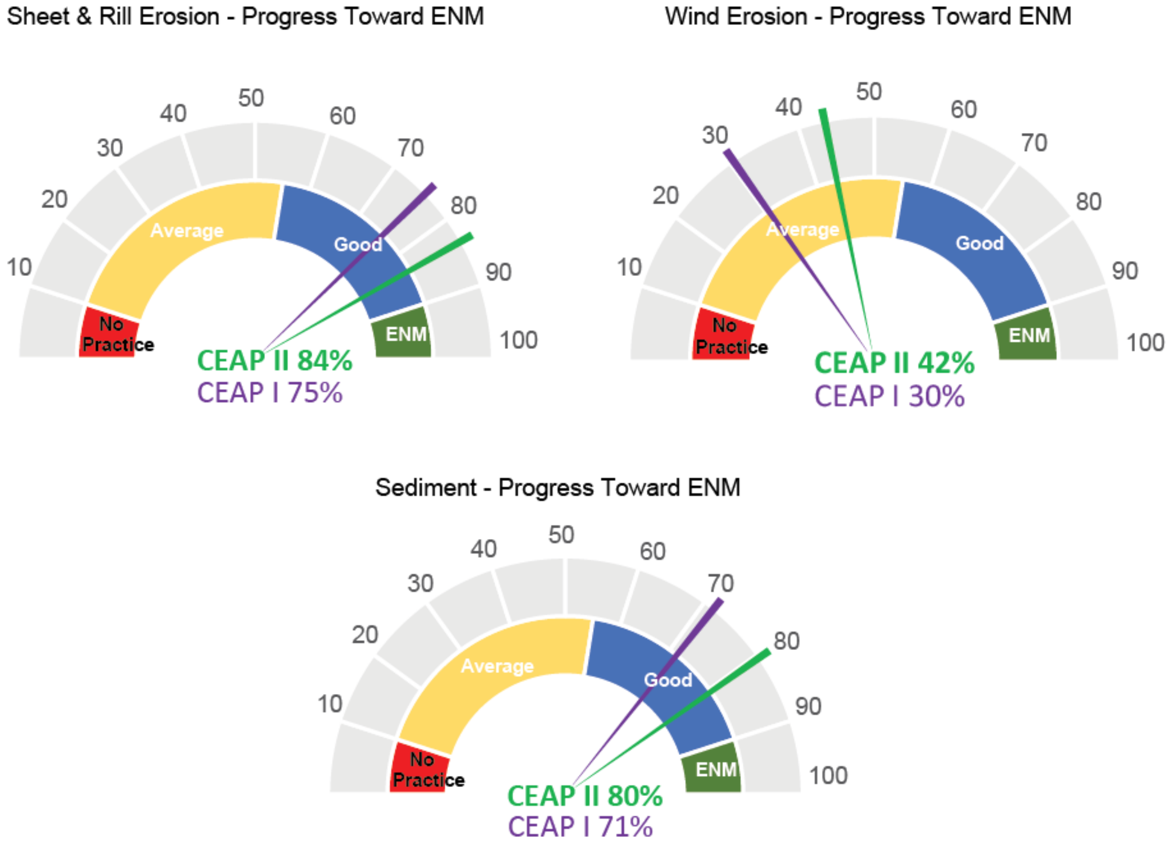
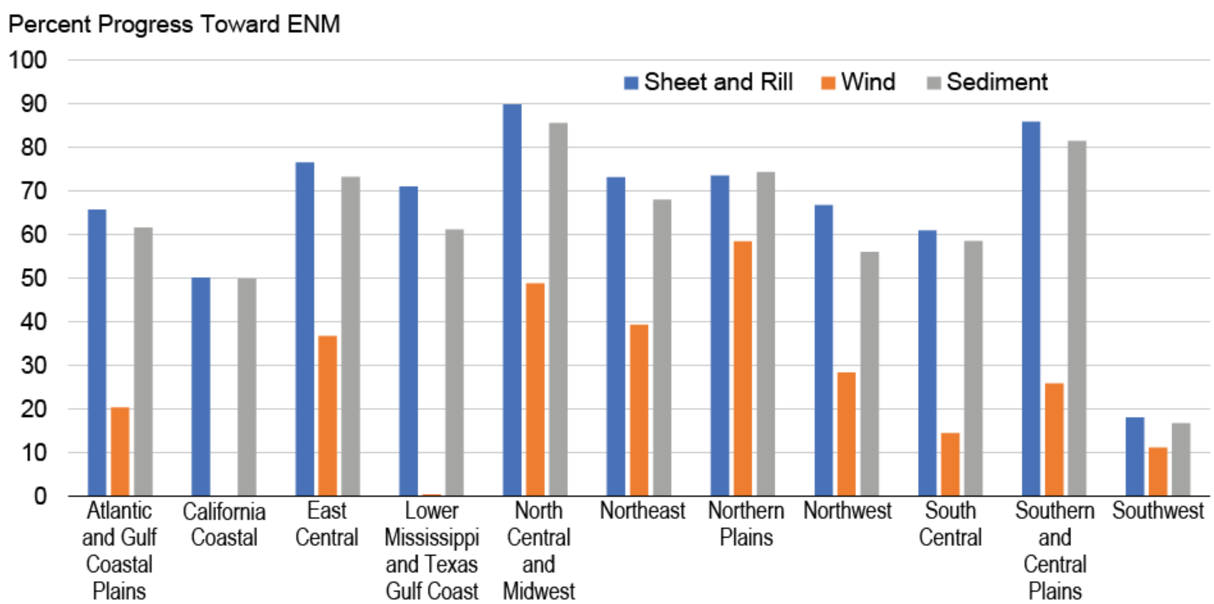


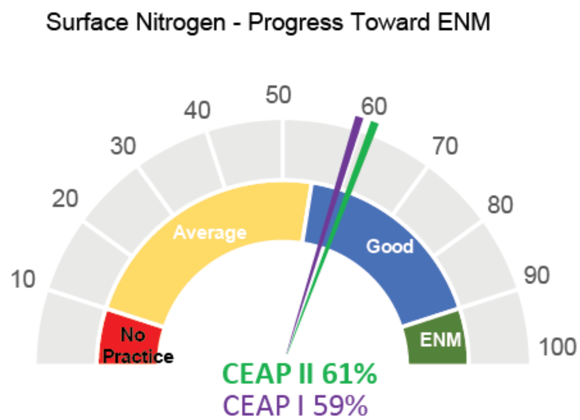
Figure 61. Progress toward Erosion and Sediment ENM by Loss Pathway and Region, CEAP II

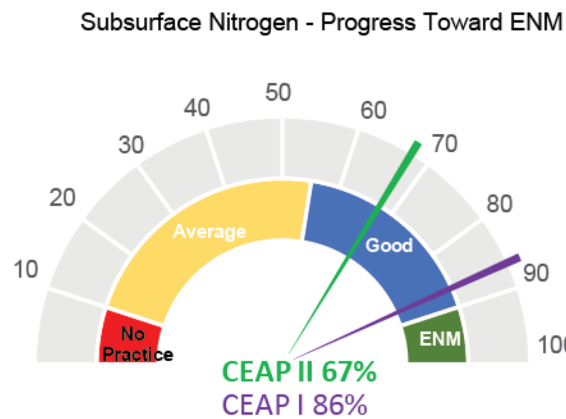


Nitrogen

Progress toward ENM for the nitrogen-related resource concerns was mixed, reflecting the increase in conservation measures that controlled runoff and the general decline in nutrient management practices between the CEAP surveys (fig. 62). The surface nitrogen resource concern was at 61 percent of ENM performance in CEAP II, up only slightly from 59 percent in CEAP I. However, it was the only nitrogen loss pathway that increased in progress toward ENM treatment level between the two survey periods. Control of subsurface nitrogen losses experienced a significant decline in progress toward ENM, dropping from 86 percent in CEAP I to 67 percent in CEAP II, consistent with the decline in nutrient management practices, particularly the decline in nutrient incorporation.

Figure 62. Surface and Subsurface Nitrogen Progress Toward ENM, CEAP I and CEAP II

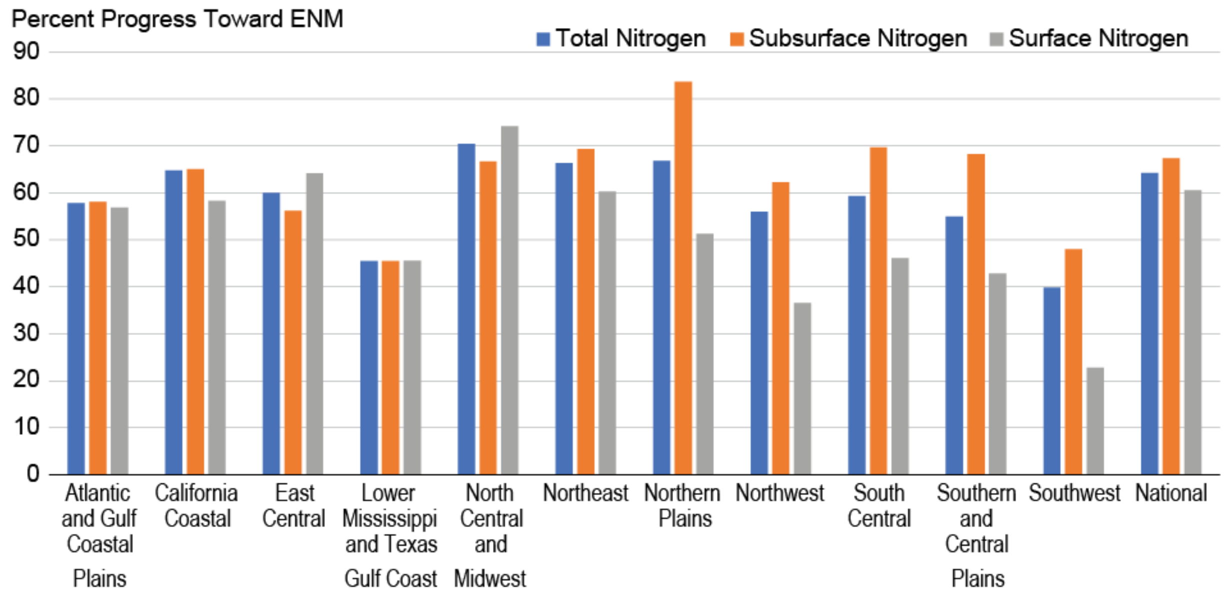




Over the decade between surveys, five of the 11 regions had increases in total nitrogen losses, led by the Northern Plains with a 49-percent increase, followed by the East Central (32 percent) and North Central and Midwest (13 percent). Two regions—the North Central and Midwest and Northern Plains—had the greatest increase in nitrogen losses, but also had progress toward ENM above the 64-percent national average, at 70 and 67 percent, respectively.

Progress toward the surface nitrogen ENM was led by the North Central and Midwest and East Central regions, at 74-percent and 64-percent progress, respectively. The Northern Plains region led progress toward the subsurface ENM at 84 percent, 16 percentage points above the national average. Only two regions (Northwest and South Central) performed better in CEAP II than CEAP I relative to the ENM for all three measures (fig. 63).

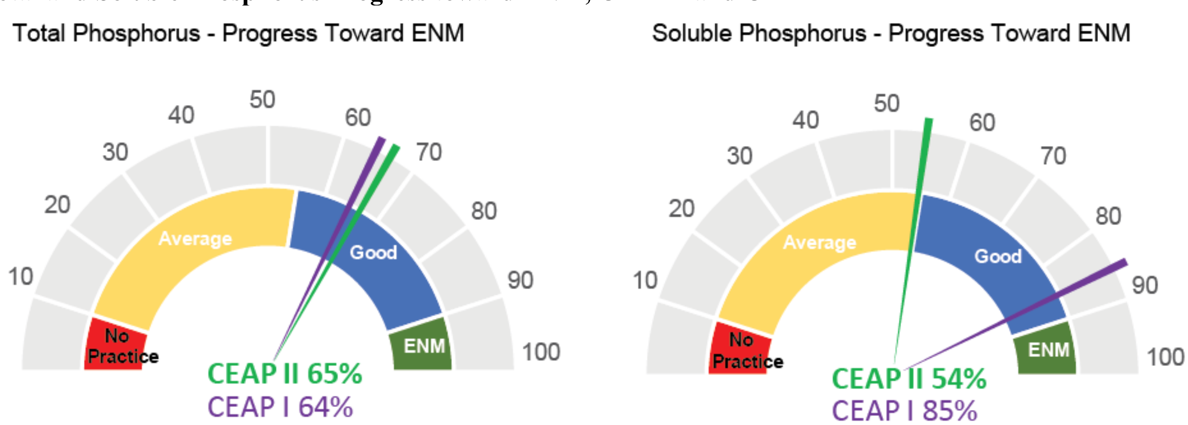
Figure 63. Progress toward Nitrogen ENM by Loss Pathway and Region, CEAP II



Phosphorus

Like nitrogen, phosphorus resource concerns also experienced mixed progress toward ENM, reflecting the change in conservation adoption over the decade (fig. 64). The total phosphorus resource concern made progress, reaching 65 percent of ENM by CEAP II, up from 64 percent in CEAP I. In contrast, soluble phosphorus progress toward ENM was at 54 percent in CEAP II, down from 85 percent in CEAP I and experiencing the largest percentage decline of all resource concerns, reflecting increased application rates and the declines in nutrient incorporation. The progress for total phosphorus was affected by the soluble decline, tempering its performance. In comparison, for sediment-transported phosphorus (discussed elsewhere in the report) progress toward ENM increased from 63 percent to 66 percent in CEAP I and CEAP II, respectively.

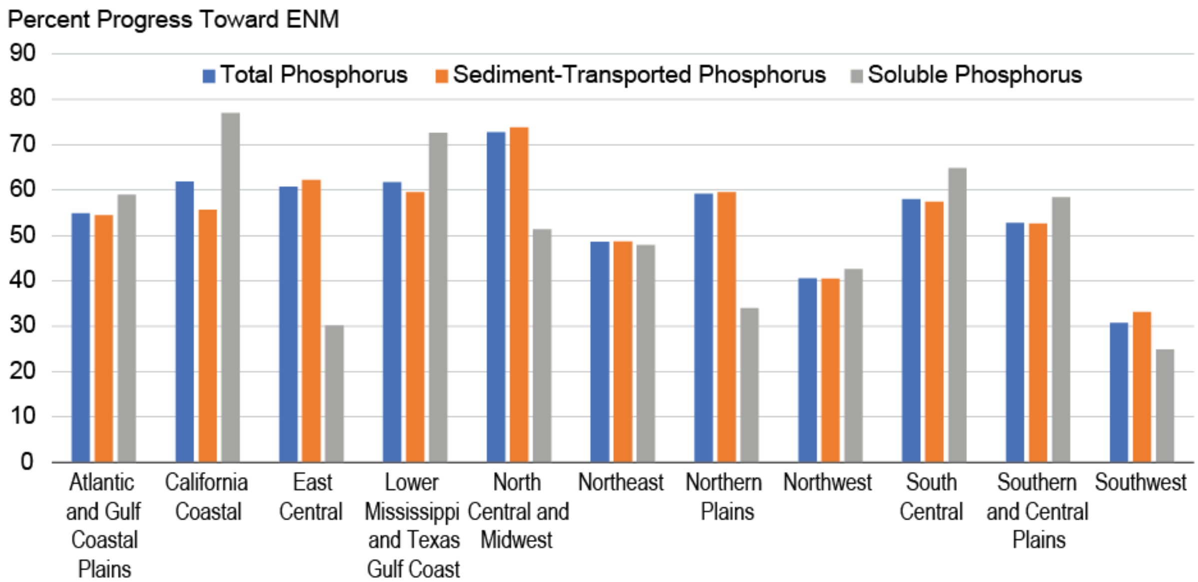
Figure 64. Total and Soluble Phosphorus Progress toward ENM, CEAP I and CEAP II



Nearly every region gained in progress toward the total phosphorus ENM between the two surveys, while only one region—North Central and Midwest—was above the average national progress. The North Central and Midwest was also the only region above the national average for the sediment-transported ENM, at 74 percent, the same as the region's CEAP I progress. The

California Coastal and Lower Mississippi and Texas Gulf Coast regions led progress toward the soluble phosphorus ENM at 77 and 73 percent, respectively (fig. 65).

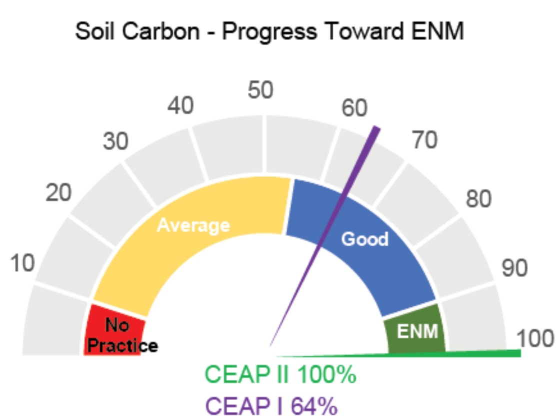
Figure 65. Progress toward Phosphorus ENM by Loss Pathway and Region, CEAP II



Soil Carbon

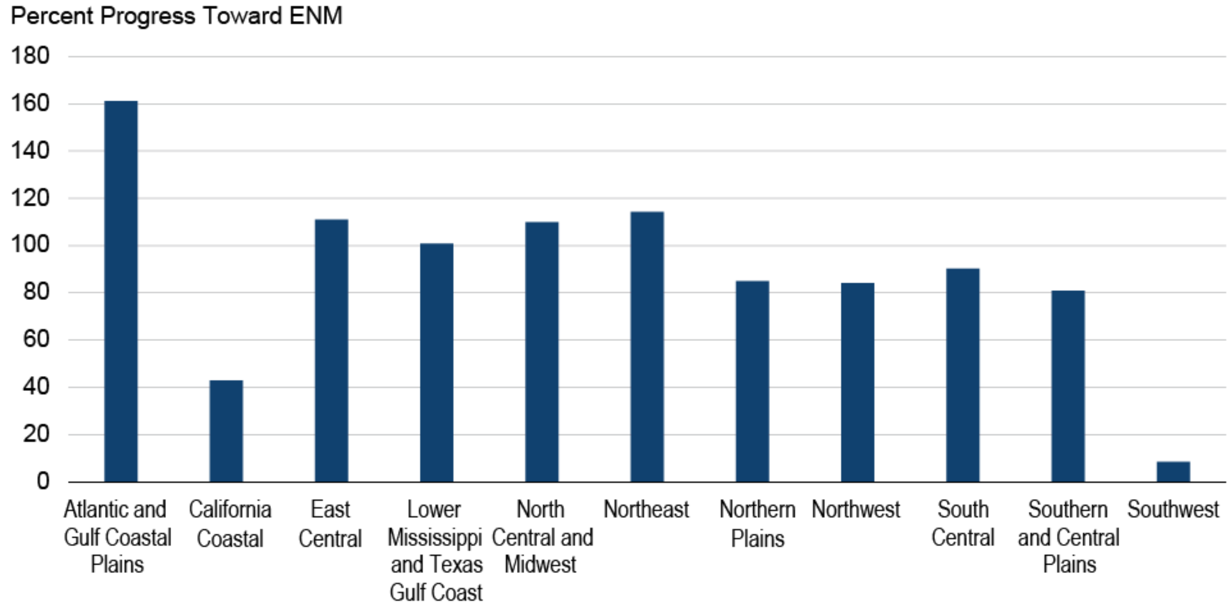
Soil carbon is evaluated in terms of carbon maintained or gained rather than a reduction in losses. In CEAP II, soil carbon was the only resource concern achieving 100 percent of the ENM treatment level, up from 64 percent in CEAP I and reflecting the significant increase in conservation tillage and structural practices that retained organic matter on farm fields (fig. 66). With the ENM treatment, the reduced nutrient application rate may result in lower biomass production on some acres and lower the net change in carbon. In a comprehensive plan, soil carbon may not be able to be maximized on all acres if other resource concerns such as water quality are priorities.

Figure 66. Soil Carbon Progress toward ENM, CEAP I and CEAP II



All but one region (South Central) gained in progress toward the soil carbon ENM between the two surveys, and four regions—Atlantic and Gulf Coastal Plains, East Central, North Central and Midwest, and Northeast—were above the national average of 100 percent. Although progress in the drier regions of California Coastal and Southwest trailed other regions, each had among the largest increases between the survey periods at 163 and 155 percent, respectively (fig. 67).

Figure 67. Progress toward Soil Carbon ENM by Region, CEAP II



Summary

Between the CEAP surveys, most resource concerns made progress toward ENM performance levels with two notable exceptions—subsurface nitrogen and soluble phosphorus. Both resource concerns experienced the effects of a decline in nutrient management practices, in some areas amplified by the adoption of conservation practices that managed runoff and related losses but promoted infiltration and soluble losses. Nevertheless, despite setbacks in CEAP II, all but two of the eight resource concerns were at 60 percent or more of their respective ENM levels. One of the two with lower performance, wind erosion, faces challenges related to the scant toolbox for controlling the loss pathway. Also, all but two resource concerns had moved closer to ENM levels between the CEAP surveys. The decline in subsurface nitrogen and soluble phosphorus resource concerns underscores the importance of conservation planning that considers all applicable resource concerns to build on progress and prevent unintended consequences.

SUMMARY AND AGENCY ACTIONS

The CEAP II report (2013–16) reveals progress from the time of the first CEAP report (2003–06) in addressing resource concerns such as sediment loss, soil erosion, and water use. Farmer adoption of structural practices and conservation tillage, alone or in combination, increased by nearly 42 million acres nationwide between the two CEAP surveys. The greatest gains were made in the adoption of structural practices plus conservation tillage, evidence that farmers were increasingly integrating multiple conservation treatments to achieve improved results. As a result, sheet and rill erosion dropped by nearly 70 million tons per year (an 11-percent reduction relative to CEAP I) and wind erosion dropped by 94 million tons per year (a 15-percent reduction relative to CEAP I). Irrigators gained efficiencies, reducing per-acre application rates and national withdrawals over the decade.

However, the new findings also indicate some declines in nutrient management levels on working lands. Changes in commodity prices, climate factors, and evolving technology have driven shifts in cropping patterns in many areas toward corn and soybeans and away from wheat. Corn and soybeans have significantly higher average nutrient needs than wheat, explaining some of the increase in nutrient application rates between the CEAP surveys. Nutrient incorporation declined, and consequently the shifts in rate, timing, and method of nutrient application resulted in overall increases in subsurface nitrogen and soluble phosphorus losses over the decade. Without attention to appropriate timing and method, increased application rates are less effective in improving production and may even lead to reduced yields. While most cultivated cropland acres met the various soil and nutrient loss thresholds in both survey periods, most of the related material losses come from the small number of cultivated cropland acres that exceeded those loss thresholds.

Since 2016, NRCS has made considerable strides in addressing key resource challenges as presented in this report. In addition, the agency has developed new tools, such as the Conservation Assessment Ranking Tool and Conservation Desktop, and implemented new initiatives and program opportunities, including the National Water Quality Initiative, and Regional Conservation Partnership Program.

In response to these new CEAP II findings, and building upon post-2016 progress, NRCS has renewed its focus on proper nutrient and manure management, as well as an agencywide commitment to targeted solutions to further improve the Nation's water quality. NRCS formed interdisciplinary teams to develop recommendations and assist with the agency's strategy for integrating CEAP II findings into policies, programs, and targeted initiatives that will result in greater conservation outcomes. Each team focused on a core discipline: conservation planning and program implementation, technical infrastructure, future resource assessment, and policy.

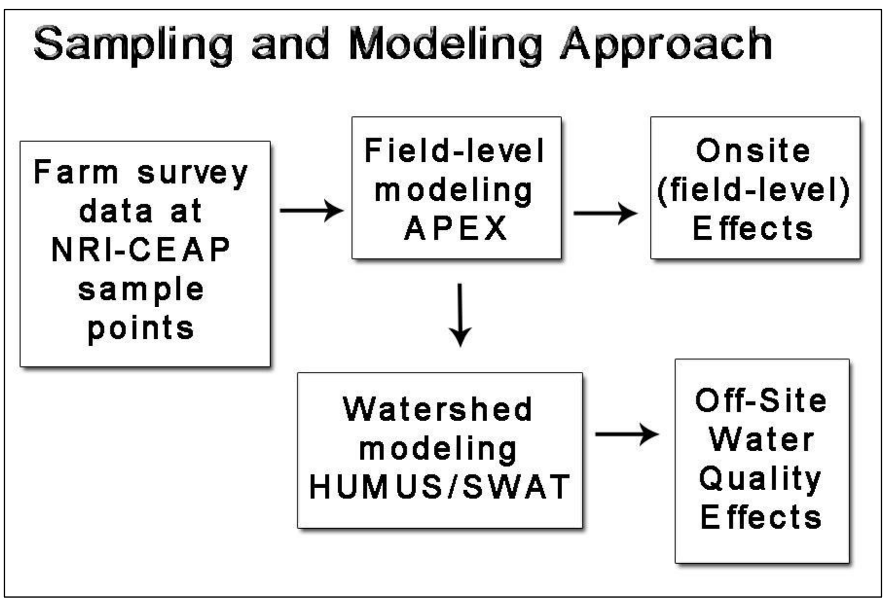
The four overarching goals of our evolving nutrient management strategy are: developing a nutrient management campaign to educate and engage partners; revitalizing the agency's nutrient management planning and implementation processes; focusing technical assistance on integrated conservation planning; and enhancing program implementation with a nutrient management focus. Each overarching goal contains a set of specific recommendations that will help NRCS and producers continue to adapt nutrient management to national changes in markets, trade, climate, and cropping systems.

APPENDIX 1. OVERVIEW OF THE CEAP SAMPLING AND MODELING APPROACH

The CEAP Cropland National Assessment is a collaborative effort led by NRCS in partnership with USDA's Agricultural Research Service and Texas A&M University's Texas Agri-Life Research Center in Temple, TX. In addition, USDA's National Agricultural Statistics Service and Farm Service Agency provide important data collection and related contributions.

CEAP uses a sampling and modeling approach that integrates natural resource and farmer survey data with modeling to quantify the effects of commonly used conservation practices on cultivated cropland. CEAP defines cultivated cropland as land in row crops or close-grown crops, hay and pasture in rotation with row crops and close-grown crops, and land in long-term conserving cover, such as land enrolled in the Conservation Reserve Program general signup. Cultivated cropland does not include agricultural land that has been in hay, pasture, or horticulture for four or more consecutive years.

CEAP Statistical Sampling and Modeling Approach to Simulate Conservation Practice Effects



The CEAP Cropland sampling and modeling approach captures the diversity of land use, soils, climate, and topography; accounts for site-specific farming activities; estimates the loss of materials at the field scale where the science is most developed; and provides a statistical basis for aggregating results to the national and regional levels. The approach consists of four components:

- Sampling – A subset of National Resources Inventory (NRI) sample points serves as "representative fields." These NRI sample points, which are located on cultivated cropland and land in long-term conserving cover, provide the statistical framework for the model as well as information on soils, climate, and topography. Nationally, the CEAP sample consists of about 18,700 points representing cropped acres. The CEAP sample was designed to allow reporting of results at a 4-digit watershed scale (4-digit hydrologic unit code [HUCs]). The sample size is too small, in most cases, for reliable and defensible reporting of results for areas below this level. CEAP cropland modeling results are reported as estimates because of the uncertainty associated with the statistical sample.

- Farmer Surveys – The CEAP Cropland Farmer Surveys are used to collect information needed at the selected NRI sample points to run field-level models and assess the effects of conservation practices. NASS partners with state departments of agriculture to interview farmers to obtain current information on farming practices, including:
    - field characteristics, such as proximity to a water body or wetland and presence of tile or surface drainage systems;
    - conservation practices associated with the field;
    - crop rotation plan;
    - application of commercial fertilizers (rate, timing, method, and form) for crops grown in the previous 3 years;
    - application of manure (source and type, consistency, application rate, method, and timing) on the field over the previous 3 years;
    - application of pesticides (chemical, rate, timing, and method) for the previous 3 years;
    - pest management practices;
    - irrigation practices (system type, amount, and frequency);
    - timing and equipment used for all field operations (tillage, planting, cultivation, harvesting) over the previous 3 years, and;
    - general characteristics of the operator and the operation.

  Farmer participation is voluntary, and the information is confidential. Because of the large size of the sample, the data collection process occurs over multiple years, from 2003 through 2006 for CEAP I and 2013 through 2016 for CEAP II. [30] The final CEAP samples for each survey period were constructed by pooling the set of usable, completed surveys from all years.
- The Physical Process Model – The Agricultural Policy Environmental Extender (APEX) is used to assess the field-level effects of conservation practices. APEX simulates day-to-day farming activities, wind and water erosion, the loss or gain of soil organic carbon, and edge-of-field losses of soil, nutrients, and pesticides.
- Watershed Model and System of Databases – The Soil and Water Assessment Tool / Hydrologic Unit Model of the United States (SWAT/HUMUS) is used to simulate the transport of edge-of-field losses (APEX model output) to receiving streams and routes instream loads from one watershed to another. SWAT/HUMUS allows estimation of the changes in in-stream concentrations of sediment, nutrients, and pesticides attributable to conservation practice implementation.

[30] The surveys, the enumerator instructions, and other documentation can be found at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/na/?cid=nrcs143_014163

The modeling strategy for estimating the effects of conservation practices consists of model scenarios that are produced for each sample point. The effects of conservation practices are obtained by taking the difference in model results between the various scenarios.[31] For example, to simulate "no practices" for sample points with structural and annual conservation practices (buffers, terraces, grassed waterways, conservation tillage, nutrient management, etc.), model simulations were conducted as if the practices were not present and compared to the results with the practices in place to estimate the change. Multiple alternative treatment scenarios were developed for analysis, including:

1. No Practice – simulates model results as if no conservation practices were in use but holds all other model inputs and parameters the same as in the current conservation condition scenario (e.g., CEAP I).
2. CEAP I and CEAP II – simulates model results that account for cropping patterns, farming activities, and conservation practices as reported in the CEAP Cropland Surveys and other sources for each survey period (CEAP I, 2003–06, and CEAP II, 2013–16).
3. Erosion Control (EC) – simulates model results associated with conservation practices designed to control and trap soil losses from cropped fields primarily through additions of structural conservation practices. Tillage practices are not altered.
4. Nutrient Management (NM) – simulates model results related to conservation practices designed to avoid excess surface and subsurface nutrient losses through adjustments to nutrient application method, timing, and rate. A 10-percent reduction in nutrient application rate is used in this scenario.[32] Nutrient form is not adjusted as it may relate to decision factors not in the survey such as equipment or the need to use manure from the operation.
5. Erosion Control and Nutrient Management (ENM) – simulates model results reflecting a comprehensive conservation plan by combining the EC and NM scenarios with additional improvements to structural conservation practices and nutrient management.
6. Erosion Control and Nutrient Management 85 (ENM85) – simulates erosion control and nutrient management but with only 85 percent of the nutrient form being applied and with additional improvements to nutrient timing and incorporation and runoff controls to improve nutrient-use efficiency.

Technical information on the CEAP Cropland methodology studies, including documentation reports on the modeling methodology, models and databases are available on the Web as part of the CEAP Cropland National Assessment.[33]

[31] This modeling strategy is similar to NRI estimates of soil erosion and the intrinsic erosion rate used to identify highly erodible land. The NRI uses the Universal Soil Loss Equation (USLE) to estimate sheet and rill erosion at each sample point based on site-specific factors. Soil loss per unit area is equal to R*K*L*S*C*P. The first four factors—R, K, L, S—represent the conditions of climate, soil, and topography existing at a site. The last two factors—C and P—represent the degree to which management influences the erosion rate. The product of the first four factors is sometimes called the intrinsic, or potential, erosion rate. The intrinsic erosion rate divided by T, the soil loss tolerance factor, produces estimates of the erodibility index. The intrinsic erosion rate is thus a "no-practice" representation of sheet and rill erosion since C=1 represents smooth-tilled continuous fallow and P=1 represents no supporting practices.

[32] The 10-percent reduction was selected as a level where productivity is maintained on most soils while demonstrating the effects of improved use efficiency that is provided through rate reductions in combination with improved timing and application methods, particularly in precision agriculture systems.

[33] https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/pub/?cid=nrcs143_014165

APPENDIX 2. REGIONAL TABLES

Table A-1. Cultivated Cropland Acreage by Region, CEAP I and CEAP II

Production Region	CEAP I		CEAP II		CEAP II minus CEAP I		Acre Change Relative to CEAP I
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Percent
Atlantic and Gulf Coastal Plains	14,395	5	13,825	4	-570	0	-4
California Coastal	4,447	1	3,913	1	-534	0	-12
East Central	9,312	3	10,166	3	854	0	9
Lower Mississippi and Texas Gulf Coast	21,816	7	20,916	7	-900	0	-4
North Central and Midwest	120,134	38	123,296	39	3,162	1	3
Northeast	7,190	2	7,597	2	407	0	6
Northern Plains	48,420	15	51,130	16	2,710	1	6
Northwest	14,010	4	13,438	4	-571	0	-4
South Central	6,135	2	5,107	2	-1,027	0	-17
Southern and Central Plains	64,337	21	62,732	20	-1,605	-1	-2
Southwest	2,870	1	3,183	1	313	0	11
National	313,065		315,303		2,238		1

Table A-2. Harvested Crops, Top Five by Acreage, National and by Region, CEAP I and CEAP II

Region	CEAP I				CEAP II			
	Crop	Harvested Acres		Count	Crop	Harvested Acres		Count
		(1,000s)	(percent)			(1,000s)	(percent)	
National								
	Soybean	81,563	26	11,011	Soybean	92,275	29	7,250
	Corn	79,186	25	10,445	Corn	89,963	29	6,691
	Winter Wheat	45,528	15	4,361	Winter Wheat	43,258	14	2,871
	Idle/Fallow	20,648	7	2,031	Idle/Fallow	16,794	5	1,070
	Durum & Spring Wheat	19,030	6	1,290	Durum & Spring Wheat	15,570	5	765
Atlantic and Gulf Coastal Plains								
	Cotton	4,087	28	422	Soybean	4,366	32	498
	Soybean	3,822	27	821	Cotton	3,083	22	223
	Corn	2,740	19	664	Corn	2,446	18	330
	Peanuts	1,433	10	196	Winter Wheat	2,030	15	247
	Winter Wheat	1,099	8	288	Peanuts	1,807	13	156
California Coastal								
	Vegetable	906	20	28	Rice	942	24	51
	Cotton	887	20	11	Vegetable	863	22	57
	Rice	814	18	38	Winter Wheat	636	16	39
	Corn Silage	520	12	8	Corn Silage	509	13	32
	Idle/Fallow	436	10	20	Alfalfa/Clover	263	7	18
East Central								
	Soybean	3,602	39	642	Soybean	4,621	45	582
	Corn	2,862	31	601	Corn	3,582	35	480
	Winter Wheat	1,140	12	190	Winter Wheat	1,649	16	218
	Cotton	654	7	84	Corn Silage	389	4	43
	Corn Silage	582	6	80	Close grown	371	4	47
Lower Mississippi and Texas Gulf Coast								
	Soybean	8,776	40	1,183	Soybean	9,740	47	1015
	Cotton	4,762	22	464	Corn	3,099	15	446
	Rice	2,921	13	430	Rice	2,843	14	308
	Corn	2,323	11	497	Cotton	1,745	8	180
	Idle/Fallow	1,121	5	170	Idle/Fallow	997	5	128
North Central and Midwest								
	Corn	53,893	45	6,925	Corn	58,295	47	3,750
	Soybean	52,460	44	7,015	Soybean	52,404	43	3,623
	Winter Wheat	3,965	3	874	Winter Wheat	4,687	4	410
	Alfalfa/Clover	3,211	3	357	Alfalfa/Clover	3,530	3	138
	Corn Silage	2,533	2	300	Close grown	2,448	2	177
Northeast								
	Corn	2,450	34	555	Corn	2,351	31	413
	Corn Silage	1,405	20	273	Soybean	2,022	27	382
	Soybean	1,354	19	393	Corn Silage	1,288	17	163
	Alfalfa/Clover	509	7	101	Winter Wheat	1,000	13	190
	Winter Wheat	498	7	172	Alfalfa/Clover	864	11	101
Northern Plains								
	Durum & Spring Wheat	15,806	33	922	Durum & Spring Wheat	12,990	25	587
	Soybean	7,214	15	507	Soybean	12,463	24	599
	Idle/Fallow	5,827	12	384	Corn	7,784	15	452
	Corn	4,678	10	371	Idle/Fallow	3,839	8	190
	Winter Wheat	3,351	7	228	Winter Wheat	3,698	7	192

Table A-2. Harvested Crops, Top Five by Acreage, National and by Region, CEAP I and CEAP II—Cont.

Region	CEAP I				CEAP II			
	Crop	Harvested Acres		Count	Crop	Harvested Acres		Count
		(1,000s)	(percent)			(1,000s)	(percent)	
Northwest								
	Winter Wheat	3,917	28	537	Winter Wheat	4,133	31	314
	Idle/Fallow	2,758	20	382	Idle/Fallow	2,623	20	192
	Barley	1,610	11	251	Durum & Spring Wheat	1,406	10	112
	Durum & Spring Wheat	1,452	10	203	Alfalfa/Clover	985	7	82
	Alfalfa/Clover	827	6	77	Barley	826	6	103
South Central								
	Winter Wheat	1,831	30	118	Winter Wheat	1,243	24	114
	Corn	1,127	18	83	Soybean	1,242	24	120
	Soybean	1,080	18	112	Corn	1,217	24	104
	Sorghum	740	12	47	Sorghum	400	8	47
	Oats	502	8	14	Cotton	361	7	33
Southern and Central Plains								
	Winter Wheat	28,005	44	1,667	Winter Wheat	22,609	36	969
	Idle/Fallow	8,719	14	733	Corn	10,582	17	621
	Corn	8,500	13	656	Cotton	8,479	14	296
	Cotton	6,712	10	427	Idle/Fallow	7,134	11	372
	Sorghum	5,388	8	409	Soybean	5,418	9	431
Southwest								
	Cotton	534	19	64	Alfalfa/Clover	614	19	27
	Winter Wheat	448	16	66	Winter Wheat	593	19	35
	Vegetable	430	15	24	Cotton	500	16	31
	Alfalfa/Clover	324	11	29	Vegetable	346	11	21
	Idle/Fallow	281	10	48	Idle/Fallow	332	10	27

Table A-3. Cultivated Cropland by Treatment Group by Region, CEAP I and CEAP II

Treatment Group and Region	CEAP I		CEAP II	
	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres
Structural Practices plus Conservation Tillage				
Atlantic and Gulf Coastal Plains	2,157	15	2,934	21
California Coastal	481***	11***	77***	2***
East Central	3,015	32	4,181	41
Lower Mississippi and Texas Gulf Coast	2,127	10	3,017	14
North Central and Midwest	38,854	32	58,046	47
Northeast	1,295	18	2,882	38
Northern Plains	7,588	16	13,027	25
Northwest	1,259	9	3,425	25
South Central	704***	11***	1,167	23
Southern and Central Plains	7,279	11	18,657	30
Southwest	100***	3***	76***	2***
National	**64,860**	**21**	**107,489**	**34**
Structural Practices Only				
Atlantic and Gulf Coastal Plains	1,747	12	2,210	16
California Coastal	239***	5***	772	20
East Central	1,532	16	640	6
Lower Mississippi and Texas Gulf Coast	1,885	9	3,384	16
North Central and Midwest	17,577	15	15,720	13
Northeast	1,751	24	1,125	15
Northern Plains	4,720	10	4,559	9
Northwest	1,804	13	2,396	18
South Central	1,786	29	1,383	27
Southern and Central Plains	21,521	33	10,819	17
Southwest	727***	25***	616***	19***
National	**55,289**	**18**	**43,623**	**14**
Conservation Tillage Only				
Atlantic and Gulf Coastal Plains	5,189	36	5,169	37
California Coastal	373***	8***	507***	13***
East Central	3,654	39	4,612	45
Lower Mississippi and Texas Gulf Coast	7,551	35	5,874	28
North Central and Midwest	35,306	29	32,598	26
Northeast	1,514	21	1,977	26
Northern Plains	22,994	47	25,314	50
Northwest	2,754	20	3,679	27
South Central	858	14	1,220	24
Southern and Central Plains	11,787	18	21,546	34
Southwest	283***	10***	546***	17***
National	**92,265**	**29**	**103,042**	**33**
No Structural Practices or Conservation Tillage				
Atlantic and Gulf Coastal Plains	5,302	37	3,512	25
California Coastal	3,353	75	2,557	65
East Central	1,111	12	733	7
Lower Mississippi and Texas Gulf Coast	10,252	47	8,641	41
North Central and Midwest	28,396	24	16,931	14
Northeast	2,630	37	1,614	21
Northern Plains	13,117	27	8,230	16
Northwest	8,193	58	3,938	29
South Central	2,787	45	1,337	26
Southern and Central Plains	23,750	37	11,711	19
Southwest	1,760	61	1,944	61
National	**100,651**	**32**	**61,148**	**19**

**** Too few acres for significance change analysis*

Table A-4. Structural Practice Adoption by Region, CEAP I and CEAP II

Region	CEAP I		CEAP II	
	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres
One Or More Structural Practices				
Atlantic and Gulf Coastal Plains	3,904	27	5,144	37
California Coastal	721***	16***	849	22
East Central	4,547	49	4,821	47
Lower Mississippi and Texas Gulf Coast	4,013	18	6,401	31
North Central and Midwest	56,431	47	73,766	60
Northeast	3,046	42	4,007	53
Northern Plains	12,309	25	17,586	34
Northwest	3,063	22	5,821	43
South Central	2,489	41	2,550	50
Southern and Central Plains	28,799	45	29,475	47
Southwest	827	29	692***	22***
National	**120,149**	**38**	**151,113**	**48**
More Than One Structural Practice				
Atlantic and Gulf Coastal Plains	1,827	13	2,362	17
California Coastal	577***	13***	363***	9***
East Central	1,930	21	2,236	22
Lower Mississippi and Texas Gulf Coast	972	4	2,234	11
North Central and Midwest	24,095	20	39,819	32
Northeast	1,191	17	2,315	30
Northern Plains	2,012	4	4,224	8
Northwest	715	5	2,026	15
South Central	1,318	21	1,571	31
Southern and Central Plains	16,961	26	18,181	29
Southwest	66***	2***	163***	5***
National	**51,664**	**17**	**75,494**	**24**
One Structural Practice				
Atlantic and Gulf Coastal Plains	2,076	14	2,782	20
California Coastal	143***	3***	486***	12***
East Central	2,617	28	2,584	25
Lower Mississippi and Texas Gulf Coast	3,041	14	4,167	20
North Central and Midwest	32,336	27	33,947	28
Northeast	1,856	26	1,691	22
Northern Plains	10,297	21	13,362	26
Northwest	2,348	17	3,795	28
South Central	1,171	19	979	19
Southern and Central Plains	11,839	18	11,295	18
Southwest	761***	27***	529***	17***
National	**68,485**	**22**	**75,619**	**24**
No Structural Practices				
Atlantic and Gulf Coastal Plains	10,491	73	8,681	63
California Coastal	3,726	84	3,064	78
East Central	4,766	51	5,345	53
Lower Mississippi and Texas Gulf Coast	17,803	82	14,515	69
North Central and Midwest	63,702	53	49,529	40
Northeast	4,144	58	3,590	47
Northern Plains	36,111	75	33,544	66
Northwest	10,947	78	7,617	57
South Central	3,645	59	2,557	50
Southern and Central Plains	35,537	55	33,256	53
Southwest	2,043	71	2,491	78
National	**192,916**	**62**	**164,190**	**52**

**** Too few acres for significance change analysis*

Table A-5. Structural Practice Groups by Region, CEAP I and CEAP II

Region/Structural Practice Groups	CEAP I			CEAP II		
	Acres (1,000s)	Percent Regional Acres	Count	Acres (1,000s)	Percent Regional Acres	Count
Atlantic and Gulf Coastal Plains						
Overland Flow Control	1,925	13	126	2,375	17	117
Concentrated Flow Control	1,777	12	129	1,516	11	90
Edge of Field Buffering and Filtering	817	6	101	1,408	10	98
Field Border	1,123	8	81	1,857	13	121
Wind Erosion Control	309***	2***	25	631	5	43
California Coastal						
Overland Flow Control	557***	13***	4	397***	10***	18
Concentrated Flow Control	122***	3***	3	185***	5***	10
Edge of Field Buffering and Filtering	481***	11***	1	248***	6***	16
Field Border	50***	1***	3	358***	9***	24
Wind Erosion Control	38***	1***	2	66***	2***	6
East Central						
Overland Flow Control	2,209	24	202	2,001	20	153
Concentrated Flow Control	2,421	26	245	2,297	23	167
Edge of Field Buffering and Filtering	839	9	77	1,119	11	85
Field Border	1,134	12	89	1,644	16	132
Wind Erosion Control	162***	2***	13	479	5	37
Lower Mississippi and Texas Gulf						
Overland Flow Control	963	4	117	2,146	10	165
Concentrated Flow Control	2,677	12	267	2,749	13	202
Edge of Field Buffering and Filtering	641	3	61	948	5	74
Field Border	484	2	42	2,957	14	184
Wind Erosion Control	154***	1***	9	505	2	37
North Central and Midwest						
Overland Flow Control	26,101	22	1,812	30,322	25	1,061
Concentrated Flow Control	34,268	29	2,338	46,387	38	1,628
Edge of Field Buffering and Filtering	11,139	9	715	21,715	18	728
Field Border	6,106	5	394	17,451	14	604
Wind Erosion Control	4,222	4	283	9,244	7	340
Northeast						
Overland Flow Control	2,057	29	241	2,100	28	206
Concentrated Flow Control	1,172	16	159	1,453	19	144
Edge of Field Buffering and Filtering	432	6	68	1,001	13	93
Field Border	280***	4***	30	1,174	15	106
Wind Erosion Control	281	4	40	812	11	77
Northern Plains						
Overland Flow Control	3,982	8	98	3,406	7	76
Concentrated Flow Control	3,296	7	102	5,513	11	117
Edge of Field Buffering and Filtering	564***	1***	15	1,770	3	45
Field Border	860	2	33	4,640	9	94
Wind Erosion Control	5,110	11	147	6,788	13	163
Northwest						
Overland Flow Control	1,665	12	139	4,146	31	149
Concentrated Flow Control	834	6	55	1,523	11	54
Edge of Field Buffering and Filtering	752	5	40	1,291	10	40
Field Border	220***	2***	14	448***	3***	24
Wind Erosion Control	194***	1***	12	400***	3***	21
South Central						
Overland Flow Control	1,242	20	43	1,125	22	47
Concentrated Flow Control	1,591	26	50	1,352	26	59
Edge of Field Buffering and Filtering	308***	5***	13	769	15	31
Field Border	274***	4***	10	856	17	40
Wind Erosion Control	194***	3***	7	555***	11***	26

Table A-5. Structural Practice Groups by Region, CEAP I and CEAP II—Cont.

Region/Structural Practice Groups	CEAP I			CEAP II		
	Acres (1,000s)	Percent Regional Acres	Count	Acres (1,000s)	Percent Regional Acres	Count
Southern and Central Plains						
Overland Flow Control	24,970	39	890	23,617	38	672
Concentrated Flow Control	10,733	17	394	11,937	19	343
Edge of Field Buffering and Filtering	1,448	2	55	3,133	5	102
Field Border	641***	1***	30	2,393	4	80
Wind Erosion Control	2,534	4	95	3,784	6	128
Southwest						
Overland Flow Control	138***	5***	8	242***	8***	7
Concentrated Flow Control	554***	19***	21	404***	13***	14
Edge of Field Buffering and Filtering	0***	0***	0	0***	0***	0
Field Border	62***	2***	3	243***	8***	7
Wind Erosion Control	101***	4***	3	51***	2***	4
National Summary						
Overland Flow Control	65,809	21	3,680	71,877	23	2,671
Concentrated Flow Control	59,445	19	3,763	75,316	24	2,828
Edge of Field Buffering and Filtering	17,422	6	1,146	33,403	11	1,312
Field Border	11,233	4	729	34,022	11	1,416
Wind Erosion Control	13,300	4	636	23,315	7	882

*** Too few acres for significance change analysis

Table A-6. Tillage Groups by Region, CEAP I and CEAP II

Tillage Group and Region	CEAP I			CEAP II		
	Acres (1,000s)	Percent Regional Acres	Count	Acres (1,000s)	Percent Regional Acres	Count
Conservation Tillage						
Atlantic and Gulf Coastal Plains	7,346	51	714	8,103	59	515
California Coastal	854***	19***	7	584***	15***	14
East Central	6,669	72	665	8,794	86	638
Lower Mississippi and Texas Gulf Coast	9,679	44	949	8,891	43	651
North Central and Midwest	74,160	62	5,166	90,644	74	3,185
Northeast	2,809	39	412	4,859	64	470
Northern Plains	30,583	63	995	38,341	75	961
Northwest	4,013	29	264	7,104	53	282
South Central	1,562	25	75	2,388	47	137
Southern and Central Plains	19,066	30	822	40,203	64	1,119
Southwest	383***	13***	24	622***	20***	30
National	**157,124**	**50**	10,093	**210,532**	**67**	8,002
Reduced Tillage						
Atlantic and Gulf Coastal Plains	3,633	25	315	3,533	26	209
California Coastal	560***	13***	6	511***	13***	12
East Central	2,149	23	207	2,108	21	146
Lower Mississippi and Texas Gulf Coast	5,833	27	496	5,518	26	373
North Central and Midwest	51,274	43	3,402	56,601	46	1,982
Northeast	1,453	20	194	2,108	28	188
Northern Plains	14,397	30	459	13,957	27	323
Northwest	2,856	20	174	3,801	28	151
South Central	1,093	18	54	1,659	32	100
Southern and Central Plains	12,004	19	535	17,279	28	488
Southwest	321***	11***	20	348***	11***	21
National	**95,572**	**31**	5,862	**107,423**	**34**	3,993
Continuous No Till						
Atlantic and Gulf Coastal Plains	3,713	26	399	4,570	33	306
California Coastal	294***	7***	1	73***	2***	2
East Central	4,520	49	458	6,685	66	492
Lower Mississippi and Texas Gulf Coast	3,846	18	453	3,373	16	278
North Central and Midwest	22,886	19	1,764	34,043	28	1,203
Northeast	1,357	19	218	2,750	36	282
Northern Plains	16,186	33	536	24,384	48	638
Northwest	1,157	8	90	3,303	25	131
South Central	469***	8***	21	729	14	37
Southern and Central Plains	7,062	11	287	22,923	37	631
Southwest	63***	2***	4	274***	9***	9
National	**61,553**	**20**	4,231	**103,108**	**33**	4,009
Conventional Tillage						
Atlantic and Gulf Coastal Plains	7,049	49	576	5,721	41	249
California Coastal	3,593	81	104	3,329	85	193
East Central	2,643	28	249	1,373	14	102
Lower Mississippi and Texas Gulf Coast	12,137	56	871	12,025	57	739
North Central and Midwest	45,973	38	2,899	32,652	26	1,020
Northeast	4,381	61	476	2,738	36	196
Northern Plains	17,838	37	523	12,789	25	251
Northwest	9,997	71	784	6,334	47	265
South Central	4,572	75	157	2,720	53	142
Southern and Central Plains	45,271	70	1,793	22,529	36	684
Southwest	2,487	87	166	2,561	80	105
National	**155,941**	**50**	8,598	**104,771**	**33**	3,946

**** Too few acres for significance change analysis*

Table A-7. Highly Erodible Land (HEL) Cultivated Cropland by Treatment Group and Region, CEAP I and CEAP II

Treatment Group and Region	CEAP I			CEAP II		
	Acres (1,000s)	Percent Regional Acres	Count	Acres (1,000s)	Percent Regional Acres	Count
Structural Practices plus Conservation Tillage						
Atlantic and Gulf Coastal Plains	153***	18***	15	213***	25***	18
California Coastal	0***	0***	0	0***	0***	0
East Central	1,294	40	135	2,036	55	144
Lower Mississippi and Texas Gulf Coast	642	39	116	950	50	75
North Central and Midwest	13,186	56	1,009	18,741	70	668
Northeast	667	28	97	1,340	49	139
Northern Plains	3,335	22	88	5,148	33	112
Northwest	614	12	44	1,408	29	58
South Central	38***	11***	3	196***	35***	8
Southern and Central Plains	1,946	8	85	5,763	22	147
Southwest	97***	7***	4	68***	4***	1
National	**21,971**	**28**	**1,596**	**35,862**	**42**	**1,370**
Structural Practices Only						
Atlantic and Gulf Coastal Plains	285***	34***	18	242***	29***	12
California Coastal	8***	31***	1	58***	28***	2
East Central	572	18	53	328***	9***	28
Lower Mississippi and Texas Gulf Coast	156***	9***	22	46***	2***	4
North Central and Midwest	3,368	14	244	2,912	11	110
Northeast	689	29	88	305***	11***	29
Northern Plains	1,648	11	47	680***	4***	17
Northwest	824	16	57	894***	18***	27
South Central	202***	59***	8	98***	17***	5
Southern and Central Plains	6,120	25	251	3,270	12	104
Southwest	255***	18***	16	364***	20***	11
National	**14,127**	**18**	**805**	**9,197**	**11**	**349**
Conservation Tillage Only						
Atlantic and Gulf Coastal Plains	205***	25***	21	275***	33***	26
California Coastal	0***	0***	0	0***	0***	0
East Central	1,136	35	120	1,209	33	98
Lower Mississippi and Texas Gulf Coast	575	35	98	703	37	64
North Central and Midwest	4,853	21	416	3,922	15	147
Northeast	448	19	64	770	28	60
Northern Plains	7,581	50	252	9,025	57	225
Northwest	1,152	22	73	1,109	23	37
South Central	20***	6***	2	118***	21***	9
Southern and Central Plains	5,103	21	225	10,427	39	240
Southwest	91***	6***	7	367***	21***	19
National	**21,164**	**27**	**1,278**	**27,926**	**33**	**925**
No Structural Practices or Conservation Tillage						
Atlantic and Gulf Coastal Plains	193***	23***	19	115***	14***	6
California Coastal	19***	69***	1	153***	72***	7
East Central	239***	7***	29	125***	3***	12
Lower Mississippi and Texas Gulf Coast	291***	18***	27	213***	11***	15
North Central and Midwest	2,055	9	158	1,072	4	38
Northeast	601	25	71	300***	11***	20
Northern Plains	2,537	17	84	911***	6***	26
Northwest	2,694	51	193	1,461	30	49
South Central	84***	24***	6	155***	27***	6
Southern and Central Plains	11,472	47	536	7,309	27	198
Southwest	969	69	71	985	55	39
National	**21,155**	**27**	**1,195**	**12,800**	**15**	**416**

Table A-7. Highly Erodible Land (HEL) Cultivated Cropland by Treatment Group and Region, CEAP I and CEAP II—Cont.

Treatment Group and Region	CEAP I			CEAP II		
	Acres (1,000s)	Percent Regional Acres	Count	Acres (1,000s)	Percent Regional Acres	Count
National Summary						
Atlantic and Gulf Coastal Plains	835	6	73	844	6	62
California Coastal	27***	1***	2	212***	5***	9
East Central	3,241	35	337	3,699	36	282
Lower Mississippi and Texas Gulf Coast	1,665	8	263	1,911	9	158
North Central and Midwest	23,462	20	1,827	26,648	22	963
Northeast	2,406	33	320	2,714	36	248
Northern Plains	15,101	31	471	15,764	31	380
Northwest	5,284	38	367	4,873	36	171
South Central	344***	6***	19	568***	11***	28
Southern and Central Plains	24,640	38	1,097	26,769	43	689
Southwest	1,412	49	98	1,784	56	70
National	**78,417**	**25**	**4,874**	**85,785**	**27**	**3,060**

Table A-8. Cultivated Cropland with High and Moderately High Runoff (SVI) ratings by Treatment Group and Region, CEAP I and CEAP II

Region and Treatment Group	CEAP I		CEAP II	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent
Atlantic and Gulf Coastal Plains				
Structural Practices, Conservation Tillage, or Both				
High	**143**	**79**	**116**	**66**
Moderately High	**920**	**82**	**1,171**	**80**
Structural Practices plus Conservation Tillage				
High	*22*	*12*	*60*	*34*
Moderately High	*209*	*19*	*368*	*25*
Conservation Tillage Only				
High	*54*	*30*	*42*	*24*
Moderately High	*431*	*38*	*563*	*39*
Structural Practices Only				
High	*67*	*37*	*14*	*8*
Moderately High	*279*	*25*	*239*	*16*
No Structural Practices or Conservation Tillage				
High	**37**	**21**	**60**	**34**
Moderately High	**204**	**18**	**290**	**20**
Regional Total				
High	**180**	**1**	**176**	**1**
Moderately High	**1,124**	**8**	**1,461**	**11**
California Coastal				
Structural Practices, Conservation Tillage, or Both				
High	**0**	**0**	**101**	**100**
Moderately High	**0**	**0**	**138**	**79**
Structural Practices plus Conservation Tillage				
High	*0*	*0*	*44*	*43*
Moderately High	*0*	*0*	*33*	*19*
Conservation Tillage Only				
High	*0*	*0*	*0*	*0*
Moderately High	*0*	*0*	*0*	*0*
Structural Practices Only				
High	*0*	*0*	*57*	*57*
Moderately High	*0*	*0*	*105*	*60*
No Structural Practices or Conservation Tillage				
High	**0**	**0**	**0**	**0**
Moderately High	**50**	**100**	**36**	**21**
Regional Total				
High	**0**	**0**	**101**	**3**
Moderately High	**50**	**1**	**174**	**4**

Table A-8. Cultivated Cropland with High and Moderately High Runoff (SVI) ratings by Treatment Group and Region, CEAP I and CEAP II—Cont.

Region and Treatment Group	CEAP I		CEAP II	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent
East Central				
Structural Practices, Conservation Tillage, or Both				
High	**1,519**	**93**	**2,153**	**96**
Moderately High	**2,364**	**86**	**2,832**	**95**
Structural Practices plus Conservation Tillage				
High	*501*	*31*	*1,126*	*50*
Moderately High	*1,122*	*41*	*1,401*	*47*
Conservation Tillage Only				
High	*606*	*37*	*801*	*36*
Moderately High	*914*	*33*	*1,330*	*45*
Structural Practices Only				
High	*412*	*25*	*226*	*10*
Moderately High	*328*	*12*	*100*	*3*
No Structural Practices or Conservation Tillage				
High	**110**	**7**	**98**	**4**
Moderately High	**373**	**14**	**150**	**5**
Regional Total				
High	**1,629**	**17**	**2,250**	**22**
Moderately High	**2,737**	**29**	**2,982**	**29**
Lower Mississippi and Texas Gulf Coast				
Structural Practices, Conservation Tillage, or Both				
High	**398**	**95**	**564**	**95**
Moderately High	**1,606**	**78**	**1,827**	**86**
Structural Practices plus Conservation Tillage				
High	*162*	*39*	*299*	*51*
Moderately High	*654*	*32*	*925*	*44*
Conservation Tillage Only				
High	*223*	*53*	*264*	*45*
Moderately High	*721*	*35*	*834*	*39*
Structural Practices Only				
High	*13*	*3*	*0*	*0*
Moderately High	*232*	*11*	*68*	*3*
No Structural Practices or Conservation Tillage				
High	**21**	**5**	**27**	**5**
Moderately High	**447**	**22**	**290**	**14**
Regional Total				
High	**419**	**2**	**590**	**3**
Moderately High	**2,053**	**9**	**2,117**	**10**

Table A-8. Cultivated Cropland with High and Moderately High Runoff (SVI) ratings by Treatment Group and Region, CEAP I and CEAP II—Cont.

Region and Treatment Group	CEAP I		CEAP II	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent
North Central and Midwest				
Structural Practices, Conservation Tillage, or Both				
High	**13,908**	**92**	**18,737**	**97**
Moderately High	**19,567**	**83**	**22,162**	**90**
Structural Practices plus Conservation Tillage				
High	*9,000*	*59*	*14,673*	*76*
Moderately High	*9,232*	*39*	*13,941*	*57*
Conservation Tillage Only				
High	*2,501*	*16*	*2,312*	*12*
Moderately High	*6,420*	*27*	*5,130*	*21*
Structural Practices Only				
High	*2,406*	*16*	*1,752*	*9*
Moderately High	*3,916*	*17*	*3,092*	*13*
No Structural Practices or Conservation Tillage				
High	**1,270**	**8**	**640**	**3**
Moderately High	**4,018**	**17**	**2,505**	**10**
Regional Total				
High	**15,178**	**13**	**19,377**	**16**
Moderately High	**23,585**	**20**	**24,668**	**20**
Northeast				
Structural Practices, Conservation Tillage, or Both				
High	**1,403**	**76**	**1,926**	**79**
Moderately High	**1,230**	**64**	**1,691**	**80**
Structural Practices plus Conservation Tillage				
High	*532*	*29*	*1,142*	*47*
Moderately High	*314*	*16*	*616*	*29*
Conservation Tillage Only				
High	*315*	*17*	*500*	*21*
Moderately High	*465*	*24*	*678*	*32*
Structural Practices Only				
High	*556*	*30*	*284*	*12*
Moderately High	*451*	*24*	*397*	*19*
No Structural Practices or Conservation Tillage				
High	**432**	**24**	**500**	**21**
Moderately High	**683**	**36**	**425**	**20**
Regional Total				
High	**1,834**	**26**	**2,426**	**32**
Moderately High	**1,913**	**27**	**2,116**	**28**

Table A-8. Cultivated Cropland with High and Moderately High Runoff (SVI) ratings by Treatment Group and Region, CEAP I and CEAP II—Cont.

Region and Treatment Group	CEAP I		CEAP II	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent
Northern Plains				
Structural Practices, Conservation Tillage, or Both				
High	**2,710**	**87**	**2,837**	**95**
Moderately High	**8,846**	**79**	**9,541**	**97**
Structural Practices plus Conservation Tillage				
High	*384*	*12*	*1,118*	*37*
Moderately High	*2,022*	*18*	*3,415*	*35*
Conservation Tillage Only				
High	*1,934*	*62*	*1,714*	*57*
Moderately High	*5,559*	*50*	*5,434*	*55*
Structural Practices Only				
High	*392*	*13*	*5*	*0.2*
Moderately High	*1,264*	*11*	*692*	*7*
No Structural Practices or Conservation Tillage				
High	**417**	**13**	**152**	**5**
Moderately High	**2,310**	**21**	**316**	**3**
Regional Total				
High	**3,128**	**6**	**2,990**	**6**
Moderately High	**11,155**	**23**	**9,857**	**19**
Northwest				
Structural Practices, Conservation Tillage, or Both				
High	**2,123**	**64**	**3,321**	**86**
Moderately High	**1,395**	**44**	**2,386**	**69**
Structural Practices plus Conservation Tillage				
High	*641*	*19*	*1,575*	*41*
Moderately High	*216*	*7*	*1,021*	*30*
Conservation Tillage Only				
High	*775*	*24*	*742*	*19*
Moderately High	*752*	*24*	*873*	*25*
Structural Practices Only				
High	*707*	*21*	*1,005*	*26*
Moderately High	*427*	*13*	*493*	*14*
No Structural Practices or Conservation Tillage				
High	**1,173**	**36**	**536**	**14**
Moderately High	**1,788**	**56**	**1,049**	**31**
Regional Total				
High	**3,296**	**24**	**3,858**	**29**
Moderately High	**3,183**	**23**	**3,436**	**26**

Table A-8. Cultivated Cropland with High and Moderately High Runoff (SVI) ratings by Treatment Group and Region, CEAP I and CEAP II—Cont.

Region and Treatment Group	CEAP I		CEAP II	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent
South Central				
Structural Practices, Conservation Tillage, or Both				
High	**20**	**100**	**133**	**63**
Moderately High	**1,158**	**70**	**1,293**	**78**
Structural Practices plus Conservation Tillage				
High	*0*	*0*	*71*	*34*
Moderately High	*348*	*21*	*431*	*26*
Conservation Tillage Only				
High	*20*	*100*	*62*	*29*
Moderately High	*183*	*11*	*283*	*17*
Structural Practices Only				
High	*0*	*0*	*0*	*0*
Moderately High	*627*	*38*	*579*	*35*
No Structural Practices or Conservation Tillage				
High	**0**	**0**	**78**	**37**
Moderately High	**499**	**30**	**374**	**22**
Regional Total				
High	**20**	**0.3**	**211**	**4**
Moderately High	**1,657**	**27**	**1,667**	**33**
Southern and Central Plains				
Structural Practices, Conservation Tillage, or Both				
High	**1,195**	**86**	**1,453**	**94**
Moderately High	**5,092**	**85**	**8,862**	**95**
Structural Practices plus Conservation Tillage				
High	*362*	*26*	*866*	*56*
Moderately High	*1,322*	*22*	*4,679*	*50*
Conservation Tillage Only				
High	*258*	*19*	*441*	*29*
Moderately High	*809*	*13*	*2,253*	*24*
Structural Practices Only				
High	*574*	*41*	*146*	*9*
Moderately High	*2,962*	*49*	*1,929*	*21*
No Structural Practices or Conservation Tillage				
High	**198**	**14**	**87**	**6**
Moderately High	**926**	**15**	**478**	**5**
Regional Total				
High	**1,393**	**2**	**1,539**	**2**
Moderately High	**6,018**	**9**	**9,340**	**15**

Table A-8. Cultivated Cropland with High and Moderately High Runoff (SVI) ratings by Treatment Group and Region, CEAP I and CEAP II—Cont.

Region and Treatment Group	CEAP I		CEAP II	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent
Southwest				
Structural Practices, Conservation Tillage, or Both				
High	**35**	**51**	**0**	**0**
Moderately High	**72**	**29**	**212**	**61**
Structural Practices plus Conservation Tillage				
High	*0*	*0*	*0*	*0*
Moderately High	*58*	*24*	*68*	*19*
Conservation Tillage Only				
High	*20*	*30*	*0*	*0*
Moderately High	*14*	*6*	*59*	*17*
Structural Practices Only				
High	*15*	*22*	*0*	*0*
Moderately High	*0*	*0*	*85*	*24*
No Structural Practices or Conservation Tillage				
High	**33**	**49**	**14**	**100**
Moderately High	**174**	**71**	**136**	**39**
Regional Total				
High	**68**	**2**	**14**	**0.4**
Moderately High	**247**	**9**	**349**	**11**

Table A-9. Conservation Crop Rotations by Group and Region, CEAP II

Region and Crop Rotation Group	Acres (1,000)	Count	Acres with Conservation Crop Rotations*	Acres with High-Biomass Conservation Crop Rotations**	Acres without Conservation Crop Rotations	
					Total	Acres with Idle in one or more years of the Rotation
			Percent			
Atlantic and Gulf Coastal Plains						
Hay with other crops	451	25	89.4	87.7	10.6	14.1
Close-grown crops, no hay or row crops	805	8	98.5	98.5	1.5	0.0
Row and close-grown crops, no hay	2,325	183	94.5	82.2	5.5	0.0
Row crops, no close-grown or hay	10,244	548	34.8	19.4	65.2	4.2
All cultivated cropland	13,825	764	50.3	36.8	49.7	4.2
California Coastal						
Hay with other crops	447	23	92.6	83.1	7.4	0.0
Close-grown crops, no hay or row crops	1,641	65	75.7	75.7	24.3	100.0
Row and close-grown crops, no hay	816	38	64.0	64.0	36.0	27.8
Row crops, no close-grown or hay	1,009	81	27.4	26.5	72.6	7.9
All cultivated cropland	3,913	207	62.7	61.4	37.3	36.9
East Central						
Hay with other crops	833	54	99.0	89.4	1.0	100.0
Close-grown crops, no hay or row crops	100	6	100.0	100.0	0.0	0.0
Row and close-grown crops, no hay	2,002	155	96.1	82.3	3.9	66.6
Row crops, no close-grown or hay	7,231	525	68.0	22.3	32.0	3.7
All cultivated cropland	10,166	740	76.4	40.4	23.6	6.0
Lower Mississippi and Texas Gulf Coast						
Hay with other crops	277	15	72.1	66.5	27.9	67.5
Close-grown crops, no hay or row crops	3,195	171	58.9	56.3	41.1	99.2
Row and close-grown crops, no hay	4,190	290	81.7	27.8	18.3	22.0
Row crops, no close-grown or hay	13,254	914	36.6	8.1	63.4	6.1
All cultivated cropland	20,916	1,390	49.5	20.2	50.5	19.3

Table A-9. Conservation Crop Rotations by Group and Region, CEAP II—Cont.

Region and Crop Rotation Group	Acres (1,000)	Count	Acres with Conservation Crop Rotations*	Acres with High-Biomass Conservation Crop Rotations**	Acres without Conservation Crop Rotations	
					Total	Acres with Idle in one or more years of the Rotation
			Percent			
North Central and Midwest						
Hay with other crops	6,539	154	96.6	94.8	3.4	0.0
Close-grown crops, no hay or row crops	785	7	22.4	22.4	77.6	100.0
Row and close-grown crops, no hay	10,601	382	79.9	31.0	20.1	8.5
Row crops, no close-grown or hay	105,371	3,662	88.1	14.2	11.9	11.3
All cultivated cropland	123,296	4,205	87.4	20.0	12.6	14.2
Northeast						
Hay with other crops	1,669	124	96.3	95.3	3.7	100.0
Close-grown crops, no hay or row crops	118	8	79.3	79.3	20.7	100.0
Row and close-grown crops, no hay	1,751	161	84.3	63.7	15.7	58.4
Row crops, no close-grown or hay	4,059	373	73.4	31.6	26.6	6.2
All cultivated cropland	7,597	666	81.0	53.7	19.0	21.7
Northern Plains						
Hay with other crops	2,635	84	86.3	74.2	13.7	91.8
Close-grown crops, no hay or row crops	13,636	296	46.7	30.9	53.3	94.8
Row and close-grown crops, no hay	21,156	483	63.2	11.1	36.8	12.3
Row crops, no close-grown or hay	13,703	349	64.1	9.3	35.9	7.6
All cultivated cropland	51,130	1,212	60.2	19.2	39.8	42.1
Northwest						
Hay with other crops	1,437	83	99.1	96.1	0.9	100.0
Close-grown crops, no hay or row crops	7,694	280	28.0	26.1	72.0	98.1
Row and close-grown crops, no hay	3,376	136	51.0	13.3	49.0	11.2
Row crops, no close-grown or hay	931	48	12.7	6.2	87.3	3.0
All cultivated cropland	13,438	547	40.3	29.0	59.7	70.6

Table A-9. Conservation Crop Rotations by Group and Region, CEAP II—Cont.

Region and Crop Rotation Group	Acres (1,000)	Count	Acres with Conservation Crop Rotations*	Acres with High-Biomass Conservation Crop Rotations**	Acres without Conservation Crop Rotations	
					Total	Acres with Idle in one or more years of the Rotation
			Percent			
South Central						
Hay with other crops	453	32	100.0	95.7	0.0	0.0
Close-grown crops, no hay or row crops	530	31	51.0	46.4	49.0	100.0
Row and close-grown crops, no hay	2,011	111	92.8	66.3	7.2	34.2
Row crops, no close-grown or hay	2,113	105	55.5	26.1	44.5	22.5
All cultivated cropland	5,107	279	73.7	50.2	26.3	38.7
Southern and Central Plains						
Hay with other crops	4,852	141	71.3	65.5	28.7	80.5
Close-grown crops, no hay or row crops	18,157	464	53.9	51.9	46.1	99.0
Row and close-grown crops, no hay	16,919	427	55.6	34.1	44.4	88.4
Row crops, no close-grown or hay	22,804	771	58.4	26.2	41.6	10.2
All cultivated cropland	62,732	1,803	57.4	38.8	42.6	63.6
Southwest						
Hay with other crops	1,193	42	90.1	90.1	9.9	7.4
Close-grown crops, no hay or row crops	630	23	30.1	30.1	69.9	100.0
Row and close-grown crops, no hay	571	25	48.2	16.0	51.8	21.4
Row crops, no close-grown or hay	790	45	11.4	11.4	88.6	26.4
All cultivated cropland	3,183	135	51.2	45.4	48.8	44.9

** Acres with a crop rotation biomass index score greater than or equal to 1.5*
*** Acres with a crop rotation biomass index score greater than or equal to 2.0*

Table A-10. Nitrogen Application by Incorporation and Region, CEAP I and CEAP II

Region	Applications Incorporated	CEAP I			CEAP II		
		Applied Acres (1,000s)	Average Annual Load (Tons)	Count	Applied Acres (1,000s)	Average Annual Load (Tons)	Count
Atlantic and Gulf Coastal Plains							
	All	5,244	223,611	430	2,716	93,937	143
	Some	5,191	258,082	500	5,775	282,570	317
	None	3,187	119,621	288	4,403	160,678	246
California Coastal							
	All	2,130	152,210	64	904	42,705	45
	Some	895	108,644	34	2,134	191,172	118
	None	631	69,242	9	494	23,508	37
East Central							
	All	2,376	115,143	234	1,192	48,978	79
	Some	3,651	182,313	366	3,528	184,091	258
	None	2,872	131,247	277	4,947	234,656	366
Lower Mississippi and Texas Gulf Coast							
	All	6,700	316,551	487	4,324	196,616	229
	Some	6,345	337,315	538	6,540	391,308	441
	None	4,706	210,066	469	5,592	260,718	404
North Central and Midwest							
	All	55,860	2,183,989	3694	40,029	1,727,760	1361
	Some	45,794	2,074,316	3061	58,035	2,810,193	1966
	None	13,694	449,583	969	20,292	740,370	734
Northeast							
	All	2,414	97,128	262	1,774	66,953	142
	Some	3,454	199,569	416	3,613	200,187	307
	None	1,065	50,468	178	1,994	98,583	192
Northern Plains							
	All	33,146	801,565	1004	26,274	811,072	592
	Some	10,501	317,500	349	17,514	687,296	423
	None	2,822	82,520	101	4,768	175,509	138
Northwest							
	All	8,031	252,198	566	6,553	191,570	244
	Some	3,761	227,441	294	3,943	240,744	164
	None	1,901	97,545	166	2,499	118,957	116
South Central							
	All	2,575	113,403	81	1,441	53,710	66
	Some	1,839	88,189	80	1,765	93,604	107
	None	1,535	61,199	62	1,431	70,784	77
Southern and Central Plains							
	All	32,737	978,233	1332	21,331	599,833	615
	Some	18,498	710,712	764	24,923	989,328	712
	None	8,083	230,505	319	10,419	299,894	306
Southwest							
	All	1,052	41,340	85	884	30,694	35
	Some	1,418	140,917	78	1,246	106,003	54
	None	277	10,944	23	788	39,501	32

Table A-11. Phosphorus Application by Incorporation and Region, CEAP I and CEAP II

Region	Applications Incorporated	CEAP I			CEAP II		
		Applied Acres (1,000s)	Average Annual Load (Tons)	Count	Applied Acres (1,000s)	Average Annual Load (tons)	Count
Atlantic and Gulf Coastal Plains							
	All	4,803	57,643	398	2,657	29,365	130
	Some	5,056	62,825	485	5,463	61,980	296
	None	3,083	31,719	279	4,158	40,467	236
California Coastal							
	All	1,370	25,536	48	575	6,709	30
	Some	895	19,997	34	2,052	38,484	112
	None	505	6,835	6	376	5,835	31
East Central							
	All	2,373	33,011	234	1,193	14,724	77
	Some	3,569	49,516	361	3,350	46,103	248
	None	2,750	37,397	270	5,003	73,192	372
Lower Mississippi and Texas Gulf Coast							
	All	6,113	54,586	453	5,991	60,286	346
	Some	6,144	64,164	519	6,276	76,950	423
	None	4,128	39,482	435	5,467	53,851	398
North Central and Midwest							
	All	55,107	523,582	3650	40,118	439,128	1371
	Some	45,455	527,005	3036	57,329	700,839	1941
	None	13,320	135,044	934	19,502	243,774	717
Northeast							
	All	2,357	28,217	259	1,662	16,679	132
	Some	3,402	57,679	408	3,541	52,187	301
	None	982	15,378	165	1,877	25,973	181
Northern Plains							
	All	30,423	168,544	924	25,339	189,356	580
	Some	10,386	66,158	346	17,314	141,363	417
	None	2,416	16,479	85	4,308	40,965	128
Northwest							
	All	5,180	46,167	372	5,718	39,055	202
	Some	3,452	43,997	270	3,533	54,901	149
	None	1,290	16,859	116	1,897	23,879	97
South Central							
	All	1,935	16,396	64	1,386	12,452	70
	Some	1,839	17,909	80	1,732	19,602	105
	None	1,104	8,958	52	1,148	11,787	63
Southern and Central Plains							
	All	23,010	151,936	950	15,894	111,530	457
	Some	17,817	123,911	731	23,844	194,861	679
	None	5,929	39,874	237	7,911	58,405	231
Southwest							
	All	705	10,492	54	462	4,145	18
	Some	1,378	36,443	74	1,160	30,445	52
	None	197	3,835	16	624	10,925	24

Table A-12. Nitrogen Application Timing and Incorporation by Region, CEAP I and CEAP II

Region	Timing	Incorporation	CEAP I			CEAP II		
			Application Acres (1,000s)	Average Annual Load (Tons)	Count	Application Acres (1,000s)	Average Annual Load (Tons)	Count
Atlantic and Gulf Coastal Plains								
	Pre-plant 7-21 days							
		Incorporated	2,009	53,748	148	1,338	25,076	72
		Not Incorporated	1,330	19,594	147	2,128	23,280	137
	Pre-plant >21 days							
		Incorporated	1,551	39,680	135	1,604	35,720	80
		Not Incorporated	1,864	41,921	175	2,786	52,473	184
	At-plant							
		Incorporated	5,970	112,671	559	4,861	77,667	267
		Not Incorporated	3,260	56,835	351	4,282	89,899	275
	Post-plant							
		Incorporated	5,388	159,607	453	3,707	103,919	216
		Not Incorporated	3,310	89,831	252	4,454	109,239	205
California Coastal								
	Pre-plant 7-21 days							
		Incorporated	450	22,533	19	770	30,165	46
		Not Incorporated	107	1,881	4	377	6,190	26
	Pre-plant >21 days							
		Incorporated	531	18,168	14	595	35,420	32
		Not Incorporated	259	4,872	8	829	14,451	42
	At-plant							
		Incorporated	2,082	99,429	60	2,055	69,988	107
		Not Incorporated	488	23,817	12	883	17,879	55
	Post-plant							
		Incorporated	915	38,846	30	345	12,554	24
		Not Incorporated	972	48,653	23	1,665	36,510	106
East Central								
	Pre-plant 7-21 days							
		Incorporated	829	21,942	79	499	15,596	35
		Not Incorporated	1,387	30,321	139	2,198	55,113	174
	Pre-plant >21 days							
		Incorporated	622	18,252	60	418	11,759	31
		Not Incorporated	1,521	37,875	150	3,087	76,811	247
	At-plant							
		Incorporated	4,147	98,213	419	3,088	63,761	226
		Not Incorporated	3,421	90,711	329	4,260	111,588	306
	Post-plant							
		Incorporated	2,243	62,354	229	1,743	47,439	120
		Not Incorporated	1,632	41,053	173	2,725	67,115	215
Lower Mississippi and Texas Gulf Coast								
	Pre-plant 7-21 days							
		Incorporated	895	25,034	93	1,453	43,356	82
		Not Incorporated	1,153	28,968	134	1,279	31,085	83
	Pre-plant >21 days							
		Incorporated	1,551	44,304	100	2,055	62,387	93
		Not Incorporated	1,174	35,077	126	2,069	51,938	144
	At-plant							
		Incorporated	5,292	156,629	448	3,313	98,646	219
		Not Incorporated	3,157	76,663	347	4,238	103,045	318
	Post-plant							
		Incorporated	5,335	226,024	408	3,403	116,399	210
		Not Incorporated	6,397	239,179	497	8,074	332,255	549

Table A-12. Nitrogen Application Timing and Incorporation by Region, CEAP I and CEAP II—Cont.

Region	Timing	Incorporation	CEAP I			CEAP II		
			Application Acres (1,000s)	Average Annual Load (Tons)	Count	Application Acres (1,000s)	Average Annual Load (Tons)	Count
North Central and Midwest								
	Pre-plant 7-21 days							
		Incorporated	13,001	373,286	860	17,471	531,202	608
		Not Incorporated	5,927	116,001	424	13,854	229,789	460
	Pre-plant >21 days							
		Incorporated	34,525	1,081,118	2086	31,782	956,353	1040
		Not Incorporated	23,696	445,569	1497	33,411	512,203	1152
	At-plant							
		Incorporated	63,656	1,428,509	4445	53,376	1,096,451	1836
		Not Incorporated	19,078	370,455	1425	22,846	421,154	844
	Post-plant							
		Incorporated	18,445	549,272	1365	34,288	1,019,138	1204
		Not Incorporated	8,959	198,436	618	23,731	396,842	813
Northeast								
	Pre-plant 7-21 days							
		Incorporated	676	15,950	85	536	12,607	48
		Not Incorporated	715	13,938	97	1,117	20,123	119
	Pre-plant >21 days							
		Incorporated	849	24,404	106	702	21,065	50
		Not Incorporated	1,670	51,822	214	2,219	56,373	209
	At-plant							
		Incorporated	5,085	110,990	562	4,547	79,961	375
		Not Incorporated	1,832	41,073	275	2,979	64,978	271
	Post-plant							
		Incorporated	1,068	24,104	131	1,422	28,657	116
		Not Incorporated	1,539	44,990	200	1,972	56,664	179
Northern Plains								
	Pre-plant 7-21 days							
		Incorporated	3,279	48,749	96	3,586	75,321	82
		Not Incorporated	1,381	22,674	50	4,276	84,760	105
	Pre-plant >21 days							
		Incorporated	7,524	166,828	215	6,173	168,488	123
		Not Incorporated	3,634	71,176	123	5,768	121,557	149
	At-plant							
		Incorporated	39,155	674,359	1212	37,704	743,358	886
		Not Incorporated	5,711	100,792	206	10,448	228,100	274
	Post-plant							
		Incorporated	889	20,406	38	2,993	43,103	76
		Not Incorporated	1,374	27,454	46	3,761	60,951	94
Northwest								
	Pre-plant 7-21 days							
		Incorporated	2,272	55,078	177	1,580	44,412	73
		Not Incorporated	313	7,422	34	1,021	24,266	46
	Pre-plant >21 days							
		Incorporated	3,538	81,157	253	3,462	75,972	107
		Not Incorporated	1,350	41,908	107	3,003	54,227	139
	At-plant							
		Incorporated	7,177	179,737	540	7,018	153,595	282
		Not Incorporated	1,229	29,478	98	1,398	34,210	54
	Post-plant							
		Incorporated	567	14,195	59	514	15,598	26
		Not Incorporated	827	40,050	84	902	48,380	55

Table A-12. Nitrogen Application Timing and Incorporation by Region, CEAP I and CEAP II—Cont.

Region	Timing	Incorporation	CEAP I			CEAP II		
			Application Acres (1,000s)	Average Annual Load (Tons)	Count	Application Acres (1,000s)	Average Annual Load (Tons)	Count
South Central								
	Pre-plant 7-21 days							
		Incorporated	725	11,253	23	591	8,817	32
		Not Incorporated	149	2,014	12	407	9,044	22
	Pre-plant >21 days							
		Incorporated	1,192	28,993	35	1,358	28,950	63
		Not Incorporated	628	17,607	23	1,597	37,138	86
	At-plant							
		Incorporated	2,899	72,426	109	1,373	31,699	76
		Not Incorporated	1,368	31,729	56	933	17,274	57
	Post-plant							
		Incorporated	1,143	28,580	38	831	23,563	38
		Not Incorporated	845	25,200	45	1,279	48,376	69
Southern and Central Plains								
	Pre-plant 7-21 days							
		Incorporated	5,410	113,824	236	5,841	111,789	183
		Not Incorporated	2,581	44,788	114	5,340	79,432	148
	Pre-plant >21 days							
		Incorporated	17,331	462,332	707	16,325	398,124	453
		Not Incorporated	8,930	175,751	363	20,335	336,036	590
	At-plant							
		Incorporated	33,379	589,547	1359	26,598	340,601	795
		Not Incorporated	8,167	146,985	327	9,471	153,151	298
	Post-plant							
		Incorporated	4,627	144,481	217	7,221	164,236	210
		Not Incorporated	3,742	103,375	185	8,650	211,432	259
Southwest								
	Pre-plant 7-21 days							
		Incorporated	466	8,031	24	285	5,305	15
		Not Incorporated	120	4,490	8	85	1,743	8
	Pre-plant >21 days							
		Incorporated	572	21,774	47	593	20,936	30
		Not Incorporated	394	13,578	26	983	16,364	35
	At-plant							
		Incorporated	1,289	36,070	78	1,318	30,655	50
		Not Incorporated	474	6,346	18	466	9,308	18
	Post-plant							
		Incorporated	633	27,243	51	506	20,236	17
		Not Incorporated	518	21,618	35	942	46,788	39

Table A-13. Phosphorus Application Timing and Incorporation by Region, CEAP I and CEAP II

Region	Timing	Incorporation	CEAP I			CEAP II		
			Application Acres (1,000s)	Average Annual Load (Tons)	Count	Application Acres (1,000s)	Average Annual Load (Tons)	Count
Atlantic and Gulf Coastal Plains								
	Pre-plant 7-21 days							
		Incorporated	1,996	17,504	149	1,309	9,661	72
		Not Incorporated	1,311	8,700	150	2,357	14,396	134
	Pre-plant >21 days							
		Incorporated	1,713	18,165	163	1,874	13,911	78
		Not Incorporated	2,017	17,362	175	2,251	17,980	134
	At-plant							
		Incorporated	5,057	38,618	476	3,469	21,904	208
		Not Incorporated	2,937	23,092	303	3,598	25,278	226
	Post-plant							
		Incorporated	1,389	16,842	84	1,232	13,673	37
		Not Incorporated	1,143	8,482	93	2,222	12,733	83
California Coastal								
	Pre-plant 7-21 days							
		Incorporated	187	5,890	8	413	3,391	27
		Not Incorporated	107	950	4	243	1,325	17
	Pre-plant >21 days							
		Incorporated	474	4,543	11	552	11,572	25
		Not Incorporated	191	1,473	6	641	4,859	28
	At-plant							
		Incorporated	1,425	17,279	43	1,172	10,984	71
		Not Incorporated	707	5,784	12	589	5,423	38
	Post-plant							
		Incorporated	160	2,504	8	187	1,802	13
		Not Incorporated	460	4,980	12	712	5,477	41
East Central								
	Pre-plant 7-21 days							
		Incorporated	754	6,882	71	334	3,120	25
		Not Incorporated	1,364	12,172	140	2,331	22,991	180
	Pre-plant >21 days							
		Incorporated	733	7,757	69	376	3,441	28
		Not Incorporated	1,556	15,689	164	2,878	30,139	224
	At-plant							
		Incorporated	3,574	36,282	355	2,400	19,282	174
		Not Incorporated	3,169	30,397	317	3,950	39,247	287
	Post-plant							
		Incorporated	426	5,165	38	278	1,644	18
		Not Incorporated	514	3,780	58	1,269	8,272	102
Lower Mississippi and Texas Gulf Coast								
	Pre-plant 7-21 days							
		Incorporated	1,063	7,289	87	2,323	21,581	130
		Not Incorporated	1,174	9,121	143	1,520	10,665	95
	Pre-plant >21 days							
		Incorporated	2,278	17,184	142	3,202	27,239	175
		Not Incorporated	1,489	11,027	148	2,029	14,220	131
	At-plant							
		Incorporated	6,071	49,507	487	6,077	54,992	395
		Not Incorporated	3,019	24,657	360	4,210	35,131	327
	Post-plant							
		Incorporated	1,504	15,377	99	1,118	7,835	65
		Not Incorporated	2,541	22,607	207	2,432	18,645	163

Table A-13. Phosphorus Application Timing and Incorporation by Region, CEAP I and CEAP II—Cont.

Region	Timing	Incorporation	CEAP I			CEAP II		
			Application Acres (1,000s)	Average Annual Load (Tons)	Count	Application Acres (1,000s)	Average Annual Load (Tons)	Count
North Central and Midwest								
	Pre-plant 7-21 days							
		Incorporated	8,436	64,514	525	10,564	86,430	358
		Not Incorporated	5,241	41,200	381	12,109	97,621	421
	Pre-plant >21 days							
		Incorporated	24,702	226,077	1475	21,034	183,942	668
		Not Incorporated	28,758	287,610	1827	34,713	317,150	1173
	At-plant							
		Incorporated	55,364	391,995	3968	45,684	342,303	1626
		Not Incorporated	14,863	109,934	1119	14,728	105,457	560
	Post-plant							
		Incorporated	2,752	26,268	170	9,570	85,852	299
		Not Incorporated	2,489	19,463	181	17,352	132,296	602
Northeast								
	Pre-plant 7-21 days							
		Incorporated	725	5,806	94	499	3,152	44
		Not Incorporated	611	4,058	82	962	7,689	102
	Pre-plant >21 days							
		Incorporated	905	10,320	113	696	6,878	52
		Not Incorporated	1,652	19,282	211	1,738	17,428	160
	At-plant							
		Incorporated	4,524	37,597	499	3,762	23,978	301
		Not Incorporated	1,275	8,344	189	2,127	15,914	189
	Post-plant							
		Incorporated	323	2,198	48	248	1,312	19
		Not Incorporated	704	9,016	83	953	9,770	82
Northern Plains								
	Pre-plant 7-21 days							
		Incorporated	1,720	8,797	58	2,955	18,282	71
		Not Incorporated	554	1,802	20	2,121	10,773	52
	Pre-plant >21 days							
		Incorporated	4,272	23,892	133	4,684	29,479	99
		Not Incorporated	2,133	12,313	71	2,980	25,881	81
	At-plant							
		Incorporated	36,486	185,236	1117	36,739	220,223	859
		Not Incorporated	2,546	10,935	102	6,506	35,440	174
	Post-plant							
		Incorporated	174	1,395	9	1,908	8,889	45
		Not Incorporated	252	1,439	9	1,029	4,925	32
Northwest								
	Pre-plant 7-21 days							
		Incorporated	1,634	12,257	133	1,224	7,879	60
		Not Incorporated	266	1,583	27	671	4,631	30
	Pre-plant >21 days							
		Incorporated	1,465	15,801	129	1,674	17,121	67
		Not Incorporated	900	10,628	74	1,177	6,686	66
	At-plant							
		Incorporated	5,556	37,138	418	6,596	38,827	243
		Not Incorporated	890	6,678	65	1,095	5,512	42
	Post-plant							
		Incorporated	629	3,604	45	286	3,028	13
		Not Incorporated	417	3,639	50	626	16,044	37

Table A-13. Phosphorus Application Timing and Incorporation by Region, CEAP I and CEAP II—Cont.

Region	Timing	Incorporation	CEAP I			CEAP II		
			Application Acres (1,000s)	Average Annual Load (Tons)	Count	Application Acres (1,000s)	Average Annual Load (Tons)	Count
South Central								
	Pre-plant 7-21 days							
		Incorporated	740	4,810	28	664	3,855	37
		Not Incorporated	165	876	12	404	2,826	14
	Pre-plant >21 days							
		Incorporated	976	5,444	31	1,174	7,143	58
		Not Incorporated	344	1,430	17	845	5,185	44
	At-plant							
		Incorporated	2,062	16,331	87	1,566	12,344	89
		Not Incorporated	971	5,240	43	659	4,988	38
	Post-plant							
		Incorporated	317	2,133	14	399	2,702	17
		Not Incorporated	437	2,165	23	463	2,962	24
Southern and Central Plains								
	Pre-plant 7-21 days							
		Incorporated	3,048	14,684	140	3,880	21,798	117
		Not Incorporated	1,599	9,669	71	3,151	14,294	85
	Pre-plant >21 days							
		Incorporated	10,201	68,140	417	7,802	49,419	218
		Not Incorporated	4,426	27,250	188	9,671	62,787	282
	At-plant							
		Incorporated	26,294	140,971	1065	24,836	138,651	721
		Not Incorporated	5,034	25,147	189	6,457	31,514	186
	Post-plant							
		Incorporated	1,449	10,553	63	2,041	11,642	69
		Not Incorporated	893	6,324	42	3,407	16,147	91
Southwest								
	Pre-plant 7-21 days							
		Incorporated	264	2,981	20	242	2,610	10
		Not Incorporated	91	2,076	6	57	1,244	5
	Pre-plant >21 days							
		Incorporated	500	9,417	38	443	11,001	22
		Not Incorporated	285	6,479	18	480	3,431	21
	At-plant							
		Incorporated	850	11,163	55	883	6,688	34
		Not Incorporated	257	4,430	9	397	6,952	13
	Post-plant							
		Incorporated	166	956	18	162	1,350	4
		Not Incorporated	76	3,191	6	208	1,233	12

Table A-14. Sheet and Rill Erosion Relative to Threshold by Region, CEAP I and CEAP II

Region	Cultivated Cropland Exceeding Threshold		Cultivated Cropland Meeting Threshold		Loss on Acres Exceeding Threshold		Loss on Acres Meeting Threshold	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Tons (1,000s)	Percent
CEAP I								
Atlantic and Gulf Coastal Plains	2,245.6	16	12,148.9	84	21,968	60	14,705	40
California Coastal	57.6	1	4,389.0	99	338	26	968	74
East Central	3,305.1	35	6,007.3	65	31,649	79	8,363	21
Lower Mississippi and Texas Gulf Coast	3,567.3	16	18,248.4	84	35,246	55	28,634	45
North Central and Midwest	18,133.4	15	102,000.1	85	176,671	60	118,543	40
Northeast	2,772.4	39	4,417.9	61	23,803	79	6,259	21
Northern Plains	759.6	2	47,660.7	98	4,553	14	28,098	86
Northwest	220.1	2	13,789.6	98	1,395	29	3,407	71
South Central	1,516.9	25	4,617.7	75	15,267	62	9,455	38
Southern and Central Plains	2,940.9	5	61,395.9	95	20,899	30	48,280	70
Southwest		0	2,870.4	100	-	0	120	100
National	**35,519**	**11**	**277,546**	**89**	**331,789**	**55**	**266,834**	**45**
CEAP II								
Atlantic and Gulf Coastal Plains	2,006.5	15	11,818.2	85	22,070	62	13,350	38
California Coastal	38.7	1	3,874.2	99	345	28	873	72
East Central	3,257.8	32	6,908.4	68	31,965	77	9,745	23
Lower Mississippi and Texas Gulf Coast	3,412.4	16	17,503.5	84	32,729	55	26,570	45
North Central and Midwest	16,324.3	13	106,971.6	87	150,280	57	113,539	43
Northeast	2,395.0	32	5,202.0	68	18,174	75	6,077	25
Northern Plains	753.4	1	50,376.8	99	4,833	19	20,825	81
Northwest	84.8	1	13,353.5	99	919	28	2,380	72
South Central	1,455.7	29	3,651.6	71	15,011	71	6,139	29
Southern and Central Plains	1,352.9	2	61,378.8	98	9,389	20	36,597	80
Southwest	89.5	3	3,093.5	97	296	65	156	35
National	**31,171**	**10**	**284,132**	**90**	**286,012**	**55**	**236,252**	**45**

Table A-15. Wind Erosion Relative to Threshold by Region, CEAP I and CEAP II

Region	Cultivated Cropland Exceeding Threshold		Cultivated Cropland Meeting Threshold		Loss on Acres Exceeding Threshold		Loss on Acres Meeting Threshold	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Tons (1,000s)	Percent
CEAP I								
Atlantic and Gulf Coastal Plains	-	0	14,395	100	-	0	1,284	100
California Coastal	-	0	4,447	100	-	0	133	100
East Central	-	0	9,312	100	-	0	204	100
Lower Mississippi and Texas Gulf Coast	373	2	21,443	98	2,836	29	6,849	71
North Central and Midwest	2,653	2	117,481	98	20,770	24	67,120	76
Northeast	-	0	7,190	100	-	0	418	100
Northern Plains	11,267	23	37,153	77	83,096	57	62,228	43
Northwest	3,660	26	10,350	74	25,780	64	14,295	36
South Central	64	1	6,070	99	342	7	4,458	93
Southern and Central Plains	19,676	31	44,661	69	199,396	67	98,885	33
Southwest	941	33	1,930	67	12,466	80	3,044	20
National	**38,634**	**12**	**274,431**	**88**	**344,686**	**57**	**258,919**	**43**
CEAP II								
Atlantic and Gulf Coastal Plains	-	0	13,825	100	-	0	659	100
California Coastal	-	0	3,913	100	-	0	102	100
East Central	-	0	10,166	100	-	0	138	100
Lower Mississippi and Texas Gulf Coast	537	3	20,379	97	5,054	52	4,737	48
North Central and Midwest	1,875	2	121,421	98	13,809	21	52,996	79
Northeast	-	0	7,597	100	-	0	225	100
Northern Plains	12,253	24	38,877	76	94,851	66	48,979	34
Northwest	1,870	14	11,568	86	16,295	58	11,747	42
South Central	106	2	5,001	98	610	20	2,379	80
Southern and Central Plains	13,549	22	49,183	78	174,193	70	73,327	30
Southwest	802	25	2,381	75	7,025	73	2,615	27
National	**30,994**	**10**	**284,309**	**90**	**311,836**	**61**	**197,904**	**39**

Table A-16. Sediment Relative to Threshold by Region, CEAP I and CEAP II

Region	Cultivated Cropland Exceeding Threshold		Cultivated Cropland Meeting Threshold		Loss on Acres Exceeding Threshold		Loss on Acres Meeting Threshold	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Tons (1,000s)	Percent
CEAP I								
Atlantic and Gulf Coastal Plains	1,949	14	12,445	86	11,329	71	4,713	29
California Coastal	108	2	4,339	98	928	53	826	47
East Central	2,694	29	6,619	71	20,777	85	3,561	15
Lower Mississippi and Texas Gulf	6,067	28	15,749	72	39,696	80	9,690	20
North Central Midwest	17,262	14	102,872	86	112,803	74	39,791	26
Northeast	2,437	34	4,754	66	16,757	86	2,816	14
Northern Plains	1,783	4	46,638	96	6,606	38	10,716	62
Northwest	922	7	13,087	93	5,855	64	3,246	36
South Central	2,172	35	3,963	65	14,319	83	2,868	17
Southern and Central Plains	2,695	4	61,641	96	12,508	42	17,463	58
Southwest	24	1	2,846	99	110	30	258	70
National	**38,113**	**12**	**274,952**	**88**	**241,689**	**72**	**95,946**	**28**
CEAP II								
Atlantic and Gulf Coastal Plains	1,663	12	12,162	88	11,341	72	4,310	28
California Coastal	200	5	3,713	95	1,056	54	906	46
East Central	2,868	28	7,298	72	21,079	85	3,627	15
Lower Mississippi and Texas Gulf	5,104	24	15,812	76	28,860	74	9,999	26
North Central Midwest	13,613	11	109,682	89	81,469	69	36,841	31
Northeast	1,766	23	5,831	77	12,564	82	2,771	18
Northern Plains	758	1	50,373	99	3,229	29	7,885	71
Northwest	472	4	12,967	96	3,640	62	2,240	38
South Central	1,666	33	3,442	67	11,101	83	2,218	17
Southern and Central Plains	1,104	2	61,628	98	5,266	30	12,177	70
Southwest	122	4	3,061	96	632	72	244	28
National	**29,335**	**9**	**285,968**	**91**	**180,237**	**68**	**83,218**	**32**

Table A-17. Surface Nitrogen Relative to Threshold by Region, CEAP I and CEAP II

Region	Cultivated Cropland Exceeding Threshold		Cultivated Cropland Meeting Threshold		Loss on Acres Exceeding Threshold		Loss on Acres Meeting Threshold	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Tons (1,000s)	Percent
CEAP I								
Atlantic and Gulf Coastal Plains	294	2	14,101	98	4	22	15	78
California Coastal	58	1	4,389	99	1	35	1	65
East Central	1,478	16	7,834	84	22	60	15	40
Lower Mississippi and Texas Gulf Coast	2,262	10	19,554	90	32	45	40	55
North Central and Midwest	11,517	10	108,617	90	164	45	202	55
Northeast	1,118	16	6,072	84	16	56	12	44
Northern Plains	8,578	18	39,842	82	97	47	108	53
Northwest	871	6	13,139	94	11	25	32	75
South Central	1,387	23	4,748	77	18	59	12	41
Southern and Central Plains	7,310	11	57,027	89	85	32	179	68
Southwest	209	7	2,661	93	2	33	5	67
National	**35,084**	**11**	**277,981**	**89**	**452**	**42**	**621**	**58**
CEAP II								
Atlantic and Gulf Coastal Plains	481	3	13,344	97	7	31	16	69
California Coastal	49	1	3,864	99	1	29	2	71
East Central	1,770	17	8,396	83	30	63	18	37
Lower Mississippi and Texas Gulf Coast	2,277	11	18,639	89	29	43	40	57
North Central and Midwest	9,039	7	114,257	93	157	45	196	55
Northeast	1,047	14	6,550	86	17	60	12	40
Northern Plains	11,442	22	39,688	78	153	63	92	37
Northwest	606	5	12,832	95	10	32	21	68
South Central	1,326	26	3,781	74	21	69	9	31
Southern and Central Plains	5,764	9	56,968	91	69	34	132	66
Southwest	143	4	3,040	96	2	25	5	75
National	**33,946**	**11**	**281,357**	**89**	**497**	**48**	**541**	**52**

TableA-18. Sediment-Transported Phosphorus Relative to Threshold by Region, CEAP I and CEAP II

Region	Cultivated Cropland Exceeding Threshold		Cultivated Cropland Meeting Threshold		Loss on Acres Exceeding Threshold		Loss on Acres Meeting Threshold	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Tons (1,000s)	Percent
CEAP I								
Atlantic and Gulf Coastal Plains	1,543	11	12,852	89	5.0	57	3.7	43
California Coastal	79	2	4,368	98	0.3	37	0.5	63
East Central	2,396	26	6,917	74	11.1	81	2.6	19
Lower Mississippi and Texas Gulf Coast	3,102	14	18,714	86	11.4	62	6.9	38
North Central and Midwest	14,678	12	105,456	88	56.5	62	34.6	38
Northeast	2,614	36	4,576	64	12.9	86	2.0	14
Northern Plains	2,705	6	45,715	94	6.7	29	16.4	71
Northwest	1,007	7	13,002	93	3.6	51	3.5	49
South Central	1,660	27	4,475	73	5.0	71	2.1	29
Southern and Central Plains	5,170	8	59,166	92	16.6	41	23.7	59
Southwest	257	9	2,614	91	1.1	64	0.6	36
National	**35,211**	**11**	**277,854**	**89**	**130**	**57**	**97**	**43**
CEAP II								
Atlantic and Gulf Coastal Plains	1,606	12	12,218	88	6.0	65	3.3	35
California Coastal	61	2	3,852	98	0.2	27	0.5	73
East Central	2,743	27	7,424	73	12.4	82	2.7	18
Lower Mississippi and Texas Gulf Coast	2,845	14	18,071	86	9.3	58	6.8	42
North Central and Midwest	13,640	11	109,655	89	59.6	65	32.1	35
Northeast	2,334	31	5,264	69	10.9	85	1.9	15
Northern Plains	4,730	9	46,400	91	12.0	45	14.6	55
Northwest	836	6	12,602	94	3.2	61	2.1	39
South Central	1,221	24	3,886	76	4.4	72	1.7	28
Southern and Central Plains	3,476	6	59,256	94	11.1	39	17.1	61
Southwest	138	4	3,045	96	0.4	41	0.5	59
National	**33,630**	**11**	**281,673**	**89**	**129**	**61**	**83**	**39**

Table A-19. Subsurface Nitrogen Relative to Threshold, CEAP I and CEAP II

Region	Cultivated Cropland Exceeding Threshold		Cultivated Cropland Meeting Threshold		Loss on Acres Exceeding Threshold		Loss on Acres Meeting Threshold	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Tons (1,000s)	Percent
CEAP I								
Atlantic and Gulf Coastal Plains	7,601	53	6,794	47	254	83	51	17
California Coastal	1,553	35	2,894	65	86	86	14	14
East Central	3,806	41	5,506	59	98	73	37	27
Lower Mississippi and Texas Gulf Coast	10,256	47	11,560	53	242	75	81	25
North Central and Midwest	32,828	27	87,306	73	785	61	498	39
Northeast	3,404	47	3,786	53	123	84	23	16
Northern Plains	4,746	10	43,674	90	133	56	105	44
Northwest	2,545	18	11,465	82	111	80	28	20
South Central	1,939	32	4,196	68	79	81	18	19
Southern and Central Plains	5,036	8	59,301	92	173	61	112	39
Southwest	1,068	37	1,802	63	74	95	4	5
National	**74,779**	**24**	**238,286**	**76**	**2,159**	**69**	**971**	**31**
CEAP II								
Atlantic and Gulf Coastal Plains	8,260	60	5,565	40	254	87	39	13
California Coastal	1,311	34	2,602	66	70	87	10	13
East Central	5,055	50	5,111	50	145	81	34	19
Lower Mississippi and Texas Gulf Coast	9,886	47	11,030	53	273	79	74	21
North Central and Midwest	38,371	31	84,925	69	1,025	68	491	32
Northeast	3,769	50	3,828	50	126	83	25	17
Northern Plains	9,988	20	41,142	80	285	69	128	31
Northwest	2,684	20	10,754	80	115	85	21	15
South Central	2,045	40	3,062	60	76	81	17	19
Southern and Central Plains	6,784	11	55,948	89	202	65	108	35
Southwest	764	24	2,419	76	29	89	4	11
National	**88,914**	**28**	**226,389**	**72**	**2,601**	**73**	**949**	**27**

Table A-20. Soluble Phosphorus Relative to Threshold by Region, CEAP I and CEAP II

Region	Cultivated Cropland Exceeding Threshold		Cultivated Cropland Meeting Threshold		Loss on Acres Exceeding Threshold		Loss on Acres Meeting Threshold	
	Acres (1,000s)	Percent	Acres (1,000s)	Percent	Tons (1,000s)	Percent	Tons (1,000s)	Percent
CEAP I								
Atlantic and Gulf Coastal Plains	10,820	75	3,575	25	6	91	1	9
California Coastal	285	6	4,161	94	1	74	0.4	26
East Central	6,004	64	3,309	36	3	85	1	15
Lower Mississippi and Texas Gulf Coast	14,634	67	7,182	33	10	92	1	8
North Central and Midwest	31,059	26	89,074	74	18	63	11	37
Northeast	4,328	60	2,862	40	3	85	0.5	15
Northern Plains	468	1	47,953	99	0.2	10	2	90
Northwest	1,351	10	12,659	90	1	68	0.4	32
South Central	2,231	36	3,903	64	1	74	0.4	26
Southern and Central Plains	1,297	2	63,039	98	1	28	2	72
Southwest	432	15	2,439	85	0.4	77	0	23
National	**72,909**	**23**	**240,156**	**77**	**45**	**71**	**18**	**29**
CEAP II								
Atlantic and Gulf Coastal Plains	9,527	69	4,297	31	5	88	1	12
California Coastal	665	17	3,248	83	1	80	0.2	20
East Central	7,486	74	2,680	26	4	90	0.5	10
Lower Mississippi and Texas Gulf Coast	16,233	78	4,683	22	11	94	1	6
North Central and Midwest	40,064	32	83,232	68	25	69	11	31
Northeast	4,478	59	3,119	41	2	83	1	17
Northern Plains	748	1	50,382	99	0.3	12	2	88
Northwest	877	7	12,561	93	1	58	0.4	42
South Central	2,586	51	2,521	49	2	81	0.3	19
Southern and Central Plains	1,405	2	61,327	98	1	22	2	78
Southwest	292	9	2,891	91	0	88	0.1	12
National	**84,361**	**27**	**230,942**	**73**	**51**	**73**	**19**	**27**

Table A-21. Soil Carbon Relative to Threshold by Region, CEAP I and CEAP II

Region	Cultivated Cropland Exceeding Threshold		Cultivated Cropland Meeting Threshold	
	Acres (1000)	Percent	Acres (1000)	Percent
CEAP I				
Atlantic and Gulf Coastal Plains	1,494	10	12,900	90
California Coastal	1,439	32	3,007	68
East Central	1,150	12	8,162	88
Lower Mississippi and Texas Gulf Coast	2,685	12	19,130	88
North Central and Midwest	15,542	13	104,592	87
Northeast	1,361	19	5,830	81
Northern Plains	10,883	22	37,537	78
Northwest	2,925	21	11,085	79
South Central	1,283	21	4,852	79
Southern and Central Plains	10,221	16	54,116	84
Southwest	720	25	2,150	75
National	**49,703**	**16**	**263,362**	**84**
CEAP II				
Atlantic and Gulf Coastal Plains	2,083	15	11,742	85
California Coastal	1,514	39	2,398	61
East Central	1,381	14	8,785	86
Lower Mississippi and Texas Gulf Coast	2,966	14	17,949	86
North Central and Midwest	15,826	13	107,470	87
Northeast	1,543	20	6,054	80
Northern Plains	10,146	20	40,985	80
Northwest	1,875	14	11,564	86
South Central	1,514	30	3,593	70
Southern and Central Plains	8,860	14	53,872	86
Southwest	802	25	2,381	75
National	**48,511**	**15**	**266,792**	**85**

Table A-22. Sediment Management on Cultivated Cropland by Region, CEAP I and CEAP II

Region	Sediment Management Level							
	Low		Moderate		Moderately High		High	
	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres
CEAP I								
Atlantic and Gulf Coastal Plains	4,879	34	6,929	48	2,053	14	534	4
California Coastal	2,334	52	1,597	36	35	1	481	11
East Central	842	9	5,101	55	2,594	28	775	8
Lower Mississippi and Texas Gulf	8,954	41	10,382	48	2,324	11	155	1
North Central and Midwest	23,705	20	55,270	46	34,032	28	7,126	6
Northeast	1,584	22	3,879	54	1,535	21	192	3
Northern Plains	12,113	25	24,328	50	11,592	24	386	1
Northwest	5,380	38	6,178	44	2,159	15	294	2
South Central	1,410	23	3,574	58	1,140	19	10	0
Southern and Central Plains	14,549	23	37,183	58	12,226	19	378	1
Southwest	1,159	40	1,502	52	209	7	0	0
National	**76,910**	**25**	**155,923**	**50**	**69,900**	**22**	**10,332**	**3**
CEAP II								
Atlantic and Gulf Coastal Plains	2,924	21	7,511	54	2,600	19	790	6
California Coastal	1,364	35	2,131	54	418	11	0	0
East Central	491	5	5,029	49	3,579	35	1,067	10
Lower Mississippi and Texas Gulf	7,187	34	10,029	48	3,150	15	550	3
North Central and Midwest	13,343	11	48,244	39	45,138	37	16,570	13
Northeast	1,007	13	3,215	42	2,618	34	756	10
Northern Plains	9,217	18	26,912	53	12,921	25	2,081	4
Northwest	2,988	22	5,268	39	4,405	33	777	6
South Central	971	19	2,470	48	1,151	23	516	10
Southern and Central Plains	8,108	13	28,861	46	23,061	37	2,701	4
Southwest	1,186	37	1,540	48	449	14	8	0
National	**48,787**	**15**	**141,210**	**45**	**99,490**	**32**	**25,816**	**8**

Table A-23. Nitrogen Management on Cultivated Cropland by Region, CEAP I and CEAP II

Region	Nitrogen Management Level							
	Low		Moderate		Moderately High		High	
	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres
CEAP I								
Atlantic and Gulf Coastal Plains	3,279	23	973	7	5,539	38	4,603	32
California Coastal	2,215	50	142	3	857	19	1,233	28
East Central	2,918	31	571	6	3,789	41	2,034	22
Lower Mississippi and Texas Gulf Coast	6,584	30	1,796	8	6,098	28	7,338	34
North Central and Midwest	16,191	13	15,276	13	46,315	39	42,352	35
Northeast	1,957	27	427	6	2,680	37	2,127	30
Northern Plains	2,174	4	772	2	13,038	27	32,436	67
Northwest	3,303	24	267	2	2,899	21	7,541	54
South Central	1,531	25	576	9	2,309	38	1,719	28
Southern and Central Plains	7,293	11	1,275	2	21,963	34	33,805	53
Southwest	1,176	41	139	5	737	26	819	29
National	**48,620**	**16**	**22,213**	**7**	**106,224**	**34**	**136,007**	**43**
CEAP II								
Atlantic and Gulf Coastal Plains	2,994	22	907	7	6,868	50	3,057	22
California Coastal	1,969	50	235	6	863	22	846	22
East Central	3,734	37	524	5	4,427	44	1,482	15
Lower Mississippi and Texas Gulf Coast	7,321	35	766	4	6,088	29	6,741	32
North Central and Midwest	25,013	20	21,158	17	47,757	39	29,368	24
Northeast	2,345	31	463	6	3,176	42	1,612	21
Northern Plains	5,547	11	1,505	3	19,936	39	24,143	47
Northwest	3,054	23	406	3	3,651	27	6,327	47
South Central	1,343	26	584	11	1,900	37	1,281	25
Southern and Central Plains	8,784	14	2,467	4	27,352	44	24,128	38
Southwest	1,176	37	206	6	937	29	864	27
National	**63,279**	**20**	**29,220**	**9**	**122,954**	**39**	**99,850**	**32**

Table A-24. Phosphorus Management on Cultivated Cropland by Region, CEAP I and CEAP II

Region	Phosphorus Management Level							
	Low		Moderate		Moderately High		High	
	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres	Acres (1,000s)	Percent Regional Acres
CEAP I								
Atlantic and Gulf Coastal Plains	1,667	12	2,884	20	2,628	18	7,215	50
California Coastal	802	18	713	16	124	3	2,808	63
East Central	1,417	15	2,975	32	1,490	16	3,430	37
Lower Mississippi and Texas Gulf	805	4	2,642	12	4,330	20	14,038	64
North Central and Midwest	7,000	6	20,477	17	25,112	21	67,545	56
Northeast	1,420	20	1,298	18	651	9	3,821	53
Northern Plains	202	0	1,218	3	2,889	6	44,111	91
Northwest	1,175	8	1,037	7	1,040	7	10,758	77
South Central	182	3	451	7	1,296	21	4,205	69
Southern and Central Plains	954	1	3,058	5	7,215	11	53,111	83
Southwest	521	18	377	13	312	11	1,660	58
National	**16,146**	**5**	**37,130**	**12**	**47,086**	**15**	**212,703**	**68**
CEAP II								
Atlantic and Gulf Coastal Plains	1,762	13	2,492	18	3,716	27	5,856	42
California Coastal	739	19	852	22	376	10	1,946	50
East Central	2,252	22	3,317	33	2,105	21	2,493	25
Lower Mississippi and Texas Gulf	1,371	7	3,974	19	4,120	20	11,451	55
North Central and Midwest	10,460	8	33,569	27	24,504	20	54,763	44
Northeast	1,226	16	1,613	21	1,257	17	3,501	46
Northern Plains	1,072	2	3,703	7	5,353	10	41,002	80
Northwest	1,342	10	880	7	1,128	8	10,089	75
South Central	375	7	774	15	951	19	3,008	59
Southern and Central Plains	1,994	3	5,330	8	9,553	15	45,855	73
Southwest	550	17	400	13	486	15	1,748	55
National	**23,140**	**7**	**56,902**	**18**	**53,549**	**17**	**181,711**	**58**

Table A-25. Sediment Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II

Region	SVI-R	Sediment Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
Atlantic and Gulf Coastal Plains								
	High		**180**	**1**	**15**	**176**	**1**	**15**
		High	-	-	-	36	20	2
		Moderately High	49	27	4	24	14	4
		Moderate	99	55	7	64	37	7
		Low	32	18	4	51	29	2
	Moderately High		**1,124**	**8**	**122**	**1,461**	**11**	**101**
		High	62	5	9	190	13	8
		Moderately High	173	15	16	272	19	18
		Moderate	685	61	77	712	49	59
		Low	204	18	20	286	20	16
	Moderate		**1,976**	**14**	**197**	**2,932**	**21**	**159**
		High	30	1	4	226	8	10
		Moderately High	389	20	27	557	19	36
		Moderate	934	47	99	1,629	56	82
		Low	624	32	67	519	18	31
	Low		**11,115**	**77**	**956**	**9,256**	**67**	**489**
		High	442	4	30	338	4	36
		Moderately High	1,443	13	116	1,746	19	111
		Moderate	5,211	47	485	5,105	55	246
		Low	4,019	36	325	2,067	22	96
California Coastal								
	High		**-**	**-**		**101**	**3**	**4**
		High	-	-	-	-	-	
		Moderately High	-	-	-	44	43	3
		Moderate	-	-	-	57	57	1
		Low	-	-	-	-	-	
	Moderately High		**50**	**1**	**2**	**174**	**4**	**8**
		High	-	-	-	-	-	-
		Moderately High	-	-	-	43	25	2
		Moderate	-	-	-	103	59	4
		Low	50	100	2	27	16	2
	Moderate		**1,102**	**25**	**25**	**647**	**17**	**28**
		High	-	-	-	-	-	-
		Moderately High	8	1	1	-	-	-
		Moderate	236	21	10	326	50	16
		Low	858	78	14	320	50	12
	Low		**3,295**	**74**	**84**	**2,992**	**76**	**167**
		High	481	15	1		-	
		Moderately High	27	1	2	331	11	8
		Moderate	1,361	41	45	1,645	55	106
		Low	1,426	43	36	1,017	34	53

Table A-25. Sediment Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Sediment Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
East Central								
	High		**1,629**	**17**	**168**	**2,250**	**22**	**172**
		High	118	7	7	396	18	29
		Moderately High	502	31	56	812	36	62
		Moderate	928	57	94	986	44	75
		Low	81	5	11	57	3	6
	Moderately High		**2,737**	**29**	**299**	**2,982**	**29**	**215**
		High	245	9	25	196	7	14
		Moderately High	956	35	108	1,348	45	97
		Moderate	1,264	46	131	1,305	44	96
		Low	271	10	35	132	4	8
	Moderate		**1,347**	**14**	**116**	**2,085**	**21**	**136**
		High	188	14	12	242	12	21
		Moderately High	374	28	32	570	27	40
		Moderate	668	50	61	1,164	56	68
		Low	117	9	11	108	5	7
	Low		**3,600**	**39**	**331**	**2,849**	**28**	**217**
		High	224	6	20	232	8	16
		Moderately High	761	21	78	849	30	70
		Moderate	2,241	62	195	1,574	55	115
		Low	374	10	38	193	7	16
Lower Mississippi and Texas Gulf Coast								
	High		**419**	**2**	**86**	**590**	**3**	**51**
		High	3	1	1	64	11	4
		Moderately High	173	41	38	279	47	27
		Moderate	231	55	43	220	37	18
		Low	12	3	4	27	5	2
	Moderately High		**2,053**	**9**	**255**	**2,117**	**10**	**161**
		High	29	1	8	183	9	12
		Moderately High	745	36	96	752	36	58
		Moderate	855	42	112	922	44	73
		Low	424	21	39	261	12	18
	Moderate		**11,941**	**55**	**882**	**7,786**	**37**	**485**
		High	57	0	7	148	2	9
		Moderately High	741	6	69	776	10	55
		Moderate	5,742	48	423	3,611	46	232
		Low	5,402	45	383	3,251	42	189
	Low		**7,402**	**34**	**597**	**10,423**	**50**	**693**
		High	66	1	9	155	1	12
		Moderately High	666	9	68	1,344	13	98
		Moderate	3,553	48	310	5,276	51	352
		Low	3,116	42	210	3,648	35	231

Table A-25. Sediment Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Sediment Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
North Central and Midwest								
	High		**15,178**	**13**	**1,199**	**19,377**	**16**	**687**
		High	2,233	15	152	5,076	26	170
		Moderately High	7,038	46	567	10,175	53	354
		Moderate	5,111	34	414	3,704	19	144
		Low	795	5	66	423	2	19
	Moderately High		**23,585**	**20**	**1,737**	**24,668**	**20**	**870**
		High	1,550	7	99	4,238	17	148
		Moderately High	8,262	35	631	10,764	44	393
		Moderate	10,562	45	773	8,129	33	286
		Low	3,211	14	234	1,536	6	43
	Moderate		**19,444**	**16**	**1,232**	**13,923**	**11**	**484**
		High	1,010	5	54	1,260	9	50
		Moderately High	4,938	25	308	4,667	34	165
		Moderate	8,909	46	583	6,729	48	223
		Low	4,587	24	287	1,267	9	46
	Low		**61,927**	**52**	**3,897**	**65,329**	**53**	**2,164**
		High	2,333	4	149	5,996	9	197
		Moderately High	13,794	22	901	19,533	30	669
		Moderate	30,688	50	1,929	29,683	45	984
		Low	15,112	24	918	10,118	15	314
Northeast								
	High		**1,834**	**26**	**238**	**2,426**	**32**	**204**
		High	63	3	10	336	14	31
		Moderately High	589	32	79	1,023	42	96
		Moderate	984	54	124	735	30	62
		Low	198	11	25	333	14	15
	Moderately High		**1,913**	**27**	**241**	**2,116**	**28**	**178**
		High	43	2	11	99	5	12
		Moderately High	405	21	56	695	33	67
		Moderate	975	51	116	1,077	51	78
		Low	489	26	58	244	12	21
	Moderate		**1,014**	**14**	**107**	**950**	**13**	**89**
		High	8	1	1	61	6	7
		Moderately High	92	9	17	245	26	29
		Moderate	625	62	63	562	59	44
		Low	289	28	26	83	9	9
	Low		**2,429**	**34**	**302**	**2,105**	**28**	**195**
		High	78	3	11	260	12	22
		Moderately High	448	18	63	656	31	60
		Moderate	1,295	53	153	842	40	88
		Low	608	25	75	347	17	25

Table A-25. Sediment Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Sediment Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
Northern Plains								
	High		**3,128**	**6**	**110**	**2,990**	**6**	**87**
		High	33	1	1	345	12	10
		Moderately High	957	31	34	974	33	27
		Moderate	1,779	57	62	1,518	51	46
		Low	359	11	13	152	5	4
	Moderately High		**11,155**	**23**	**331**	**9,857**	**19**	**242**
		High	60	1	3	648	7	13
		Moderately High	3,669	33	116	3,817	39	87
		Moderate	5,156	46	149	5,097	52	131
		Low	2,270	20	63	295	3	11
	Moderate		**8,232**	**17**	**236**	**8,896**	**17**	**201**
		High	41	1	1	229	3	7
		Moderately High	1,557	19	48	1,899	21	47
		Moderate	3,710	45	114	5,755	65	122
		Low	2,924	36	73	1,013	11	25
	Low		**25,905**	**54**	**841**	**29,388**	**57**	**682**
		High	252	1	10	859	3	21
		Moderately High	5,409	21	174	6,230	21	152
		Moderate	13,683	53	452	14,543	49	362
		Low	6,560	25	205	7,757	26	147
Northwest								
	High		**3,296**	**24**	**227**	**3,858**	**29**	**128**
		High	42	1	3	372	10	8
		Moderately High	850	26	62	1,633	42	70
		Moderate	1,403	43	100	1,478	38	43
		Low	1,001	30	62	374	10	7
	Moderately High		**3,183**	**23**	**233**	**3,436**	**26**	**134**
		High	77	2	2	173	5	6
		Moderately High	363	11	23	1,113	32	43
		Moderate	1,389	44	105	1,273	37	49
		Low	1,353	43	103	876	26	36
	Moderate		**558**	**4**	**63**	**779**	**6**	**32**
		High	31	6	1	-	-	-
		Moderately High	83	15	4	231	30	8
		Moderate	269	48	31	347	45	17
		Low	175	31	27	201	26	7
	Low		**6,973**	**50**	**525**	**5,366**	**40**	**253**
		High	144	2	7	232	4	11
		Moderately High	861	12	67	1,428	27	65
		Moderate	3,117	45	217	2,170	40	106
		Low	2,851	41	234	1,537	29	71

Table A-25. Sediment Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Sediment Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
South Central								
	High		**20**	**0**	**2**	**211**	**4**	**8**
		High	-	-	-	31	15	1
		Moderately High	-	-	-	91	43	4
		Moderate	20	100	2	49	23	2
		Low	-	-	-	40	19	1
	Moderately High		**1,657**	**27**	**65**	**1,667**	**33**	**85**
		High	-	-	-	113	7	5
		Moderately High	405	24	15	586	35	37
		Moderate	998	60	41	766	46	34
		Low	255	15	9	202	12	9
	Moderate		**2,458**	**40**	**88**	**1,898**	**37**	**104**
		High	5	0	1	198	10	12
		Moderately High	472	19	14	218	11	14
		Moderate	1,407	57	49	947	50	45
		Low	574	23	24	535	28	33
	Low		**1,999**	**33**	**77**	**1,331**	**26**	**82**
		High	5	0	1	174	13	4
		Moderately High	264	13	11	255	19	17
		Moderate	1,149	57	40	708	53	49
		Low	581	29	25	193	15	12
Southern and Central Plains								
	High		**1,393**	**2**	**66**	**1,539**	**2**	**46**
		High	24	2	1	228	15	3
		Moderately High	515	37	22	739	48	24
		Moderate	775	56	37	538	35	18
		Low	78	6	6	34	2	1
	Moderately High		**6,018**	**9**	**253**	**9,340**	**15**	**261**
		High	104	2	4	597	6	18
		Moderately High	1,678	28	70	4,748	51	123
		Moderate	3,680	61	155	3,781	40	112
		Low	557	9	24	214	2	8
	Moderate		**6,194**	**10**	**244**	**4,701**	**7**	**157**
		High	32	1	1	112	2	6
		Moderately High	1,147	19	43	1,839	39	61
		Moderate	3,757	61	147	2,126	45	70
		Low	1,258	20	53	624	13	20
	Low		**50,732**	**79**	**2,052**	**47,151**	**75**	**1,339**
		High	219	0	10	1,764	4	49
		Moderately High	8,886	18	368	15,736	33	443
		Moderate	28,971	57	1,125	22,415	48	660
		Low	12,656	25	549	7,236	15	187

Table A-25. Sediment Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Sediment Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
Southwest								
	High		**68**	**2**	**6**	**14**	**0**	**1**
		High	-	-	-	-	-	-
		Moderately High	-	-	-	-	-	-
		Moderate	38	56	4	14	100	1
		Low	30	44	2	-	-	-
	Moderately High		**247**	**9**	**19**	**349**	**11**	**12**
		High	-	-	-	-	-	-
		Moderately High	58	24	3	127	36	3
		Moderate	74	30	8	113	32	7
		Low	115	47	8	109	31	2
	Moderate		**269**	**9**	**16**	**185**	**6**	**12**
		High	-	-	-	-	-	-
		Moderately High	15	6	1	-	-	-
		Moderate	162	60	10	73	39	6
		Low	92	34	5	112	61	6
	Low		**2,287**	**80**	**149**	**2,636**	**83**	**110**
		High	-	-	-	8	0	1
		Moderately High	136	6	9	322	12	13
		Moderate	1,229	54	58	1,341	51	53
		Low	922	40	82	965	37	43

Table A-26. Nitrogen Management and Soil Vulnerability Index—Leaching (SVI-L) by Region, CEAP I and CEAP II

Region	SVI-L Rating	Nitrogen Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
Atlantic and Gulf Coastal Plains								
	High		**6,694**	47		**4,069**	29	
		High	2,007	30	154	967	24	49
		Moderately High	2,668	40	210	1,954	48	107
		Moderate	312	5	25	332	8	18
		Low	1,707	25	101	817	20	54
	Moderately High		**3,661**	25		**4,760**	34	
		High	1,233	34	107	1,086	23	48
		Moderately High	1,338	37	127	2,305	48	106
		Moderate	310	8	28	353	7	14
		Low	781	21	61	1,016	21	38
	Moderate		**3,799**	26		**3,938**	28	
		High	1,308	34	136	809	21	55
		Moderately High	1,403	37	185	2,045	52	118
		Moderate	351	9	32	189	5	11
		Low	737	19	99	895	23	73
	Low		**240**	2		**1,058**	8	
		High	56	23	6	195	18	13
		Moderately High	130	54	14	563	53	36
		Moderate	-	0	0	33	3	3
		Low	54	22	5	267	25	21
California Coastal								
	High		**621**	14		**1,369**	35	
		High	163	26	8	219	16	12
		Moderately High	152	25	7	380	28	33
		Moderate	14	2	1	79	6	5
		Low	291	47	10	691	50	41
	Moderately High		**388**	9		**386**	10	
		High	36	9	2	66	17	3
		Moderately High	59	15	1	108	28	5
		Moderate	30	8	1	51	13	1
		Low	263	68	3	161	42	15
	Moderate		**2,278**	51		**1,543**	39	
		High	912	40	8	371	24	12
		Moderately High	438	19	9	218	14	10
		Moderate	63	3	1	105	7	5
		Low	865	38	22	849	55	41
	Low		**1,160**	26		**615**	16	
		High	122	11	3	191	31	4
		Moderately High	208	18	8	156	25	7
		Moderate	34	3	2	-	0	0
		Low	796	69	25	269	44	13

Table A-26. Nitrogen Management and Soil Vulnerability Index—Leaching (SVI-L) by Region, CEAP I and CEAP II—Cont.

Region	SVI-L Rating	Nitrogen Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
East Central								
	High		**1,756**	19		**1,081**	11	
		High	496	28	42	119	11	12
		Moderately High	656	37	58	469	43	35
		Moderate	129	7	12	111	10	7
		Low	475	27	47	382	35	23
	Moderately High		**705**	8		**1,339**	13	
		High	192	27	20	115	9	12
		Moderately High	279	40	31	715	53	50
		Moderate	73	10	7	68	5	5
		Low	161	23	17	441	33	31
	Moderate		**6,728**	72		**5,980**	59	
		High	1,306	19	134	955	16	58
		Moderately High	2,785	41	279	2,405	40	183
		Moderate	362	5	38	277	5	25
		Low	2,275	34	214	2,343	39	160
	Low		**123**	1		**1,767**	17	
		High	40	32	4	294	17	23
		Moderately High	69	56	9	837	47	62
		Moderate	7	6	1	68	4	8
		Low	8	6	1	568	32	46
Lower Mississippi and Texas Gulf Coast								
	High		**4,463**	20		**6,374**	30	
		High	1,529	34	103	2,192	34	141
		Moderately High	851	19	79	1,932	30	130
		Moderate	266	6	20	168	3	12
		Low	1,816	41	130	2,083	33	130
	Moderately High		**11,773**	54		**7,781**	37	
		High	4,242	36	316	3,034	39	180
		Moderately High	3,471	29	280	1,981	25	135
		Moderate	1,060	9	57	255	3	14
		Low	3,000	25	253	2,511	32	155
	Moderate		**4,772**	22		**4,258**	20	
		High	1,386	29	152	888	21	86
		Moderately High	1,363	29	173	1,324	31	104
		Moderate	380	8	57	183	4	12
		Low	1,643	34	176	1,862	44	143
	Low		**808**	4		**2,502**	12	
		High	180	22	7	626	25	47
		Moderately High	413	51	9	851	34	44
		Moderate	89	11	3	159	6	9
		Low	126	16	5	865	35	48

Table A-26. Nitrogen Management and Soil Vulnerability Index—Leaching (SVI-L) by Region, CEAP I and CEAP II—Cont.

Region	SVI-L Rating	Nitrogen Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
North Central and Midwest								
	High		**42,935**	36		**49,186**	40	
		High	15,473	36	1018	11,756	24	378
		Moderately High	15,642	36	1015	18,278	37	608
		Moderate	5,870	14	349	9,623	20	293
		Low	5,950	14	369	9,529	19	311
	Moderately High		**20,061**	17		**14,715**	12	
		High	6,880	34	447	3,975	27	127
		Moderately High	8,059	40	509	5,582	38	194
		Moderate	2,897	14	162	2,405	16	87
		Low	2,225	11	142	2,752	19	91
	Moderate		**54,003**	45		**48,928**	40	
		High	18,602	34	1355	10,783	22	397
		Moderately High	21,340	40	1518	19,592	40	727
		Moderate	6,241	12	406	7,331	15	261
		Low	7,820	14	542	11,221	23	397
	Low		**3,133**	3		**10,467**	8	
		High	1,397	45	92	2,853	27	85
		Moderately High	1,273	41	100	4,304	41	144
		Moderate	267	9	24	1,798	17	60
		Low	196	6	17	1,511	14	45
Northeast								
	High		**1,055**	15		**1,167**	15	
		High	457	43	46	229	20	18
		Moderately High	282	27	33	605	52	46
		Moderate	29	3	6	116	10	6
		Low	286	27	32	216	19	25
	Moderately High		**692**	10		**1,026**	14	
		High	268	39	33	290	28	27
		Moderately High	255	37	29	469	46	40
		Moderate	48	7	6	53	5	6
		Low	120	17	16	214	21	21
	Moderate		**5,304**	74		**3,746**	49	
		High	1,335	25	136	601	16	56
		Moderately High	2,095	39	264	1,497	40	140
		Moderate	348	7	42	202	5	21
		Low	1,527	29	223	1,447	39	147
	Low		**140**	2		**1,658**	22	
		High	66	47	9	492	30	32
		Moderately High	48	34	7	605	36	37
		Moderate	1	1	1	93	6	11
		Low	24	17	5	468	28	33

Table A-26. Nitrogen Management and Soil Vulnerability Index—Leaching (SVI-L) by Region, CEAP I and CEAP II—Cont.

Region	SVI-L Rating	Nitrogen Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
Northern Plains								
	High		**12,828**	26		**13,880**	27	
		High	7,623	59	227	6,114	44	118
		Moderately High	4,058	32	128	5,257	38	108
		Moderate	362	3	9	460	3	9
		Low	785	6	25	2,049	15	49
	Moderately High		**4,362**	9		**5,659**	11	
		High	2,945	67	77	2,817	50	58
		Moderately High	1,080	25	33	2,061	36	44
		Moderate	151	3	4	172	3	3
		Low	187	4	4	608	11	11
	Moderate		**28,080**	58		**27,756**	54	
		High	19,703	70	596	13,557	49	332
		Moderately High	7,060	25	251	10,791	39	284
		Moderate	259	1	8	729	3	20
		Low	1,057	4	41	2,679	10	70
	Low		**3,150**	7		**3,835**	7	
		High	2,165	69	71	1,655	43	43
		Moderately High	841	27	35	1,826	48	51
		Moderate	-	0	0	143	4	3
		Low	144	5	9	210	5	9
Northwest								
	High		**3,024**	22		**2,269**	17	
		High	1,573	52	107	887	39	44
		Moderately High	554	18	49	550	24	30
		Moderate	111	4	6	93	4	6
		Low	785	26	76	738	33	33
	Moderately High		**651**	5		**259**	2	
		High	248	38	14	71	27	6
		Moderately High	91	14	14	86	33	9
		Moderate	11	2	3	52	20	3
		Low	301	46	29	50	19	5
	Moderate		**9,866**	70		**10,244**	76	
		High	5,498	56	334	5,141	50	167
		Moderately High	2,186	22	154	2,770	27	102
		Moderate	132	1	15	238	2	12
		Low	2,050	21	209	2,094	20	101
	Low		**468**	3		**667**	5	
		High	222	47	15	228	34	11
		Moderately High	67	14	7	244	37	10
		Moderate	12	3	2	23	4	1
		Low	167	36	14	172	26	7

Table A-26. Nitrogen Management and Soil Vulnerability Index—Leaching (SVI-L) by Region, CEAP I and CEAP II—Cont.

Region	SVI-L Rating	Nitrogen Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
South Central								
	High		**836**	14		**464**	9	
		High	411	49	11	115	25	6
		Moderately High	146	17	6	123	26	8
		Moderate	31	4	2	109	24	5
		Low	248	30	7	116	25	9
	Moderately High		**1,290**	21		**1,038**	20	
		High	390	30	16	357	34	18
		Moderately High	525	41	27	269	26	19
		Moderate	61	5	3	127	12	3
		Low	314	24	17	285	27	18
	Moderate		**1,689**	28		**1,359**	27	
		High	305	18	17	417	31	24
		Moderately High	848	50	35	632	47	33
		Moderate	40	2	3	76	6	3
		Low	496	29	15	234	17	17
	Low		**2,320**	38		**2,246**	44	
		High	613	26	21	391	17	19
		Moderately High	790	34	24	875	39	50
		Moderate	444	19	10	271	12	13
		Low	473	20	18	708	32	34
Southern and Central Plains								
	High		**16,869**	26		**10,784**	17	
		High	7,748	46	340	3,638	34	98
		Moderately High	6,460	38	260	4,440	41	145
		Moderate	215	1	11	574	5	20
		Low	2,446	14	130	2,132	20	75
	Moderately High		**2,330**	4		**1,708**	3	
		High	948	41	43	587	34	15
		Moderately High	936	40	41	764	45	29
		Moderate	46	2	4	26	2	1
		Low	398	17	16	330	19	15
	Moderate		**39,522**	61		**45,308**	72	
		High	22,177	56	835	17,728	39	454
		Moderately High	12,544	32	484	20,000	44	511
		Moderate	889	2	42	1,690	4	60
		Low	3,912	10	183	5,890	13	198
	Low		**5,616**	9		**4,932**	8	
		High	2,932	52	120	2,175	44	79
		Moderately High	2,023	36	81	2,148	44	78
		Moderate	125	2	4	177	4	7
		Low	536	10	21	432	9	18

Table A-26. Nitrogen Management and Soil Vulnerability Index—Leaching (SVI-L) by Region, CEAP I and CEAP II—Cont.

Region	SVI-L Rating	Nitrogen Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
Southwest								
	High		**432**	15		**638**	20	
		High	80	19	6	287	45	14
		Moderately High	167	39	7	170	27	11
		Moderate	52	12	2	68	11	4
		Low	132	31	10	114	18	8
	Moderately High		**142**	5		**63**	2	
		High	76	53	5	-	0	0
		Moderately High	66	47	4	6	10	1
		Moderate	-	0	0	42	67	1
		Low	-	0	0	15	23	2
	Moderate		**2,103**	73		**2,356**	74	
		High	637	30	40	560	24	22
		Moderately High	481	23	37	694	29	26
		Moderate	85	4	6	97	4	4
		Low	899	43	58	1,005	43	34
	Low		**194**	7		**126**	4	
		High	26	13	2	17	14	3
		Moderately High	22	11	3	67	53	2
		Moderate	1	<1	1	-	0	0
		Low	145	75	9	42	33	3

Table A-27. Phosphorus Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II

Region	SVI-R	Phosphorus Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
Atlantic and Gulf Coastal Plains								
	High		**180**	1		**176**	1	
		High	107	59	8	77	44	6
		Moderately High	20	11	2	45	25	4
		Moderate	13	7	2	40	23	3
		Low	40	22	3	14	8	2
	Moderately High		**1,124**	8		**1,461**	11	
		High	510	45	47	499	34	33
		Moderately High	251	22	29	374	26	29
		Moderate	261	23	34	371	25	26
		Low	102	9	12	217	15	13
	Moderate		**1,976**	14		**2,932**	21	
		High	1,084	55	118	1,032	35	71
		Moderately High	320	16	31	1,071	37	47
		Moderate	404	20	35	534	18	25
		Low	168	9	13	295	10	16
	Low		**11,115**	77		**9,256**	67	
		High	5,514	50	512	4,248	46	237
		Moderately High	2,037	18	180	2,226	24	116
		Moderate	2,206	20	197	1,547	17	92
		Low	1,357	12	67	1,235	13	44
California Coastal								
	High		**-**	0		**101**	3	
		High	-	0	0	44	43	3
		Moderately High	-	0	0	-	0	0
		Moderate	-	0	0	57	57	1
		Low	-	0	0	-	0	0
	Moderately High		**50**	1		**174**	4	
		High	-	0	0	129	74	4
		Moderately High	-	0	0	-	0	0
		Moderate	21	43	1	10	6	1
		Low	29	57	1	35	20	3
	Moderate		**1,102**	25		**647**	17	
		High	535	49	16	265	41	11
		Moderately High	24	2	2	34	5	2
		Moderate	513	47	6	167	26	8
		Low	29	3	1	180	28	7
	Low		**3,295**	74		**2,992**	76	
		High	2,273	69	51	1,508	50	81
		Moderately High	100	3	6	342	11	20
		Moderate	178	5	12	618	21	38
		Low	745	23	15	524	18	28

Table A-27. Phosphorus Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Phosphorus Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
East Central								
	High		**1,629**	17		**2,250**	22	
		High	580	36	63	416	18	37
		Moderately High	173	11	17	508	23	40
		Moderate	640	39	61	705	31	53
		Low	236	14	27	622	28	42
	Moderately High		**2,737**	29		**2,982**	29	
		High	769	28	83	660	22	41
		Moderately High	509	19	53	592	20	43
		Moderate	1,042	38	118	1,113	37	84
		Low	416	15	45	617	21	47
	Moderate		**1,347**	14		**2,085**	21	
		High	576	43	47	642	31	32
		Moderately High	168	13	14	444	21	32
		Moderate	372	28	38	491	24	41
		Low	230	17	17	508	24	31
	Low		**3,600**	39		**2,849**	28	
		High	1,504	42	130	774	27	58
		Moderately High	640	18	52	562	20	43
		Moderate	921	26	98	1,007	35	76
		Low	535	15	51	506	18	40
Lower Mississippi and Texas Gulf Coast								
	High		**419**	2		**590**	3	
		High	157	37	22	69	12	10
		Moderately High	141	34	29	110	19	10
		Moderate	97	23	28	350	59	25
		Low	24	6	7	61	10	6
	Moderately High		**2,053**	9		**2,117**	10	
		High	895	44	81	565	27	46
		Moderately High	417	20	61	517	24	36
		Moderate	568	28	83	858	41	64
		Low	173	8	30	177	8	15
	Moderate		**11,941**	55		**7,786**	37	
		High	8,273	69	585	4,728	61	298
		Moderately High	2,449	21	187	1,512	19	91
		Moderate	904	8	86	1,068	14	69
		Low	315	3	24	478	6	27
	Low		**7,402**	34		**10,423**	50	
		High	4,713	64	363	6,089	58	395
		Moderately High	1,323	18	121	1,981	19	149
		Moderate	1,073	14	87	1,698	16	109
		Low	292	4	26	655	6	40

Table A-27. Phosphorus Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Phosphorus Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
North Central and Midwest								
	High		**15,178**	13		**19,377**	16	
		High	7,597	50	607	7,540	39	267
		Moderately High	3,068	20	248	3,417	18	120
		Moderate	3,390	22	260	6,930	36	244
		Low	1,123	7	84	1,489	8	56
	Moderately High		**23,585**	20		**24,668**	20	
		High	12,610	53	960	10,554	43	364
		Moderately High	4,740	20	324	4,210	17	160
		Moderate	4,562	19	338	7,261	29	254
		Low	1,674	7	115	2,643	11	92
	Moderate		**19,444**	16		**13,923**	11	
		High	11,278	58	718	6,154	44	216
		Moderately High	4,233	22	254	2,767	20	96
		Moderate	3,040	16	197	3,664	26	126
		Low	894	5	63	1,338	10	46
	Low		**61,927**	52		**65,329**	53	
		High	36,061	58	2349	30,515	47	999
		Moderately High	13,072	21	777	14,111	22	469
		Moderate	9,486	15	573	15,713	24	529
		Low	3,309	5	198	4,990	8	167
Northeast								
	High		**1,834**	26		**2,426**	32	
		High	968	53	116	995	41	81
		Moderately High	167	9	24	381	16	36
		Moderate	358	19	49	608	25	50
		Low	342	19	49	443	18	37
	Moderately High		**1,913**	27		**2,116**	28	
		High	892	47	104	981	46	73
		Moderately High	284	15	41	360	17	29
		Moderate	346	18	48	442	21	45
		Low	391	20	48	333	16	31
	Moderate		**1,014**	14		**950**	13	
		High	603	59	58	553	58	51
		Moderately High	46	5	5	178	19	18
		Moderate	194	19	23	103	11	11
		Low	171	17	21	117	12	9
	Low		**2,429**	34		**2,105**	28	
		High	1,358	56	157	972	46	91
		Moderately High	154	6	28	339	16	33
		Moderate	399	16	60	461	22	38
		Low	517	21	57	333	16	33

Table A-27. Phosphorus Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Phosphorus Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
Northern Plains								
	High		**3,128**	6		**2,990**	6	
		High	2,937	94	105	2,433	81	70
		Moderately High	191	6	5	300	10	11
		Moderate	-	0	0	207	7	5
		Low	-	0	0	50	2	1
	Moderately High		**11,155**	23		**9,857**	19	
		High	10,739	96	309	8,499	86	200
		Moderately High	327	3	18	796	8	25
		Moderate	90	1	4	360	4	10
		Low	-	0	0	201	2	7
	Moderate		**8,232**	17		**8,896**	17	
		High	7,458	91	211	7,172	81	160
		Moderately High	553	7	17	910	10	17
		Moderate	221	3	8	719	8	21
		Low	-	0	0	95	1	3
	Low		**25,905**	54		**29,388**	57	
		High	22,977	89	738	22,898	78	517
		Moderately High	1,818	7	60	3,347	11	83
		Moderate	907	4	32	2,418	8	61
		Low	202	1	11	725	2	21
Northwest								
	High		**3,296**	24		**3,858**	29	
		High	3,046	92	202	3,530	91	114
		Moderately High	114	3	10	138	4	7
		Moderate	66	2	6	90	2	5
		Low	71	2	9	100	3	2
	Moderately High		**3,183**	23		**3,436**	26	
		High	2,631	83	183	2,631	77	93
		Moderately High	128	4	12	255	7	13
		Moderate	226	7	18	218	6	12
		Low	197	6	20	332	10	16
	Moderate		**558**	4		**779**	6	
		High	329	59	28	495	63	21
		Moderately High	72	13	9	190	24	7
		Moderate	83	15	13	38	5	2
		Low	74	13	13	57	7	2
	Low		**6,973**	50		**5,366**	40	
		High	4,752	68	334	3,434	64	157
		Moderately High	726	10	50	546	10	35
		Moderate	662	9	69	533	10	31
		Low	833	12	72	853	16	30

Table A-27. Phosphorus Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Phosphorus Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
South Central								
	High		**20**	<1		**211**	4	
		High	10	49	1	63	30	2
		Moderately High	10	51	1	70	33	2
		Moderate	-	0	0	42	20	2
		Low	-	0	0	36	17	2
	Moderately High		**1,657**	27		**1,667**	33	
		High	990	60	38	919	55	47
		Moderately High	541	33	20	289	17	17
		Moderate	74	4	4	270	16	15
		Low	53	3	3	189	11	6
	Moderate		**2,458**	40		**1,898**	37	
		High	1,853	75	59	1,247	66	72
		Moderately High	408	17	18	243	13	15
		Moderate	167	7	9	324	17	14
		Low	30	1	2	85	4	3
	Low		**1,999**	33		**1,331**	26	
		High	1,352	68	47	779	59	51
		Moderately High	337	17	17	349	26	17
		Moderate	211	11	10	138	10	7
		Low	99	5	3	65	5	7
Southern and Central Plains								
	High		**1,393**	2		**1,539**	2	
		High	1,187	85	57	1,046	68	30
		Moderately High	113	8	5	317	21	10
		Moderate	38	3	2	96	6	4
		Low	55	4	2	80	5	2
	Moderately High		**6,018**	9		**9,340**	15	
		High	4,918	82	206	6,912	74	187
		Moderately High	761	13	32	1,451	16	40
		Moderate	264	4	12	846	9	29
		Low	75	1	3	131	1	5
	Moderate		**6,194**	10		**4,701**	7	
		High	5,098	82	200	3,755	80	123
		Moderately High	770	12	31	581	12	23
		Moderate	318	5	12	208	4	8
		Low	8	<1	1	157	3	3
	Low		**50,732**	79		**47,151**	75	
		High	41,908	83	1693	34,142	72	960
		Moderately High	5,570	11	214	7,203	15	189
		Moderate	2,438	5	103	4,181	9	142
		Low	816	2	42	1,625	3	48

Table A-27. Phosphorus Management and Soil Vulnerability Index—Runoff (SVI-R) by Region, CEAP I and CEAP II—Cont.

Region	SVI-R	Phosphorus Management Level	CEAP I			CEAP II		
			Acres (1,000s)	Percent	Count	Acres (1,000s)	Percent	Count
Southwest								
	High		**68**	2		**14**	<1	
		High	68	100	6	14	100	1
		Moderately High	-	0	0	-	0	0
		Moderate	-	0	0	-	0	0
		Low	-	0	0	-	0	0
	Moderately High		**247**	9		**349**	11	
		High	205	83	14	321	92	7
		Moderately High	22	9	2	25	7	3
		Moderate	1	<1	1	1	<1	1
		Low	19	8	2	2	<1	1
	Moderate		**269**	9		**185**	6	
		High	181	68	10	115	62	6
		Moderately High	-	0	0	46	25	3
		Moderate	8	3	1	3	2	1
		Low	79	29	5	21	11	2
	Low		**2,287**	80		**2,636**	83	
		High	1,206	53	91	1,298	49	61
		Moderately High	289	13	11	414	16	12
		Moderate	368	16	19	396	15	17
		Low	423	19	28	528	20	20

APPENDIX 3. MANAGEMENT LEVELS CRITERIA

Throughout the report, cultivated cropland is categorized by the level of sediment, nitrogen, and phosphorus management being applied to allow comparison of conservation treatment between the two survey periods. Cultivated cropland acres are placed into one of four management levels—high, moderately high, moderate, and low. The criteria are based on an Avoid, Control, and Trap approach to reducing sediment losses, and a Rate, Method, and Timing approach to reducing nutrient losses from cropland. The following provides an overview of the criteria for categorizing sediment, nitrogen, and phosphorus management.

Sediment Management Levels:

1. **High**: At least one practice from each category with no practice counting twice.
    a. Avoid:
        i. All crops in the rotation are in conservation tillage (continuous no-till or reduced tillage)
    b. Control:
        i. At least one structural practice in overland flow or concentrated flow control categories (e.g., terrace, contouring, or grassed waterway), or
        ii. A high biomass conservation crop rotation (i.e., a crop residue score of 2 or more).
    c. Trap:
        i. At least one structural practice to trap potential losses (e.g., filter or buffer), or
        ii. A field border structural practice with a minimum of 30 feet in width and placed to intercept flow from cropped area.
2. **Moderately High**: At least one practice from two of the categories with no practice counting twice.
    a. Avoid:
        i. All crops in the rotation are in conservation tillage (continuous no-till or reduced tillage)
    b. Control:
        i. At least one structural practice in overland flow or concentrated flow control categories (e.g., terrace, contouring, or grassed waterway), or
        ii. A high biomass conservation crop rotation (i.e., a crop residue score of 2 or more) if all crops are in conservation tillage.
    c. Trap:
        i. At least one structural practice to trap potential losses (e.g., filter or buffer), or
        ii. If all crops are in conservation tillage, a field border structural practice with a minimum of 30 feet in width and placed to intercept flow from cropped area can be substituted for filter or buffer trapping practice.
3. **Moderate**: At least one practice from any category.
    a. Avoid:
        i. All crops in the rotation are under conservation tillage (continuous no-till or reduced tillage),
    b. Control:
        i. At least one structural practice in overland flow or concentrated flow control categories (e.g., terrace, contouring, or grassed waterway), or
        ii. A high biomass conservation crop rotation (i.e., a crop residue score of 2 or more).

c. Trap:
   i. At least one trapping practice such as a filter or buffer, or
   ii. A Field Border can be substituted if it is minimum of 30 feet in width and intercepts flow from cropped area.

4. **Low**:
   a. At least one crop in the rotation under conventional tillage, and
   b. No avoid, control, or trap practices are applied

Nutrient Management:
For nitrogen and phosphorus management, management levels are based primarily on rate, method, and timing of nutrient application:

Rate: Four rate classes are based on the average annual per acre nutrient application for the crop rotation:

1. **Nitrogen:**
   a. ***Low***: Rotational average of 75 pounds or less per acre annually.
   b. ***Moderate***: Rotational average of greater than 75 pounds and less than or equal to 90 pounds per acre annually.
   c. ***Moderately High***: Rotational average of greater than 90 pounds and less than or equal to 120 pounds per acre annually.
   d. High: Rotational average of more than 120 pounds per acre annually.
2. **Phosphorus**
   a. ***Low***: Rotational average of 20 pounds or less per acre annually.
   b. ***Moderate***: Rotational average of greater than 20 pounds and less than or equal to 35 pounds per acre annually.
   c. ***Moderately High***: Rotational average of greater than 35 pounds and less than or equal to 50 pounds per acre annually.
   d. ***High***: Rotational average more than 50 pounds per acre annually

Method: Three method classes are based on the level of incorporation of the applied nutrient for the crop rotation:

1. All applications are incorporated within 48 hours through tillage, injection, knifing, or banding. Fertigation is considered incorporation since the water moves the nutrients from surface into subsurface.
2. Some applications are incorporated within 48 hours.
3. No applications are incorporated within 48 hours.

Post-plant and fall applications to perennials and winter annuals are exempted from the method assessment. Post-plant applications on actively growing crops with full surface coverage have very low loss risk through surface and subsurface pathways, especially with late winter/early spring top dressing of winter annuals (e.g., wheat).

Timing: Two timing classes are based on fall and winter applications (beginning of September to end of February) for the crop rotation:

1. No fall or winter application. Fall manure applications are considered acceptable for all crops in the rotation, however, winter manure applications are not acceptable for any crop in the rotation, including winter annuals and perennials. All non-manure applications are acceptable for winter annuals and perennials regardless of season.

2. At least one fall or winter application.

<u>Nitrogen Management Levels:</u>

High:

i. Rate class is low, or
ii. Rate class is moderate, all or some applications are incorporated, and there are no fall or winter applications.

Moderately High:

i. Rate class is moderate, or
ii. Rate class is moderately high, all applications are incorporated, and there are no fall or winter applications.

Moderate:

i. Rate class is moderately high, and all or some applications are incorporated.

Low:

i. Rate class is moderately high, and no applications are incorporated, or
ii. Rate class is high.

<u>Phosphorus Management Levels:</u>

High:

i. No phosphorus is applied, or
ii. Rate class is low, and all applications are incorporated, or
iii. Rate class is low, some applications are incorporated, and there are no fall or winter applications, or
iv. Rate class is moderate, all applications are incorporated, and there are no fall or winter applications, or
v. Rate class is low, and all applications are post-plant applications on winter annuals or perennials.

Moderately High:

i. Rate class is low, some applications are incorporated, and there are fall or winter applications, or
ii. Rate class is low, and no applications are incorporated, or
iii. Rate class is moderate, and all applications are incorporated, or
iv. Rate class is moderate, and all applications are post-plant applications on winter annuals or perennials.

Moderate:

i. Rate class is moderate, and some or none of the applications are incorporated, or
ii. Rate class is moderately high, and all applications are incorporated, or
iii. Rate class is moderately high, and all applications are post-plant applications on winter annuals or perennials.

Low:

i. Rate class is moderately high and some or none of the applications are incorporated, or
ii. Rate class is high.