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

Conservation Practices on Cultivated Cropland in the California Coastal Production Region

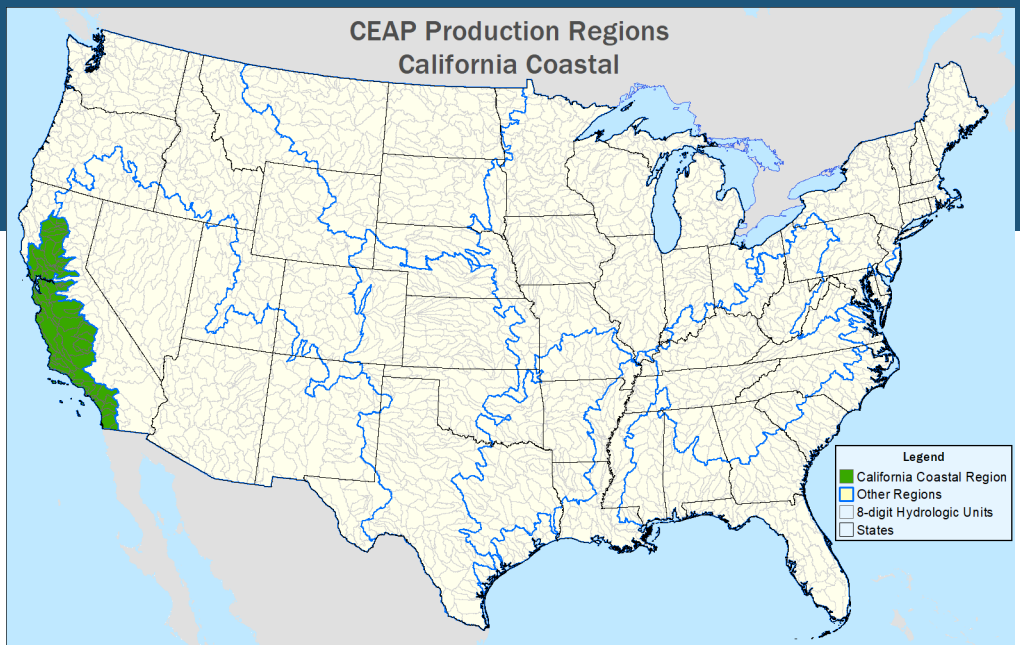
OCTOBER 2024

USDA-NRCS

About CEAP Croplands

The Natural Resources Conservation Service (NRCS) evaluates conservation trends and effects on cultivated cropland through the multi-agency Conservation Effects Assessment Project (CEAP). CEAP uses natural resource and farmer survey data and physical process modeling to estimate the environmental effects of conservation practices on cultivated cropland. USDA's National Agricultural Statistics Service conducted the first set of farmer surveys in 2003–06 (CEAP I) with reports released from 2010 through 2014. Now, comparison data from farmer surveys conducted from 2013–16 (CEAP II) make it possible to estimate shifts in conservation adoption and effects between the CEAP survey periods.

The California Coastal Production Region



The California Coastal (CC) production region is contained within the state of California. The region held 3.9 million acres of cultivated cropland in CEAP II, or about 10 percent of the region's total land area and 1 percent of all cultivated cropland in the United States. Between survey periods, the production region lost 534,000 acres (12 percent relative to CEAP I) of cultivated cropland. Over the same time, the region saw a gain in uncultivated cropland and urban and built-up land, which may have contributed to the decrease in cultivated cropland.

The CC production region was among the most diverse in the nation for crop types grown and harvested, where many production regions had just a few crops that made up over three-quarters of harvested acreage. Rice, vegetables, winter wheat, and corn silage together made up 49 and 64 percent of harvested crop acres in the CC production region in CEAP I and CEAP II, respectively. The CC production region did see some consolidation in crops harvested between survey periods as winter wheat harvested acres nearly tripled and helped drive those top four crops from about half of the acreage to nearly two-thirds. Vegetable, corn silage, and alfalfa/clover harvested acres decreased slightly (by 2 to 5 percent relative to CEAP I) between survey periods. Other crops such as corn for grain, oats, and durum and spring wheat saw increases between surveys, but each made up less than 10 percent of harvested acres in CEAP II.

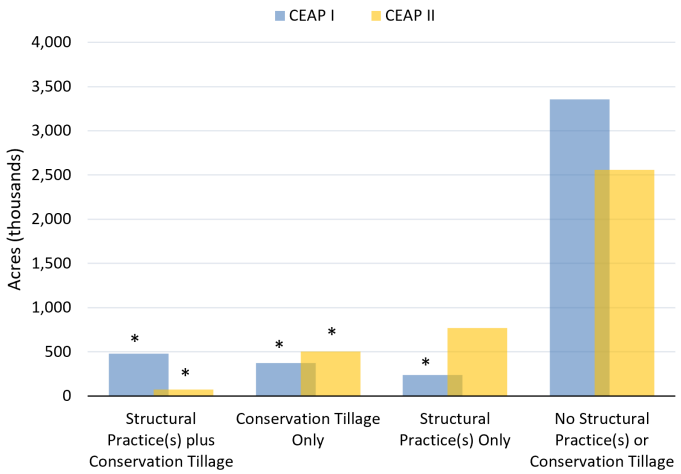
Cultivated cropland in the region is concentrated in the gently rolling valleys, which have lower vulnerability to wind and water erosion. With its dry Mediterranean climate, water management and irrigation practices are higher priorities than erosion control within fields or at their edges. Production practices, pest and disease control measures, and industry requirements for the fresh market reduce producers' ability to adopt conservation tillage on a continuous basis.

Conservation Practice Adoption

Adoption of conservation practices—regardless of state, federal, or other financial or technical assistance—was estimated based on operator responses to the CEAP I and CEAP II farmer surveys and saw a number of changes between survey periods in the CC production region.

Structural practices and conservation tillage

adoption increased over time,with the greatest gains made in the structural practices (e.g., field borders, terraces, grassed waterways, etc.) without conservation tillage treatment group (Figure 1), which increased by 533,000 acres to represent 20 percent of regional acres by CEAP II. However, adoption of the two practices together decreased over time, and there were too few points representing this treatment group in both periods to draw conclusions beyond trend. By CEAP II, 1.4 million acres, representing 35 percent of cultivated cropland in the CC production region, had one or both types of practices. The number of acres with neither type of practice adopted decreased by 24 percent, reaching 2.6 million acres or 65 percent of cultivated cropland in the CC production region by CEAP II. Adoption of these practices was low in the CC production region compared with the rest of the production regions, in large part due to the complexity and diversity of cropping systems in the region, many of which have low suitability for conservation tillage.

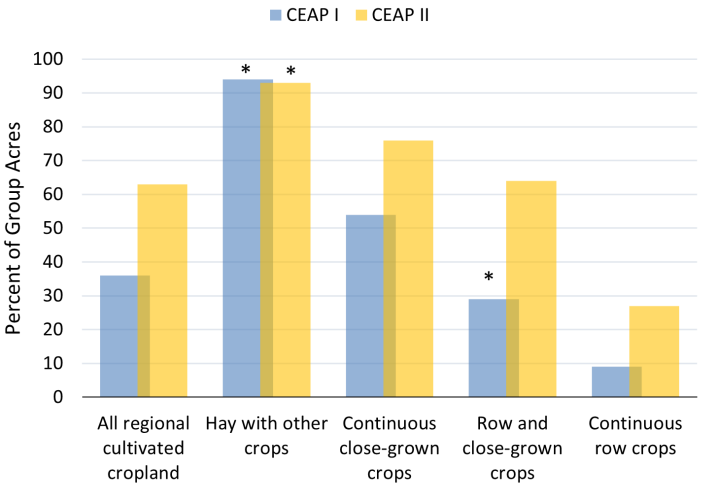


* Indicated values represent fewer than 30 data points and cannot be used to draw reliable conclusions.

Figure 1. Acres adopting combinations of structural practices and conservation tillage in CEAP I and CEAP II.

By CEAP II, just 15 percent of acres were reporting some form of conservation tillage (i.e., continuous no-till or reduced tillage practices), a slight downtrend from 19 percent in CEAP I, though there were fewer than 30 points representing this tillage type for the region in either period. Among acres using conventional tillage, there was a slight positive trend in use of seasonal conventional instead of continuous conventional tillage, with an 11 percent increase in adoption relative to CEAP I.

Conservation crop rotation[1] adoption increased in the CC production region between survey periods with 36 and 63 percent of acres adopting this practice in CEAP I and CEAP II, respectively (Figure 2). Adoption in the CC production region was lower than national adoption, which reached 70 percent of cultivated cropland in CEAP II. In the CC production region, adoption of conservation crop rotations was highest in rotations with hay and other crops, but this rotation group was represented by fewer than 30 points. Rotations with continuous close-grown crops had the next highest adoption, with 54 percent of rotation group acres in CEAP I and 76 percent in CEAP II. Rotations of continuous row crops had the lowest adoption of conservation crop rotations in both periods, 9 percent of rotation group acres in CEAP I and 27 percent in CEAP II.



*Indicated values represent fewer than 30 data points and cannot be used to draw reliable conclusions.

Figure 2. Percent of aces with conservation crop rotations by crop rotation group in CEAP I and CEAP II.

Cover crop use was low in the CC production region, with 176,000 acres—4 percent of the region's cultivated cropland acres—reporting a cover crop in 1 or more years of the crop rotation in CEAP II, and similar adoption in CEAP I. Cover crop use in the CC production region during CEAP II was slightly lower than the national average of 6 percent of cultivated cropland acres. It is important to note that not all cropping systems or environments are conducive to the use of cover crops, and low water availability or production of multiple crops in a season may be key tradeoffs in this region.

1 The full criteria for determination of conservation crop rotation in CEAP is available in Box 3 on Page 26 of the full report: Conservation Practices on Cultivated Cropland in the California Coastal Production Region.

Table 1. Nitrogen and phosphorous application rates in CEAP I and CEAP II

NUTRIENT SOURCE	APPLICATION RATE LBS/AC/Y		
	CEAP I	CEAP II	CEAP II - CEAP I
Commercial nitrogen without manure	144	132	-12
Commercial phosphorous without manure	30	28	-2

Irrigation use in the CC production region decreased from nearly 3.8 million acres during the CEAP I survey period to about 3.2 million acres by the CEAP II period. However, irrigated acreage accounted for about 82 percent of the 3.9 million acres of total cropland in the region in CEAP II, which was the highest rate of irrigation out of all the production regions. In comparison, only 16 percent of acres were irrigated nationally in CEAP II. Surface water was the primary water source during both survey periods at 67 percent for CEAP I and 66 percent for CEAP II. Gravity irrigation systems were dominant in the region, in part driven by the 942,000 harvested acres of rice grown in CEAP II, as rice uses water as a growing practice. Rice acreage represented 41 percent of total gravity irrigated acres for the region.

Nutrient management experienced some changes over time in the CC production region, with decreases to nutrient application rates and rates of nutrient incorporation. Practices to manage nutrients include varying the application rate, changing the application timing, modifying the way nutrients are applied, and switching the form of nutrients used. These practices make up a **SMART Nutrient Management Plan**, which includes the 4Rs of nutrient stewardship (the right Source, right Method, right Rate, and right Timing) and emphasizes smart activities for reducing nutrient loss through the Assessment of comprehensive, site-specific conditions.

Rates of nutrient application in the region decreased between survey periods for both nitrogen (N) and phosphorus (P) (Table 1). Average annual application rates of commercial N without manure decreased by just over 8 percent, and average annual application rates of commercial P without manure decreased by nearly 7 percent. Soil testing is a practice that aligns nutrient application rates with crop needs, and soil testing in the CC production region increased between survey periods, from 40 percent of acres (represented by fewer than 30 points) in CEAP I to 54 percent of acres in CEAP II. Adoption of this practice was slightly lower than the national average in CEAP II (i.e., 54 versus 60 percent nationally).

Soil incorporation of nutrients is an application method that can reduce surface losses of nutrients to waterbodies, especially when combined with other SMART nutrient management plan practices. The percentage of acreage with "all" or "some" incorporation for N applications was similar between survey periods in the CC production region, at 87 and 86 percent of acres in CEAP I and CEAP II, respectively. Notably, however, the percentage of acres reporting "all" applications incorporated decreased substantially, from 63 to 26 percent, with corresponding increases in the "some" applications incorporated category. Results were similar for P applications, though acres reporting "all" or "some" incorporation increased slightly from 82 to 87 percent between surveys in the region. Again, acreage reporting "all" applications incorporated decreased substantially, from 49 to 19 percent, with corresponding increases in the "some" applications incorporated category.

Timing of nutrient applications also plays an important role in nutrient management, with nutrients most vulnerable to loss when applied more than 21 days before planting. For both N and P in the CC production region, most acres applied nutrients at the "at-plant" stage (Figure 3). All application timings increased between survey periods for N, and all but the "at-plant" timing increased for P, indicating increases to the overall acres reporting N and P applications between survey periods. For both nutrients, pre-plant timings were

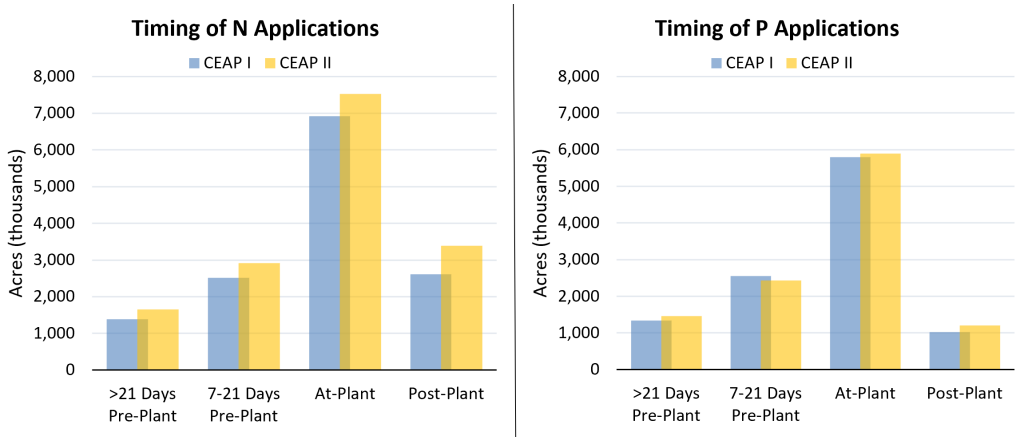


Figure 3. Comparison of application timing for nitrogen (left) and phosphorus (right) applications in CEAP I and CEAP II.

reported by too few data points to draw conclusions beyond trend. Variable rate technology and enhanced efficiency fertilizers are advances in nutrient management that can more effectively apply and release plant nutrients. Variable rate technology matches nutrient rates to a soil type's crop yield potential whereas enhanced efficiency fertilizers control the release of nutrients to minimize volatilization losses. Both practices increased in adoption over time, though they were still used on a small portion of acres by CEAP II. Variable rate technology was used on 104,000 more acres of cultivated cropland within the region but represented just 8 percent of acres by CEAP II. Enhanced efficiency fertilizers were adopted on 222,000 more acres in CEAP II than CEAP I and represented 10 percent of acres by CEAP II. Adoption of these practices was represented in both cases by fewer than 30 points and both practices were adopted at lower rates in the CC production region than the national average.

Integrated pest management (IPM) increased decreased between survey periods in the CC production region, as measured by the CEAP IPM indicator score. Scores—which are measured on a 100-point scale and increase with increased IPM activity—declined between surveys at 33.8 and 28.5 in CEAP I and II, respectively. During CEAP I, the CC production region scored higher than the national average, but in CEAP II the CC production region scored lower than the national average on this measure. Scouting for weeds, insects, and disease, deliberate scouting, and cleaning equipment after field work were the most common IPM practices in CEAP II, with adoption over 56 percent for each. Like most production regions, the CC experienced an increase in overall average annual pesticide applications, from 2.7 in CEAP I to 3.3 in CEAP II (Figure 4). Unlike the national changes, the increase in overall pesticide use for the CC production region was driven by an increase in insecticide and fungicide use, rather than herbicides. These changes may be indicative of increased pest pressures for the crops grown in the production region, or a mismatch between scouting behaviors and suppression activities.

Sediment and Nutrient Management Levels

Cultivated cropland acres were categorized by the level of sediment management being applied and of N and P management need to allow comparison of conservation treatment between the two CEAP survey periods. Sediment management and N and P management need levels were measured by assessing combinations of practices in support of comprehensive conservation management and can tell a different story than measurements of the adoption of individual conservation practices alone.

Sediment management levels[2] showed some change between surveys in the CC production region, with increased acreage in the moderately high management level and declines in acres with high management level (Figure 5). Despite these changes, most acres were in either the moderately high or high sediment management level, showing adequate treatment for sediment management needs in much of the region, even with large acreages of conventional tillage and low adoption of structural practices compared with other regions. Conservation crop rotation use is a component of sediment management level rating and increased between survey periods for this region.

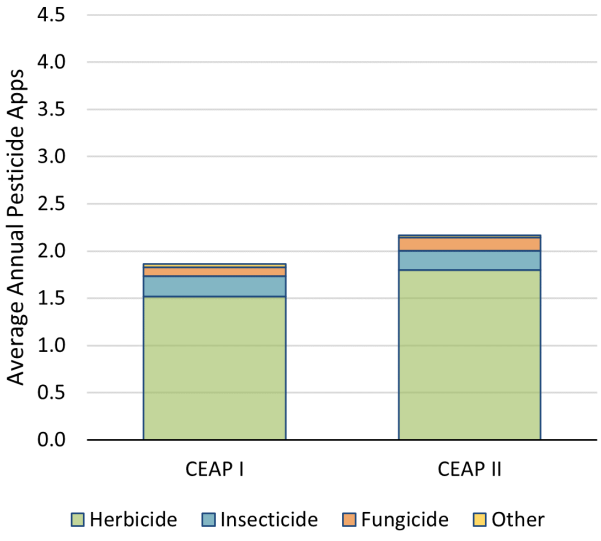


Figure 4. Average annual number of pesticide applications reported for CEAP I and CEAP II, broken down by pesticide type.

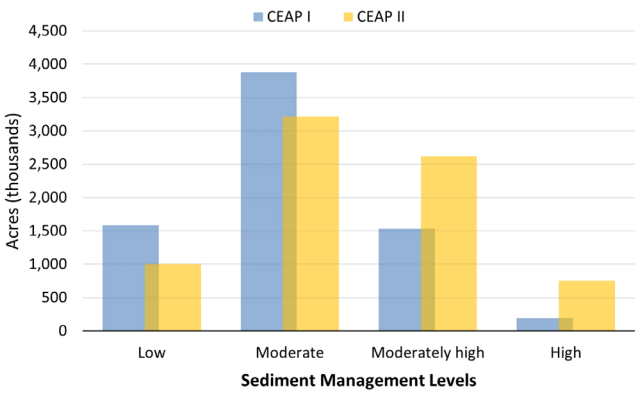
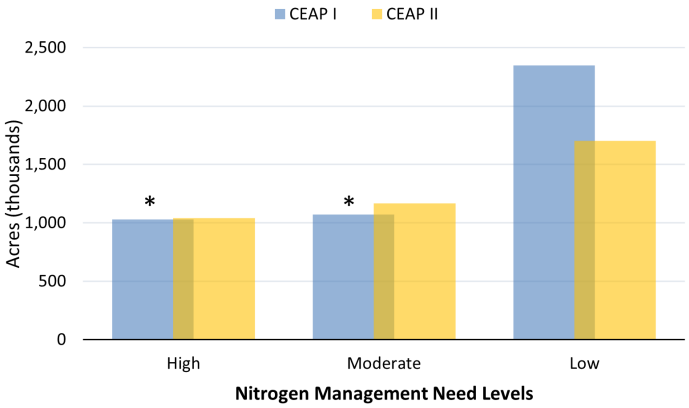


Figure 5. Cultivated cropland acreage compared between sediment management levels in CEAP I and CEAP II.

2 For more information on the criteria for sediment management levels, see Appendix 3 in the full report: Conservation Practices on Cultivated Cropland in the California Coastal Production Region.

Nitrogen management need levels[3] saw small increases in the high and moderate N management need levels and a decrease in the low N management need level, though it remained dominant in CEAP II (Figure 6). Declines in this category are reflective of the overall cultivated cropland acreage decrease between survey periods for the region, since the other management need levels saw little change. The CC production region had 43 percent of acres in the low N management need level in CEAP II and was lower than national performance on this measure. Nationally, 60 percent of acres were in the low N management need level in CEAP II. High N and P management **need** levels correspond with low N and P management performance, and low N and P management **need** levels correspond with high N and P management performance.

Phosphorous management need levels had high performance in this region and showed little change over time. The region had most (i.e., 96 percent in CEAP I and 97 percent in CEAP II) of its acres in the low P management need level. Low rainfall amounts and soils with low vulnerability to runoff make this region less susceptible to P loss. Comparatively, on the national scale 24 percent of acres in CEAP II had a high P management need, with over half in the low management need level.



*Indicated values represent fewer than 30 data points and cannot be used to draw reliable conclusions.

Figure 6. Cultivated cropland acreage compared between N management need levels in CEAP I and CEAP II.

Effects on Conservation Outcomes

Conservation practice adoption and environmental condition together drive conservation effects on the landscape in terms of success at meeting data-driven thresholds for addressing resource concerns (e.g., erosion, N and P loss). Data from this section of the report represent Agricultural Policy Environmental Extender (APEX) modeled results estimating edge-of-field losses of sediment and nutrients, as well as soil carbon accumulation under the conservation conditions indicated by the CEAP I and CEAP II farmer surveys and alternative treatment scenarios developed to assess conservation potential [4].

Conservation measures adopted by farmers between CEAP I and CEAP II helped to reduce the number of acres exceeding the resource concern threshold for sheet and rill erosion, surface N, subsurface N, and total P, though the percentage of acres exceeding these thresholds was less than 5 percent for all but subsurface N (Table 2). Soil carbon, subsurface N,

Table 2. Cultivated cropland exceeding resource concern thresholds in CEAP I and CEAP II

RESOURCE CONCERN EXCEEDANCE	CEAP I		CEAP II		CEAP II - CEAP I	
	Acres (thousands)	Percent	Acres (thousands)	Percent	Acres (thousands)	Percent change Relative to CEAP I
Sheet and rill erosion (>T)	58*	1*	39*	1*	-19*	-33*
Wind erosion (>T)	0*	0*	0*	0*	0*	0*
Sediment (>2 t/ac/y)	108*	2*	200*	5*	92*	86*
Surface nitrogen (>15 lbs/ac/y)	58*	1*	49*	1*	-9*	-15*
Total phosphorus (>3 lbs/ac/y)	234*	5*	131*	3*	-103*	-44*
Subsurface nitrogen (>25 lbs/ac/y)	1,552	35	1,311	33	-242	-16
Soluble phosphorus (>0.5 lbs/ac/y)	285*	6*	665	17	380*	133*
Soil carbon (losing)	1,439	32	1,514	39	75	5

*values represent fewer than 30 data points and cannot be used to draw reliable conclusions

3 For more information on the criteria for phosphorus and nitrogen management need levels, see Appendix 4 in the full report: Conservation Practices on Cultivated Cropland in the California Coastal Production Region.
4 For more information on the modeling process, see Appendix 1 in the full report: Conservation Practices on Cultivated Cropland in the California Coastal Production Region.

and soluble P were the resource concerns with the largest percentage of acres exceeding their respective resource concern thresholds in both survey periods, and soluble P and soil carbon saw increased acreage exceeding thresholds. No acres were exceeding the wind erosion threshold in either survey period.

While erosion and sediment loss are related resource concerns, they describe different outcomes for sediment. Erosion describes all material that is picked up and moved by either wind or water, while sediment loss only considers the material that leaves the field. Sediment losses are estimated edge-of-field sediment loss with surface water runoff (including both sheet and rill and gully erosion) and do not include sediment losses due to wind erosion. Resource concern thresholds for erosion are reliant on the soil loss tolerance rate (T), which 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 T values than shallow or previously eroded soils.

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. Additionally, opportunities remain where conservation measures are in place but the pressures on the land require more comprehensive treatment. 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. Solutions may include targeted conservation practices within a systems approach, higher end technology, or some combination of these and other tools.

For many resource concerns, the acres exceeding the threshold tend to drive changes in estimated edge-of-field losses or soil carbon change, but even acres meeting the resource concern thresholds can be experiencing some losses. Losses and soil carbon change are expressed in thousands of tons per year and are estimated for the entire region, regardless of whether the acres were meeting or exceeding the resource concern threshold. In the CC production region, erosion, total P, subsurface N, and soluble P showed positive trends for management of resource concerns, with reduced losses (Table 3). Acres exceeding the sediment and soil carbon resource concerns increased and estimated losses also increased. Acres exceeding the soluble P threshold increased, but estimated losses decreased slightly between survey periods. The opposite was true for subsurface N losses, where acres exceeding the threshold increased, but losses decreased between survey periods..

Summary

The CC production region made up about 1 percent of cultivated cropland acres nationally, with 3.9 million acres in cropland in CEAP II. Cultivated cropland is concentrated in the 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.

Just under two-thirds of acres were meeting all resource concern thresholds, and there were only small changes evident in the acres meeting thresholds where there were enough exceeding points to draw conclusions. Subsurface N, soluble P, and soil carbon were the only resource concerns with more than 5 percent of acres exceeding the resource concern thresholds. Despite those exceedances for soluble

Table 3. Estimated edge-of-field losses and soil carbon on cultivated cropland in the California Coastal Production Region in CEAP I and CEAP II

RESOURCE CONCERN	CEAP I (thousands of tons per year)	CEAP II (thousands of tons per year)	CEAP II - CEAP I	
			Change (thousands of tons per year)	Change (percent)
Sheet and rill erosion (losses)	1,307	1,218	-89	-7
Wind erosion (losses)	133	102	-31	-23
Sediment (losses)	1,754	1,961	207	12
Surface nitrogen (losses)	2	3	1	53
Total phosphorus (losses)	2	2	-0.4	-17
Subsurface nitrogen (losses)	101	80	-21	-21
Soluble phosphorus (losses)	1	1	-0.2	-17
Soil carbon (gains)	-6	-148	-142	2275

P and subsurface N, losses of both nutrients were reduced between survey periods. Soil carbon gains were challenging for this region for a number of reasons, including the major crops grown which do not leave much biomass in the field, the low adoption rate for conservation tillage, and water quantity challenges that make biomass gains and adoption of practices like cover crops difficult to accomplish.

Adoption of soil health-promoting practices in the CC production region lagged behind national trends, with a smaller percentage of acres adopting conservation tillage, cover crops, and structural practices than the national average. Approximately 95 percent of the CC production region received less than 25 inches of average annual rainfall, and 82 percent of the cultivated cropland acres were irrigated in CEAP II—the most of any production region. Water limitations and a reliance on irrigation for crop growth can make adoption of plant growth-based practices like cover crops and certain structural practices difficult for producers. The top harvested crops in the CC production region are also tillage intensive, which may lead to carbon losses. By CEAP II, 85 percent of acres in the CC production region were still using conventional tillage (compared to 33 percent nationally). Opportunities to improve soil carbon could include emphasis on conservation tillage and structural practice adoption on suitable crops like corn and winter wheat, which made up nearly a third of harvested acres in CEAP II.

While application rates for both N and P decreased on acres receiving commercial fertilizer and most acres still reported "some" incorporation of nutrients, acres reporting "all" incorporation of N and P applications decreased even as conventional tillage remained dominant. Adoption of technology-based practices like variable rate technology and enhanced efficiency fertilizers were used on too few points to draw conclusions and could be an area for nutrient management emphasis in the future.

Conservation efforts to balance nutrient management and soil health objectives and overcome challenging environmental conditions remains an NRCS priority. Efforts such as implementation of **SMART Nutrient Management Plans**, which include the right Source, right Method, right Rate, and right Timing—and emphasize smart activities to reduce nutrient loss by Assessment of comprehensive, site-specific conditions, continue to be important in this production region to meet these difficult resource concern objectives.