There are nearly 400 million acres of cropland in the conterminous 48 States, including about 30 million acres of environmentally sensitive cropland retired under long-term Conservation Reserve Program (CRP) contracts. U.S. cropland is concentrated in the upper Midwest, the Great Plains, and the Mississippi River Valley (fig. 1). Because it is used intensively, cropland is subject to accelerated soil erosion by wind and water, which reduces the inherent productivity of the soil and releases sediment, nutrients, and other contaminants to rivers and streams.

**Controlling Sediment and Nutrient Losses**

Farmers reduced total cropland erosion caused by wind and water by 43 percent between 1982 and 2007 (fig. 2). On a per-acre basis, average annual sheet and rill erosion rates on cropland declined more than 30 percent during this period, from 4 tons per acre per year in 1982 to 2.7 tons per acre per year in 2007. Wind erosion rates also dropped by more than 30 percent, from 3.3 to 2.1 tons per acre per year during the same period. Although the rate of decrease in soil erosion has slowed since 1997, the general downward trend continued at least through 2007, the latest year for which erosion estimates are available. Soil erosion on cultivated cropland\(^1\) is concentrated geographically and on

---

\(^1\) Cultivated cropland includes land in row crops or close-grown crops, hay and pasture in rotation with row crops and close-grown crops (such as wheat and other small grain crops), and land in long-term conserving cover. Cultivated cropland does not include agricultural land that has been in hay, pasture, or horticulture for four or more consecutive years.
highly erodible land. Fifty-four percent of the cropland sheet and rill erosion occurs in just two of the ten farm production regions—the Corn Belt and the Northern Plains.

Nutrients, including nitrogen and phosphorus, can move beyond the edge of the field in overland flow in soluble form or attached to soil particles, or through subsurface pathways in soluble form. While erosion-control practices reduce the loss of nutrients through surface runoff, they also can promote the infiltration of soluble nutrients, which can then move through subsurface pathways to rivers and streams. Tile drains can intercept subsurface flow and route it directly to surface flows.

**CEAP Data and Modeling Framework**

USDA is conducting the interagency Conservation Effects Assessment Project (CEAP) to quantify the effects of past conservation efforts and better recommend future conservation practices on agricultural land in the United States. The CEAP assessment uses results from on-farm surveys and historical data coupled with a statistical sampling and modeling approach to estimate the effects of current conservation systems on sediment, nitrogen, phosphorus, and carbon dynamics. The National Resources Inventory (NRI), a statistical survey of conditions and trends in soil, water, and related resources on U.S. non-Federal land conducted by USDA’s Natural Resources Conservation Service, provides the statistical framework for the CEAP modeling effort. The NRI, together with Soil Survey databases, also provides the landscape and soil attribute information used in the CEAP modeling system.

Information on farming activities and conservation practices was obtained primarily from a farmer survey conducted during the period 2003–06. The assessment includes not only practices associated with Federal conservation programs but also the conservation efforts of States, independent organizations, and individual landowners and farm operators. The analysis assumes that structural practices (such as buffers, terraces, and grassed waterways) reported in the farmer survey or obtained from other data sources were appropriately designed, installed, and maintained.

Physical process simulation models are used to estimate the effects of conservation practices on natural resources. The field-level effects of the conservation practices were assessed using a field-scale physical process-based model—the Agricultural Policy Environmental Extender (APEX)—which simulates the day-to-day farming activities, wind and water erosion, loss or gain of soil organic carbon, and edge-of-field losses of nutrients and pesticides. A watershed model and system of databases—the Hydrologic Unit Model for the United States (HUMUS)—was used to simulate how reductions of field losses have reduced in-stream concentrations and loadings of sediment, nutrients, and pesticides. The Soil and Water Assessment Tool

---

**Figure 2. Trends in cropland erosion, conterminous 48 States, 1982–2007**

<table>
<thead>
<tr>
<th>Year</th>
<th>Sheet &amp; Rill Erosion</th>
<th>Wind Erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>1.68</td>
<td>0.99</td>
</tr>
<tr>
<td>1987</td>
<td>1.49</td>
<td>0.85</td>
</tr>
<tr>
<td>1992</td>
<td>1.18</td>
<td>0.80</td>
</tr>
<tr>
<td>1997</td>
<td>1.04</td>
<td>0.77</td>
</tr>
<tr>
<td>2002</td>
<td>1.01</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>0.96</td>
<td></td>
</tr>
</tbody>
</table>

*Source: USDA-NRCS, 2007 National Resources Inventory*

---

2 For more information on the NRI sample design, see [www.nrcs.usda.gov/technical/NRI/](http://www.nrcs.usda.gov/technical/NRI/).
(SWAT) model was used to simulate nonpoint source loadings from land uses other than cropland and to route in-stream loads from one watershed to another.

The CEAP cultivated cropland sample is a subset of NRI sample points from the 2003 NRI. The sample is statistically representative of cultivated cropland and formerly cultivated land that had been converted to long-term conserving cover by 2003. Nationally, there were over 30,000 samples in the original sample draw. The NRI-CEAP usable sample consists of about 18,700 NRI points representing cropped acres, and about 13,000 NRI points representing land enrolled in the CRP General Signup.

Conservation practices have the greatest effect on the more vulnerable acres, such as highly erodible land and soils prone to leaching. Across all basins, focusing on high-treatment-need acres generates a proportionally larger benefit relative to treating every acre. USDA has developed a vulnerability assessment tool based on soil characteristics to identify locations where potential losses of sediment and nutrients are greatest. The red and orange shaded areas in figures 3 and 4 identify soils with high and moderately high vulnerability.

---


---

Figure 3. Soil runoff potential, conterminous 48 States

Figure 4. Soil leaching potential, conterminous 48 States
vulnerabilities for runoff or leaching. Management measures, such as conservation buffers and nutrient management, can mitigate these inherent vulnerabilities and reduce the movement of soil, nutrients, and pesticides to surface and subsurface water resources.

Table 1 displays simulation results from the four CEAP-Cropland regional assessments completed to date. Findings suggest that existing conservation practices have reduced field-level losses of sediment, nitrogen, and phosphorus, and typically improved soil organic carbon levels, compared to conditions that would be expected to exist if no conservation practices were in place. It is now possible to estimate the in-field and edge-of-field impacts of applying additional conservation practices on sediment, nitrogen, phosphorus, and soil organic matter.

These CEAP results indicate that while much has been accomplished, there remains much yet to be done to protect and conserve natural resources. Informed choices need to be made to get the most bang for the conservation buck. The following sections present the results of using the CEAP data and models to analyze various conservation opportunities on cropland.

Optimization: An Approach to Targeting Acres, Allocating Funding, and Determining Alternatives

No single practice or set of practices is the best conservation solution for all cropland acres. Rather, some soils and operations might benefit most from adding cover crops, others from adopting drainage water management, and still others from improved nutrient management or other practices. Recognizing that budget constraints preclude USDA and producers from adopting full treatment on all acres, we have developed an optimization model that identifies the best practice or practices to apply across the surveyed cropland to maximize the benefits of conservation investments under alternative funding scenarios. Cropland Analysis #1 presents the results of this optimization analysis and the simulated potential for reductions in sediment, nitrogen, and phosphorus loads, along with the impacts on soil health as measured by soil organic carbon content.

Biofuels and U.S. Agriculture

Biofuels currently account for 20 percent of the Nation’s renewable energy supply and are expected to increase in response to incentives for energy independence. The effects of increased biofuels production on the landscape will depend greatly on what crops are produced; where and how they are produced, harvested, and converted into biofuels; and what measures are used to conserve soil, water, and related resources.

Ethanol from corn grain dominates the current U.S. biofuels market (fig. 5). Cellulosic feedstocks, however, are expected to provide at least 16 billion gallons a year of advanced biofuels under the Renewable Fuels Standard. The volumes of biomass necessary for cellulosic biofuels production will come from a variety of sources, including dedicated energy crops such as switchgrass.

As cellulosic technologies mature, it is likely that some marginal cropland will be converted to the production of feedstocks. Cropland Analysis #2 analyzes the potential for converting marginal cropland to switchgrass production, and presents the resultant potential impacts on soil carbon, and on sediment, nitrogen, and phosphorus loss reductions.

Conservation Reserve Program

With commodity prices running high and the acreage cap for the CRP possibly being lowered in the next farm bill, there is concern about the potential adverse environmental impacts of converting highly erodible and other environmentally sensitive lands back to cultivated cropland at the end of their CRP contracts. This could have negative consequences for soil health, water quality, aquifer recharge, and wildlife habitat, and in some cases could increase taxpayer costs. Cropland Analysis #3 assesses these potential impacts using the CEAP data and treatment criteria, as well as additional data on wildlife habitat and water supplies.

<table>
<thead>
<tr>
<th>Region</th>
<th>Sediment losses</th>
<th>Nitrogen losses—Total phosphorus losses</th>
<th>Change in soil organic carbon content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>with surface runoff</td>
<td>in subsurface flow</td>
</tr>
<tr>
<td>Upper Mississippi River Basin</td>
<td>61</td>
<td>45</td>
<td>9</td>
</tr>
<tr>
<td>Chesapeake Bay Region</td>
<td>55</td>
<td>42</td>
<td>31</td>
</tr>
<tr>
<td>Great Lakes Region</td>
<td>47</td>
<td>43</td>
<td>30</td>
</tr>
<tr>
<td>Ohio-Tennessee River Basin</td>
<td>52</td>
<td>35</td>
<td>11</td>
</tr>
</tbody>
</table>
Figure 5. Harvested corn acreage, by end use (status from 2000 to 2009 and projection from 2010 to 2019)

Source: USDA World Agricultural Outlook