The U.S. Department of Agriculture’s Conservation Effects Assessment Project (CEAP) has undertaken a series of studies designed to quantify the effects of conservation practices on cultivated cropland in the conterminous 48 States. One of these studies covers the Souris-Red-Rainy Basin.

The Souris, Red, and Rainy Rivers drain eastern North Dakota, western and northern Minnesota, and a small part of northeastern South Dakota before flowing north into Canada where they discharge ultimately into Hudson Bay. In the center of the region, the Red River forms most of the boundary between North Dakota and Minnesota; to the east, the Rainy River is part of the U.S.-Canada boundary. The Souris-Red-Rainy Basin drains about 38 million acres in the United States, including some 20 million acres of cultivated cropland (fig. 1).

Cultivated cropland makes up nearly two-thirds of the total area of the Souris and Red River Basins. The Rainy River Basin has less than 100,000 acres of cultivated cropland and is mostly forest land and wetlands. Wheat, soybeans, and corn are the main crops grown. The region produced 28 percent of the national barley crop, 19 percent of the national sugarbeet crop, and 13 percent of the national wheat crop in 2007.

Figure 1. Location of and land cover in the Souris-Red-Rainy Basin

SOURCE: TEXAS AGRILIFE RESEARCH, TEXAS A&M UNIVERSITY (USDA-NASS DATA)
Study Methodology

The assessment uses a statistical sampling and modeling approach to estimate the effects of conservation practices. 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 study. Physical process simulation models were used to estimate the effects of conservation practices that were in use during the period 2003 to 2006. Information on farming activities and conservation practices was obtained primarily from a farmer survey conducted as part of the study. 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.

The national sample for the farmer survey consists of 18,700 sample points with 476 of these sample points located in the Souris-Red-Rainy Basin. This sample size is sufficient for reliable and defensible reporting at the regional scale and for large watersheds within the region, but is generally insufficient for assessments of smaller areas.

The modeling strategy for estimating the effects of conservation practices consists of two model scenarios that are produced for each sample point.

1. A baseline scenario, the “baseline conservation condition” scenario, provides model simulations that account for cropping patterns, farming activities, and conservation practices as reported in the NRI-CEAP Cropland Survey (2003–06) and other sources.

2. An alternative scenario, the “no-practice” scenario, simulates model results as if no conservation practices were in use but holds all other model inputs and parameters the same as in the baseline conservation condition scenario.

The effects of conservation practices are obtained by taking the difference in model results between the two scenarios. The need for additional conservation treatment was evaluated using a common set of criteria and protocols applied to all regions in the country to provide a systematic, consistent, and comparable assessment at the national level.
Study Findings
The findings summarized below represent the baseline conservation condition, using conservation practices reported in the 2003–06 NRI-CEAP Cropland Survey.

Voluntary, Incentives-Based Conservation Approaches Are Achieving Results
Farmers have reduced sediment, nutrient, and pesticide losses from farm fields through conservation practice adoption throughout the Souris-Red-Rainy Basin, compared to losses that would be expected if no conservation practices were in use. Structural practices for controlling water erosion are in place on 18 percent of all cropped acres in the region, including 23 percent of highly erodible land. Fifty-five percent of cropped acres meet criteria for mulch till, and 17 percent meet criteria for no-till. Eighty-nine percent of cropped acres have structural or tillage and residue management practices, or both. Farmers meet criteria for good nitrogen management—appropriate rate, timing, and method of application—on 38 percent of the cropped acres during every year of production, and good phosphorus management on 43 percent.

Conservation practice adoption on cropped acres—whether through Federal or State programs or through landowners’ initiative—has reduced wind erosion by 52 percent, edge-of-field waterborne sediment losses by 43 percent, nitrogen loss with windborne sediment by 45 percent, nitrogen loss with runoff by 67 percent, nitrogen loss through leaching by 71 percent, and total phosphorus loss by 57 percent.

Opportunities Exist to Further Reduce Soil Erosion and Nutrient Losses from Cultivated Cropland
The need for additional conservation treatment in the region was determined by imbalances between the level of conservation practice use and the level of inherent soil vulnerability. Three levels of treatment need were estimated:

- **A high level of need** for conservation treatment exists where the loss of sediment and/or nutrients is greatest and where additional conservation treatment can provide the greatest reduction in agricultural pollutant loadings. **Although some cropland in the region needs additional treatment for loss of sediment or nutrients, these needs are not widespread enough to be considered to have a high-level of need for additional conservation treatment.**

- **A moderate level of need** for conservation treatment exists where the loss of sediment and/or nutrients is not as great and where additional conservation treatment has less potential for reducing agricultural pollutant loadings. **Approximately 4.3 million acres—25 percent of the cropped acres in the region—have a moderate level of need for additional conservation treatment, all for wind erosion.**

- **A low level of need** for conservation treatment exists where the existing level of conservation treatment is adequate compared to the level of inherent soil vulnerability. **Approximately 13.2 million acres—75 percent of the cropped acres in the region—have a low level of need for additional conservation treatment.**

Water quality concerns associated with crop production the Souris-Red-Rainy Basin are not pronounced because of the low levels of precipitation, the short growing season, the preponderance of close-grown crops, the widespread use of conservation practices on cropland, and the high percentage of cropped acres that have low potential for runoff or leaching. The most significant conservation need in the region—control of wind erosion—exists mainly in the Red River subregion. Only about 2 percent of cropped acres have annual nitrogen leaching losses higher than 25 pounds per acre per year, but because these acres were widely distributed across the region we did not consider them to have a significant need for conservation treatment. Although additional conservation practices could be applied on the low-treatment-need cropland, further reductions in sediment and nutrient loss would be minimal. The greatest gains would come through treatment to reduce wind erosion.
Conservation Practice Effects on Water Quality

Cultivated cropland makes up about 68 percent of the land base of the Souris and Red River subregions but contributes 77 percent of the loadings of sediment, 83 percent of the nitrogen, and 57 percent of the phosphorus to rivers and streams in the region. (The Rainy River subregion has too little cropland to support reliable estimates of sediment and nutrient loss.) Urban point and nonpoint sources, which make up only about 5 percent of the land base, account for the bulk of the remaining sediment and nutrient loads.

Model simulations suggest that conservation practices in use on cultivated cropland in the period 2003-06 have reduced loads from cultivated cropland delivered to rivers and streams from the combined Souris and Red River subregions by—
- 50 percent for sediment,
- 75 percent for nitrogen, and
- 52 percent for phosphorus.

See figure 2, next page.

Some of the sediment and nutrients that reach rivers and streams are removed, trapped, or deposited before the rivers reach Canada. The proportion of instream loads attributed to cropland sources that are exported to Canada from the Souris River subregion are estimated to be—
- 33 percent of the sediment,
- 91 percent of total nitrogen, and
- 66 percent of total phosphorus.

The proportion of instream loads attributed to cropland sources that are exported to Canada from the Red River subregion are estimated to be—
- 13 percent of the sediment,
- 86 percent of the nitrogen, and
- 52 percent of the phosphorus.

In the Souris River subregion, conservation practices have reduced instream loads from all sources of—
- sediment by 20 percent,
- nitrogen by 83 percent, and
- phosphorus by 33 percent.

In the Red River subregion, conservation practices have reduced instream loads from all sources of—
- sediment by 5 percent,
- nitrogen by 75 percent, and
- phosphorus by 38 percent.
Summary of Findings
Assessment of the Effects of Conservation Practices on Cultivated Cropland in the Souris-Red-Rainy Basin
Regional Comparisons

- At 38 million acres, the U.S. portion of the Souris-Red-Rainy Basin covers only about 12 percent as much area as does the largest U.S. water resource region, the Missouri River Basin (322 million acres). It is, however, more than four times larger than the smallest region, the Delaware River Basin (8.7 million acres).
- The percentage of cultivated cropland acres with structural and/or management practices for erosion control is similar to the percentage of such measures in most other regions.
- Losses of waterborne sediment, waterborne nitrogen through surface and subsurface pathways, and waterborne phosphorus are lower than in other regions, on average.
- Reductions in sediment loss to wind and water due to conservation practice use are similar to those in other regions. Reductions in nitrogen and phosphorus loss, however, are higher than in most other regions. In no other region have farmers reduced nitrogen loss through leaching by more than the 72-percent reduction in the Souris-Red-Rainy Basin.
- Field-level losses and conservation treatment needs in this region are similar to those for the western portion of the Missouri River Basin. Both of these areas have significant wind erosion and low levels of sediment loss, nitrogen lost with surface water runoff, nitrogen lost in subsurface flows, and phosphorus lost to surface water. Both regions have less than 1 percent of cropped acres with a high need for additional conservation treatment, and both have about one-fourth of cropped acres with a moderate need for additional conservation treatment for wind erosion. Average annual precipitation in the two regions is also similar (18 inches per year in the western portion of the Missouri River Basin and 20 inches per year in the Souris-Red-Rainy Basin.)

Changes on the Farm Since the 2003-06 Survey

The evaluation of conservation practices and associated estimates of conservation treatment needs as reported here were based on practice use derived from a farmer survey conducted during the years 2003–06. As such, the report provides full documentation of the estimates of conservation treatment needs in the Souris-Red-Rainy Basin as reported in the 2011 RCA Appraisal.

Reviewers familiar with local conditions within the basin report that there have been significant changes in cropped acreage and cropping practices since 2003–06. It is thus likely that conservation treatment needs in this region have risen above levels reported here. Among the changes are—

- a shift in some areas to corn-soybean cropping systems, replacing barley and other close-grown crops, and an increase in the production of canola in other areas,
- increased use of commercial fertilizer in the region as corn acreage has expanded,
- expansion of the installation of tile drainage throughout the basin,
- conversion of land enrolled in the Conservation Reserve Program back to cultivation,
- cultivation of new acres previously in native grasses in response to changes in commodity prices and land values, and
- removal of shelterbelts to increase cropped acreage, which reduces protection from wind erosion.
River Basin Cropland Modeling Study Reports

The U.S. Department of Agriculture initiated the Conservation Effects Assessment Project (CEAP) in 2003 to determine the effects and effectiveness of soil and water conservation practices on agricultural lands. The CEAP report *Assessment of the Effects of Conservation Practices on Cultivated Cropland in the Souris-Red-Rainy Basin* is one in a series of studies covering the major river basins and water resource regions of the conterminous 48 United States. It was designed to quantify the effects of conservation practices commonly used on cultivated cropland in the Lower Mississippi River Basin, evaluate the need for additional conservation treatment in the region, and estimate the potential gains that could be attained with additional conservation treatment. This series is a cooperative effort among USDA’s Natural Resources Conservation Service and Agricultural Research Service, Texas AgriLife Research of Texas A&M University, and the University of Massachusetts.

**Upper Mississippi River Basin (draft released June 2010, revision completed July 2012)**

**Chesapeake Bay Region (released March 2011)**

**Great Lakes Region (released September 2011)**

**Ohio-Tennessee River Basin (released February 2012)**

**Missouri River Basin (released August 2012)**

**Arkansas-White-Red River Basin (April 2013)**

**Lower Mississippi River Basin (August 2013)**

**Pacific Northwest Basin (June 2014)**

**South Atlantic-Gulf Basin (June 2014)**

**Souris-Red-Rainy Basin (July 2014)**

**Delaware River Basin**

**Texas Gulf Basin**

The Northeast and Western Water Resource Regions cannot be completed because there are too few National Resources Inventory sample points for reliable statistical estimation.

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