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A cooperative educational program to reduce soil erosion

By David P. Shelton, Elbert C. Dickey, Paul J. Jasa, David A. Biere, and Susan Smydra Krotz

EASTERN Nebraska, especially the northeastern portion, has a history of severe soil erosion, due in part to a predominance of steep slopes and highly erodible soils (72). While the average annual allowable soil loss ("T" value) for most of these soils is five tons per acre, some fields have annual soil erosion rates that exceed 100 tons per acre. The loss of topsoil is critical, of course, but erosion from cropland also results in the removal of fertilizers and pesticides, which degrades water quality.

Even though farmers are generally aware that soil erosion is a national problem, many fail to recognize it as a problem in their own farming operation. Nowak (74) indicated that sheet and rill erosion often is largely invisible to farmers. Furthermore, while soil erosion has occurred, farmers generally have not experienced corresponding losses in productivity. In some cases, potential losses have been masked by use of fertilizers, improved hybrids, and irrigation.

Conservation practices, both structural and nonstructural, can be used to reduce soil erosion to acceptable levels. Existing conservation structures in many parts of eastern Nebraska, however, have not been maintained or have been removed, and there is a general reluctance to install new structures. Adoption of conservation tillage practices, especially no-till planting, also has been slow in much of northeastern Nebraska. Tradition is a strong deterrent. Even though soil erosion is a major problem, concerns about possible yield reductions, weed control, fertilizer requirements, soil limitations, and influence by peers have delayed widespread use of conservation tillage.

A working agreement

In mid-1984, personnel from the University of Nebraska Cooperative Extension (CE) and the Soil Conservation Service (SCS) met to discuss what actions could accelerate adoption of soil conservation practices in northeastern Nebraska. Participants agreed that a coordinated and concerted educational program would have the best chance for success. Cooperative Extension was invited to develop a proposal for such a project that would be funded by SCS. The proposal was accepted, and early in 1985 both agencies signed a working agreement that would provide $50,000 to Cooperative Extension each year.

The working agreement was a plan to develop and implement a comprehensive educational program or model study with the overall objective of reducing soil erosion in a northeastern Nebraska target area. The specific goals to be accomplished in the target area by 1990 were:

1. Reduce overall soil erosion by 20 percent.
2. Increase the acreage protected by conservation structures by 10 percent.
3. Increase the acreage protected by nonstructural practices by 20 percent.
   a. Expand conservation tillage for row crop acreage by 20 percent.
   b. Expand no-till planting of row crop acreage by 10 percent.
4. Increase the number of total farm conservation plans by 10 percent.

In addition to these goals, it was determined that, if the program were successful, the approaches could be used in other areas of Nebraska and throughout the nation.

The project approach

Various approaches to soil conservation education and practice implementation were used. These approaches included both established or traditional methods and nontraditional procedures.

Selecting the target area. Shortly after the working agreement between CE and SCS was finalized, representatives from these agencies, the Agricultural Stabilization and Conservation Service (ASCS), and the Lower Elkhorn Natural Resources District (LENRD) met to establish target area boundaries. Because of previous requests for assistance, problems with flooding and sedimentation, a low proportion of existing conservation structures, and a general resistance to conservation practices, a subwatershed area of several small tributaries to Logan Creek was selected. Logan Creek is a major waterway with a moderately flat grade that meanders and floods regularly. In some locations, the channel has been straightened and has subsequently deepened and widened. Because of this creek, the project was named the Logan Creek Special Study.

The target area encompassed 49,424 acres in parts of Cuming, Thurston, and Wayne Counties in northeastern Nebraska. Topography is characterized by steep, irregular hills with short slopes. Land use in the area is almost entirely cropland.

Estimated average annual sheet and rill erosion within the target area was more than 700,000 tons, or slightly more than 14 tons per acre. Although about 65 percent of the soil losses occurred on 26 percent of the land area, conservation treatment of some kind was needed on more than 87 percent of the area. Conservation plans had been prepared for less than 10 percent of the area,
and many of these plans needed to be updated to reflect recent changes in technology, current soil loss standards, new construction practices, and more appropriate cropping systems or rotations. There were about 350 operating units within the area (11).

**Developing a work plan.** From the start of the project, participants knew that multi-agency support, cooperation, and coordination would be required. Thus, a formal work plan specifying the role of each cooperator was developed (11). This plan also established a new set of project goals, which essentially increased the objectives outlined in the working agreement by 50 percent. In all, 18 agencies and organizations approved and signed the work plan.

**Project publicity.** A descriptive brochure was developed in conjunction with the work plan (10). This attractive, full-color brochure was mailed to all landowners and operators, agribusinesses, and others in the target area. The brochure briefly explained the project, listed the area’s conservation needs, and invited active participation.

A logo also was developed to increase project recognition and visibility. The logo was used on project correspondence, brochures, newsletters, and other literature. A three-color version of the logo, approximately 15 inches by 16 inches, also was produced as a self-adhesive decal used on road and cooperator identification signs.

Large signs, approximately 3 feet by 6 feet, were placed along major highways entering the target area. Smaller signs that included the cooperator's name were placed adjacent to project demonstration fields, demonstration plots, and fields where terraces were built during the project. These signs also carried the project logo, which provided additional visibility and identity and perhaps even created a sense of pride and teamwork among project participants and cooperators.

**Extra hands.** Cooperative Extension employed an engineer for the project whose responsibilities were to conduct day-to-day project activities, develop and coordinate educational activities in the target area, and work directly with producers, implement dealers, chemical company representatives, and governmental personnel. The engineer also provided direct support to farmers who needed equipment modifications or adjustments and other technical help in adopting conservation tillage systems. The minimum requirements established for this position were a bachelor of science degree in an agricultural-related field, work experience in conservation tillage, and familiarity with conducting educational programs.

SCS was a cooperator in the educational program development and planned and applied the needed structural conservation practices in the area. To handle the increased workload, two full-time SCS employees, a soil conservationist and a soil conservation technician, were assigned to the target area.

All three project assistants worked out of the Cuming County SCS field office. Additional educational program support and technical assistance were provided by a broad range of extension specialists, extension agents and SCS personnel from the three county offices, SCS personnel from the area and state offices, and LENRD personnel.

**Existing practices and perceptions.** Early in the Logan Creek project, information was collected to evaluate the use of conservation practices, farmer perceptions regarding conservation tillage, and preferred methods of information dissemination. We used mail surveys, field residue measurements, and personal visits to gather this information. A mail questionnaire was sent to all farm owners and operators in the target area. Fifty-five percent of the 347 surveys sent were returned, which accounted for about 68 percent of the land area (16).

Results from the mail surveys indicated that 91 percent of the respondents believed they were presently using as much or more conservation tillage than they had five years earlier. The survey information showed a substantial decline in the use of the moldboard plow, 67 percent in 1976 to 14 percent in 1985, and a corresponding increase in the use of a chisel plow or disk as the primary tillage implement. This indicated a possible misconception that simply not using the moldboard plow was equivalent to practicing conservation tillage. Respondents also had concerns about the cost and effectiveness of herbicide programs and the cost and performance of equipment used for conservation tillage, especially planters used on residue-covered fields (2, 16). These concerns helped direct some of the subsequent educational activities.

In addition to the mail survey, we took field measurements to determine the amount of residue cover left after planting. Samples were taken on 42 randomly selected fields on 27 farms, which represented 15 percent of the cropland in the project area. At the time the field measurements were taken, we conducted short, informal interviews with landowners to obtain field information to estimate soil erosion losses and determine what field operations were used prior to planting the most recent row crop. The large number of tillage operations reported by some farmers further indicated the belief that no longer using the moldboard plow was equal to practicing conservation tillage. The percentage of residue cover or total number of tillage operations was not considered by some farmers.

Field residue samples indicated that none of the fields surveyed had residue cover that exceeded the 30 percent minimum level suggested by the Conservation Technology Information Center (1) and used by SCS to define conservation tillage. Thirty-two of the sampled fields (76 percent) had less than 15 percent residue cover (16). These residue measurements, together with the interview information, verified that the perception between practicing conservation tillage and not moldboard plowing truly existed. We then developed educational programs emphasizing that residue cover, rather than choice of tillage implement, was the most important factor in reducing soil erosion.

**Financial incentives.**

As part of its soil conservation efforts, LENRD had several programs designed for all producers in the districts. Two of these programs were used for a limited time to support the project. Under the “Lands for Conservation” program, landowners were eligible for a $40-per-acre payment on land made available for construction of approved conservation practices between June and September. Under the program, farmers could plant and harvest oats on these acres and still receive direct payments.

Another program, the district’s “Conservation Tillage Demonstration Plot,” offered a $25-per-acre payment for up to 10 acres. This program helped first-time conservation

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**Agencies or organizations involved in the Logan Creek work plan development and endorsement**

- University of Nebraska Cooperative Extension
- Soil Conservation Service Lower Elkhorn Natural Resources District
- Agricultural Stabilization and Conservation Service
- Farmers Home Administration
- Nebraska Natural Resources Commission
- USDA Food and Agricultural Councils from (a) State of Nebraska, (b) Cuming County, (c) Thurston County, and (d) Wayne County
- Nebraska Department of Roads
- Nebraska Department of Environmental Control
- Nebraska Game and Parks Commission
- Cuming, Thurston, and Wayne County Governing Boards
- Villages of Bancroft and Pender, Nebraska
tillage farmers get started with no-till planting on a small area. However, in 1987 only one plot was funded under this program even though four sites could have been funded. The program was discontinued after 1987.

Through joint efforts by LENRD and ASCS, a cost-share rate of 90 percent of the lesser of actual costs or average established costs was designated for structural practices installed in the target area during a one-year period ending September 30, 1986. Because this high cost-share level was available for only a relatively short time and because these practices would be constantly visible, project personnel attempted to maximize the number of installations during this period. About 87 percent of the program’s conservation structures were installed during this period. Demonstrations, newsletters, and media releases focused on the need for and benefits of conservation structures. The cost-share rate at the start of the project was 75 percent. After September 1986, it was reduced to 65 percent and then to 60 percent. In total, more than $510,000 of LENRD funds were committed to the project, virtually all of which was used to cost-share structural practices.

**Educational tools.** Our educational program was aimed at achieving the specific goals of increasing use of conservation tillage and no-till planting methods. Like other new technology, adoption of conservation tillage by producers follows a complicated and time-consuming decision process (13). The process requires (a) an awareness of either a problem or the new technology, (b) recognition of the problem’s cause and one’s ability to change the situation, and (c) technical and economic information, assistance, and support for making the change. At every step of the process it is essential to provide well-defined information that addresses specific farmer needs.

Within the target area, we had producers at all stages of the conservation tillage adoption process. The results of our field and mail surveys showed that some farmers were still routinely moldboard plowing, while a few others were already no-till planting. Our educational program had to encompass a wide range of producer knowledge and experience. Of course, we also had many farmers who believed that not moldboard plowing was the same as using conservation tillage, which created a special challenge. We first had to educate them about what truly constituted conservation tillage before they could progress in the adoption process. Our educational programs and activities ranged from creating an awareness of residue management as a means of reducing soil erosion to assistance with individualized problems. Guidance from local producers and project personnel, as well as information from the surveys, helped us develop specific educational programs, as follows:

- **Field days:** Ten field days were held in the target area during the project. Average attendance was about 55. Generally, demonstrations included two or three planters operating in no-till or tilled conditions with appreciable amounts of crop residue. The planters usually belonged to local farmers. We made sure that time was available during the field days for farmers to ask technical questions of extension personnel, cooperating implement dealers, or equipment owners. Variations of these field days included demonstrations of no-till drills, cultivators suitable for heavy-residue conditions, and other conservation tillage equipment. Demonstrations by SCS and LENRD personnel showed how to measure residue cover and how to lay out and construct terraces.

These field days often included tours of tillage plots or other demonstration plots in the immediate area. Refreshments were usually provided by local implement dealers, local land improvement contractors, chemical company representatives, or financial institutions. Field days and other project events were advertised in a variety of ways, including printed posters in area businesses, media releases, direct mailings, and paid advertisements in local papers.

Field days adjacent to the target area also were used to supplement project activities. In one instance, a conservation tillage field day, which was promoted as featuring $1.5 million of agricultural equipment, was sponsored by CE, SCS, and the chamber of commerce in a nearby community. Rather than attempting to organize a similar event, we chartered a bus to transport farmers from the project area to this field-day site.

- **Rainfall simulator:** To demonstrate visually the effectiveness of residue cover in reducing erosion, a portable, rotating-boom rainfall simulator was used in some field demonstrations. The simulator, which has been used extensively in Nebraska erosion research (5, 6, 9, 17), applies water at a rate of about 2.5 inches per hour; this gives a rainfall erosion index (EI) typical of a single storm event expected to occur once every two years in eastern Nebraska (18). In preparation for this demonstration, an area of land was uniformly tilled to eliminate most of the existing surface residue cover. Using metal borders, we established two side-by-side plots, each approximately 30 feet long and 5 feet wide in the tilled area on each side of the simulator. Residue (usually small grain straw) was placed on the surface of these plots, resulting in four different degrees of residue cover: 0 to 5 percent (cleanly tilled), 90 to 100 percent (representing no-till), and 25 and 50 percent (representing varying amounts of tillage). As rainfall was applied, runoff water passed through flumes where field-day participants could visually compare differences in both soil erosion and water runoff.

While originally designed for research purposes, the rainfall simulator proved to be...
an effective educational tool, as it has elsewhere (7). Farmers generally were surprised at what a difference even relatively small amounts of residue cover made in the clarity of runoff water and how bare a plot with 50 percent residue looked. The simulator used in our project requires little set-up time, land area, and relatively little water.

**Demonstration plot comparisons:** Demonstration plots showed various aspects of conservation tillage. These plots included side-by-side comparisons of no-till planting and conventional tillage and planting systems; various fertilizer application methods; different herbicide combinations; and narrow-row soybean planting. Entire fields of no-till or conservation tillage were used whenever practical, as local advisors expressed the concern that, while nearly anything could be made to work on small, plot-sized areas, farmers need to see field-size solutions. The plots or fields were planted and tilled as appropriate by the cooperating farmer, usually using his equipment. Project assistants helped with necessary equipment adjustments, herbicide recommendations, and plot layout.

Generally, demonstration plots were included on tours or field days. We asked cooperating farmers to describe the tillage and planting systems used, the herbicide programs, and solutions to any problems they encountered. Whenever possible, we displayed the appropriate conservation tillage equipment used at each tour stop.

**Crop yield and costs:** Crop yield and cost data were obtained from the plots with side-by-side comparisons of different tillage and planting systems. These data were then presented at local meetings as part of the educational program so that local farmers could see no-till planting equipment in use, follow the growth of the crop, and learn what the final yield and production costs were.

These data provided evidence to dispel the perception that no-till planting reduces yields and increases costs. For example, combined results from 1984 through 1988 for the Logan Creek project and a companion project, called the Agricultural Energy Conservation Project (4), showed that no-till corn yields were equal to or greater than with the farmer's conventionally planted system at 28 of the 35 comparison sites. Also, no-till production costs were at least $5.00 per acre less in 25 of the 35 comparisons and had the same cost in four comparisons. Similarly, in both projects during the same period there were 18 sites comparing no-till soybeans to soybeans grown with conventional or reduced-tillage systems. In 17 of these comparisons, no-till soybeans had the same or better yields than under the tilled system. The no-till soybean fields were at least $5.00 per acre less expensive for seven of the 18 comparisons and had the same cost for eight comparisons (8).

**Meetings:** Annually, we held at least one meeting of an on-going series of extension meetings entitled “Area Conservation Tillage Meetings” in the target area (3). The meetings were designed to apply to a broad range of farming experience. For example, discussions on residue cover benefits helped create an awareness of this type of erosion control method, and other topics covered specific planter adjustments for no-till operations. Extension specialists representing a broad spectrum of disciplines presented most of the one day, in-depth program. Printed proceedings, with articles devoted to each topic presented, as well as other articles pertaining to conservation tillage, were distributed to meeting participants as part of the registration fee. Farmers from within the target area were offered a reduced registration fee for these meetings. Farmers from the local area also presented information about their specific conservation tillage system in a panel format. Many of these farmers were those who hosted field days or demonstration plot tours. Project assistants often helped the farmers prepare visual aids to better present their information. Presentations by farmers were well received by meeting attendees. Meeting evaluations often indicated that this aspect of the program should be expanded.

Meeting evaluation forms also were used to provide additional guidance for the educational program. Evaluations questioned whether landowners had plans to adopt conservation tillage or to change tillage practices. Averaged across five years of Area Conservation Tillage Meetings, 84 percent of the farmers who filled out an evaluation indicated they would be changing their tillage programs as a result of the information presented during the meeting. The most positive response to this question was 89 percent in 1986. Overall, 97 percent of the respondents indicated that they would attend another meeting of this kind (16).

The second type of meeting we used was a local, small, informal group setting we called “coffee shop” meetings. The local extension agent and other project personnel were on hand to answer specific questions posed by farmers. Attendance was usually less than 20, but the discussion and interaction that occurred were valuable to those just getting started in conservation tillage, or those with specific questions. This type of meeting also was used by SCS, ASCS, and LENRD personnel to explain provisions of the 1985 Food Security Act and to provide information about developing farm conservation compliance plans and the availability of other conservation programs.

**Equipment clinics:** Essentially a combination of a group meeting and a field demonstration, equipment clinics provided another educational method. Typically, these sessions began with a one-hour indoor meeting with extension specialists who presented information about equipment, operating procedures, adjustments, etc. The audience then moved to a nearby field for hands-on demonstrations. Sprayer calibration and planter adjustments were typical topics covered at these clinics.

**Media:** News releases and fact sheets were used to increase awareness and provide...
education to the general public. Farmers and agribusinesses in the target area. Generally published three times each year, the newsletter provided appropriate management information and kept clients advised of the project’s progress, upcoming activities, and governmental program requirements and deadlines.

**Established conservationist:** Based in part on Missouri’s Neighbor-to-Neighbor conservation practice tours (15), a self-guided tour entitled “Established Conservationist” was developed. Three farmers were chosen as host sites. The practices seen on the tour included parallel terraces, farmer-built narrowbase terraces, and no-till planting. We produced brochures describing the practices and providing directions to the sites, and placed them in pocketed posters located in 15 local businesses and in the local CE, SCS, and ASCS offices. This educational method was implemented near the end of the project. The idea, however, has merit when used as one portion of an overall educational program.

**What success?**

Although a local soil conservation project can never be truly completed, the Logan Creek project ended in September 1989. Terrencia construction probably had the most visible impact on the area. Increased cost-share levels and maximum cooperation among SCS, CE, ASCS, and LENRD personnel resulted in the installation of some form of conservation structure by 61 cooperators. Specifically, a total of 304,250 feet of terraces with 125,072 feet of underground tile outlets were installed, and nearly 30 acres of grassed waterways were established. These structures reduced soil erosion on about 5,700 acres of cropland, or slightly more than 11 percent of the target area. With the terraces, the estimated annual soil erosion within the area was reduced from 705,600 to 539,100 tons, an annual savings of 166,500 tons, or 24 percent (16).

To evaluate the project’s impact on tillage practices and residue cover changes, in the spring of 1989 we conducted a second field survey on 74 randomly selected fields. Similar to the 1986 field survey, our information included in-field measurements of surface residue cover.

Using this residue cover and tillage information, we determined the average cover and management practice or universal soil loss equation cover (C) factors (18) for the sample fields. In 1989, the average C factor was 0.28, compared to 0.32 in 1986 (16).

Conservation tillage use increased during this time period. In 1986, none of the 42 sampled fields had a 30 percent or greater residue cover, and only one field had been no-till planted. In 1989, 12 percent of the fields sampled had a 30 percent or greater residue cover, and 22 percent of the sampled fields were no-till planted, nearly a tenfold increase from the 1986 survey (16). The most common change was from two tillage operations to no-till planting of corn into soybean residue. This was a practice change stressed throughout the project.

Average residue cover for the 42 fields sampled in 1986 was 9.3 percent after all tillage and planting operations. In 1989, the average cover had nearly doubled to 15.6 percent, mainly due to a reduction in the number of tillage operations. The tenfold increase in no-till planting, combined with the increased residue cover, resulted in an estimated annual soil savings of 140,000 tons—a 20 percent reduction in soil loss over the project area during the study period. In total, the estimated annual soil erosion was reduced by 306,500 tons, or 43 percent, well over our established goal (16).

Although the total impacts of the Logan Creek project cannot be fully evaluated because changes in conservation practices will reap benefits for many years, our specific project goals were met or surpassed. Most importantly, this project has shown that a cooperative, multiagency conservation educational program targeted to a specific audience can have substantial impacts in a short amount of time.

**REFERENCES CITED**