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Enhancing the adoption of soil conservation practices with targeted educational programs

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ABSTRACT: Two independent, but closely related, grant funded educational programs have been developed and implemented to reduce soil erosion in selected areas of eastern Nebraska, U.S.A. Traditional extension programming methods as well as other more non-traditional approaches have been extensively used. In one program, encompassing 220,000 ha of cropland, annual soil erosion has been reduced by 2.5 Mt and annual fuel savings of 1.5 ML have been achieved through a reduction in the number of tillage operations. During a one-year period in the second project, more than 81,000 m of terraces were constructed, which resulted in an annual soil erosion reduction of 170,000 t. These projects have demonstrated that targeted conservation educational programs can be very effective.

RÉSUMÉ: Deux programmes éducatifs bénéficiant de subventions--indépendants, mais étroitement liés--ont été developpés et mis en oeuvre pour réduire l'érosion des sols dans des régions choisies dans l'est du Nebraska (USA). Des méthodes de vulgarisation traditionnelles, ainsi que d'autres approches moins traditionnelles ont été beaucoup utilisées. Dans un programme, portant sur 220.000 ha de surface cultivée, l'érosion annuelle des sols a été réduite de 2.5 Mt et des économies annuelles de carburant de 1.5 ML ont été réalisées grâce à une réduction du nombre des labours. Pendant une période d'un an dans le second projet, plus de 81.000 m de terrasses ont été construits, avec pour résultat une réduction de l'érosion des sols de 170.000 t par an. Ces projets ont demontre que des programmes éducatifs orientes ver l'education dans le domaine de la conservation du sol pouvaient être très efficaces.

ABSTRAKT: Um in ausgewählten Gegenden im östlichen Nebraska die Bodenerosion zu reduzieren, sind zwei unabhängig von einander, jedoch im Zusammenhang zu einander stehende, subventionierte, pädagogische Programme entwickelt und implementiert worden. Allgemein übliche erweiterungs-programmierende Methoden (Traditional Extension Programming Methods) sowie andere eher unübliche Ansätze sind ausgedehnt angewendet worden. Durch Verminderung der Bodenbestellung ist im ersten Projekt, 220.000 Hektar umfassen, die jährliche Bodenerosion um 2.5 Megatonnen und der jährliche Dieselverbrauch um 1.5 mill. Liter gesenkt worden. Während einer einjährigen Periode wurden im zweiten Projekt mehr als 81.000 m Terrassen angelegt, was eine Senkung der jährlichen Bodenerosion um 170.000 t erzeugte. Diese Projekte haben deutlich gezeigt, daB die geziehlte Anwendung von pädagogischen Programmen zur Bodenkonservierung effektiv sein kann.

1 BACKGROUND

Soil erosion and subsequent sedimentation have been identified as major water quality problems in Nebraska (NNRC, 1979) and in much of the Midwestern United States. 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. Some fields have annual soil erosion rates exceeding 225 t/ha. In a study on a silt loam soil with a 10 percent slope, measured soil losses were nearly 55 t/ha from 63.5 mm of simulated rainfall applied over a 60 minute period (Dickey et al., 1984). As a means of comparison, the average annual allowable soil loss (T value) is 11.2 t/ha for this soil. While loss of topsoil is critical, erosion also results in the removal of fertilizers and pesticides, thus potentially contributing to water quality degradation.

Land in grain production in eastern Nebraska has been increasing as pastures are converted to row crops. The primary row crops, with a combined production area exceeding 3.2 million ha, are corn, soybeans, and grain sorghum. Soybeans, comprising one-quarter of this cropland, can contribute significantly to the erosion problem in two ways. Generally, soybeans are planted into a well-tilled seedbed which leaves an unprotected soil surface that is susceptible to erosion. However, the major criticism leveled against soybeans is the loose, mellow soil surface condition which increases the erosion potential the year following soybeans. Measured erosion following soybeans, in some cases, has been 350 percent greater than the erosion following corn for identical tillage systems (Dickey et al., 1985).

Conservation practices, both structural and non-structural, can be used to reduce soil losses to acceptable levels. However, adoption of many erosion control practices in eastern Nebraska has been slow. Such is the case with conservation tillage, one of the most effective and least expensive methods of reducing soil erosion.

The term "conservation tillage" includes all tillage and planting systems that leave at least 30 percent of the soil surface covered with crop residues after planting (CTIC, 1986). Residue protects the soil from raindrop impact and reduces the movement of soil particles by runoff water. Research has shown that a minimum residue cover of 20 percent can reduce erosion by 50 percent of that which would occur from a cleanly tilled field (Dickey et al., 1984; 1985).

One of the largest detriments to the adoption of conservation tillage is tradition. While soil erosion has occurred, farmers generally have not seen corresponding productivity losses. In some cases, potential losses have been masked by inputs of fertilizer, improved hybrids, and irrigation. Even though soil erosion is a major problem, farmer concerns about possible yield decreases, weed control, fertilizer requirements, and soil limitations have delayed widespread implementation of conservation tillage.

Conservation tillage systems alone can reduce soil losses to acceptable levels on many fields in Nebraska. However, on steeper slopes, residue amounts greater than the 30 percent minimum may be required. Further, some fields will need additional conservation practices such as terraces, grassed waterways, contour farming, and other proven practices to achieve adequate soil erosion control.

Structural erosion control practices have been promoted by the United States Department of Agriculture Soil Conservation Service for almost 50 years. Terraces, which reduce soil loss by reducing slope lengths, are the most common structural practice for controlling erosion. Soil losses are typically reduced by 50 percent, with closer terrace spacings or terraces with underground outlets being even more effective.

Additionally, contour farming generally can reduce soil erosion by up to 50 percent. Nebraska research on soybean residue has shown that planting on the contour reduced erosion by an average of approximately 75 percent (Jasa et al., 1986). Contour farming combined with terraces can generally reduce soil loss by at least 75 percent of that which occurs from a nonterraced field, farmed up and down hill.

Other erosion control structures can include farm ponds, grade stabilization structures, and water and sediment control basins. These practices, when used alone, do not reduce erosion on areas upslope from the structure. However, they do have a high sediment trap efficiency and can prevent soil from leaving the field, farm, or watershed, and thus improve downstream water quality. With controlled release of excess runoff, these structures also help prevent downstream flooding and erosion.

Removal of existing conservation structures in some areas of Nebraska, and a resistance to construction of new erosion control structures in other areas, has been a problem. Some reasons given for this trend include an inability to utilize large equipment, maintenance requirements, land taken out of production, cost, and decreased field efficiency for certain field operations. However, a well designed conservation planning program can help eliminate many of these concerns.

2 EDUCATIONAL PROGRAMS

To enhance the adoption of soil conservation practices in eastern Nebraska, two University of Nebraska Cooperative Extension Service educational programs were developed and implemented. The first program, initiated late in 1983, was the Agricultural Energy Conservation Project (AECP). Funding of over $1 million was acquired from the State of Nebraska (energy overcharge funds) and the University of Nebraska Foundation for this 5-year program which had overall goals to reduce energy requirements while conserving soil and water. This project had three distinct portions: a) conservation tillage; b) ecofallow; and c) irrigation water management. Conservation tillage, centered in eastern Nebraska, is the only portion of the AECP discussed in this paper.

An important and somewhat unique aspect of the AECP was the selection or targeting of high priority areas to receive concentrated educational programming efforts. Three specific target areas, encompassing portions or all of seven counties and totalling about 220,000 ha of row crop land, were selected for the conservation tillage component of the AECP. Criteria for selection of these target areas included: estimated soil erosion losses; farmer use and interest in conservation tillage; and the extension agents' desire to make conservation tillage a major educational thrust within their county programs.

The second educational program, initiated in early 1985, was the Logan Creek Special Study (LCSS). Funded annually by the Soil Conservation Service, this project consisted of a single target area encompassing about 20,000 ha in portions of three northeast Nebraska counties. The LCSS target area was chosen from several areas considered by personnel from the Soil Conservation Service (SCS), Agricultural Stabilization and Conservation Service (ASCS), Cooperative Extension Service (CES), Natural Resource Districts (NRD), and other agencies actively involved in soil conservation programs.

The Logan Creek area is characterized by steep, irregular hills with short slope lengths. Conservation land treatment has not been readily accepted in the area as evidenced by the fact that less than 15 percent of the cropland area had adequate erosion protection at the outset of the project (LCSS, 1986). The average annual sheet and rill erosion within the LCSS area was over 635,000 t or approximately 32 t/ha.

3 OVERALL OBJECTIVE AND SPECIFIC GOALS

The overall objective of the two educational programs was to reduce soil erosion through the adoption of conservation practices. Specific goals to be attained within the target areas for the conservation tillage component of the AECP were to:

1. increase the use of conservation tillage by 20 percent; and
2. increase the use of no-till planting by 10 percent.

Specific target area goals for the 5-year LCSS included the same goals as the AECP, plus three additional goals:

1. increase the area protected by conservation structures by 10 percent;
2. increase the number of total farm conservation plans by 10 percent; and
3. reduce overall soil erosion by 20 percent.

4 METHODOLOGY

While traditional Extension programming methods (meetings, field demonstrations, demonstration plots, media releases, etc.) have been extensively used in these two projects, various non-traditional approaches have also been employed. For example: specific priority areas of the state have been targeted for concentrated programming efforts; extension assistants were employed to carry out day-to-day project activities and work closely with farmers and others in the target areas; local guidance committees were developed and used to help define the educational needs and appropriate methods to meet those needs; surveys were conducted early in the projects to evaluate the existing use of conservation practices and farmer perceptions relating to conservation tillage; field measurements of residue cover remaining after planting were taken and correlated with the survey data; a rainfall simulator was used to demonstrate the effectiveness of residue cover in reducing soil erosion; and, in the LCSS, a quarterly newsletter was developed and mailed to landowners and operators in the target area.

4.1 Extension assistants

Three extension assistants (classified as either Extension Engineer or Extension Technologist) were employed to work in the four targeted areas. Two of these assistants were assigned to the AECP and one to the LCSS. Job responsibilities were to conduct day-to-day project activities, develop and coordinate educational activities in the target areas, and work directly with producers, implement dealers, chemical company representatives, as well as governmental and other agency personnel. The assistants also provided direct support to farmers needing equipment modifications or adjustments and other technical help when adopting conservation tillage systems. Minimum requirements for these positions were a bachelor of science degree, work experience in conservation tillage, and a familiarity with conducting educational programs. Extension specialists from a broad range of disciplines, extension agents in the target areas, and the project leaders provided additional programming support.

4.2 Local guidance committees

Local committees were formed to provide guidance in defining educational needs and what educational methods would be best suited for their respective target area. Committee membership included farmers, agribusiness representatives, and personnel from the local NRD, SCS, and CES offices. Educational programs were then tailored to meet specific needs within each target area, and changed as the needs and conditions changed to better enhance the adoption of conservation practices.

During the organizational meeting of each guidance committee, some additional resource people, such as local media representatives, were included to help ensure success. In two of the target areas, a special effort was made to involve farmers who were not using conservation tillage. The contributions and ideas from these farmers proved to be very valuable, as educational activities were better designed to overcome concerns and myths often expressed by non-users.

4.3 Documentation of existing conservation practices and perceptions

Early in both projects, information was collected to evaluate farmer perceptions regarding conservation tillage and the existing use of conservation practices. Mail surveys, field residue measurements, and personal visits were used in gathering this preliminary information.

The mail survey questionnaire for the AECP was sent to 229 randomly selected farmers in the three target areas, and had a return rate of 56 percent. For the LCSS, a survey questionnaire was sent to all farm owners and operators in the target area. Of the 347 forms sent, 55 percent were returned.

Results from the AECP mail survey indicated that over 50 percent of the respondents felt they were presently using conservation tillage (Dickey et al., 1987). Respondents were also asked to list the field operations used prior to planting their most recent row crop. The relatively large number of tillage operations (as many as 10) listed by some of the respondents indicated a possible misconception that not using the moldboard plow was equivalent to practicing conservation tillage. Respondents also indicated concerns about the cost and effectiveness of herbicide programs, and the cost and performance of conservation tillage equipment, especially planters when operating in residue covered fields. These concerns helped direct some of the subsequent educational activities.

In addition to the mail survey, field measurements were taken to determine the residue cover remaining after planting. Measurements were taken on one field from each of 294 randomly selected farmers within the three AECP target areas, representing about 9 percent of the row crop producers. Fields from 27 farmers, representing 15 percent of the total cropland in the LCSS area were sampled. When the field measurements of residue were taken, a short, informal interview was conducted to determine specific field operations, and to obtain field information to estimate soil erosion losses.

Field residue measurements indicated that less than 5 percent of the fields surveyed had residue covers exceeding 30 percent (Dickey et al., 1986), the minimum residue level suggested by the Conservation Tillage Information Center (CTIC, 1986) and used by the SCS to define conservation tillage. These measurements, together with the interview information, verified that the perception between practicing conservation tillage and not moldboard plowing truly existed. Educational programs were therefore developed which emphasized that residue cover, rather than the choice of tillage implement, was the most important factor in reducing soil erosion.

4.4 Educational activities

Guidance from the local committees as well as information gained from the surveys were used to develop specific educational programs. There were, however, several similarities among the recommendations from the local committees. For example, field demonstrations, plot comparisons, and informational meetings were recommended in each target area. Other types of educational activities included radio and print media, tours for agribusiness representatives, and a quarterly newsletter. Details of various activities follow:

1. Field days: About 20 field days having a total attendance of approximately 1,000 were held in the four target areas during a three year period. Often, two or three planters operating in no-till, ridge-plant, or tilled conditions where appreciable residue amounts remained were demonstrated. Time was available for farmers to ask technical questions of either extension personnel or cooperating implement dealers. Variations of these field days included demonstrations of no-till drills, no-till and ridge-till cultivators, and other conservation tillage equipment. In the LCSS, demonstrations of terrace layout and construction were also conducted.

Often these field days also included tours of tillage plots in the immediate area. Refreshments were usually provided by local implement dealers, chemical company representatives, or financial institutions.

2. Rainfall simulator: To vividly demonstrate the effectiveness of residue cover in reducing erosion, a rotating boom rainfall simulator was often used in the field demonstrations. The simulator, which has also been used extensively in Nebraska erosion research (Dickey et al., 1984 and 1985; Jasa et al., 1986; Shelton et al., 1986), applied water at a rate of approximately 64 mm/hr, giving a rainfall erosion index (EI) typical of a single storm event expected to occur once every two years in eastern Nebraska (Wischmeier and Smith, 1978).

In preparation for the demonstration, an area was uniformly tilled to eliminate most of the existing surface residue cover. Within the tilled area on each side of the simulator, two side by side plot areas, each approximately 9 m long and 1.5 m wide, were established using metal borders. Residue (often straw) was then added to the surface of three plots, resulting in four degrees of residue cover, typically 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 as a research tool, the rainfall simulator proved to be a very effective educational tool as well.

3. Demonstration plot comparisons: The guidance committees strongly encouraged the development of demonstration plots to show different aspects of conservation tillage. These plots have included side-by-side comparisons of no-till planting and the farmer's conventional tillage and planting system, various fertilizer application methods, and different herbicide combinations. Whole fields of no-till or

ridge-plant were sometimes used since some of the local committees felt that anything could be made to work on smaller plot areas, but to make much impact, field sized areas would be necessary. The plots or fields were planted and tilled as appropriate by the cooperating farmer, usually using his equipment. The extension assistants generally helped with necessary equipment adjustments, herbicide recommendations, and plot layout.

Many of the plots were included on tours or field days. As part of the tour, the cooperating farmer told what tillage and planting system was used, the herbicide program, and the solution to any problems encountered. Sometimes the farmer displayed the planter or other appropriate piece of conservation tillage equipment that was used.

4. Identification signs: Signs, which included the cooperator's name and a project logo, were placed adjacent to the demonstration fields or plots. These signs, which remained in place during the entire growing season, provided additional project identity and visibility. In the LCSS, large signs, approximately 1.2 m by 2.4 m, were also placed along the major highways that entered the designated target area.

5. Crop yield and costs: Yield and cost data were obtained from the plots having side by side comparisons of different tillage and planting systems. These data were then incorporated into local meetings as part of the educational program. Thus, farmers in the area were able to see no-till planting equipment in use, could follow the growth of the crop, and had an opportunity to learn what the yield and production costs were.

These data provided evidence to dispel the perception that no-till planting will have reduced yields and increased costs. For example, the 1984 and 1985 results showed that for corn production, no-till planting had a crop yield that was equal to or greater than the farmer's conventionally planted system at 24 of the 31 comparison sites. No-till was also at least \$12/ha less expensive in 19 of the 31 comparisons, and had the same cost in 6 comparisons. Similarly, there were 13 sites of no-till planted soybeans compared to a conventional or reduced tillage system in 1985. In 12 comparisons, no-till soybeans had the same or better yield than the tilled system. The no-till soybean fields were \$12/ha less expensive for 5 of the 13 comparisons, and had the same cost for 7 comparisons (Dolesh et al., 1987).

6. Meetings: Meetings were developed and used in the target areas. One type was a full day, in-depth, conservation tillage meeting. Extension specialists representing a broad spectrum of disciplines presented most of the program. Printed proceedings, with articles devoted to each topic presented as well as many other articles pertaining to conservation tillage, were distributed to meeting participants as part of the registration fee. Farmers from the local area also presented information, in a panel format, about their specific conservation tillage system. Often these farmers were the same ones that had hosted a field day or plot tour. The extension assistants often helped the farmer prepare visuals. The farmer presentations were well received by meeting attendees, with meeting evaluations often indicating that this aspect of the program should be expanded.

At these in-depth meetings, evaluation forms were used to provide additional guidance for the overall educational program. These forms also inquired about plans to adopt or change tillage practices. Averaged across 4 years, 80 percent of the farmers filling out a questionnaire indicated they would be changing their tillage programs as a result of the information presented during the meeting. The range in response to this question was from 75 percent in 1984 to 84 percent in 1986. About 40 percent of the 1987 meeting attendees indicated that they had not previously attended a similar conservation tillage meeting.

The second type of meeting used was a local, small group meeting often labelled as a "coffee shop" meeting. These meetings were very informal. Generally, the extension agent in the area and the extension assistants answered questions that farmers had regarding conservation tillage. Attendance was usually less than 20, but the discussion and interaction that occurred was of tremendous help to those farmers just getting started with conservation tillage, or those with quite specific questions. This type of meeting was also used in the LCSS, in conjunction with SCS, ASCS, and NRD personnel, to explain provisions of the United States 1985 Food Security Act (Farm Bill), and to provide information regarding the development of farm conservation plans.

Two other meeting formats included both sprayer and planter clinics. These generally involved calibration or adjustment of farmer owned equipment and were often conducted in farmer owned shops. The planter clinics were also conducted at local equipment dealer facilities.

7. Media: News releases and factsheets have been used frequently as a means of increasing awareness and providing education. Many of the farmers having tillage plots were the subject of news releases prepared by the extension assistants. The factsheets, brief and to the point, were written in response to some of the most commonly asked questions. Radio tapes have also been used to promote upcoming events and provide timely information to area producers.

8. Newsletter: In the LCSS, a quarterly newsletter entitled "Focus on Conservation" was also developed as an educational tool. The newsletter, which was typeset on high quality paper and included photographs, was mailed to all landowners and farm operators in the target area, and provided timely advice, keeping clients advised on progress being made, upcoming activities, and governmental program requirements and deadlines.

5 ACCOMPLISHMENTS

The AECP was completed in December, 1988. To evaluate the project impact, a second field survey of 304 randomly selected fields was conducted. The information obtained was similar to that obtained in the 1984 survey. Using this information and the Universal Soil Loss Equation (Wischmeier and Smith, 1978) the average average annual soil loss from the 294 randomly selected fields in 1984 was 48.3 t/ha, whereas the average annual soil loss from the 304 randomly selected fields in 1988 was 37.1 t/ha. Since the AECP target area encompassed 220,000 row crop ha, the annual erosion reduction in the target area was 2.5 Mt. This was achieved because the number of tillage operations was reduced between 1984 and 1988. There was also about a three fold increase in the use of no-till planting. The most common change in 1988 was no-till planting of corn into soybean residue, rather than the previously used system having at least two tillage operations.

The reduction in the number of tillage operations also reduced the amount of fuel and labor required. Using the stated field operations performed on each field, and the fuel requirements for each operation given by Shelton et al. (1979), the average fuel use on the fields surveyed in 1984 was 30.7 L/ha, whereas the 1988 fuel use was 23.9 L/ha, for an annual savings of 6.8 L/ha. For the AECP target area, annual fuel savings amounted to 1.5 ML. Similarly, annual labor savings because of the reduced number of tillage operations were 60,000 hours.

While not yet completed, the LCSS has had a tremendous impact on terrace construction. Through a combined effort of the local NRD and ASCS, 90 percent cost-sharing was available for structural practices completed in the target area during a one-year period ending September 30, 1986. Because of this level of cost sharing and maximum cooperative efforts among SCS, CES, ASCS, and the NRD, 52 cooperators installed some form of conservation structure. Specifically, a total of 81,000 m of terraces having 35,000 m of underground outlets were installed. These structures benefitted over 2,000 ha of cropland, or slightly over 10 percent of the target area. The estimated annual soil erosion from this land was reduced from 640,000 to 470,000 t, an annual savings of 170,000 t, or 27 percent.

The total impact of both projects will not be fully documented until the LCSS is completed in late 1989. However, it appears that project goals will be met or exceeded. Most importantly, both of these projects have already shown that conservation educational programs targeted to specific audiences can have substantial impacts in a short amount of time.

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