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An Overview of Soil Conservation Research in Agricultural Economics

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by

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Introduction

During the past eight years considerable research has been conducted in Agricultural Economics to investigate economic aspects of agricultural soil erosion. This research consists of studies at watershed, regional, and state levels. A major portion of these studies has evaluated economic suitability of soil conserving tillage practices in different regions of Ohio. Another part of the research has analyzed economic impacts of reducing soil and phosphorus losses under alternative policy options. Also, certain off-site damage costs associated with sediments from cropland have been estimated. Furthermore, a number of recent studies in AERS have focused on soil erosion problems in the third world countries.

The following presents an overview of the above-mentioned research. First, it summarizes research on economics of conservation tillage systems, off-site damage costs of cropland erosion, and soil erosion problems in developing countries. Then, it briefly describes current soil conservation projects. Finally, it outlines some of the future research plans on soil erosion.

A. AERS Studies on Economic Impacts of Conservation Tillage Systems

Forster et al. [1] investigated Ohio tillage conditions by using the five soil management groups identified by Van Doren, Tripplett, and Bone [14]. This study simulated crop production on five major soil types (i.e., Wooster, Rossmoyne, Crosby, Brookston, and Hoytville) under conventional tillage, minimum tillage, and no-till systems. The research concluded that societal interests (reduction of soil loss) and the farmers' own economic interests appear to be in harmony on the majority of Ohio soils. Specifically, the study results hypothesized that conservation tillage systems are profitable relative to conventional tillage for the well, moderately well, and somewhat poorly drained soils represented by Wooster, Rossmoyne, and Crosby soil types. However, the flat, fine-textured Brookston and Hoytville soils favor the conventional tillage method. A significant reduction in net returns was hypothesized with the adoption of no-tillage system on these soils.

In other AERS research on economics of conservation tillage practices, Forster [2] looked at economic impacts of changing tillage systems in the Lake Erie Basin. This study first determined the Basin's soil series and identified their characteristics. Then it simulated economic effects of adopting conservation tillage technologies in the Basin. The study results indicated that using conservation tillage on economically suitable soils with concurrent conventional farming of poorly-drained soils may result in a 1 to 6 percent increase in the Basin's net farm income compared to conventional farming of entire watershed. Furthermore, the study results showed that application of reduced tillage farming to extremely poorly-drained, alluvial, and fine-textured soils may lead to a very large decrease in the Basin net farm income.

In a study on reducing the diffuse source of phosphorus loads to Lake Erie, Forster et al. [3] analyzed an accelerated implementation program to increase the use of conservation tillage systems as a cost effective method of achieving acceptable levels of diffuse phosphorus loadings. In addition to conservation tillage emphasis, the accelerated program proposed by the study stressed fertilization management. The study estimated that by the year 2002 about 59 percent of the cropland in the Lake Erie Basin will have conservation tillage practices with 44 percent reduced tillage and 15 percent no-till. However, under the proposed program these percentages should be increased to 46 percent for reduced tillage and 30 percent for no-till, for a total of 76 percent of cropland under conservation tillage. The study concluded that with the accelerated program, annual erosion in the Basin will decline from 16.3 million mt in 1982 to 8.5 million mt in year 2002. As a result, a reduction of 32 percent in the U.S. diffuse source phosphorus load to Lake Erie would be achieved.

In further research on adoption of reduced tillage and other conservation practices in the Lake Erie Basin, Forster and Stem [4] identified baseline data on the degree of adoption of conservation practices in the Basin. The research also investigated some factors which explain adoption of reduced tillage and other conservation practices in the Basin. Furthermore, the study identified then existing educational and technical assistance programs within the Basin. The results show that at the time of the study (1979) minimum tillage was being used on 21 percent and no-till was being used on 2 percent of row crop acreage in the Basin. These results also indicated that farmers with larger row crop acreage tend to have higher reduced tillage adoption rates.

In other soil conservation research, Hemmer and Forster [9] studied farmers' experiences with reduced tillage systems. They analyzed tillage observations for crop year 1978-1980 in ten counties of western Lake Erie Basin. The objective of this research was to determine whether the net returns and yields from reduced tillage technologies were significantly different than those of conventional tillage in the study region. Farmers were interviewed by questionnaire and telephone. The results showed that net returns for chisel plow and no-till were slightly higher than those under conventional tillage. However, net returns with minimum tillage were significantly higher relative to conventional tillage system. In general the study results supported the contention that conservation tillage technologies could be utilized as an economical method of reducing gross erosion from cropland, and that these technologies need not result in reduced net farm incomes for adopters in the Lake Erie Basin.

Rask and Forster [13] investigated impacts of increase in energy prices on the economic choice of tillage systems. They tested the hypothesis that midwestern crop production systems would tend toward conservation tillage systems as energy prices increase. Using three soil types (Crosby, Brookston, and Rossmoyn) and three tillage systems (conventional, minimum, and no-till) the study simulated a set of short- and long-run scenarios. The results showed that in both short- and long-run situations energy prices would have little or no impact on the economic choice of tillage practices. In summary, the study concluded that choice of the most profitable tillage system would continue to be determined by soil type and other cultural factors.

In addition to the research described above, two recent studies have analyzed land-use and economic impacts of adopting reduced tillage technologies. Ibrahim [11] determined the effect on net farm income and crop production of adopting reduced tillage systems in the Maumee River Basin. This research indicated that changing crop production practices from conventional tillage to minimum and no-tillage systems on suitable soils sharply reduces soil loss in the Basin. The results also showed that adoption of reduced tillage practices basin-wide increases net farm income by 3.8 percent. In a recently completed study, Nabaee-Tabriz [12] evaluated statewide land-use and economic impacts of adopting reduced tillage systems on all suitable soils in Ohio. This research simulated Ohio agricultural economy based on seven regions and 77 soil groups. It illustrated that substitution of conservation tillage for conventional tillage on suitable soils would encourage a considerable expansion of row crop agriculture on the well-drained soils of northeastern and eastern Ohio. This study also indicated that conservation tillage technologies would decrease average annual erosion rates on most of Ohio soils to some levels near or even below the corresponding soil loss tolerance limits (T-values), while increasing both net farm income and consumers' surplus.

B. Off-Site Damage Costs of Sediment Deposits and Economic Impacts of Alternative Policy Schemes to Control Nonpoint Source Agricultural Pollution

Forster and Abrahim [5] and Abrahim [11] estimated the effect on drainage ditch dredging costs, municipal water treatment costs, and harbor dredging costs associated with cropland soil loss in western Lake Erie Basin. The results of these studies indicated that about 8 percent of the gross erosion in the Basin is later removed as sediment from nearby drainage ditches. Annual costs of sediment removal was estimated to be approximately $0.45 per acre. These results also showed a significant statistical relationship between USLE gross erosion estimates and actual sediment deposition in drainage ditches. Furthermore, the findings indicated that an increase on one ton in gross soil erosion increases the annual water treatment costs in the Basin by approximately $1.90.

Forster and Becker [8], Ibrahim [11], and Nabaee-Tabriz [12] have analyzed economic impacts of alternative policy options in abating excessive agricultural soil loss in Ohio. The first study simulated impacts of restricting soil loss in the Honey Creek watershed of north central Ohio by regulation, taxation, and subsidy schemes. This research concluded that a T-value restriction on soil loss, a tax on per unit of excessive soil loss, and a subsidy for reducing a unit of excessive soil loss could achieve the same objectives. The research also found that in this watershed the soil loss tolerance factor (T-value) is the approximate level of soil loss where substantial costs increases are incurred for added reductions in pollutant loadings. Reducing soil loss below T-value forces dramatic shifts in crop and livestock production costs within the watershed. On the other hand, Ibrahim's study results indicated that restricting soil loss to T-values and less would have very minimal effect on the Maumee River Basin net farm income and agricultural production. His results also showed that internalizing soil loss damage costs at twice their estimated value has little effect on crop and livestock production, but it decreases net farm income by approximately 8 percent. Nabaee-Tabriz's results indicated that T-value restriction of soil loss under conventional tillage systems would result in a sharp increase in the State's row crop prices. Such a policy would penalize farmers in the State's more erosive regions (i.e., eastern southeastern, and southwestern Ohio), while it would reward those farmers in northeastern, northwestern, and western Ohio who benefit from less erosive cropland. However, if conservation tillage is adopted on suitable soils, T-value restrictions would have only slight impacts on crop prices and actually improve farmers' incomes.

C. Soil Erosion Problems in the Third World Countries

A number of studies in Agricultural Economics focused on soil erosion problems in developing countries. They include two studies on economic analysis of watershed protection and erosion control in the Dominican Republic by Veloz [15] and Veloz *et al*. [16], and research on the institutional factors affecting management of land in the third world areas by Southgate, Hitzhusen, and Macgregor [17]. The research by Veloz showed that adoption of soil conserving land management techniques does not benefit all farmers in a hydroelectric watershed located in DR. It also showed that the external benefits of reducing soil loss might greatly exceed the costs of accomplishing that goal.

D. AERS Current Research Projects on Soil Conservation

There are two major soil conservation related research projects currently in progress in the Department. One project directed by Forster and Rask is investigating impacts of conservation tillage on farmers' pesticide use and net returns. This study, for a sample of about 120 commercial corn and soybean farmers located in 6 Ohio Corn-Belt counties is conducting the following: (1) comparing the quantity of pesticides used with alternative tillage systems; and (2) estimating the effects of tillage systems on yields and net returns. In the second project Rask and Forster, in cooperation with the Soil Conservation Service, are developing crop budget data by Major Land Resource Area (MLRA) for corn, soybeans, wheat, oats, and hay under conventional and conservation tillage systems.

E. AERS Future Research Plans on Soil Conservation

The following briefly outlines some of the main research plans proposed by Agricultural Economics faculty: Forster, Hitzhusen, Morse, Rask, and Southgate.

1. Compare the input mix of conservation tillage systems with conventional tillage. Specifically, comparisons will be made of pesticides, labor, and machinary usage.
2. Estimate off-farm costs associated with soil erosion. A watershed has been selected which should provide relatively high off-farm costs. Previous research has measured some of the off-farm costs of soil erosion for the Maumee River Basin. These costs are relatively low as would be expected in the area with little erosion. The intent is to measure off-farm costs in an erosive watershed where downstream water users are more affected by sediment. These results would provide an estimate of the range in off-farm erosion costs.
3. Estimate the impact of conservation tillage on the economy. Conservation tillage implies changes in resource use. Machinary, labor, and pesticide requirements change. Of course, these changes have impacts on input supply

industries. Input-output analysis will be used to investigate the impact of conservation tillage on employment and income in economic sectors other than farming.

4. Improve the Model of Ohio Agricultural Economy (recently developed by Rask et al. and expanded by Nabaee-Tabriz) to simultaneouly incorporate alternative tillage systems. This multi-region, soil-specific programming model has simulated a series of short- and long-run scenarios assuming either 100 percent application of conventional tillage or application of conservation and no-tillage on all suitable soils. However, a more accurate appraisal of the trade-offs between soil conservation and agricultural production in Ohio would be accomplished if the model is allowed to determine the most profitable as well as the most soil conserving crop production activities simultaneously.

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