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Abstract

Everyone agrees that soil erosion is detrimental to Iowa agriculture. This study attempts to quantify the effects of erosion on contemporary crop yields and gauge the longer term impact on the agricultural economy in the state.

Keywords

soil, erosion, crop yield, topsoil

Disciplines

Agricultural Economics | Agriculture | Agronomy and Crop Sciences



Economic impacts of soil erosion in Iowa

Abstract:

Everyone agrees that soil erosion is detrimental to Iowa agriculture. This study attempts to quantify the effects of erosion on contemporary crop yields and gauge the longer term impact on the agricultural economy in the state.

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Management

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Budget:
\$15,768 for year one

Q What is the impact of existing soil erosion rates on crop yield and subsequent income alterations?

A Field measurements of topsoil depth coupled with crop yield monitor data were combined to identify the relationship between topsoil depth and corn yield. From this data, and other research complementing this study, short- and long-term economic impacts were estimated.



ECOLOGY

Background

Nearly everyone who travels across Iowa sees stark evidence of soil erosion. This is the movement of soil particles by wind or water, especially following spring rains that fall before the growing crops cover the soil surface. Soil erosion pollutes Iowa waters and it likely hurts crop yields. However, there is little reliable information about how much crop yields are reduced and/or the state-level economic impact of erosion on Iowa's landscape.

Topsoil, the richest soil which has the most favorable effects on crop yield, is thinned by soil erosion. Normally this means water infiltration rates and water holding capacity are reduced, fertility is lowered, and soil health in general suffers. The resulting impacts on crop productivity often are reflected in crop yield variability within a farm field. This yield variability can be recorded with field-level yield maps obtained using combine yield monitors. In fact, combine-obtained yield maps, when coupled with other soils information, can help show the magnitude of soil erosion on crop yield differences within a field.

The goal of this project was to use a combination of 1) measured topsoil depth at specific locations in a field and 2) the crop yield at each of those locations obtained from combine yield monitors to identify the effect of topsoil depth on yield. Once the relationship between topsoil depth and crop yield was determined, researchers estimated the impact of soil erosion on topsoil depth change and the resulting impact on crop yield. With this information, they were able to calculate the impact of soil erosion on broad-scale farming economics.

Approach and methods

Seven Iowa farm sites with known cropping history and available corn and soybean yield maps were studied. At two sites, multiple fields were studied. Sites selected were based in different Major Land Resource Areas. Researchers used sites with common management practices (corn-soybean rotation, similar fertilizer and herbicide inputs, and similar tillage). Site locations also were selected based on locally available high-quality rainfall records.



Light-colored soil on hill slopes results from loss of top soil and signals yield reductions in these areas.

Combined base-yield maps collected from different farm fields from 2007 to 2013 were obtained from producers whenever possible. For each field, soil probes were taken at 40 locations to determine topsoil depth at each location. Each soil probe location was geo-referenced so that the yields obtained from the combine monitors could be matched with the topsoil depth. From these matched data pairs, the relationship between topsoil depth and crop yield was calculated for each field.

Results and discussion

Relationships between topsoil depth and yield varied among fields and with summer rainfall amounts. Across all sites the average drop in corn yield per inch of topsoil lost was 1.49 bu corn/A. If sites for which manure was not part of the cropping history were considered exclusively, yield loss per inch of topsoil lost was 2.19 bu/A. Soybean yield loss was 0.79 bu/A/inch of topsoil thinning.

To estimate the crop yield impact for subsequent years, researchers coupled the yield-topsoil depth relationship for the sites that likely received no or little manure above the hillslope sheet and rill soil erosion estimates by The Daily Erosion Project for the 2007-2014 period. Averaged across the state for these eight years, a value of 5.7 tons of soil/acre/year (or 0.04 of an inch) was eroded. A wide range of erosion variability exists across the state and between years; for this erosion–crop yield cost impact calculation the team chose to use the statewide average across the eight-year period, i.e., 0.04 of an inch change annually. They also assumed a 0.5 T/A soil renewal rate; thus they modified the 0.04 soil depth loss rate to a 0.037 net topsoil depth change annually.

Assuming a 2.2 bu/A corn yield loss across 14 million acres in a given year and a corn price of \$4.00/bu, the next year's crop production loss would equate to approximately \$4.3 million total across this land area. Assuming 0.8 bu/A soybean yield loss/inch of topsoil thinning on 10 million acres and soybeans at \$10.00/bu, Iowa's subsequent year's income loss would be approximately \$2.75 million. The first year following soil thinning effects on yield, the cumulative impact (considering only the first-year impact) is \$7 million. However, by the tenth year of the trial (the ninth year of erosion cost impacts—the first year experienced soil loss, but no economic impact), the cumulative loss was estimated to be \$315 million. If extended to year 15, the cumulative cost would be \$735 million.

Conclusions

Topsoil thinning is closely linked to loss of crop production potential. Typical statewide average erosion rates have only a minor impact on crop yields in the subsequent year. However, cumulative effects are far more significant and contribute to a loss of state revenue that becomes much more important as time progresses. Short-term minor yield impacts on a per acre basis create little incentive for investing in short-term soil conservation strategies available for many farmland renters. However, as the cumulative effect compounds the economic effect over time, landowners that have longer term planning horizons are much better positioned to recover their financial investments in soil conservation practices.

Impact of results

The project will build upon active, funded research to determine scientifically defensible estimates of soil erosion impacts on crop yield and thus economic impacts to Iowa. This information will then be used as leverage in: 1) outreach activities to justify adoption of soil conservation measures and 2) the state legislature to justify stronger soil conservation-oriented policies.

Meanwhile, these results have been shared many times in presentations to farm and agency groups. Cruse has had multiple meetings with Agren Company personnel to discuss these findings and how they can be used in selling conservation to farmers through agricultural businesses. This study has influenced the conversations around the cost of erosion, but it is not clear yet if it had a major impact on land management changes.

Education and outreach

- Interview for Iowa Public Radio program “River to River.” May 8, 2014. <http://iowapublicradio.org/post/annual-1-billion-loss-soil-erosion-what-iowa-farmer-doing-about-it>
- *Des Moines Register* and AP. May 3, 2014: <http://www.desmoinesregister.com/story/money/agriculture/2014/05/03/erosion-estimated-cost-iowa-billion-yield/8682651/>
- *News & Observer*: <http://www.newsobserver.com/2014/05/04/3835489/erosion-may-cost-iowa-farmers.html>
- *Omaha World Herald*: <http://www.omaha.com/apps/pbcs.dll/article?AID=/20140505/NEWS/140509254/1707>
- Connect Tristates.com: <http://www.connecttristates.com/news/story.aspx?id=1039845#U3s73fldWSo>
- World News (WN.com): http://article.wn.com/view/2014/05/05/Erosion_may_cost_Iowa_farmers_1_billion_each_year/
- *Washington Times*: <http://www.washingtontimes.com/news/2014/may/4/erosion-may-cost-iowa-farmers-1-billion-each-year/?page=all>
- Turkeyriver.org : <http://turkeyriver.org/erosion-estimated-to-cost-iowa-1-billion-in-yield/>

Presentations:

- Cruse, R.M. January 2015. Soil Health: What is soil erosion costing us? Practical Farmers of Iowa short course. Ames, IA.
- Cruse, R.M. August 2014. Economics of soil health. “Soil Health: Do you know yours?” workshop organized by Natural Resources Conservation Service. Waverly, IA.
- Cruse, R.M. September 2014. Soil Health: What is soil erosion costing us? Iowa Chapter of the Soil and Water Conservation Society annual meeting. Nevada, IA.

Leveraged funds

This project is part of a much larger research effort, The Daily Erosion Project. It is difficult to identify which segment of this project leveraged which other segment, but this grant played a role in the whole effort of gauging the effects of soil erosion in Iowa.

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