Western Deep Loess and Drift

Environmental and economic benefits of conservation practices

Iowa has severe water-induced soil erosion and associated water quality problems because of intense agricultural activities. Soil erosion can be reduced through better field residue management and other conservation practices including reduced tillage, crop rotation, contour cropping, terracing, and vegetative filtering. The effectiveness of a given conservation practice depends on a number of factors including climate, soil type, topography, cropping systems, and existing conservation practices in that area. This study investigates the environmental and economic benefits of selected conservation practices under a corn-soybean rotation in different Iowa regions.

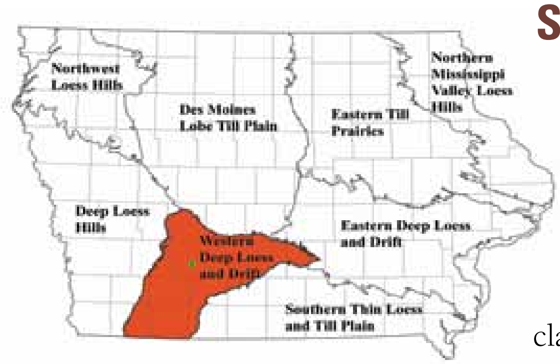

Figure 1. Western Deep Loess and Drift and study site.

Site description

In the Western Deep Loess and Drift area, slopes are mostly rolling to hilly with some nearly-level to undulating broad ridgetops. Loess soils dominate on the upland hill slopes; and soils developed in glacial till are more prominent on the steeper side slopes. Corn, soybeans, and pasture are the major crops. The farm selected to represent the typical soil type and slope in this region (Figure 1) is about 90 acres with a mean slope of 7.1 percent. Sharpsburg silty clay loam is the predominant soil in the study area.

Three common tillage systems (no-till, strip-till, and chisel plow) and three conservation structures (grassed waterways, vegetative filter strips, and terrace systems) were used for investigating environmental and economic benefits on sediment reduction.

Reducing sediment with conservation practices

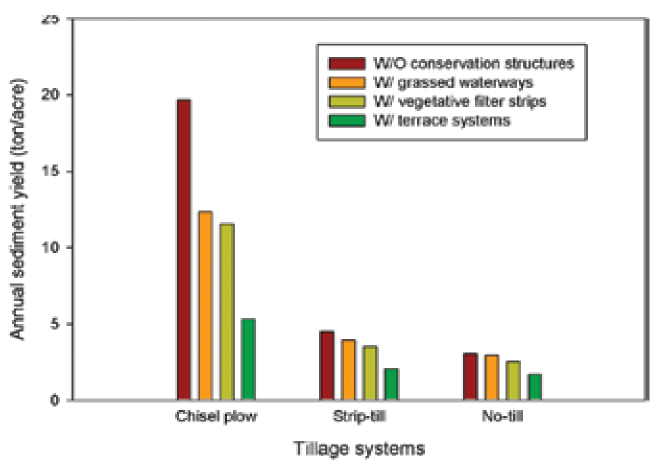

Figure 2. Impact of tillage systems and conservation structures on amount of soil leaving the field.

The estimated soil loss by the Water Erosion Prediction Project (WEPP) model showed that this area has a high erosion potential. By combining more surface residue cover with fewer and shallower tillage passes, no-till and strip-till systems reduced sediment export by 85 and 77 percent, respectively, compared to the chisel plow system (Figure 2). Conservation structures also greatly reduced sediment yield, particularly with the chisel plow system. Grassed waterways reduced sediment yield, minimizing channel erosion and retaining sediments from upland fields. Converting a portion of a row-cropped field to perennial vegetative strips was very effective in reducing sediment delivery to waterways. Terrace systems greatly reduced sediment yield slowing surface runoff and minimizing rill erosion. The effectiveness of conservation structures in sediment reduction was less significant in the no-till and strip-till systems (Figure 2), due to the already-reduced soil loss from upland soils and low suspended solid concentration in the flow water.

Cash flow and economic benefits

The six-year (2002-2008) yield study in this area (Armstrong Farm) showed that the chisel plow system had 13 and 5 more bushels per acre of corn than the strip-till and no-till systems, respectively. Soybean yields showed little response to more tillage operations (Figure 3). But the no-till and strip-till systems reduced crop production costs such as machinery, fuel and labor, compared to the chisel plow system.

The value of soil lost from the field due to erosion was estimated to be $6.30 per ton, including the on-site and off-site values. Because of the high cost of seeds and chemicals and the relatively low price of corn and soybeans at current market prices, the net return from growing corn or soybeans might be negative (Figure 4), which may vary depending on market grain prices and production costs.

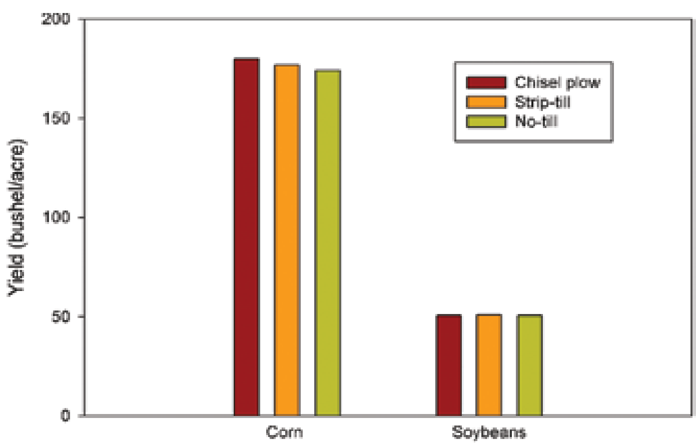

Figure 3. Yields of corn and soybeans under different tillage systems in a corn-soybean rotation.

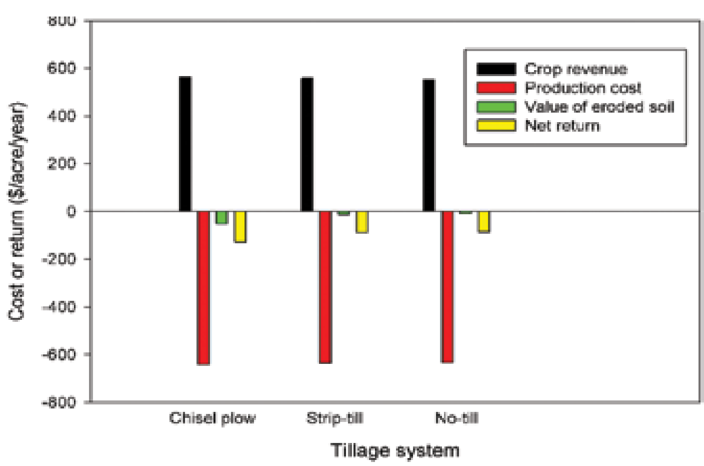

Figure 4. Costs and returns of corn-soybean rotation under different tillage systems. Net return = crop revenue – (production cost + value of eroded soil). The value of eroded soil was estimated at $6.40/ton.

Compared to the chisel plow system, all the conservation practices showed a net benefit after taking all the costs and benefits into account (Figure 5). Among the investigated practices, the use of strip-till with filter strips had the greatest economic benefit in the study area, increasing the net benefit by $48 per acre while reducing soil loss.

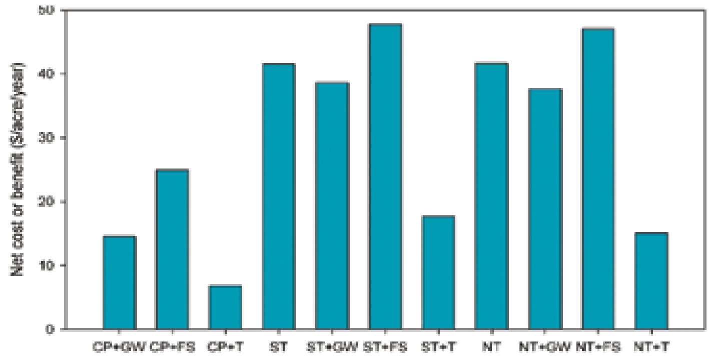

Figure 5. Net benefit or cost of conservation practices compared to the chisel plow tillage system.

Net benefit = crop revenue – (production cost + investment on conservation structure + value of eroded soil). A positive value indicates a net benefit for adopting the conservation practice(s).

Abbreviations: NT=no-till, ST=strip-till, CP=chisel plow, GW=grassed waterways, FS=filter strips, T=terraces.

For more information

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