



Soil and Crop Responses to Topsoil Replacement in Eroded Landscapes

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Key Findings:

- In a hilly landform that has been cultivated for many years, erosion had removed virtually all topsoil from the upper slope and deposited topsoil in the lower slope.
- We reversed erosion by moving 15-20 cm of soil from the lower slope to the upper slope.
- Soil addition increased soil organic carbon content, plant nutrients, water infiltration, and soil water content during crop emergence, resulting in 12-59% higher corn and soybean yields.
- Removing soil did not drastically change most measured soil properties but crop yields were sometimes lower in areas of soil removal.

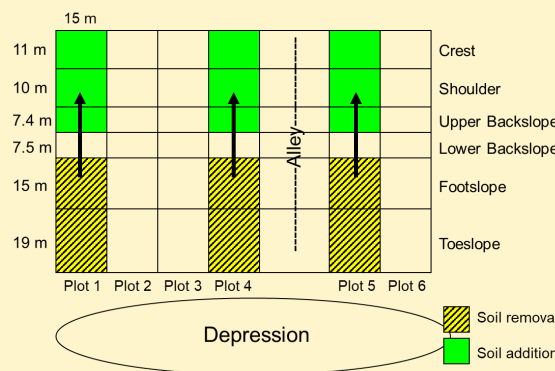
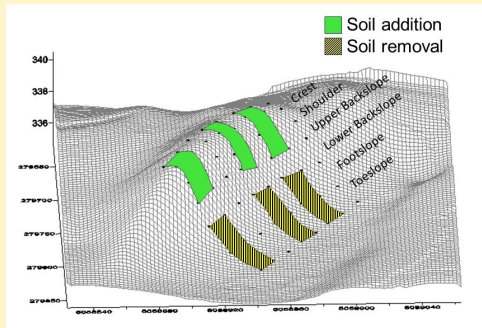
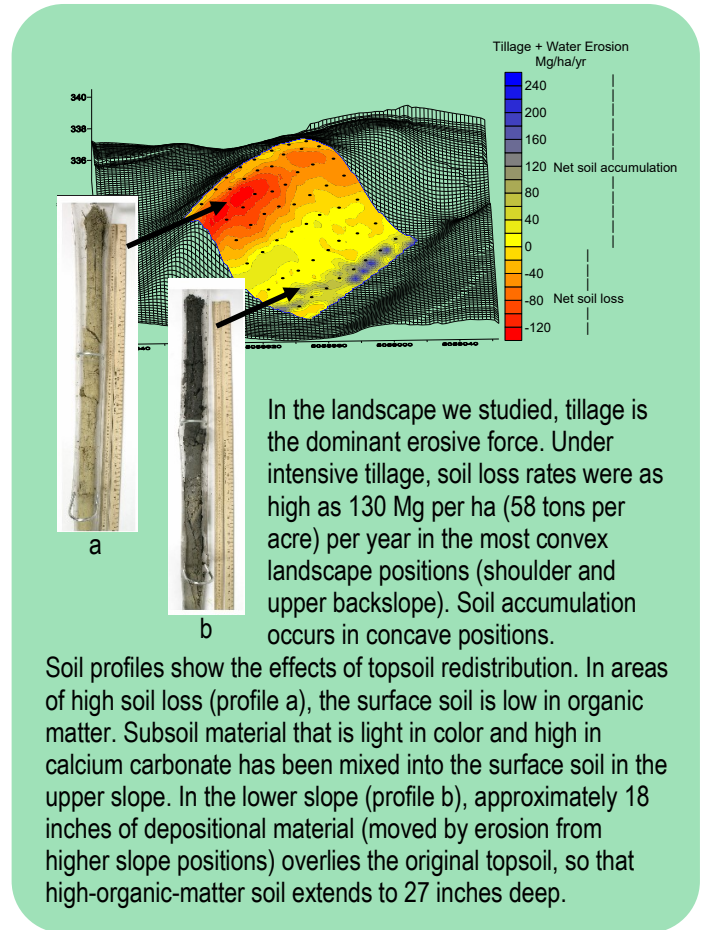
Background

In hilly agricultural landscapes, soil properties and crop yields vary throughout the field and often reflect the pattern of soil movement resulting from the combined erosive effects of tillage and water. Areas of high convexity tend to have a shallow A horizon depleted in soil organic matter, plant-essential nutrients, and available water; these areas are typically low-yielding, especially in dry years. In contrast, concavities tend to have deep topsoil accumulation, with soils high in organic matter and nutrients; these areas are high-yielding in dry years but can be low-yielding in years with excess moisture.

Reversing the erosion process by replacing translocated topsoil (soil-landscape rehabilitation) is one method to improve the productivity of eroded land.

Objective

Investigate relationships between key soil physical, chemical, and biological factors and crop growth and grain yield in eroded and rehabilitated landforms



Earth moving equipment was used to remove 6-8 inches of soil from the footslope and toeslope and add 6-8 inches of soil to the crest, shoulder, and upper backslope of the same plot.

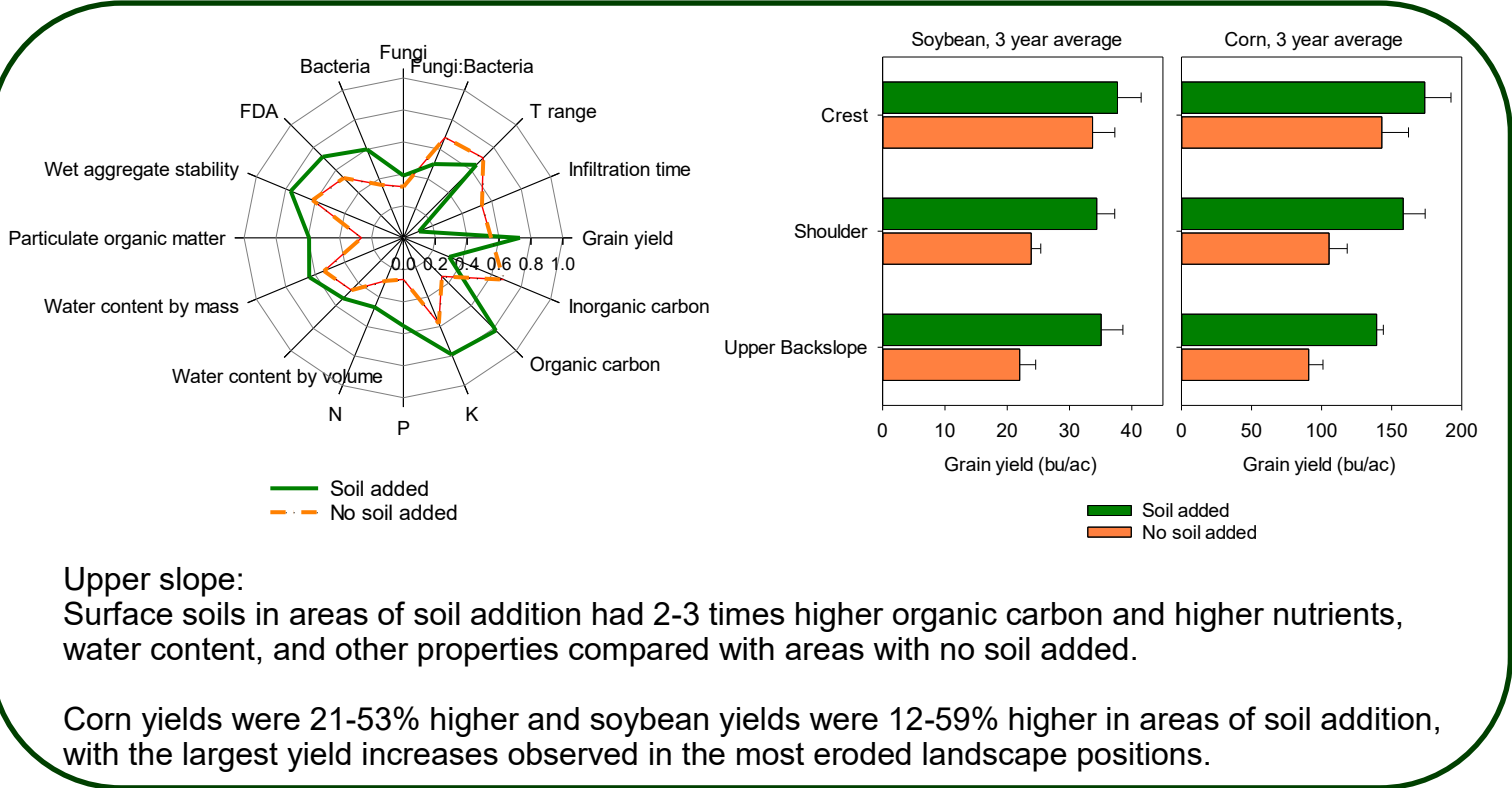
Soil was moved in 3 plots; another 3 plots remained in their eroded condition.



Methods

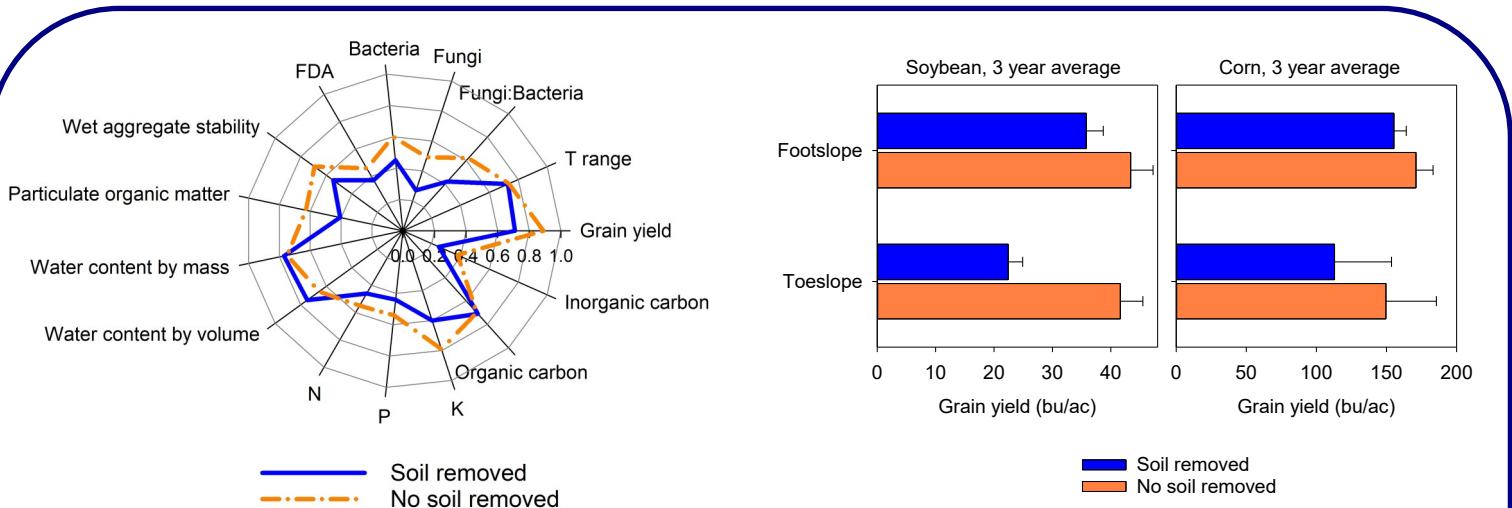
Soil samples were collected before soil movement in the fall of 2005 and annually after soil movement. We evaluated soil properties and crop responses from 2006 to 2011. The site was farmed as part of the larger field, according to regional practices implemented by the landowner.

Results



Upper slope: Surface soils in areas of soil addition had 2-3 times higher organic carbon and higher nutrients, water content, and other properties compared with areas with no soil added.

Corn yields were 21-53% higher and soybean yields were 12-59% higher in areas of soil addition, with the largest yield increases observed in the most eroded landscape positions.



Lower slope: Because of the deep accumulation of topsoil in the lower slope, removing 15-20 cm of soil did not result in a large change in most soil properties. Soil biological indicators were lower in areas from which soil was removed.

Corn and soybean yields were lower where soil was removed. The largest yield reduction was in the lowest landscape position, which was affected by excessive moisture in wet years.

Further Findings and Next Steps

This Research Brief includes information from a severely eroded site. We conducted numerous experiments at this site, addressing weed dynamics, grain quality, and other parameters not reported here.

We also evaluated this practice in a moderately eroded landform and found only marginal yield increases.

In follow-up studies, we evaluated whether a soil amendment (dairy manure solids from an aerobic digester) could improve soils properties and crop yields in a manner similar to soil. We conducted a separate study to evaluate yield responses when different depths of topsoil were added.

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Questions or comments?

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About NCARL

The North Central Agricultural Research Laboratory (NCARL) is a USDA-Agricultural Research Service laboratory located in Brookings, SD. The goal of NCARL is to develop, document, and promote soil, crop, and pest management practices that are ecologically sustainable while maintaining producer profitability.

