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Economic Outcomes of Soil Health and Conservation Practices on U.S. Cropland

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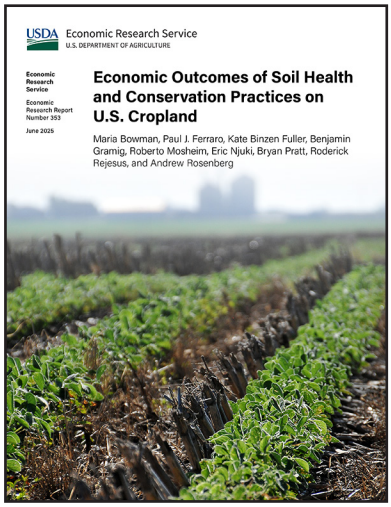
What Is the Issue?



Soil health and conservation practices, such as conservation tillage, cover cropping, and nutrient management, have the potential to provide ecosystem services for society and improve the profitability of crop and livestock production for producers. However, the economic incentives that shape a producer's decision to use these practices are complex, and the public and private costs and benefits (and net benefit) of implementing these practices—alone or in combination—are not always known to producers, researchers, or society. Net benefits also vary by region, cropping system, soil type, climate, and other factors. This report describes the complexity of producer decision making with respect to soil health and conservation practices and provides new insights into the current rates of adoption and profitability of key practices in U.S. crop agriculture.

What Did the Study Find?

A review of the literature revealed that:

- Reducing tillage intensity can reduce input costs, but net profitability varies. The short-term return to adopting cover crops was often negative without cost-share or financial assistance.
- The economic outcomes of soil health practices are dynamic (change over time) and may vary with the amount of time a producer has been using the practice.
- Risk and uncertainty affect producer adoption of new soil health practices, such as cover cropping, as do other behavioral factors, such as time and risk preferences, and peer effects and social norms.
- The profitability of individual practices depends on the suite of conservation and other management practices employed in the management system (e.g., rotations, no-till, cover cropping, nutrient management).

An analysis of Census of Agriculture and Agricultural Resource Management Survey (ARMS) data showed that adoption rates of key soil health and conservation practices on cropland (conservation tillage, cover cropping, and nutrient management) varied by practice, region, and over time:

- Adoption of conservation tillage (no-till and reduced tillage combined) continues to increase, but the adoption of no-till alone has slowed for some crops.
- Cover crop adoption rates have been relatively low but increasing in many regions. Still, analysis of Census of Agriculture data suggests that more than half of operations stopped cover cropping from 1 census year to the next. Forty-eight percent of producers with cover crop acres in 2012 reported cover cropped acres in 2017, and 46 percent of operations with reported cover crop acres in 2017 reported cover cropped acres in 2022.
- For most commodity crops, fields with no-till and reduced tillage were more likely to be planted with cover crops relative to conventionally tilled fields.
- Corn and cotton fields that were also planted with cover crops had a larger share of nitrogen applied at or after planting relative to fields without cover crops.
- Nitrogen application has remained relatively constant across crops over time, but the timing of nitrogen applications has changed for some crops. More nitrogen is being applied at or after planting on wheat fields, and there was a recent increase in fall application for corn fields.

Analysis of data from ARMS suggests the following about the relationships between soil health practices, field-level yield and costs of production, and farm-level productivity and technical efficiency (which refers to how efficient users of the practice/technology are in combining available inputs to maximize production compared with nonusers):

- Conservation tillage was associated with higher corn but not soybean yields and with lower total operating costs for both corn and soybeans.
- Farms that used no-till/strip-till in corn, soybean, and cotton production had higher aggregate output, but cover crops were not found to be associated with farm-level productivity.
- Operations that adopted no-till/strip-till (but not cover crops) were slightly less technically efficient (i.e., less successful at using inputs to their fullest potential to maximize production) than those operations that did not.
- Operations that adopted both no-till/strip-till and cover crops were more technically efficient (i.e., had greater success at maximizing crop production through the combination of various inputs) relative to operations that had not adopted both practices.

How Was the Study Conducted?

To provide background on the economic effects of soil health practices on cropland and how producers make decisions regarding practice adoption (including the behavioral economic issues unique to soil health management systems), the report authors conducted a literature review. To estimate the persistence of cover cropping and joint adoption of cover crops and conservation tillage at the farm operation level, the authors used microdata (operation-level data) from the 2012, 2017, and 2022 Censuses of Agriculture. They also used data from Phase 2 (field-level data) and Phase 3 (operation-level data) of ARMS over the last two decades to estimate the rates of soil health and conservation practice adoption by crop, the effects of conservation tillage on input costs and yields for corn and soybeans, and the effects of conservation tillage and cover crops on production efficiency at the operation level and for individual crops. ARMS is a national survey of farming operations and production practices conducted by USDA's National Agricultural Statistics Service and Economic Research Service.