

## **Economics of Soil Carbon Sequestration through Biomass Crops (77)**

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There is considerable research suggesting that changes in land use and management practices could potentially sequester 8% of US annual emissions of all greenhouse gases. These changes include, planting trees, converting from conventional to conservation tillage, adopting improved cropping systems, converting to perennial crops and restoration of wetlands. Moreover, perennial grasses have the potential to mitigate carbon emissions by providing bioenergy that can displace fossil fuels for electricity generation or transportation.

Economic incentives for landowners to switch to a sequestration friendly land uses simply based on its profitability relative to conventional use, are unlikely to lead to socially optimal land use because they disregard the external benefits of sequestration. Moreover, in the absence of well developed bioenergy markets, biomass from bioenergy crops need to compete with exiting fossil fuel market to provide enough incentive for growers to switch land from conventional to conservation uses. Further, economic incentives and environmental benefits are also likely to vary spatially, since the relative profitability of alternative uses depends on soil conditions, climate, and location relative to markets. Policy makers then need to determine the additional incentives needed to induce the socially optimal land use to achieve a desired level of sequestration. In determining the form of these incentives, it is important to consider not only spatial variations in profitability of alternative land management strategies but also the spatial and temporal variations in the amount of carbon sequestered by alternative landuse strategies.

The purpose of this study is to evaluate the extent to which biomass crops can lower the costs of carbon sequestration while also providing bioenergy for electricity generation. We examine the allocation of land between bioenergy crops and row crops with conservation tillage to achieve given carbon sequestration targets at alternative bioenergy prices and at various carbon sequestration targets. Additionally, we analyze the implications of alternative assumptions about the dynamics of soil carbon sequestration on the pattern of land use and costs of sequestration.

We develop a dynamic microeconomic behavioral model where heterogeneous land in a region is allocated among alternative uses to maximize aggregate producer's surplus to achieve a predetermined target for soil carbon level in the region. We apply this at a county level in Illinois to examine the costeffective land use allocation among alternative row crops with conventional and conservation tillage practices and two bioenergy crops, Switchgrass and Miscanthus, over a 15 year period. A transportation module is embedded in the land use model that links power plants to identify the least cost sources of bioenergy.

We find that the extent to which biomass crops lower costs of sequestration varies directly but inelastically with the price of bioenergy. A linear carbon accumulation function leads to earlier switching of land to sequestration friendly uses, than a negative exponential function, leading to significantly higher marginal costs of sequestration. The potential to rely on bioenergy crops and conservation tillage to achieve sequestration targets varies spatially; bioenergy crops are more

likely to be grown in counties that are closer to power plants while conservation tillage is more likely in the northern and southern counties where there is either considerable capacity to sequester carbon or the returns from conservation tillage in the absence of carbon credits are low.