

Carbon Mitigation Payments Can Reduce the Riskiness of Bioenergy Crop Production

Background/Objective

- Perennial bioenergy crops such as miscanthus and switchgrass can provide substantial carbon (C) mitigation benefits, but uncertain economic returns due to weather related yield risks can make farmers hesitant to adopt them.
- This work elucidates potential impacts of C mitigation payments on perennial bioenergy crop adoption by farmers with varying risk tolerance.

Approach

Coupled economic analysis with a biogeochemical model (DayCent) to examine the effect of different levels of C mitigation payments on spatially varying bioenergy crop returns and risk profiles relative to conventional crops across the rainfed U.S. Characterized crop returns in terms of first-order (FOSD) and second-order (SOSD) stochastic dominance.

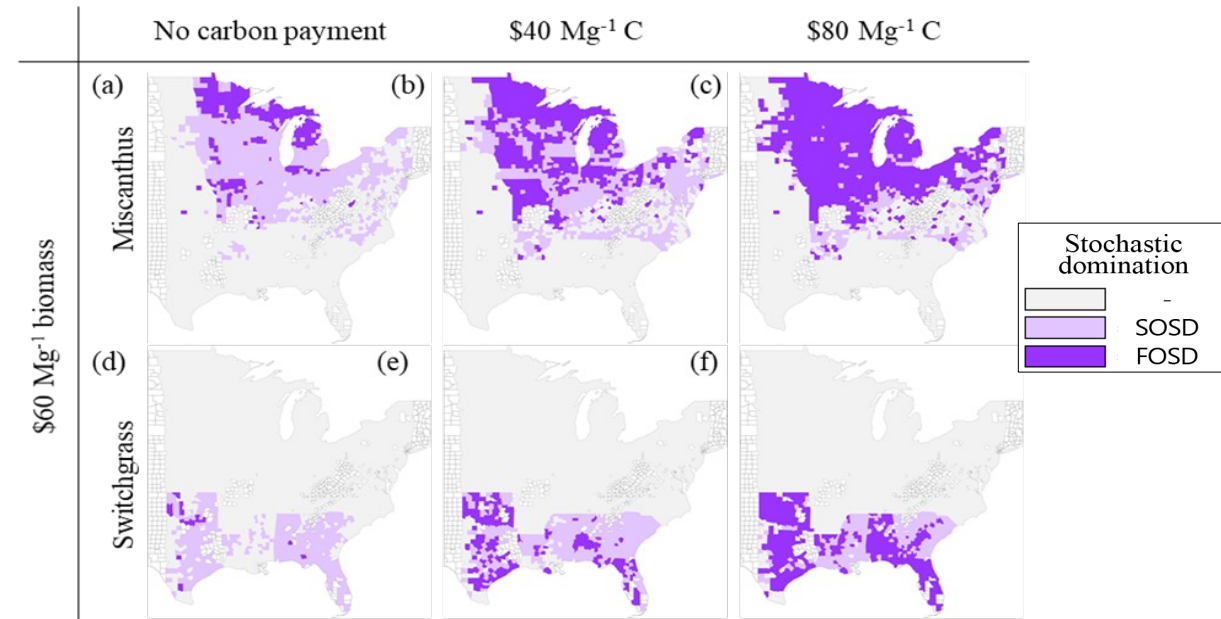
Results

- Without C mitigation payments, miscanthus (a) and switchgrass (d) may not have positive profit under all risk conditions at moderate biomass prices (\$60 Mg⁻¹) but may still appeal to risk-averse farmers (SOSD) as they have more certain returns relative to row crops.
- Carbon mitigation payments expand the regions where miscanthus and switchgrass are profitable, increase returns and reduce return risks such that these crops would appeal to farmers regardless of risk preference (FOSD).

Significance/Impacts

Our finding that C mitigation payments increase miscanthus and switchgrass profitability and potential appeal to risk-neutral and risk-averse farmers in the Midwestern and Southern U.S., respectively, sheds light on potential policy decisions that might incentivize increased bioenergy crop cultivation.

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Stochastic dominance of miscanthus over conventional crops and switchgrass, and switchgrass over conventional crops and miscanthus at \$60 Mg⁻¹ biomass price under three different C mitigation benefit scenarios. Compared to existing land use, FOSD implies likelihood of higher returns across all risk conditions, and SOSD implies lower riskiness of returns making it preferred by risk-averse farmers even when the level of returns could be lower under some risk conditions.