Impact of Innovativeness and Environmental Stewardship on Adoption of Energy Crops

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The Energy Independence and Security Act of 2007 set a renewable fuel standard of 36 billion gallons of biofuel production by 2022, of which 21 billion gallons are to come from cellulosic sources, such as Switchgrass and *Miscanthus*.

Energy Crops

- **Switchgrass** is native to North America and it has the potential of having high biomass yield per acre. The other advantage of Switchgrass is that it has easier adaptability to marginal land conditions.
- ***Miscanthus*** has higher biomass yield potential than Switchgrass, which can be as high as 2.5 times . The downside of growing *Miscanthus* is its higher establishment and operating costs than Switchgrass.

Objectives

- The objective of this study is to measure the impact of innovativeness and environmental stewardship on farmers' willingness to grow Switchgrass and *Miscanthus.*
- Time to adopt Roundup Ready® corn is used as a *proxy* to measure farmers' innovativeness.
- Time to adopt using grass filter strips around the water sources is used as a *proxy* to measure famers' environmental stewardship.

Data

- A mail survey of 2,995 farmers in Missouri and Iowa was conducted in spring 2011 to measure the farmers' willingness to grow Switchgrass and *Miscanthus*, as well as adoption of other technologies.
- The effective response rate for the survey was 21 percent.
- The average willingness to grow for Switchgrass is 2.4 and average willingness to grow for *Miscanthus* is 2.3. (*Ranged from 1 to 5, where 1 is strongly not willing to grow and 5 is strongly willing to grow*).

Econometric Model

- The willingness to grow (WTG) for either crop by farmers can be analyzed using an ordered probit model, as these variables are in the form of ordered numbers from 1 to 5.

- Since same farmers answered the questions for both crops, a bivariate-ordered probit model is used to take in the account the correlation among error terms (Green, 2008):

$$y_{1i}^* = \mathbf{X}_{1i}'\boldsymbol{\beta}_1 + \varepsilon_{1i} \qquad y_{2i}^* = \mathbf{X}_{2i}'\boldsymbol{\beta}_2 + \varepsilon_{2i} \qquad \begin{pmatrix}\varepsilon_{1i}\\ \varepsilon_{2i}\end{pmatrix} \sim N\left[\begin{pmatrix}0\\0\end{pmatrix},\begin{pmatrix}1 & \rho\\ \rho & 1\end{pmatrix}\right]$$

$$y_{1i} = \begin{cases} 1 & \text{if Strongly Not WTG} \\ 2 & \text{if Not WTG} \\ 3 & \text{if Not Sure} \\ 4 & \text{if WTG} \\ 5 & \text{if Strongly WTG} \end{cases} \qquad y_{2i} = \begin{cases} 1 & \text{if Strongly Not WTG} \\ 2 & \text{if Not WTG} \\ 3 & \text{if Not Sure} \\ 4 & \text{if WTG} \\ 5 & \text{if Strongly WTG} \end{cases}$$

Results

- The results of the current study show that innovative farmers are not more willing to grow Switchgrass or *Miscanthus* than late adopters and laggards.
- Late adopters are found to be less willing to grow *Miscanthus* than laggards.
- Farmers' environmental stewardship is found to have a negative impact on willingness to grow Switchgrass and *Miscanthus* .
- Farmers that are early adopters of conservation practices are less willing to adopt Switchgrass and *Miscanthus*.

Conclusion

- Actual levels of biomass production from Switchgrass and *Miscanthus* might be lower than the previously predicted amounts based on the available land.
- Production and market uncertainties for energy crops can be significant barriers for adoption, even for innovative farmers.
- Conservation aspect of growing energy crops might not be sufficient for adoption. Hence, more information should be provided by extension services.

References:

Greene, W. H. 2008. *Econometric Analysis*, New York, Prentice-Hall Inc.

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