Motivations to Grow Energy Crops: The Role of Crop and Contract Attributes

Madhu Khanna

Professor
Department of Agricultural and Consumer Economics/Energy Biosciences Institute
University of Illinois, Urbana-Champaign
1301, W. Gregory Drive, Urbana, IL 61801
email: khanna1@illinois.edu

Jordan Louviere

Professor
School of Marketing
University of South Australia Business School
email: Jordan.Louviere@unisa.edu.au

Xi Yang

Postdoc Research Associate
Energy Biosciences Institute
University of Illinois, Urbana-Champaign
1206, W. Gregory Drive, Urbana, IL 61801
email: xiyang@illinois.edu

Selected Poster prepared for presentation at the Agricultural & Applied Economics Association's 2014 AAEA Annual Meeting, Minneapolis, MN, July 27-29, 2014.

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Madhu Khanna*, Jordan Louviere^ and Xi Yang* ***University of Illinois Urbana Champaign ^University of South Australia Business School**

Research Motivation

Energy crops are a promising feedstock for biofuels due to their relatively high yields, even on low quality land and their potential to improve soil and water quality. However, these crops are perennials and their production involves upfront investments, a lag between establishment and income generation and a long term commitment of land.

The production of these crops also imposes learning costs on farmers since they require different management practices than annual crops and may require crop-specific equipment for planting, harvesting and baling. Farmers are likely to require long-term contracts to produce energy crops; however, long term contracts can reduce flexibility in land allocation.

The preferred length of a contract will depend on the farmer's rate of time preference. Contracts can also vary in the net return they yield and the variability in these returns.

The choice of contract can be expected to depend on its various attributes, such as length, expected net returns and variability of those returns. It will also depend on farmer characteristics such as risk preferences and other socio-demographic characteristics that determine willingness to make risky choices.

Research Objectives

The purpose of this research is to examine the crop-contract attributes likely to motivate farmers to grow an energy crop and the factors that determine the share of land they would allocate to the energy crop.

We designed and implemented a choice experiment that presented a sample of farmers with various combinations of crop-contract attributes, which we analyze to determine their effects on choices.

We also examine the trade-offs they are willing to make between the attributes and the extent to which these depend on their risk and time preferences and other socio-demographic characteristics.

Lastly, we examine the extent to which there are differential determinants of the two-step discrete-continuous decision of crop choice and land allocation.

Survey Instrument

The energy crop adoption survey was administered from March 2013 to July 2013. A total of 4800 farmers were randomly selected from five states: Illinois, Indiana, Kentucky, Missouri and Tennessee.

Responses were received from 666 farmers, yielding a response rate of 14%. We used focus groups and pilot surveys to determine the five most important attributes of the crop/contract likely to affect choices.

We considered two contract lengths (10 years or 15 years), establishment costs shared by refinery (four values: 0, 25%, 50% and 75%), requirement for crop specific equipment (0 or 1), the net gain in annual income per acre relative to the status quo income (5%, 10%, 15% and 20%), and variability in annual incomes (either 25% or 50%).

Hypotheses

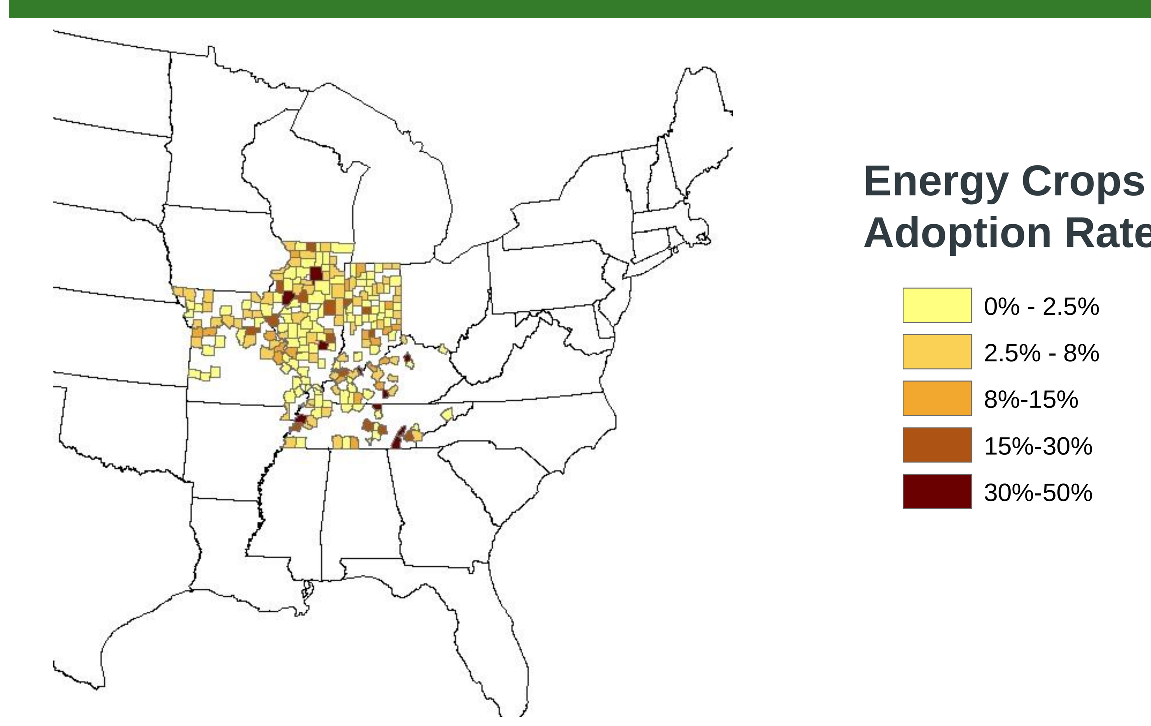
We propose a conceptual framework that models the land allocation decisions by risk averse farmers to maximize the net discounted value of expected utility. We use this framework to generate the following three testable hypotheses.

Hypothesis 1: Contracts for growing an energy crop with a higher net income and lower variability in net income are more likely to lead to adoption of an energy crop and a larger land allocation, particularly if farmers are risk averse.

Hypothesis 2: contracts of shorter length that provide a higher cost share of establishment costs by the biorefinery and do not require crop-specific equipment are more likely to lead to adoption of an energy crop and on a larger share of land, particularly if farmers have high discount rates.

Hypothesis 3: The last hypothesis is that farmers with greater availability of land with lower opportunity costs are more likely to adopt energy crops and divert a larger share of land to their production.

Summary Statistics



Key Variables	Definition	Adopters	Non-adopters
SIZE	Operated acres	1117.2 (1330.21)	998.592 (1346.01)
DEBTRATIO	Debt-to-asset-ratio (%)	18.5654 (19.0787)	14.3803 (17.2057)
STATUSQUO	Status quo annual income ($/acre)	280.816 (173.409)	302.904 (211.407)
LENGTH	Contract length (Years)	12.2798 (2.49168)	12.5228 (2.50039)
ESTABLISH	Establishment cost shared by refinery (%)	43.6176 (26.9152)	35.004 (28.0711)
EQUIPMENT	Crop-specific equipment (1=Yes 0=No)	0.44705 (0.49747)	0.54188 (0.49834)
NETGAIN	Net gain in annual income (% higher than status quo)	14.1416 (5.32839)	11.9234 (5.5677)
VARIABILITY	Variability in annual income (% around the average)	36.7057 (12.4817)	37.7432 (12.5001)
RISKPRE	Risk preference (0=Cautious 1=Willing to take risks or enjoy taking risks)	.2870796 (.452479)	.6847956 (.46469)
TIMEPRE	Time preference reflects farmers' discount rate	0.17086 (0.18052)	0.388 (0.37221)
Observation Number		2,519	897

Results

Stage 1-Adoption Decision Model: Farmers decide to adopt energy crops if their utilities from the energy crops are higher than all the other alternatives. Probit model is used to capture the dichotomous choice

Stage 2-Land allocation Decision Model: A censored regression model (tobit) is used to determine the land allocation behavior of farmers.

	Stage 1		Stage 2	
VARIABLES	Adopt	Adopt	Converted Land	Converted Land
LENGTH	-0.0750** (0.04)	-0.0296 (0.02)	-15.87** (8.09)	-9.164* (5.43)
ESTABLISH	0.0142*** (0.00)	0.0128*** (0.00)	2.925*** (0.68)	2.776*** (0.78)
EQUIPMENT	-0.448*** (0.14)	-0.422*** (0.14)	-71.82*** (24.86)	-72.81*** (24.97)
NETGAIN	0.00984** (0.00)	0.00911** (0.00)	2.292*** (0.67)	2.284*** (0.67)
VARIABILITY	0.00175 (0.01)	0.00205 (0.01)	1.657 (2.02)	1.652 (2.01)
AGEGROUP	-0.0852 (0.10)	-0.0698 (0.09)		
RISKPRE	0.904* (0.47)	0.857* (0.45)	220.4** (91.20)	221.7** (91.32)
TIMEPRE	-5.234** (2.13)	-2.462** (1.11)	-969.2** (406.50)	-592.2** (234.90)
RISK*VARIABILITY	-0.0162 (0.01)	-0.0157 (0.01)	-3.449 (2.29)	-3.496 (2.29)
DISC*LENGTH	0.211 (0.14)		32.32 (26.68)	
DISC*ESTABLISH		0.00246 (0.01)		0.687 (2.15)
Constant	0.0637 (0.68)	-0.48 (0.56)	-283.1** (130.90)	-359.6*** (139.20)
Observations	3,072	3,072	3,072	3,072

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Conclusions

Higher net gain in annual income and lower variability are significant to promote the adoption of energy crops.

Contracts of shorter length that provide a higher cost share of establishment costs by the biorefinery and do not require crop-specific equipment are more likely to lead to adoption of an energy crop and on a larger share of land.

Risk loving farmer are more willing to adopt energy crops than risk averse farmers. Farmers with low discount rate tend to adopt energy crops. Farmers with greater availability of low quality land are more likely to adopt energy crops and divert a larger share of land to their production.

Farmers would like to pay $4.5/acre to avoid an additional year of energy crop contract. Farmers are willing to pay $1.87/acre for 1% more establishment cost borne by the refinery. Farmers are willing to pay $57.96/acre for the whole lifespan of energy crops if there is no need for any crop-specific equipment. Farmers are willing to pay $1.28/acre in order to reduce 1% variability in annual income.

Acknowledgement: This research is funded by Energy Biosciences Institute