Land Requirement, Feedstock Haul Distance, and Expected Cost Consequences of Restricting Switchgrass Production to Marginal Land

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Abstract

Energy crop production has been proposed for land of poor quality to avoid competition with food production and negative indirect land use consequences. The objective of this study was to determine the land area requirements, biomass transportation distance, and expected cost consequences of restricting switchgrass biomass production, for use as biofuel feedstock, to marginal land relative to unrestricted land use. The USA soils capability classification system was used to differentiate between high quality land (Class I) and land of marginal quality (Class IV). Switchgrass biomass yield distributions were simulated for each of four land capability classes for counties in the Eastern Oklahoma case study region. For a 70 million gallons per year cellulosic ethanol biorefinery, restricting land use to capability Class IV (defined as marginal) increases the quantity of land required to support the biorefinery by 47%; increases biomass trucking distance by 118%; increases cost to delivery feedstock by 13%; and increases the expected cost to produce a gallon of ethanol by $0.19. In the absence of government restrictions, for-profit companies are not likely to limit energy crop production to land of marginal quality.

Keywords: biorefinery; EPIC; marginal land; switchgrass; yield variability

JEL classifications: C60, Q42, Q24

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Introduction

The production of energy crops such as switchgrass (*Panicum virgatum* L.) was envisioned as a way to reduce the cost of government funded set aside and land retirement programs that had been implemented to reduce excess capacity. It was assumed that most of the land in these programs was of lower quality and that it could be put to productive use growing biomass crops that could then be converted to valuable products.

A number of studies have concluded, that since millions of ha of marginal land exist, much of it could be converted relatively easily from current use to the production of switchgrass. If the land is marginal and not currently used intensively to produce food, feed, and fiber crops, it follows that conversion to switchgrass would not impact land use elsewhere and hence reduces concern regarding the environmental consequences of indirect land use. The original intent of the proposition was to avoid competition with food production and negative indirect land use consequences. However, to-date, there is a lack of information on the economic consequences of limiting energy crop production exclusively to marginal land on future biorefinery investment profitability.

Objective

The objective of this study is to determine the land area requirements, biomass transportation distance, and expected profit consequences of restricting switchgrass biomass production, for use as biofuel feedstock, to marginal land relative to unrestricted land use.

Conceptual Framework

- A biorefinery with a processing capacity of 2,200 tons per day is considered.
- Two mathematical programming models that integrate both spatial and temporal yield variability are designed and implemented:
- One model does not allow for interyear storage
- The second model integrates interyear storage.

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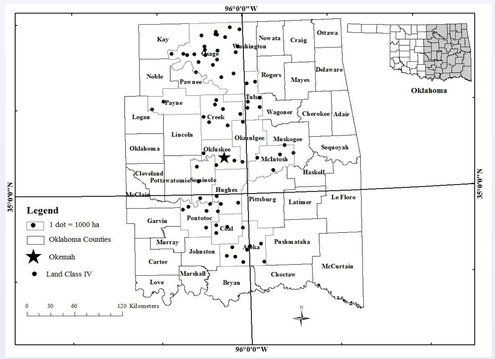
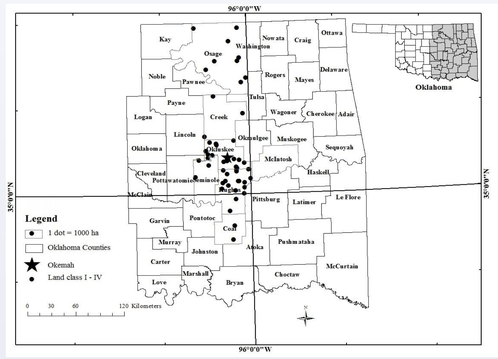
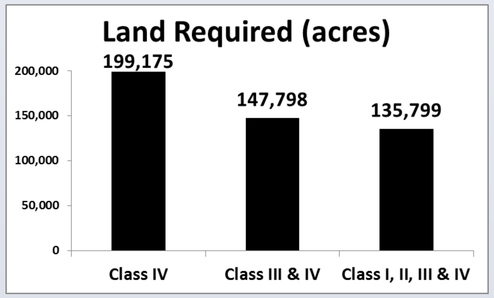
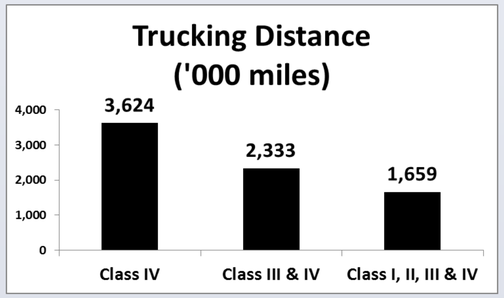


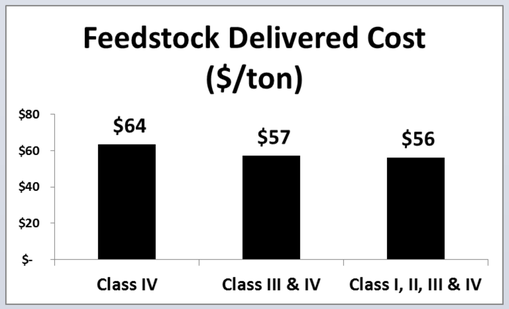
Case study region and land optimally selected for conversion to switchgrass when land use is restricted Capability Class IV ("marginal") Land

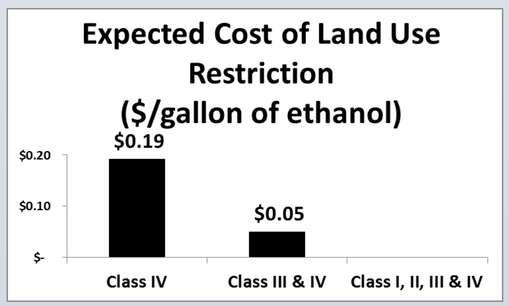


Land optimally selected for conversion to switchgrass when land use is unrestricted









Conclusion

- For the levels of biofuel price considered and a 70 million gallons per /year biorefinery, restricting land use to capability Class IV, increases the quantity of land optimally leased by 42 to 52%.
- Restricting land use to capability Class IV Increases the biomass trucking distance by 115 to 140%; and reduces the expected net returns by $7 to $16 million/year.
- In the absence of government restrictions, for-profit companies are not likely to limit energy crop production to land of marginal quality.
- Public policies that impose restrictions on the type of land that may be converted from current use for energy crop production would increase biofuel production cost and reduce the likelihood of cellulosic biorefineries being built.

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