Economic Viability of Cellulosic Biomass Production on Marginal Land in the Northern Great Lakes Region

Bradley J. Kells[1] and Scott M. Swinton[2]
[1]Department of Economics, George Mason University
[2]Department of Agricultural, Food, and Resource Economics, Michigan State University

Marginal land where crops are not grown can grow energy biomass with minimal effect on food and feed prices. The northern Great Lakes region abounds in marginal land. But marginal land can be used in many ways, so its economic viability for bioenergy crops depends upon out-earning the next best alternative land use.

Objectives

This study evaluates the expected profitability of three cellulosic biomass crops producible in the northern Great Lakes region—willow, hybrid poplar, and switchgrass—compared to mixed grass hay, a common alternative use of marginal land in the area. For each bioenergy crop, it calculates the minimum biomass price and yield needed to match the profitability of mixed grass hay.

Materials & Methods

We calculate annualized present values for costs and revenues over a 16-year time horizon to compare the annual profitability of bioenergy "challengers" to the mixed grass hay "defender" land use.

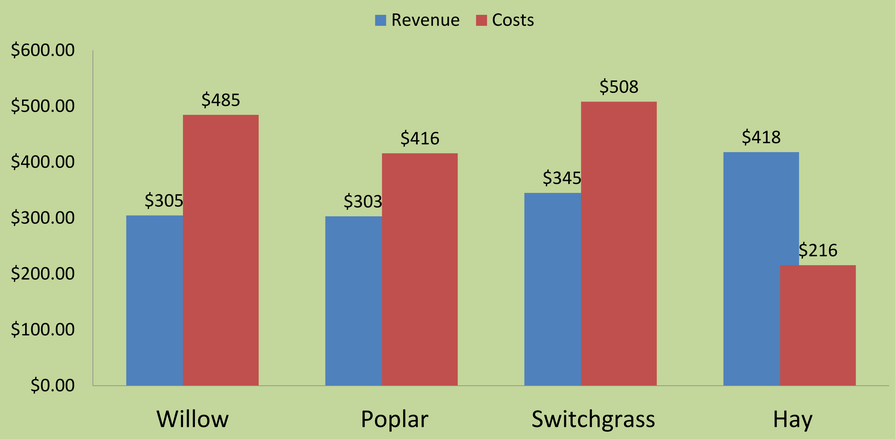
Inputs costs are based on 2010-2012 prices, including machinery, harvest, pest control, planting material, and fertilizer. Harvest costs make up the largest cost category of biomass production. The delivered price of energy biomass is assumed to be $45/dry ton, based on the USDA Biomass Crop Assistance Program maximum cost share value.

This study updates James et al (2010)'s budgets for switchgrass and poplar production in southern Michigan and compares the profitability of growing these crops in northern and southern Michigan.

Crop	Yield Green Tons (Mg/ha)	Price ($ / Mg/ha)
Hay	3.5	115
Willow	20.0	23
Poplar	16.0	23
Switchgrass	10.0	38

NB: Price based on green weight equivalent of $45 / dry metric ton.

Profitability of biomass crops (annualized $/ha)



Analysis

Breakeven Price
The price at which a "challenger" biomass crop at current yields earns a profit equal to the "defender" land use of mixed grass hay.

Breakeven Yield
The mature annual yield at which a biomass crop earns a profit equal to the "defender" land use of mixed grass hay, assuming a biomass price of $45 / dry ton.

$$p_{BE} = \frac{NPV_D + \sum_t \left(\frac{c_t}{(1+r)^t} \right)}{\sum_t \left(\frac{y_{Ct} - y_{Dt}}{(1+r)^t} \right)} \qquad AY_{BE} = \frac{NPV_D + \sum_t \left(\frac{adc_t}{(1+r)^t} \right)}{\sum_t \left(\frac{P_t - ydc_t}{(1+r)^t} \right)}$$

p_{BE} = *breakeven price per dry metric ton*
NPV_D = *net present value of the "defender" crop*
c_t = *cost of producing new biomass "challenger" crop*
y_{Dt} = *yield of "defender crop" (dry metric tons)*
y_{Ct} = *yield of "challenger" crop*
AY_{BE} = *annual average yield to break even*
P_t = *assumed biomass price*
adc_t = *area dependent costs (per hectare)*
ydc_t = *yield dependent costs (per metric ton)*
t = *year*

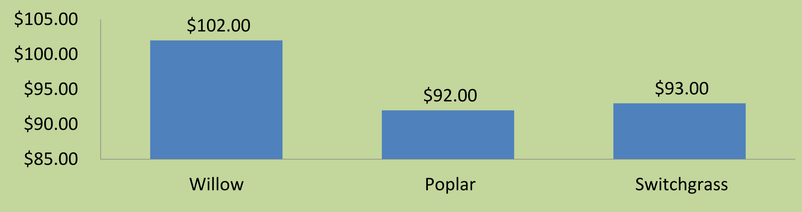
Reference
James, L.K., S.M. Swinton and K.D. Thelen (2010). "Profitability of Cellulosic Energy Crops Compared with Corn." Agronomy Journal 102(2): 675-687.

Results

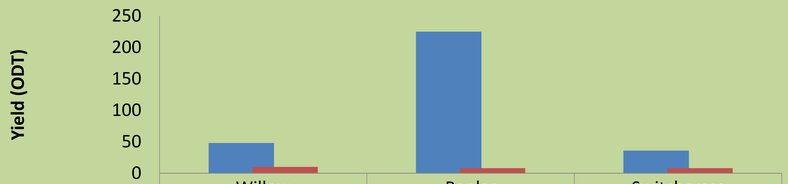
At current yields and assumed biomass prices, all three proposed biomass crops not only failed to match the profitability of mixed grass hay, but also failed to cover their own direct costs.

- Switchgrass requires the smallest percent increase in yield to break even with mixed grass hay, more than triple current yield.
- Poplar has the lowest breakeven price with mixed grass hay, at $92 per oven-dry ton.

Breakeven price ($ / dry metric ton)



Breakeven yield (dry metric tons)



	Willow	Poplar	Switchgrass
Breakeven Yield	48	225	36
Current Yield	10	8	8

Conclusions

Production of energy biomass on marginal land in the northern Great Lakes region is not competitive with conventional mixed hay at current yields and foreseeable prices. High wood propagule and harvest costs constrain biomass profitability.

However, biomass production on marginal land in the northern Great Lakes region is closer to becoming profitable than it is on cropland in the southern Great Lakes region, where corn grain has a higher opportunity cost than mixed grass hay does in the north.

More generally, when the ratio of input costs to revenue remains relatively constant across regions, if the opportunity cost of marginal land is significantly lower than the opportunity cost of crop land, marginal land is likely to be more economically viable for biomass production than cropland.

U.S. DEPARTMENT OF ENERGY
DOE Bioenergy Research Centers
WWW.GLBRC.ORG