Economic potential of regional-scale production of short rotation woody crops on marginal cropland

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Abstract

The study develops a geospatial model of SRWC production on marginal cropland of North Carolina, and maps the economic potential of growing the crops. We find the highest economic potential of growing poplars in NC is in the Piedmont region, and to be cost-effective, poplars require moderately to high fertility sites and high delivered price ($40/ton).

Introduction

Bioenergy production on marginal land, i.e., land that is suboptimal for crop production, has been a subject of numerous studies that analyzed the use of such land for growing dedicated energy crops (Skevas et al., 2018; Whitaker et al., 2018). Recent research suggests that short-rotation woody crops (SRWC) such as sycamore, green ash, poplar, or sweetgum can produce a significant volume of feedstocks for bioenergy in a relatively short, 10-year time, and can be reliably grown on many types of marginal cropland in the U.S. Southeast (Ghezehei et al., 2020). However, little is known about a regional scale production potential of such crops and how the potential is affected by changes in SRWC production input and output prices. The study develops a geospatial model of SRWC production on marginal cropland of North Carolina, and maps the economic potential of growing the crops.

Methods

The methodology integrates the GIS-based maps of marginal cropland with a field-scale SRWC productivity and economic assessment tool (SRWC-PEAM, https://projects.ncsu.edu/project/bioenergy/SR_Hardwoods.html) developed for assessing the feedstock production in the southeastern U.S. (Ghezehei et al., 2020). The tool takes the site-specific information about land use history, soil characteristics, as well as production factor and feedstock prices as inputs and estimates, among other outputs, the enterprise budgets and net returns for intended SRWC species. The SRWC-PEAM explicitly accounts for the costs of the activities (e.g., disking, mowing, and fertilizer application) and materials applied (e.g., fertilizer and pesticides) during pre-planting, planting, maintenance, and harvesting years. For cropland, the tool differentiates the typical production practices between land that was previously cropped/tilled, fallowed, or pastured.

Key assumptions

- Poplars, 10 and 15 year-old stands; 1011 trees/ac density
- Delivered prices of $30/ton and $40/ton of green wood; production costs of mid-2021
- Marginal cropland:
  - Fallow: cropland that is purposely kept out of production during a regular growing season.
  - Grassland/pasture: areas dominated by graminoid or herbaceous vegetation, >80% total vegetation, not subject to intensive management such as tilling, but can be or are utilized for grazing.

Results

Table 1- SRWC-PEAM results

Site Quality	Region	Land use/type	Mean NPV ($/acre)	
			Price @$30/ton	Price @$40/ton
Low 0.23	Coastal	Fallow	- 393.90	127.90
		Pasture	- 304.60	- 38.50
	Piedmont/Mountains	Fallow	- 443.90	- 177.90
		Pasture	- 354.60	- 88.60
Med 0.53	Coastal	Fallow	- 15.50	583.10
		Pasture	73.90	672.40
	Piedmont/Mountains	Fallow	- 128.00	470.60
		Pasture	- 38.60	555.10
High 0.89	Coastal	Fallow	460.30	1,476.80
		Pasture	549.70	1,566.20
	Piedmont/Mountains	Fallow	269.20	1,285.70
		Pasture	358.60	1,375.10

Figure 1 – Major land uses, North Carolina, 2020 CDL

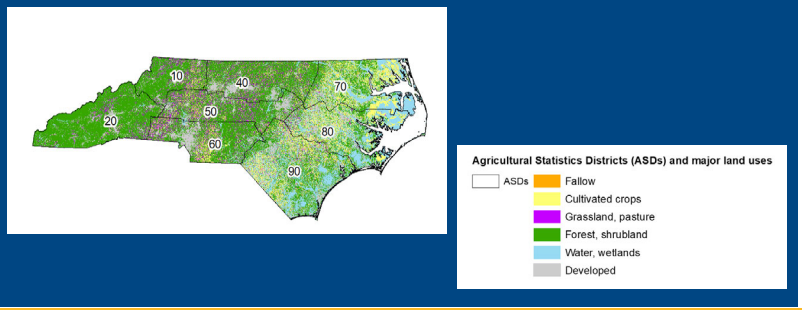
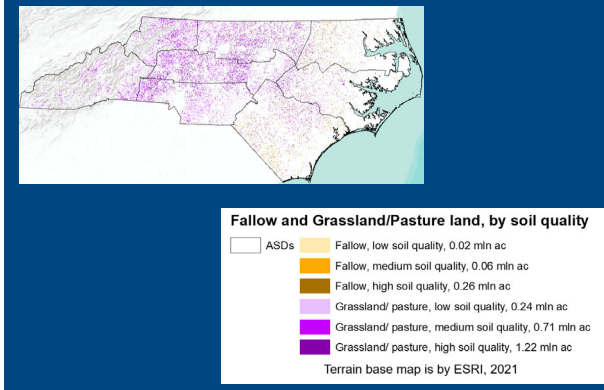


Figure 2 – Fallow and grassland, by soil quality



Conclusions

- Stand-level expected NPV varies from $-276/ac to $730/ac at $40/ton price
- Highest economic potential of growing poplars in NC is in the Piedmont region
- To be cost-effective, poplars require moderately to high fertility sites and high delivered price ($40/ton)

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