Where is the feedstock going on to come from to power a sustainable Kentucky bioeconomy?

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Abstract:

The identification of viable feedstocks and locations that these feedstocks can be produced is one of the first steps in the development of the Kentucky Bioeconomy. Kentucky has long been known for its ability to produce forages for the livestock industry. Furthermore, its subtropical climate makes it an ideal location for a wide variety of potential feedstocks. Some of these potential feedstocks include but are not limited to switchgrass, miscanthus, sweet sorghum, hemp, big blue stem, and corn stover. However, for any of these feedstocks to be adopted and purchase acres from the traditional commodities grown, such as corn, soybeans, wheat, tobacco, etc. they must provide producers with at least the same profit per acre as the current commodities being produced. In recent years, this would have been a very difficult task, but falling commodity prices have made this a more realistic situation.

Potential Feedstocks:

Miscanthus

Switchgrass

Hemp

Sweet Sorghum

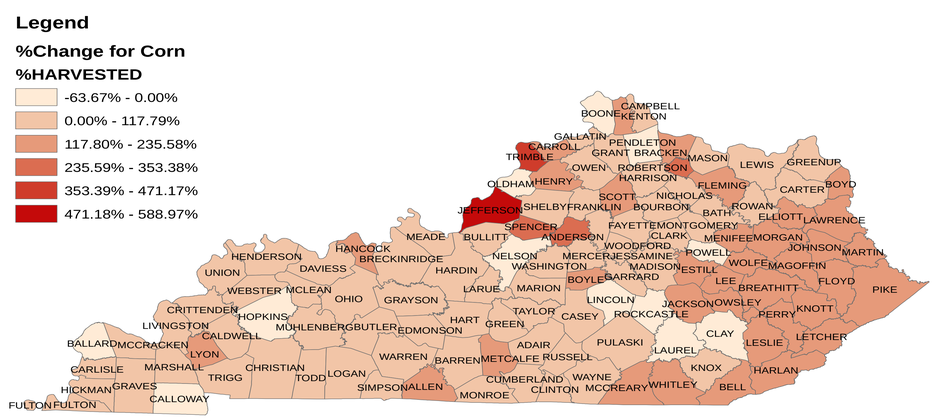
Timber (Wood)

Corn Stover

Background:

- Starting in 2006 traditional commodity prices began to climb as the production of ethanol and other demand factors on these commodities increased. In 2012, commodity prices spiked with a significant drought and reached all time highs. Increasing prices has lead to increased corn and soybean production in non traditional areas of the state, specifically Eastern Kentucky. .
- The graphics in Figure 1 shows the percentage change in corn (top) and soybean (bottom) acres by county from 2010 to 2014.
- Figure 2 shows percentage change in tobacco from 2010 to 2013.
- Now with falling commodity prices there is the potential for different feedstock to enter into production as producers look for alternative crops to produce.
- New crop adoption will occur if the Net Returns for these alternative crops are above the returns they can receive on the traditional commodities produced in these counties.

Figure 1: Percentage Change in Corn (Top) and Soybean (Bottom) in Kentucky from 2010 to 2014



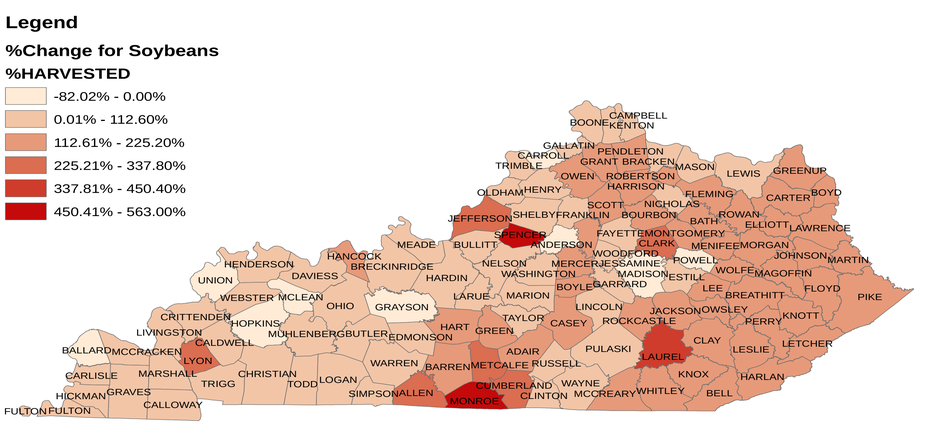
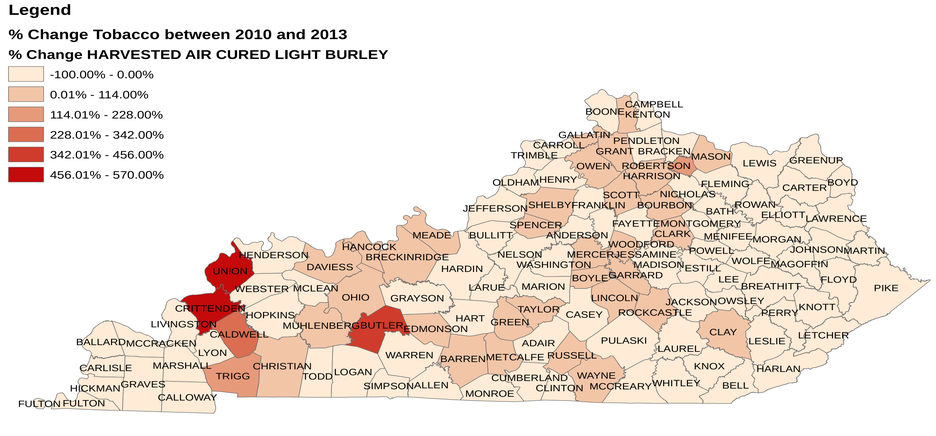


Figure 2: Percentage Change in Tobacco in Kentucky from 2010 to 2013



Objectives:

1. Simulate the expected returns of the various feedstocks being considered and compare those with the expected returns of crops currently being produced in the state.
   - Estimation of feedstock production costs
   - Estimation of land availability and Crop Mix Changes
2. Examine potential bioprocessing methods, products, and what biomanufacturers will pay for the feedstock (Future Work).
   - Estimation of processing costs
     - Driven by other pillars of project
   - Estimation of processing plant locations and transportation costs

Data and Methods:

❑Data collected from the National Agricultural Statistics Service on acreages for the following in Kentucky:

- Total Land, Crop Land, Pasture Land, and Idle Land by county
- Corn, Soybean, Wheat, and Tobacco by county
- Production cost estimates for each commodity are updated from the UK Crop Budgets
- Production costs for each of the potential feedstock are modified for Kentucky

❑Simulation Model with stochastic feedstock and commodity prices

❑Crop Mix Optimization Model:

$$\max Z = \sum_{j=1}^{n} NR_i AC_j$$

subject to

$$\sum_{i=1}^{m} l_i \le usable_j$$

$$a_{ij} \ge \min_{ij}$$

$$a_{ij} \le \max_{ij}$$

$$X_j, l_i, a_{ij}, bio_j \ge 0$$

Where:
NR = Net Returns
AC = Acres
Usable = Total Useable Land
Min = Minimum Acreage
Max = Maximum Acreage
i = County
j = Crop

Discussion and Future Work:

- ❑ The expectation is that states east of I-65 may be some of the first adopters of these potential feedstocks. These are not traditional corn and soybean areas and have higher costs of production
- ❑ Areas with high levels of idle acres will also be first adopters but these area are constrained by land type.
- ❑ Perennial crops will have a high initial investment costs and require prices and contracts that reflect.
- ❑ Annual crops will have lower initial investment costs and give producers the flexibility to move in and out of the market.
- ❑ Develop strategies to help with the development of the Bioeconomy in Kentucky.

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