Analyzing Double Cropped Acreage Variation in Southeastern North Carolina

Kianna Hendricks

Abstract

The objective of this study is to analyze double-cropped acreage variations and their relationship with crop prices and climatic conditions. The data in this study includes land usage, harvested and planted acres, crop prices, and drought data. I found that there is not sufficient evidence to indicate that crop prices and climatic conditions impact the variation in double-cropped acreage.

Introduction

Double-cropping is the practice of harvesting two crops in one year, and it is one of the primary multi-cropping practices. There is a growing demand for cropland expansion. Double cropping is a viable alternative practice with few disadvantages. The goal of this study is to summarize and interpret the variations in cropland usage in Southeastern North Carolina.

Research Objectives

The specific objectives include to:

- Analyze riskiness in soybean and winter wheat production in southeastern North Carolina
- Identify time trends in land area under soybeans, double-cropped soybeans, and winter wheat from 2008 to 2021
- Fit econometric models that define if doubled cropped acreage variation is explained by crop price and climatic conditions

The data used in this study include:

- Land use data in the categories of double-cropped winter wheat/soybeans, winter wheat, soybeans, and doubled-cropped overall from 2008 to 2021 come from USDA-NASS-SARS (2022).
- Acres harvest and acres planted for soybean and winter wheat data from 2008 to 2019 come from USDA-NASS (2022).
- Average price forecast data for February soybean and August winter wheat prices from 2008 to 2021 come from USDA-ERS (2022).
- Drought data from 2008 to 2021 come from NOAA (2022).

Study Area

The study area covers Southeastern North Carolina, which includes two ASD regions, Southern Piedmont (ASD 60) and Southern Coast (ASD 90). There are 24 counties, including 11 counties in ASD 60 and 13 counties in ASD 90.

Figure 1 - ASD 90 soybean frequency

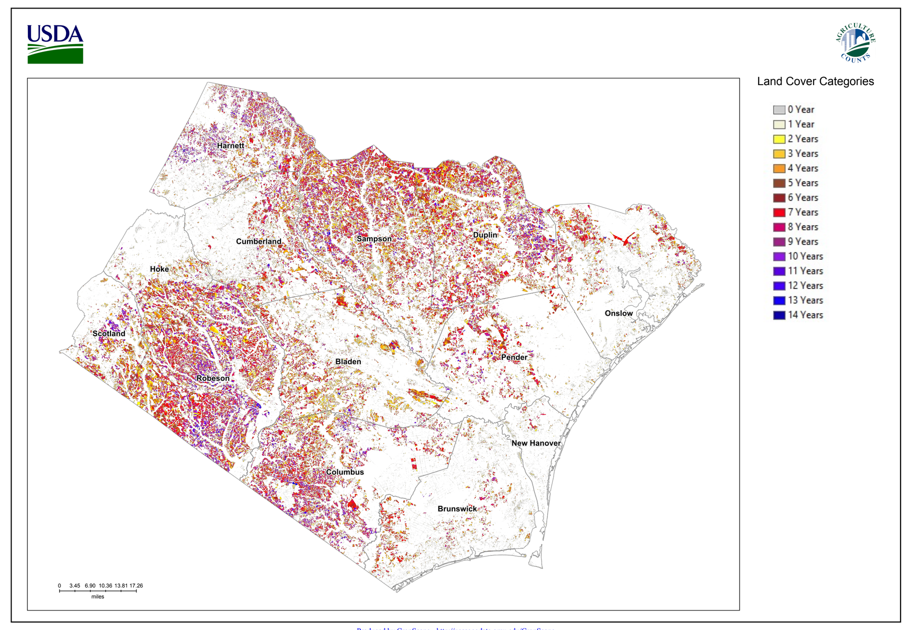
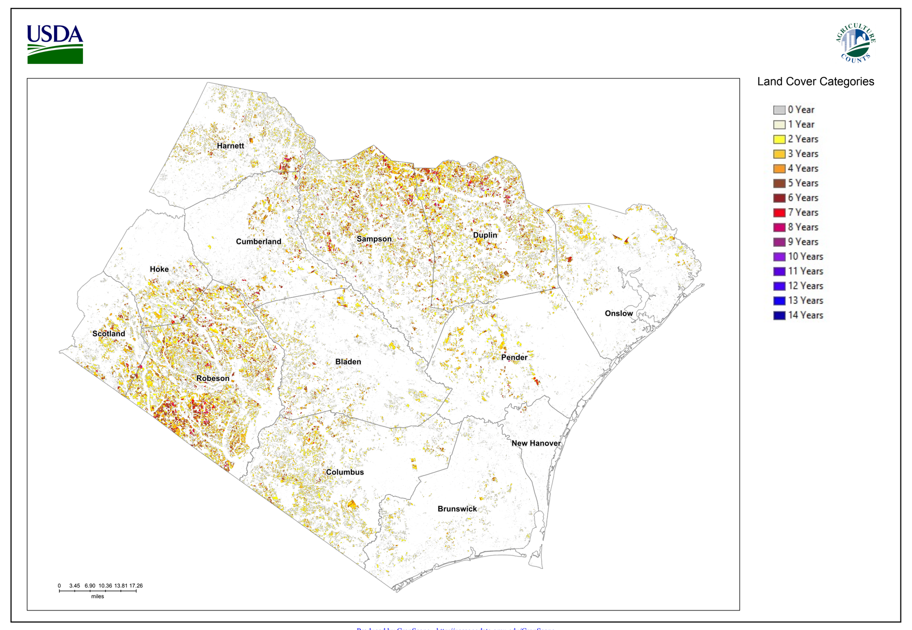


Figure 2 - ASD 90 wheat frequency



Data and Methods

For this study, I estimated six regression models on the data. Four regression models are a simple linear regression, a multiple linear regression, a log-linear regression, and a multiple log-linear regression. Two additional models, a multiple linear regression and a multiple log-linear regression, include a constructed variable of soybean price times the climatic condition.

Table 1 - Use of cropland in Southeastern North Carolina, 2008-2021

Statistic	Double cropped winter wheat soybeans, 10,000 ac	Soybeans, all, 10,000 ac	Winter wheat, all, 10,000 ac	Double cropped, all, 10,000 acres
Minimum	8.5	52.8	9.0	8.8
Median	21.5	70.6	22.3	22.1
Mean	22.3	70.2	23.2	22.9
Maximum	34.2	89.9	36.7	35.3
Standard deviation	7.4	9.0	7.7	7.6

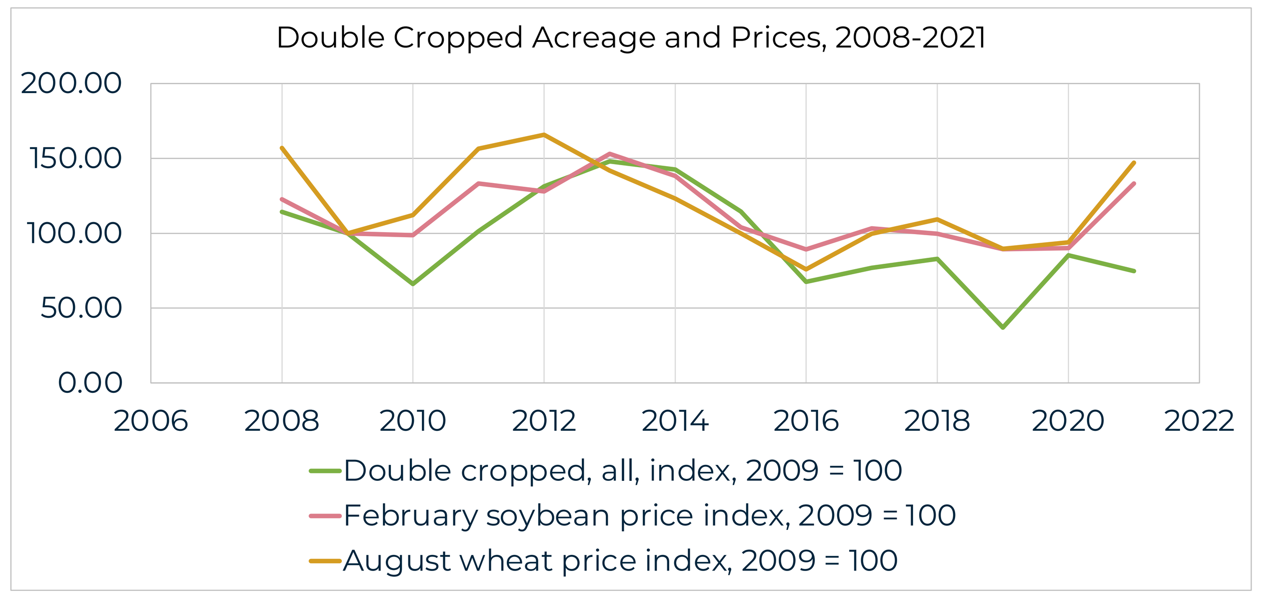
Soybean production is not risky in the region. From 2008 to 2019, the highest percentage of planted not harvested was at most 7%; the percentage is also regularly between 0% and 2%, which only exceeded 2% in 2015 and 2018.

Winter wheat production is risky in the region. From 2008 to 2019, the percentage of planted winter wheat acres not harvested has been 10% or more for 7 of those years and has also increased from 10% in 2018 to 18% in 2019.

Table 2 - Soybeans and winter wheat, planted versus harvest acres, 2008-2019

Year	Acres planted, soybeans	Acres harvested, soybeans	Percent of planted soybean acres not harvested	Acres planted, winter wheat	Acres harvested, winter wheat	Percent of planted winter wheat acres not harvested
2008	533,000	529,000	1%	257,500	228,200	11%
2009	572,500	559,400	2%	214,800	191,100	11%
2010	514,000	504,000	2%	166,600	141,500	15%
2011	448,500	444,100	1%	247,500	233,500	6%
2012	496,500	494,200	0%	310,000	300,500	3%
2013	418,500	406,000	3%	357,000	341,000	4%
2014	564,500	556,000	2%	313,000	299,000	4%
2015	579,000	541,700	6%	248,000	232,000	6%
2016	523,000	514,500	2%	153,000	137,400	10%
2017	529,000	526,500	0%	179,000	161,300	10%
2018	519,000	485,000	7%	189,000	170,700	10%
2019	475,000	468,700	1%	98,000	80,800	18%

Figure 3 – General co-movement in change between double-cropped acreage and crop prices



I find the same general co-movement of prices and double-cropped acreage as in Figure 3 of Borchers et al. (2014). Starting from 2008, I see the lines decreasing around 2008 to 2009, then generally increasing from 2010 to 2012.

Results

$$\hat{A} = -12.5 \times 10^4 + 31.3 \times 10^3 P^{soy} + 1.2 \times 10^5 D - 0.8 \times 10^4\, P^{soy} \cdot D$$
$$(9.7 \times 10^4) \quad (8.7 \times 10^3) \qquad (1.8 \times 10^5) \qquad (1.6 \times 10^4)$$

Number of observations = 14

$R^2 = 0.62$

where,

$\boldsymbol{A}$ is the number of acres under double cropping in southeastern North Carolina,

$\boldsymbol{P^{soy}}$ is the February soybean price in the same year, and

$\boldsymbol{D}$ is a dummy variable for an overly dry year: it is equal to 1 if the spring-summer was overly dry, and zero otherwise.

The results of the test of overall model significance:

$$H_0: \beta_1 = \beta_2 = \beta_3 = 0$$
$$H_A: H_0 \text{ is not true}$$

At a 1% level of significance, I do not have sufficient evidence from the sample to indicate that February soybean price, given the climatic condition and the constructed variable of soybean price times the climatic condition, as a group, explains variance in acres under double cropping.

Discussion and Conclusions

The reported model has the highest R^2out of all estimated regressions. The R^2 indicates how much variance is explained by the dependent variables: soybean price and climatic conditions. My hypothesis is rejected based on the F-test conducted. Therefore, the reported regression does not have a good econometric fit.

According to the reported model, this equation implies overly dry years:

$$\hat{A} = -0.5 \times 10^4 + 23.3 \times 10^3 P^{soy}$$

According to the reported model, this equation implies years that are not overly:

$$\hat{A} = -12.5 \times 10^4 + 31.3 \times 10^3 P^{soy}$$

These equations are consistent with the law of supply as they are both upward sloping, indicating that the number of acres under double cropping increases as the price increases.

One suggestion to improve my future study is to consider other possible explanatory variables, such as crop insurance accessibility.

References

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North Carolina Agricultural and Technical State University

CONTACT:
Kianna Hendricks
North Carolina A&T State University
Department of Economics
kahendricks@aggies.ncat.edu