COTTON PRODUCTION IN THE UNITED STATES: PRODUCTION EXPENSES AND CROP DIVERSITY

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Abstract

In the United States (U.S) cotton (*Gossypium hirsutum*) production expenses, as well as the diversity of crops grown on cotton operations, have changed over time. Census of Agriculture data from 1997, 2002, 2007, and 2012 and cost of production estimates from USDA's Economic Research Service (ERS) were used to explore differences between operations classified as cotton operations (NAICS 11192) and operations that harvest cotton, as well as how production expenses have changed over time. Additionally, county level Census of Agriculture data were used to calculate crop (operation) diversity values by county to investigate how operation diversity based on NAICS classifications changed from 2002 to 2012. Understanding production expenses and the mix of operation classifications can help researchers and educators better recognize the production challenges faced by cotton producers in the U.S.

Introduction

For most producers in the U.S, farm production expenditures have increased over the last ten years (USDA-NASS, 2016). While crop farms have seen steady farm production expenditures over the last three years; livestock farms have seen an increase in farm production expenditures. Over the last ten years, the crop farm paid index has increased or remained steady and crop farm received index has decreased, putting pressure on profitability measures (USDA-NASS, 2016). For cotton operations, the level of and change in farm production expenditures depends on the type of operation producing cotton and type of commodities being produced on the operation along with cotton. There were three main objectives: 1) use Census of Agriculture data to explore the differences in production expenses between operations classified as cotton operations (NAICS 11192) and operations that harvest cotton; 2) use Census of Agriculture data and USDA-ERS cost of production estimates to examine how production expenses have changed over time; and 3) calculate crop diversity values to investigate if crop diversity has changed from 2002 to 2012.

Materials and Methods

Using publically available data from the Census of Agriculture conducted in 1997, 2002, 2007, and 2012 (USDA-NASS, 2016) and a special compilation of Census of Agriculture data for 1997, 2002, and 2007 for Cotton Incorporated (USDA-NASS, 1997; 2002; 2007; 2012), general comparisons were made between total farm production expenses in 1997, 2002, 2007, and 2012. For analysis purposes, cotton operations were defined using two different methods. First, cotton operations were defined using the North American Industry Classification System (NAICS), which is based on the primary business activity of the operation and is used to classify economic activities in North America (hereby referred to as NAICS cotton operations). Operations with cotton production as the primary business activity are classified at the four digit level as *Other Crop Farming (1119)* and at the five-digit level as *Cotton Farming (11192)*. Second, cotton operations were defined as operations that harvest at least one acre of cotton (hereby referred to as harvested cotton farms).

While the original intent was to estimate crop diversity by county for NAICS cotton operations and harvested cotton operations based on crop specific acreage data, these data were not available at the county level without a special tabulation. Therefore, crop diversity at the county level was estimated as operation diversity based on NAICS operations by county. Operations were identified as one of fourteen NAICS classifications: oilseed and grain farming; vegetable and melon farming; fruit and tree nut farming; greenhouse, nursery, and floriculture production; tobacco; cotton; all other crop farming; beef cattle ranching and farming; cattle feedlots; dairy cattle and milk production; swine; poultry and egg production; sheep and goat farming; and other animal production. Following the methodology outlined by Aguilar et al (2015), operation diversity at the county level was calculated using the Shannon diversity index (S) to estimate the effective number of NAICS operations (ENNO). Shannon diversity index is the proportion of operations for each NAICS classification multiplied by the natural log of the proportion summed over all NAICS classifications. The ENNO is the exponential of negative S, and represents the number of NAICS classifications comprising the majority of operations in a given county. For example, if there are 10 different NAICS classifications

in a given county and 10% of operations were in each classification, the ENNO would be equal to ten. The ENNO decreases with an increase in the number of operations in a smaller number of NAICS classifications. A higher ENNO means more operation diversity. The ENNO was calculated for each county across the southern U.S. (Cotton Belt) for 2002 and 2012.

Results and Discussion

Across the U.S., the total farm production expenditures for harvested cotton operations increased from 9.15 billion US$ in 1997 to 14.47 billion US$ in 2012; however, on NAICS cotton operations, total farm production expenditures fell from 4.23 billion US$ in 1997 to 4.0 billion US$ in 2012 (Figure 1). This may be due to the decrease in the number of NAICS cotton operations by over 50% from 1997 to 2012, and a slightly smaller decrease in the acres controlled by these operations by over 46%. Per farm production expenditures increased for both harvested cotton and NAICS cotton operations; however, they increased at a slightly higher rate for harvested cotton operations than for NAICS cotton operations. When evaluated as return on investment (difference between total agricultural product sales and total farm production expenditures divided by total farm production expenditures), the return on investment decreased from 38.3% in 1997 to 22.8% in 2012 for NAICS cotton operations, and decreased from 37.3% to 31.8% for harvested cotton operations over the same time period.

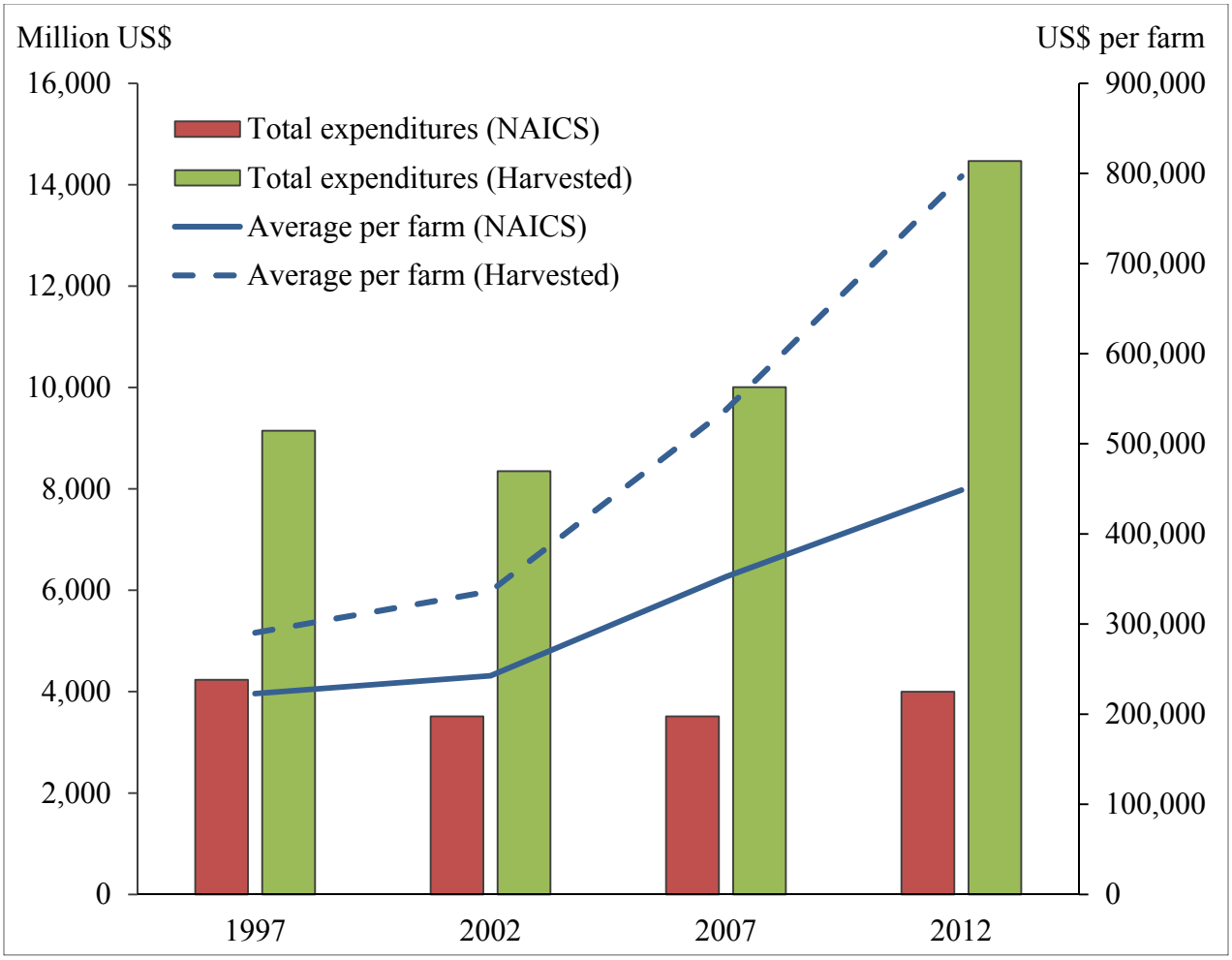

Figure 1. Total farm production expenditures and average per farm expenditures in US$ for NAICS cotton and harvested cotton operations in 1997, 2002, 2007, and 2012 (USDA-NASS, 1997; USDA-NASS, 2002; USDA-NASS, 2007; USDA-NASS, 2012)

Total farm production expenditures varied across states and by year. For NAICS cotton operations, Texas had the highest total farm production expenditures across all four years, while for harvested cotton operations, California had the highest total farm production expenditures in 1997 and 2002, and Texas had the highest in 2007 and 2012. To standardize across states, total expenditures were converted to expenditures per farm. California had the highest total expenditures per farm in all four years across both NAICS cotton and harvested cotton operations; however, they also had the highest total agricultural product sales per farm.

The ratio of total expenditures per farm to total agricultural product sales per farm (excluding government payments) was calculated to account for differences in total agricultural sales between states (Figure 2 and Figure 3). For example, the ratio of total expenditures per farm to total agricultural product sales per farm (hereby referred to as the expense to sales ratio) was 0.830 in Alabama in 1997 for NAICS cotton operations. Alabama NAICS cotton operations spent 0.83 US$ in expenses for every 1 US$ in agricultural product sales. For NAICS cotton operations in the majority of states (Figure 2), the expense to sales ratio was the highest in 2002 and 2007, especially in states bordering and east of the Mississippi River, such as Alabama, North Carolina, and South Carolina. In the western Cotton Belt, the expense to sales ratio was highest in 2012. In at least three out of four survey years, Arkansas, Missouri, Oklahoma, and Texas had expense to sales ratios less than or equal to 0.80. Furthermore, Arkansas, California, Missouri, Oklahoma, and Texas did not have an expense to sales ratio greater than one in any of the survey years.

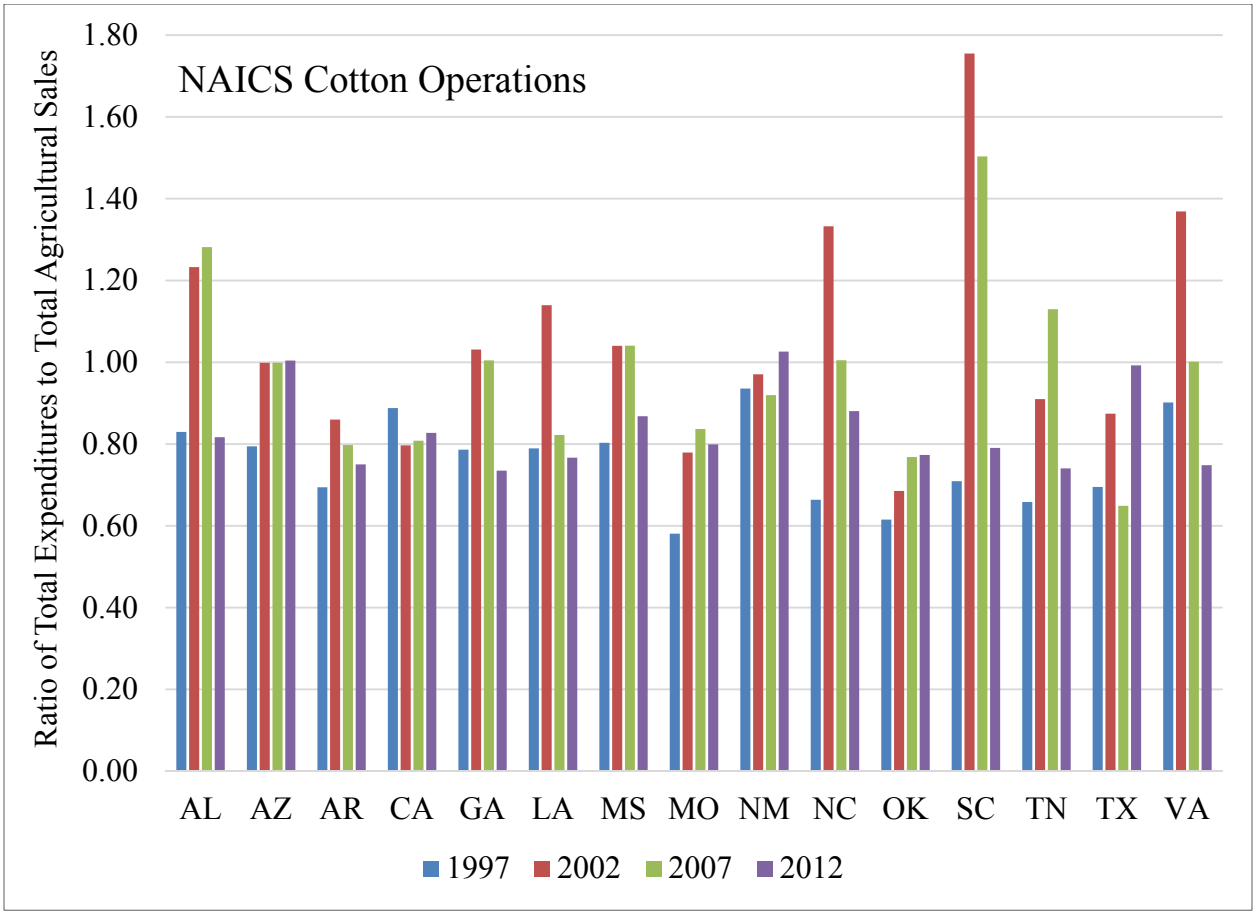

Figure 2. Ratio of total expenditures per farm to total agricultural sales per farm for NAICS cotton farms (USDA-NASS, 1997; USDA-NASS, 2002; USDA-NASS, 2007; USDA-NASS, 2012).

The story is slightly different for harvested cotton operations (Figure 3). All states, except for Alabama, Louisiana, North Carolina, South Carolina, Tennessee, and Virginia, had expense to sales ratios less than one. Once again, expense to sales ratios were the highest in 2002 and 2007 especially in states bordering and east of the Mississippi

River. There was less variability across states for harvested cotton operations than for NAICS cotton operations. For both NAICS cotton and harvested cotton operations, the expense to sales ratio may decrease with the inclusion of government commodity payments and crop insurance benefits.

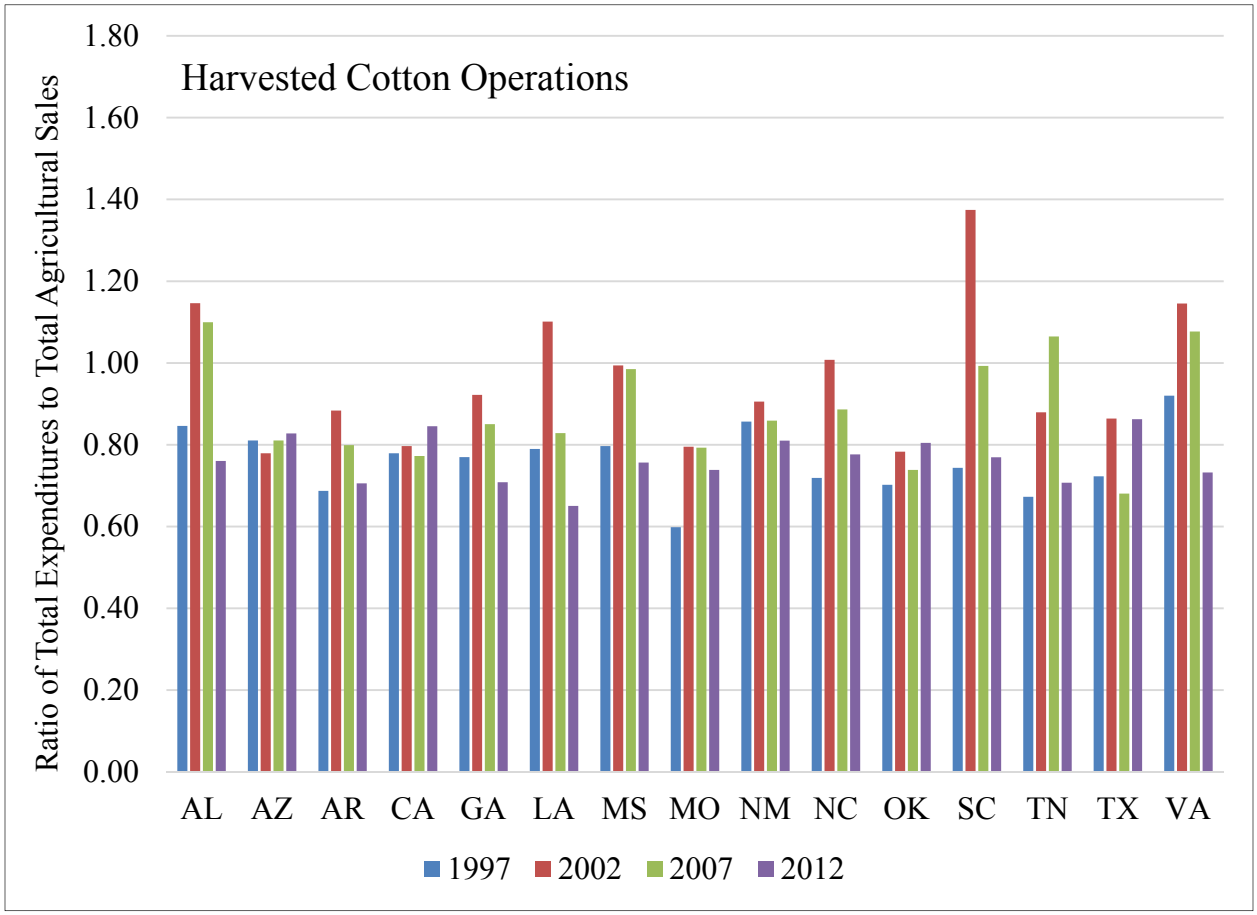

Figure 3. Ratio of total expenditures per farm to total agricultural sales per farm for harvested cotton operations (USDA-NASS, 1997; USDA-NASS, 2002; USDA-NASS, 2007; USDA-NASS, 2012)

In 2014, chemicals, fertilizers, and seeds accounted for 16.6% of input expenditures for agricultural producers in the U.S. For NAICS cotton producers, chemicals, fertilizers, and seeds comprised a larger percentage of total expenditures in 2012 than in 1997, increasing from 35% in 1997 to 44% in 2012. Expenditures on seeds accounted for the largest expenditures in 2012, while spending on chemicals held the top spot in 1997. The trend was similar for harvested cotton operations, with chemicals, fertilizers, and seeds making up a larger portion of total expenditures in 2012 than in 1997. Expenditures on seeds increased from 5.24% to 15.08% of total expenditures from 1997 to 2012.

Similar to the trend seen in the seed expense for corn (*Zea mays*) and soybeans (*Glycine max)* (Widmar, 2015), the seed expense in cotton production has increased since 1997 (Figure 4). Based on USDA-ERS cost of production estimates for cotton, real seed expenses (indexed to 2014) have increased from less than 40 US$ per acre to over 100 US$ per acre, account for between 12 and 14% of total costs (USDA-ERS, 2015). Since 2010 seed expenses have leveled out at between 102 and 105 US$ per acre. While there are differences between regions, all regions producing cotton have followed the same trend related to cotton seed expense.

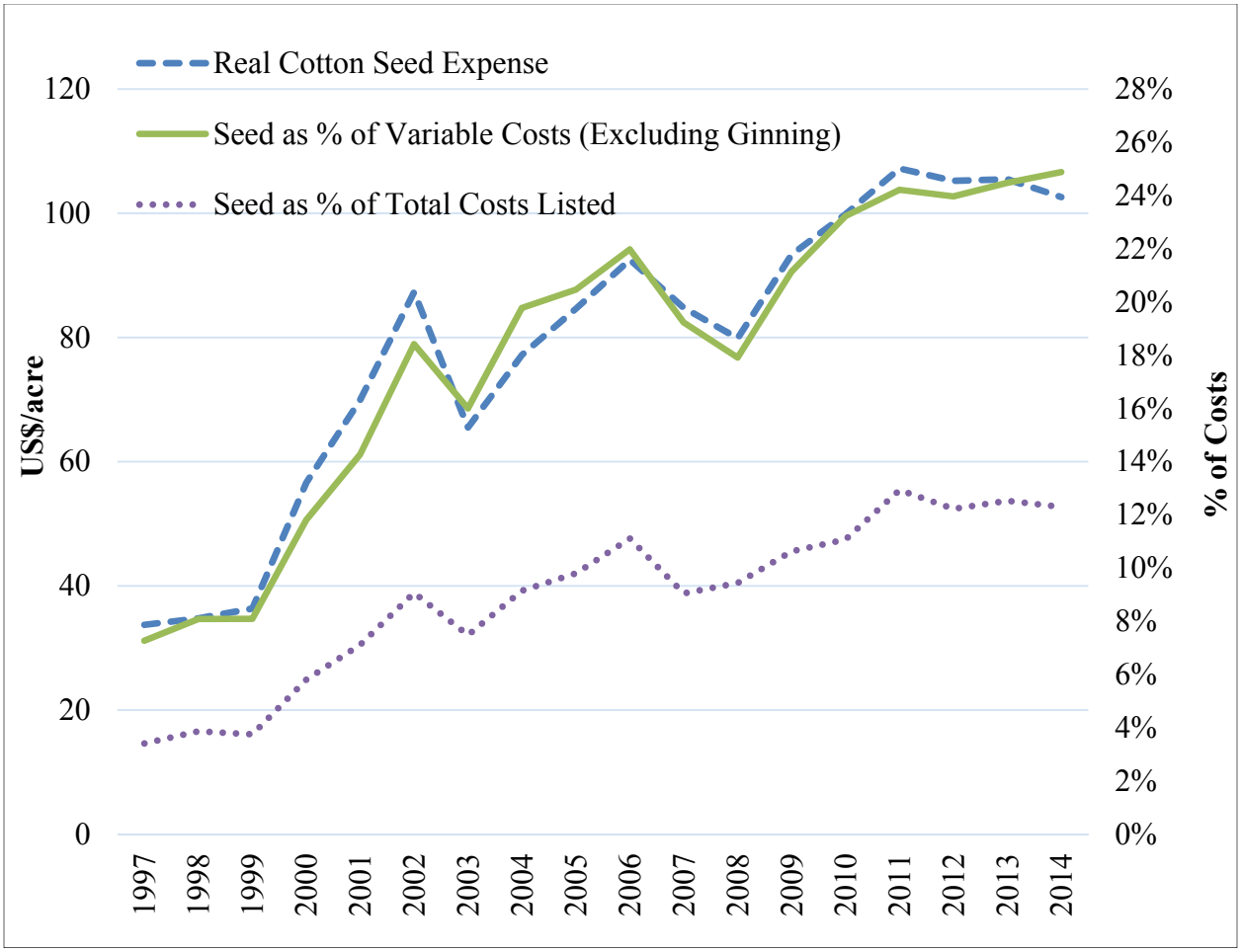

Figure 4. Cotton seed expenses for United States, 1997 – 2014 (USDA-ERS, 2015).

Averaged across the cotton belt, there was very little change in the effective number of NAICS operations (ENNO) from 2002 to 2012; however, the major differences are at the state and county levels (Figures 5 and 6). Alabama saw the greatest increase in operation diversity from 2002 to 2012 followed by Florida and Louisiana. New Mexico, Tennessee, and Kansas experienced the greatest decrease in operation diversity from 2002 to 2012; however, it was less than a 6% decline for all three states. The least amount of change (less than 1%) in operation diversity occurred in Arizona, California, and North Carolina from 2002 to 2012. The counties with the highest levels of operation diversity are in North Carolina and Georgia in 2002 and in North Carolina in 2012. There may be a more visible change in operation diversity if comparisons were made to years prior to 2002; however, that data is not publically available sorted by NAICS classifications. These results do not answer the question of how changes in operation diversity has impacted cotton operations; only that we know NAICS cotton operations have declined and there has been a change in operation diversity. Trying to answer that question is the next step of this research.

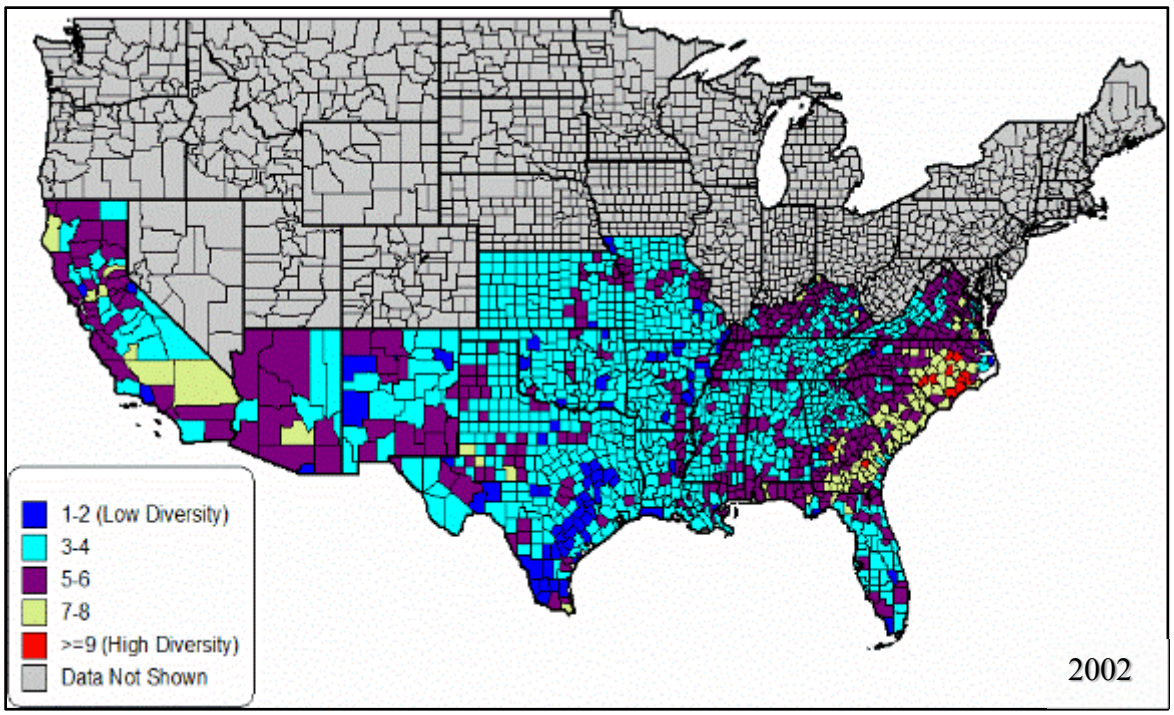

Figure 5. Effective number of NAICS operations (ENNO) by county in 2002 (USDA-NASS, 2002).

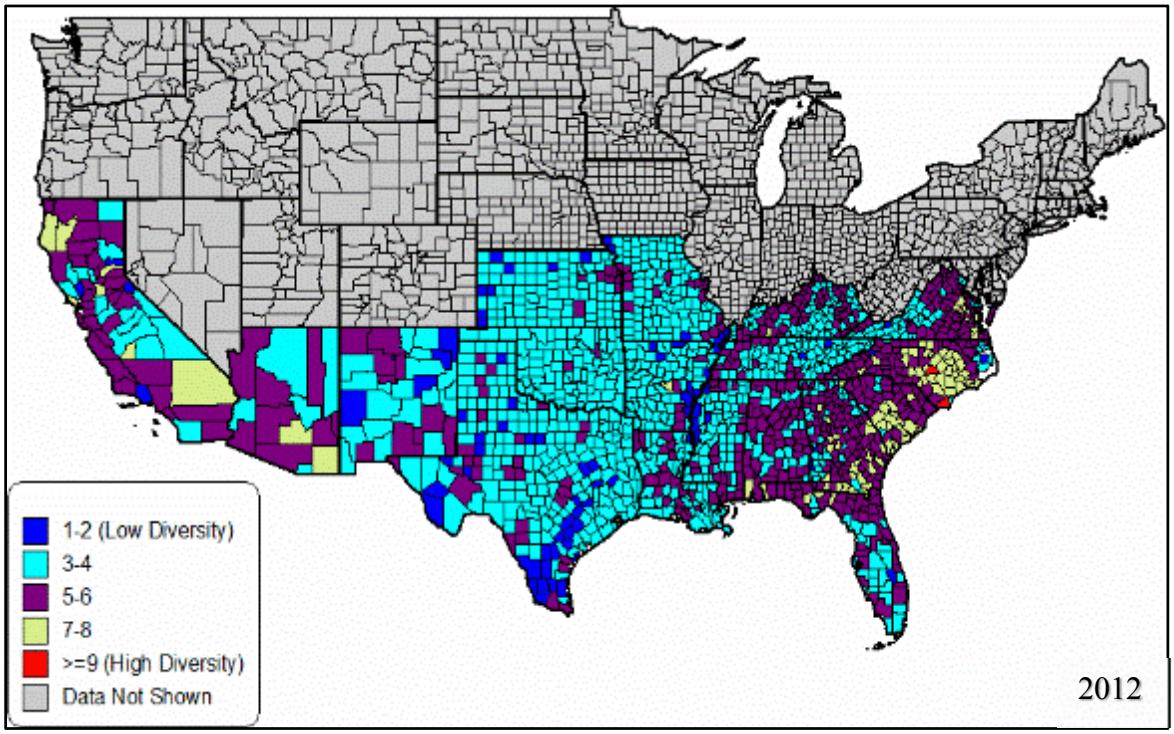

Figure 6. Effective number of NAICS operations (ENNO) by county in 2012 (USDA-NASS, 2012).

Summary

From 1997 to 2012, total farm expenditures increased for both NAICS cotton and harvested cotton operations based on U.S. Census of Agriculture data. Increasing expenditures per farm occurred in conjunction with a decrease in the number of NAICS cotton and harvested cotton operations, a decrease in the number of acres controlled by these operations, and an increase in the average size of NAICS cotton and harvested cotton operations. Farm expenditures increased the most for seeds, which accounted for 16.5% of total farm expenditures in 2012. Cotton seed expenditures have followed a similar trend for corn and soybean expenditures across the U.S. The ENNO has changed at a county level from 2002 to 2012; however, more analysis is required to determine if the change is significant, and how changes in operation and crop diversity has impacted cotton production.

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