



Soybean Production Indicators Report: Trend and Risk Analysis

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Glossary

Average/mean	This is the sum of a collection of numbers divided by the count of numbers in the collection. For past historical data as in this report, this gives an idea of what the producer or decision maker should expect.
Coefficient of variation	This is also known as the relative standard deviation. It is a statistical measure of the dispersion of data points around the mean. While it performs a similar function to the standard deviation, it is advantageous because it can be used to compare dispersion of data between distinct series of data. Furthermore, it is a unitless measure. Generally, a decision maker seeks a lower value because it provides an optimal risk-to-reward ratio with low volatility but high returns.
CYP	Calendar year price (CYP) is the nominal market value of commodity per unit, averaged from January to December. Dollar per bushel (\$/bu) is the unit for price.
CYR	Calendar year revenue (CYR), measured as the product of the nominal calendar year price and production. Dollar (\$) is the unit for revenue.
Decade	A decade is defined as a 10-year interval.
Descriptive statistics	These are brief descriptive coefficients that summarize given data sets. These are classified into the measures of central tendency (mean/average) and measures of variability (minimum, variance/standard deviation and maximum variables).
Ex-ante	These are inferences based on forecasts.
Ex-post	These are inferences based on actual results.
Harvested acreage	Area of planted acreage from which harvesting is done. Acre is the unit for planted acreage.
MYP	Marketing year price (MYP) is the nominal market value of commodity per unit, averaged from September to August. Dollar per bushel (\$/bu) is the unit for price.
MYR	Marketing year revenue (MYR), measured as the product of nominal marketing year price and production. Dollar (\$) is the unit for revenue.
Net farm income	Net farm income refers to the return to farm operators for their labor, management and capital after all production expenses have been paid. This is the gross farm income minus production expenses.
Planted acreage	Area of land used for planting crops. Acre is the unit for planted acreage.
Production efficiency	Production efficiency is concerned with producing goods and services with the optimal combination of inputs to produce maximum output for the minimum cost.
Production	Quantity of commodity produced. This is measured as bushels for both commodities (corn and soybeans).
Productivity	Productivity is the measure of output from a production process per unit of input.
Risk	A risk is the possibility of loss or gain of an event with known probabilities.
Shares	Representative proportion of the total of a variable/indicator.
Standard deviation	This is a quantification of the amount of variation or dispersion of a set of data values. This is most often a complementary information to the mean. Given any mean, there are chances of gain or a loss. Hence, knowing the possible variation can allow the decision maker or producer to plan with bounds.
Trend	A general course or prevailing tendency to take a particular direction or move in some indicated direction. In this report, the trend defines the direction of growth of the respective variable.
Uncertainty	Uncertainty refers to the occurrence of an event for which probabilities cannot be assigned.

Executive Summary

This report presents organized and structured information on soybean production indicators across geographical space and through time. The indicators considered are planted acreage, harvested acreage, production, yield, revenue and price.

The levels of aggregation are global, U.S. and North Dakota. The information is presented in the form of trends and descriptive statistics. The former reveals the direction of the growth, while the latter reveals the magnitude of expectations. The descriptive statistics are represented by the mean, standard deviation and coefficient of variation. To gauge potential competition, the share contribution of the indicators to the total also is computed.

The report is presented in four sections: (I) World countries trend and risk, (II) U.S. states trend and risk, (III) North Dakota counties trend and risk and (IV) Risk or variance decomposition and sources of variation. At the global level, the trends of the indicators are presented in addition to the descriptive statistics of the top 15 producing countries.

The trends and descriptive statistics for the top 15 producing states also are provided at the U.S. level. At the North Dakota level of aggregation, the trends and descriptive statistics for the top 15 producing counties also are provided.

This report is important because it serves as an informational guide to the soybean producers in the U.S. and the world. In the current environment, the success (productivity and net farm income stability) of agricultural production is dependent on accurate prediction of events and help with decisions to overcome them. Hence, having a comprehensive and accurate database will enable producers in decision making with confidence.

To formulate policies based on production indicator variables, you must decompose the sources of variation or risk into the identifiable systematic and random components. The sources of risk are presented in percentages and sum up to 100 for each year.

This is important for the decision maker to develop risk management tools based on the source(s) of risk or variation. Based on the sources of risk, producers can develop plans with respect to planting and marketing decisions to optimize net farm income and productivity. The study reveals that.

Trends and Descriptive Statistics

World

- The harvested soybean acreage has increased.
- Yields, production and revenue also have increased.
- Prices trended downwards in recent years.
- U.S. (34%), Brazil (29.7%), Argentina (16.9%), China (4.37%) and India (3.99%) are the top soybean producers (share of production) for the period between 2010 and 2019.

U.S.

- Planted and harvested soybean acreage increased slightly.
- Yield and production generally increased despite volatilities.
- Price and revenue also increased but had an inverted “v” shape between 2009 and 2015.
- Illinois (14%), Iowa (13.5%), Minnesota (8.85%), Nebraska (7.58%) and Indiana (7.57%) are the top soybean states for the period between 2010 and 2019.
- North Dakota (4.94%) ranked as the ninth producing state in this period, an increase in share (3.23%) and rank (10th) from the previous decade.

North Dakota

- Planted and harvested soybean acreage have increased.
- Yields and production increased with high volatility.
- Cass (10.3%), Stutsman (8.14%), Barnes (7%), Richland (6.86%) and LaMoure (5.78%) are the top counties based on the production share for the period between 2010 and 2019.

Variance or Risk Decomposition

The major sources of variation for any production indicator variable is estimated using U.S. state and county data.

State Variance or Risk Decomposition

- The sources of variation with the use of U.S. state data are identified with spatial (region and state), temporal (through time) and residual (unknown or unexplained) variations.
- Regional variation contributes to about 60% of the variations for planted acreage, harvested acreage, production and revenue.
- State variation contributes to about 38% of the variations for planted acreage, harvested acreage, production and revenue.
- The unexplained variation is volatile and high for prices but stable and below 2% for planted acreage, harvested acreage, yield production and revenue.
- The high volatility and percentage of unexplained sources attributed to prices are due to the markets and differences across states as observed in the graphs.

County Variance or Risk Decomposition

- The sources of variation based on U.S. county data are identified with spatial (region, state, crop reporting district and county), temporal (through time) and residual (unknown or unexplained) sources.
- Regional variation contributes to about 15% of the variations for planted and harvested acreage while it is about 20% for production.
- State variation contributes to about 15% of the variations for planted acreage, harvested acreage and yield while it accounts for about 20% of production.
- Variations due to the crop reporting district accounts for about 20% of the variations for planted acreage and production while it accounts for about 15% of the variations in harvested acreage and yield.
- County variation accounts for about 30% of the variations in planted acreage, harvested acreage and production while it accounts for about 20% in yield.
- The unexplained variations contribute to less than 2% of the variations in planted acreage, harvested acreage, production and yield.

Future Research

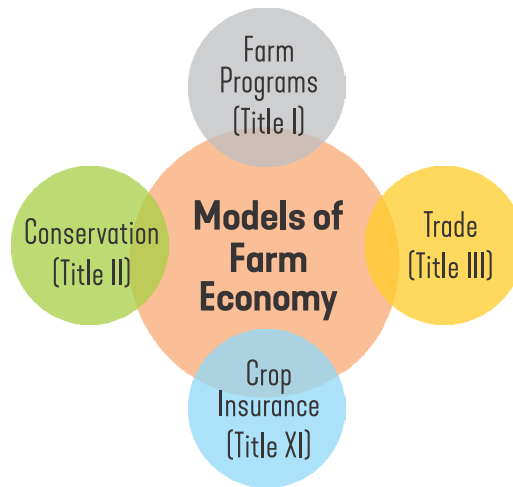
- The finding on the trend of planted acreage highlights the need for an assessment of the determinants of acreage decisions. The objective of future studies will be to evaluate the acreage price elasticities across U.S. and North Dakota counties.
- The second proposed objective is to examine the sources of yield distributions and variability across North Dakota counties.
- Finally, we propose to examine the sources of soybean price volatilities.

About the Center

Center for Agricultural Policy and Trade Studies

The vision of the Center for Agricultural Policy and Trade Studies (CAPTS) is to enhance the sustainability of the net farm income of North Dakota producers through in-depth trade and agricultural policy research. After carefully considering stakeholder inputs, interests, risks and uncertainties, the concept of efficiency, technology assessment and productivity growth¹ also are embedded into the center's research.

To address this vision, the center aims to develop a “*model of farm economy*” to conduct ex-post and ex-ante evaluations for North Dakota. The model will evaluate agricultural and trade policies with its implications on North Dakota producers' net farm income. Additionally, the implications of policy on North Dakota producers' efficiency, technology assessment and productivity growth also will be evaluated.



The model of farm economy based on multiple theoretical frameworks will not only evaluate the implications of existing agricultural and trade policies (Title I, II, III and XI) but also future policies to meet efficiency, productivity and net farm income sustainability goals of North Dakota producers. Our perception of the challenges and the choices made at this juncture in history will determine how to protect farmers in our state and secure our future. The center keeps detailed records of all activities and publishes the information that will be of value to the clientele, including commodity groups and decision makers of the state and region.

Center and Current Project

The center, in collaboration with North Dakota Soybean and Corn councils, is evaluating measures of improving net farm income sustainability for producers in the state. The project is in three dimensions; these are the production indicator report, trade report and policy report.

The phase 1 outcomes of the project include detailed and comprehensive development of databases and the presentation of trends and risks in the production indicator, trade and policy reports. These reports are useful to the producers, commodity groups and decision makers.

Also, this information will form the basis for the development of the “*model of farm economy*” to evaluate the implications of agricultural and trade policies on North Dakota producers' net farm income. Additionally, the implications of technology and policies on North Dakota producers' efficiency and productivity growth will be evaluated.

¹ The efficiency concept allows producers to evaluate input resources (cost) to produce output (revenue). The producers' efficiency will improve through time with adoption of innovative technologies to minimize cost and maximize revenue.

About the North Dakota Soybean Council

The North Dakota Soybean Council (NDSC) was established in 1985 by the North Dakota Legislature. In 1991, the NDSC became a qualified state soybean board (QSSB) under the federal [Soybean Promotion, Research and Consumer Information Act](#), when the United Soybean Board (USB) was established. Today, the NDSC serves more than 10,000 soybean farmers in North Dakota.

The NDSC is charged as the administrator of the North Dakota soybean checkoff. The checkoff is one-half of 1% of the price of each bushel of soybeans contributed at the first point of sale. Fifty percent of the funds collected remains in North Dakota for initiatives in the state. The remaining 50% is sent to the USB for national programs for the betterment of U.S. soybean farmers.

The NDSC consists of a board of 12 soybean producers elected by their peers. Board members are charged with determining how to invest the soybean checkoff into programs that support and expand research, market development, promotion and education to the benefit of the North Dakota soybean producers. In addition to the 12-member board, the office is managed by a team of six professionals to help oversee the investments as directed by the board.

Soybean production in North Dakota has grown tremendously since the mid-1980s, and soybeans are grown on farm operations statewide. Thanks to the investment in research, farmers have access to varieties that do well in our northern climate.

Because of our soy checkoff investments in transportation infrastructure and market development around the globe, North Dakota soybeans are a high-value export crop. The NDSC board strives to foster and grow strong market demand in traditional and new expanding markets, invest in research to meet the changing needs of farmers each year to ensure a quality crop, and work to ensure the tools and resources are available to help farmers remain profitable.

The soybean industry is a key piece of the North Dakota economy, helping support communities, rural and urban, creating job opportunities and sustaining healthy land that has been part of North Dakota's heritage for generations.

The North Dakota Soybean Council is committed to growing a legacy of successful farmers. To learn more about the NDSC, visit www.ndsoybean.org, or follow it on social media.

Production Indicator Report

Rationale for This Report

Global agriculture, particularly farm producers, continue to encounter a wide range of challenges due to the dynamic and ever-changing nature of these risks. The risks, therefore, affect the decisions of producers. These decisions include:

- Production decisions (allocation of acreage and inputs to influence yield, and decisions on planting/ harvest periods in response to weather forecasts and climate change)
- Marketing decisions (decisions on quantum of production based on price forecasts and market competition that determine the revenue obtained)
- Policy decisions (decisions in response to federal programs and farm bills)
- Financial decisions (implementation of required protocols to obtain price support mechanisms, purchase of crop insurance products for financial security and decisions on land conservation to access commodity program payments)

To help producers evaluate risks and make decisions, this report presents annual trends, decadal changes and summary statistics (mean, risk/deviations and coefficient of variation) and intensity of production indicator variables (shares) among countries, states and counties. In most situations, producers can manage these risks based on the year-ahead planning, integrated commodity programs, crop insurance and trade or international markets in consultation with financial institutions.

However, the challenges faced by producers also include random weather conditions and varying domestic demand. In addition, volatile exports not based on economic but geopolitical factors and disputes may lead to producers' loss of net farm income.

Soybean farmers in North Dakota also are faced with a number of challenges. These include fluctuations in global financial markets, impact of global trade policies on demand, growing competition of the international markets and unfavorable weather conditions.

For instance, in 2019, harvesting of corn and soybeans ended abruptly across large portions of the Midwest due to the development of an early blizzard. According to U.S. Department of Agriculture (USDA) forecasts, U.S. corn and soybean production in 2019 was expected to be 5% and 20% lower than their respective productions in 2018.

As part of its commitment to help mitigate the effects of these challenges faced by producers in North Dakota, the CAPTS frequently performs research. This report is the output of a collaboration between the CAPTS and NDSC with the aim of overcoming challenges of soybean production in North Dakota. To evaluate the possible effects of these challenges and propose plausible solutions, we have a need for accurate and up-to-date data at different levels of aggregation.

This report, as the first of a series of research in line with the collaborative objective, presents data on soybean production indicators. This production indicator report presents data on the following variables through time (temporal) and across geographical space (spatial):

- Planted acreage (acres)
- Harvested acreage (acres)
- Production (bushels)
- Yield (bushels/acre)
- Prices (\$/bushel)
- Revenue (\$)

The production indicators are presented for countries across the world, states within the U.S. and counties within North Dakota. The data aggregation process presents these indicators as temporal and spatial risks. These are defined as deviations from the normal.

The deviations are expected to be below (downside) or above (upside) the normal. Of major interest to the producer is the impact of the downside deviation.

Why is this report important?

The primary goal of this report is to serve as an informational guide to the soybean producers in the states as well as a foundation for future data analysis relevant to goals set by the NDSC and CAPTS. This synthesis report captures the complexity and diversity of soybeans across world countries through the U.S. and through North Dakota counties.

It is built upon accurate global, national, state and North Dakota county data that provide evidence for the integrated analysis of the main concerns necessary to achieve efficiency, productivity and net farm income sustainability. This report is an informational guide presented in an organized framework with tables and graphs based on collection and verification of accurate data.

At the global, national, state and county levels, decision makers must be acutely conscious of the fact that we have diverse challenges, multiple theoretical frameworks and a wide range of options to meet productivity and net farm income sustainability goals. Presenting the data at these levels of aggregation will enable soybean producers and decision makers to negotiate in directions of variables that serve to improve their welfare.

Typically, crop production relies on a set of given inputs that yield a target set of outputs. However, a number of exogenous and nonbehavioral factors are likely to influence the outputs.

Some of these factors that tend to influence the outcomes are soil quality, soil moisture, seed quality, planting dates and harvesting durations. The multiplier effects of these exogenous factors raise questions about the ability to predict the crop production indicators such as yield, acreage (planted/harvested) and production.

Data and Methods

The USDA's National Agricultural Statistics Service (NASS) is the source of data on U.S., state and county level soybean production indicators. All the indicators are measured in imperial units.

The global and country level production data were obtained from the Food and Agriculture Organization of the United Nations' database (FAOSTAT). This database contains information for diverse agricultural commodities. For consistency and given that data from this source are measured based on metric units, they were converted to imperial units. The conversion rates used are:

- 1 hectare = 2.47105 acres
- 1 metric ton of soybeans = 36.7437 bushels

The empirical framework for this report includes annual trends, decadal changes and summary statistics (mean, risk/deviations and coefficient of variation) and intensity of production indicator variables (shares) among countries, states and counties.

1. Annual trends: The annual trends of global harvested acreage, production, yield, prices and revenue of soybeans are presented in the report. These indicators also are presented by trends for the top 15 countries ranked by their production. At the U.S. level, the trends of these indicators, including planted acreage, are presented. The trends for top 15 U.S. states ranked by their soybean production are presented for all the production indicators. The trends are presented for acreage, production and yields at the North Dakota level. Finally, the trends for the top 15 counties (also ranked by their production) within North Dakota are presented for the acreage, production and yields. Presenting these trends in the report will provide a framework to gauge the changes through time across countries, states and counties. Knowing these trends can serve as a basis for estimating the volatilities and their sources. This can help forecast future possibilities for desired horizons for advance decision making. This is essential for farmers because success in agricultural production is dependent on proactive rather than passive choices.
2. Decadal changes: This report further presents histograms of the decadal sums of the production indicators at the various levels of aggregation (from global to county level). Having the indicators at decadal levels in the report will provide a framework to evaluate the increase/decrease or shifts across decades.
3. Summary statistics: The summary statistics are provided for the various levels of aggregation for all the production indicators enumerated. This will provide a framework to evaluate the magnitude of the variables using totals, averages, risks, coefficient of variation and intensity of production variables in the form of market share.
4. Statistical analysis: Using hierarchical linear models, the variance decomposition and price elasticities associated with quantity and acreage are presented. The variance decomposition provides information on the sources of

The intensity of production variables in the form of market share helps producers and decision makers gauge potential competition between countries (with respect to the world), between states (with respect to the U.S.) and between counties (with respect to North Dakota). This also would help the decision makers develop regional or national policies, depending on the extent of spread or concentration.

For producers to make decisions, a need exists to not only highlight the changes in the variation of the production indicator through time, but also the sources of the contribution to the overall variation. The sources of variation in production indicator variables stem from spatial (county, district, state and U.S. production regions) and temporal (decadal and annual technology changes) components. This is evaluated using statistical variance decomposition analysis.

In this regard, the responsiveness of production indicator variables to shocks or events such as climate, prices and pandemics is essential in policy formulation. One primary method that has been used to highlight these distinctions is the estimated area and yield elasticities.

Previous studies also have looked at various dimensions of these elasticities. Some include crop yield response to prices and climate, effects of crop insurance premium subsidies on crop acreage, impact of increasing temperature on crop yields and acreage decisions. The provision of accurate data in this project will serve as a foundation for researchers to delve into issues of crop indicator elasticities.

To address the diverse needs and interests of soybean producers in North Dakota, we need a shared approach to sustainability. We cannot escape our predicament by simply dwelling on untested hypothetical views.

To achieve sustainable net farm incomes and equitable collective outcomes for soybean producers in North Dakota, incentives are needed to influence the choices individual producers make. For instance, issues on land conservation require collective agreements on concerted action and governance across scales that go beyond an appeal to individual benefit. Hence, having accurate data on planted and harvested acreage will serve as valuable information upon which the foundations of such decisions could be laid.

Finally, prices form the bedrock of net farm incomes. Meanwhile price fluctuations on commodity markets are affected by varied sources of events. Some of these events such as COVID-19 are rare, with massive implications, while others such as exchange rate pegging are frequent, with substantial negative implications.

Hence, having this report with the price distributions of soybeans across space and time will serve as a foundation for assessment of the magnitude of volatilities and an evaluation of the sources of these volatilities. Knowing these will help soybean producers in North Dakota evaluate their options and plan based on expected prices ex-ante (when predicted) and ex-post (after occurrence) adverse events.

variation. This will provide a framework to evaluate the magnitude and contribution of individual sources to the overall variation of the variable of interest. The price elasticity with respect to the quantity (yield or production) and acreage will help predict agricultural supply.

The methodology used in this project is the computation of the basic statistics (average, deviations, minimum, maximum and the sums). This information was computed and presented for five-year periods and decades. The average statistic represents a single value that summarizes or represents the general significance of a set of unequal values.

The standard deviation is a measure of the dispersion of a frequency distribution. The sums for these periods present a general idea of what quantum of production to expect within a given period. It helps decision makers forecast demand and supply, which leads to shift in acreage and price expectations.

Key Findings

World Countries Trend and Risk

World trends of harvested soybean acreage have been increasing from 1960 to 2019 (Figure 1). The decadal statistics of global harvested acreage reveal the highest to be 2.55 billion acres for the period between 2010 and 2019.

The lowest coefficient of variation for the global harvested acreage is 5 for the period between 1980 and 1989. This implies that this is the period with the lowest risk-return tradeoff at the global level. This is followed by 2010-2019 and 1960-1969, with a simultaneous value of 7.8.

The yields and production quantity in bushels also have increased during the period (Figure 1). The global production is highest for the period between 2010 and 2019, 99.67 billion bushels.

The period with the lowest coefficient of variation for global production is 1980-1989, with 9.3. The highest average of global yield was observed to be 38.93 for 2010 to 2019. The lowest coefficient of variation was observed between 2000 and 2009.

The global revenue had an upward growth during the period but has seen a decline in the trend since 2014. The highest revenue (U.S. \$798 billion) was observed in the 2010-2019 decade. This decade also was characterized with the lowest coefficient of variation, 8.3.

Global prices of soybeans revealed slight volatility in trends and had a downward trend since 2012 (Figure 1). The highest average price of U.S. \$10.97/bu was observed between 2010 and 2019. The lowest coefficient of variation for global price was 14.1 for 1990 to 1999.

The top 15 producers (share of global production) of soybeans based on the period between 2010 and 2019 were:

1. U.S. (34%)
2. Brazil (29.7%)
3. Argentina (16.9%)
4. China (4.37%)
5. India (3.99%)
6. Paraguay (2.90%)

7. Canada (1.97%)
8. Ukraine (1.09%)
9. Bolivia (0.88%)
10. Russia (0.81%)
11. Uruguay (0.71%)
12. South Africa (0.31%)
13. Indonesia (0.28%)
14. Italy (0.27%)
15. Nigeria (0.20%)

The trends of all the indicators for the top five countries are presented from Figure 2 to Figure 6. The details for other indicators at the global level can be found in the **appendix**.

U.S. States Trend and Risk

At the U.S. level, planted and harvested soybean acreage has seen slight upward trends during the period (Figure 7). The decade with the highest planted and harvested acreage was 2010 to 2019, with 811.3 million and 801.9 million acres, respectively. The lowest coefficient of variation for planted and harvested acreage was 4.7 and 4.5, respectively, for 2000 to 2009.

Soybean yield and production in bushels show a general upward trend during the period, despite observed volatilities (Figure 7). The period with the highest production was 2010 to 2019, with 37.37 billion bushels produced.

Meanwhile, the period with the lowest risk-return tradeoff was 2000 to 2009, with 9.3. The period with the highest yield was 2010 to 2019, with 46.42 bu/acre. The period with the lowest coefficient of variation for yield was 1960 to 1969, with 5.6.

U.S. soybean revenue also has seen increases during the period, with a downward trend in recent years (Figure 8). Based on the calendar year revenue, the period with the least coefficient of variation is 1980 to 1989, with 11.6.

Soybean prices for the U.S. have been unstable during the period, with downward trends in recent years (Figure 8). The period with the least coefficient of variation for the calendar year price was 1960 to 1969, with 9.6.

The top 15 states in terms of production for 2010 to 2019 were:

1. Illinois (14%)
2. Iowa (13.5%)
3. Minnesota (8.86%)
4. Nebraska (7.58%)
5. Indiana (7.57%)
6. Ohio (6.31%)
7. Missouri (6.03%)
8. South Dakota (5.34%)
9. North Dakota (4.94%)
10. Kansas (4.08%)
11. Arkansas (3.86%)
12. Mississippi (2.56%)
13. Michigan (2.44%)
14. Wisconsin (2.29%)
15. Kentucky (2.10%)

The trends of the indicators for the top five states are presented in Figure 9 to Figure 16. The details for other indicators at the global level can be found in the **appendix**.

North Dakota Counties Trend and Risk

An increasing trend is observed for the planted and harvested soybean acreage in North Dakota (Figure 17). The least coefficient of variation for planted and harvested acreage was 19.8 for the period between 2010 and 2019.

Soybean yield and production show increasing trends (Figure 17). The yields show a high level of volatility. The period with the highest yield was from 2010 to 2019, with 33.75 bu/acre, while this period was also the highest for production, with 1.85 billion bushels.

The coefficient of variation for the state's production was least for 2000 to 2009, with 21.5, while it was the least for yield in the period of 2010 to 2019, with 10. The trends for these indicators for the top 15 counties are presented from Figure 19 to Figure 22.

The top 15 counties based on the production from 2010 to 2019 were:

1. Cass (10.3%)
2. Stutsman (8.14%)
3. Barnes (7%)
4. Richland (6.86%)
5. LaMoure (5.78%)
6. Traill (4.15%)
7. Dickey (3.83%)
8. Wells (3.82%)
9. Sargent (3.81%)
10. Grand Forks (3.73%)
11. Steele (3.28%)
12. Ransom (2.79%)
13. Pembina (2.72%)
14. Benson (2.67%)
15. Griggs (2.35%)

Variance Decomposition and Sources of Variation or Risk

Apart from understanding the trend and risk of production indicator variables, identifying the sources of the variation or risk is important as well. To formulate policies based on risk or variation of production indicator variables, we must decompose the sources of variation into the identifiable systematic (known or explained) and random (unknown or unexplained) components.

The systematic component is explained by spatial (region, state, crop reporting district and county) and temporal (annual and decadal) variations. The unexplained variation commonly is referred to as residuals or errors. This is important for the decision maker to identify the source(s) of variation to develop risk management tools.

Some of the measures include the use of traditional farm management solutions. Others include insuring through markets or obtaining government support. Based on the sources of variation, producers also can develop plans with respect to planting decisions (acreage) and marketing decisions (production, yield, prices and revenue) to optimize net farm income.

The major sources of variation for any production indicator variable is estimated using the U.S. state data and U.S. county data. The sources of variation with the use of U.S. state data are identified with spatial (region and state), temporal (through time) and residual (unknown or unexplained) variations.

With U.S. county data, the sources of variation are identified with spatial (region, state, crop reporting district and county) and temporal (through time) and residual (unknown or unexplained) variations. The sources of variation are presented as percentages if the sources of variation are statistically significant.

This also will help in identifying additional sources of variation that have not been considered in the analysis. This could include additional risk factors such as climate and soil characteristics, and uncertainty factors such as COVID-19.

State Variance Decomposition

The state level variance decomposition for the six production indicators are presented in this section. The yearly variance decomposition in percentages for planted acreage, harvested acreage, production, yield, revenue and prices are presented from Figure 23 to Figure 28.

The percentage of variation of planted acreage attributed to the unexplained components averages less than 2% during the period (Figure 23). Similarly, the amount of unexplained variation for harvested acreage, production, yield and revenue during the period is less than 2% (Figure 24 to 27).

Prices had the highest percentage of unexplained sources of variation. During the period, the unexplained variation for prices was above 60%, with only a few years falling below this percentage (Figure 28).

County Variance Decomposition

The variance decompositions for the various indicators at the county level are presented in this section. For county level planted acreage, the decomposition of the variance shows that the region accounted for between 0% and 20% of the variation during the period (Figure 29).

The variation attributed to the county ranged from 30% to 90%, while the percentage contribution in variation attributed to the state was between 0% and 20% during the period. The unexplained variation during the period was less than 2%.

For harvested acreage, the unexplained sources of variation accounted for less than 2% during the period (Figure 30). This implies that about 98% of the variation in harvested acreage can be explained by the region, state, crop reporting district and county during the period.

The county level production follows a similar pattern, with the unexplained sources of variation being less than 2% (Figure 31). For county level yield, less than 2% of the variation is unexplained while the other components accounted for about 98% of the variations during the period (Figure 32).

Future Research Proposal

- The finding on the trend of planted acreage highlights the need for an assessment of the determinants of acreage decisions. The objective of future studies will be to evaluate the acreage price elasticities across U.S. and North Dakota counties.
- The second proposed objective is to examine the sources of yield distributions and variability across North Dakota counties.
- The third objective will examine the sources of soybean price volatilities.



Section I

World Countries Trend and Risk

Figure 1: Global Production Indicators, Annual Trends

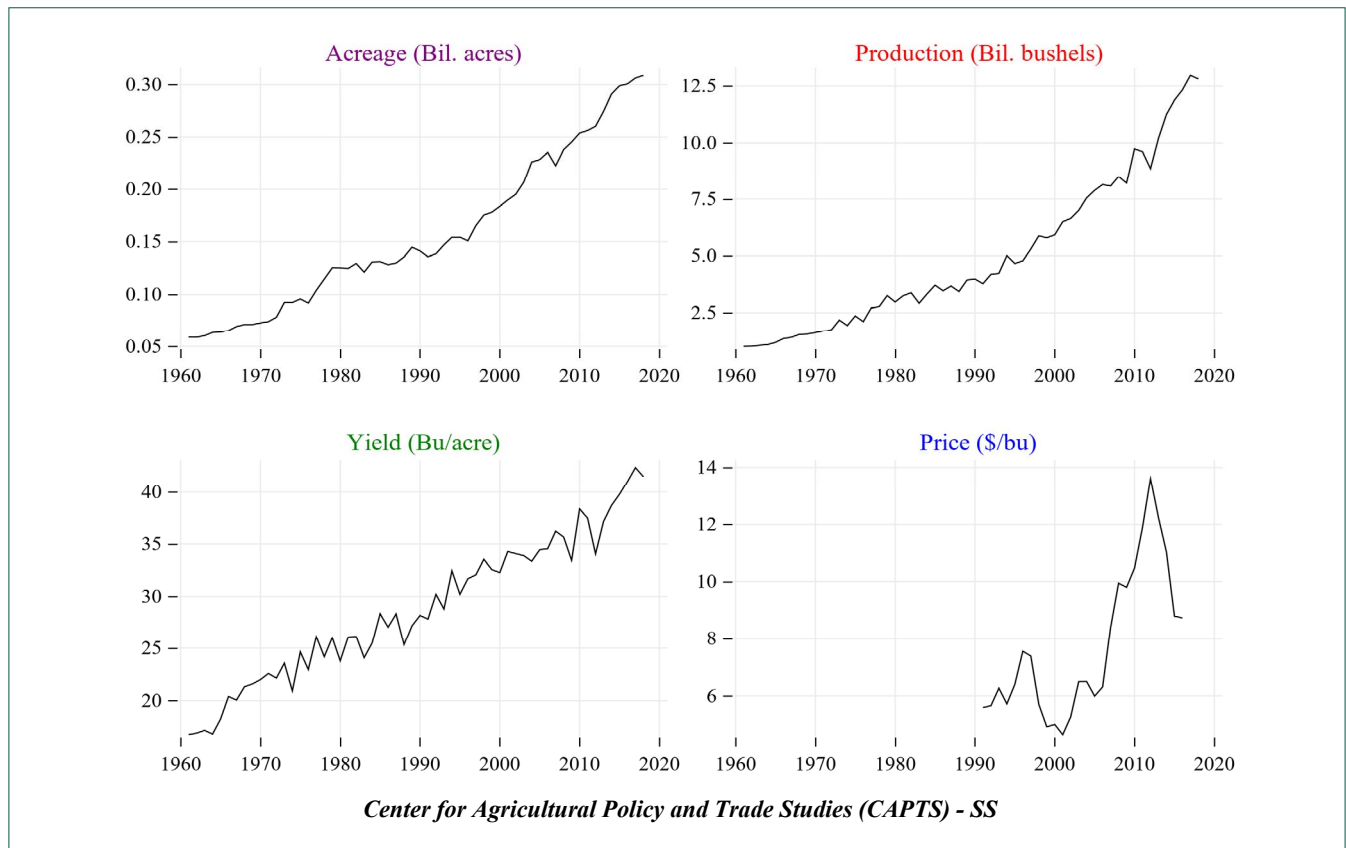


Table 1: Global Production Indicators, Annual Trends

Year	Harvested (Acres)	Production (Bushels)	Yield (Bu/acre)	Price (\$/bu)
2000	183,618,230	5,927,066,832	32.3	5.01
2001	189,685,241	6,504,397,075	34.3	4.66
2002	195,041,214	6,648,799,448	34.1	5.28
2003	206,582,120	7,002,376,541	33.9	6.49
2004	226,420,181	7,552,598,971	33.4	6.50
2005	228,753,246	7,883,094,847	34.5	5.99
2006	235,576,474	8,140,894,562	34.6	6.31
2007	222,860,100	8,076,010,810	36.2	8.40
2008	238,159,421	8,496,006,366	35.7	9.95
2009	245,410,712	8,207,837,174	33.4	9.80
2010	253,944,607	9,740,329,709	38.4	10.5
2011	256,391,152	9,612,212,657	37.5	11.9
2012	260,369,144	8,867,622,337	34.1	13.6
2013	274,554,899	10,202,719,007	37.2	12.2
2014	290,953,834	11,256,378,482	38.7	11.0
2015	298,751,297	11,879,484,466	39.8	8.80
2016	300,578,673	12,331,692,820	41.0	8.74
2017	306,148,145	12,971,510,684	42.4	.
2018	308,688,399	12,812,980,542	41.5	.

Figure 2: Top 5 Countries Harvested Acreage, Annual Trends

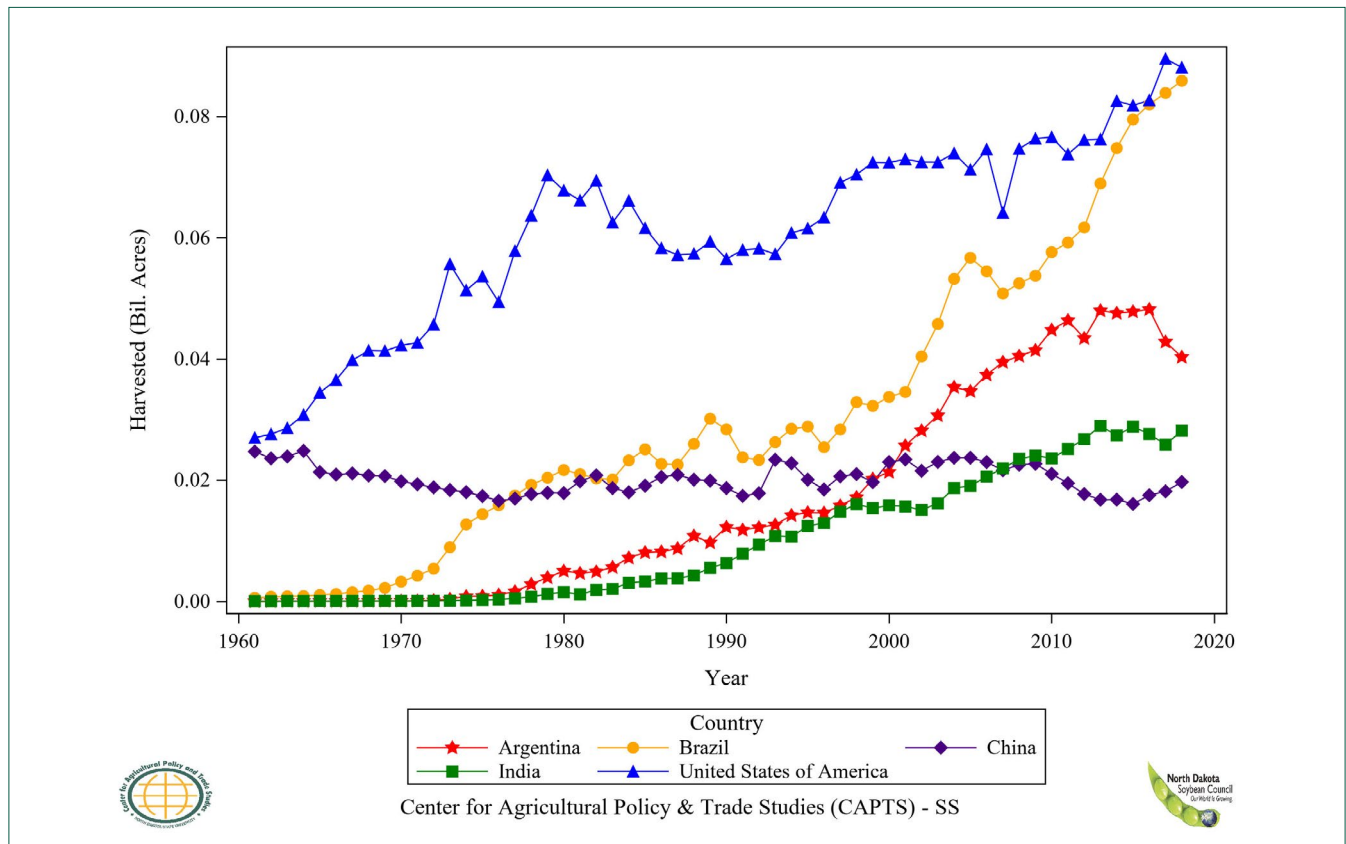


Table 2: Top 15 Countries Harvested Acreage, Annual Trends

Country	Harvested (Acres)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	
U.S.	76,610,704	73,776,682	76,144,714	76,253,712	82,591,757	81,849,751	82,706,760	89,542,821	88,110,823	
Brazil	57,642,915	59,227,765	61,715,111	68,958,789	74,807,982	79,521,461	81,997,146	83,916,559	85,922,585	
Argentina	44,802,113	46,368,883	43,434,437	47,984,885	47,574,019	47,820,044	48,196,960	42,835,904	40,322,742	
China	21,043,128	19,493,113	17,720,245	16,780,824	16,804,544	16,080,971	17,531,707	18,169,342	19,703,849	
India	23,608,881	25,155,289	26,786,182	28,951,884	27,394,060	28,837,154	27,626,339	25,871,894	28,169,970	
Paraguay	6,600,320	6,932,449	7,215,466	7,610,834	8,648,675	8,747,517	8,327,439	8,352,149	8,673,386	
Canada	3,721,154	3,840,506	4,188,183	4,608,755	5,576,419	5,516,619	5,514,889	7,252,038	6,275,479	
Ukraine	2,561,738	2,743,607	3,490,111	3,338,463	4,430,346	5,277,174	4,594,670	4,897,374	4,271,704	
Bolivia (Plurinational State of)	2,685,461	2,909,763	3,194,638	3,021,736	3,169,010	3,269,179	3,301,427	3,122,671	3,367,856	
Russian Federation	2,560,658	2,934,056	3,398,106	2,965,445	4,734,272	5,150,706	5,238,661	6,358,718	6,772,777	
Uruguay	2,097,427	2,130,292	2,183,667	2,594,603	3,265,245	3,296,381	2,816,997	2,732,981	2,715,684	
South Africa	769,609	1,032,899	1,166,336	1,276,297	1,242,691	1,698,353	1,242,444	1,418,259	1,945,211	
Indonesia	1,632,927	1,537,621	1,402,627	1,361,037	1,521,388	1,516,941	1,425,764	879,197	1,788,556	
Italy	394,132	410,083	378,053	455,034	575,426	763,503	711,811	796,709	807,013	
Nigeria	696,564	1,481,024	1,651,403	1,680,314	1,564,214	1,505,692	1,588,240	1,853,288	1,929,097	

Figure 3: Top 5 Countries Production, Annual Trends

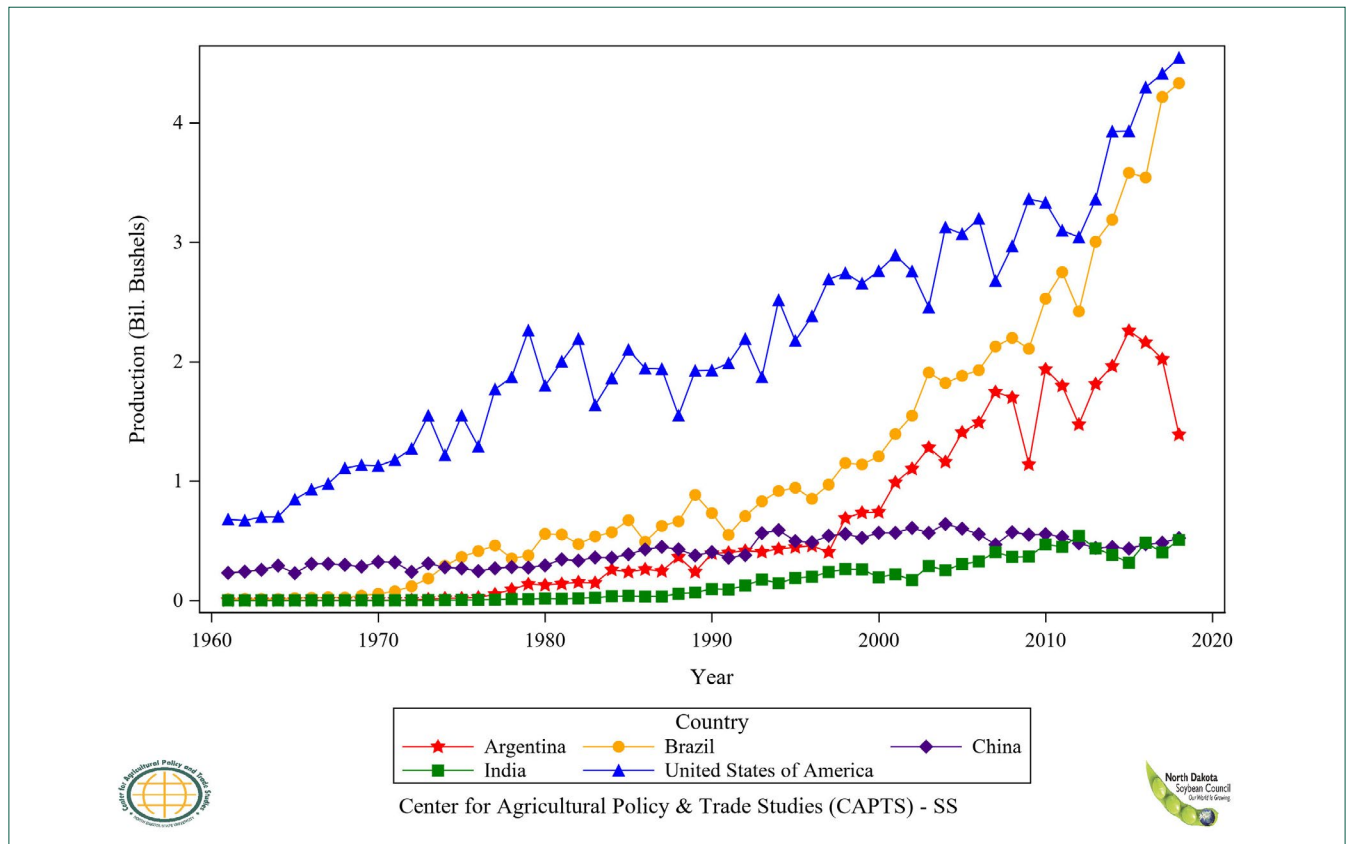


Table 3: Top 15 Countries Production, Annual Trends

Country	Production (Bushels)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	
U.S.	3,331,304,729	3,097,177,914	3,042,042,890	3,357,982,860	3,927,088,392	3,929,883,485	4,296,495,957	4,411,631,238	4,543,881,368	
Brazil	2,526,362,440	2,748,996,340	2,419,530,647	3,002,859,666	3,187,902,519	3,581,222,369	3,541,902,348	4,215,681,900	4,331,629,254	
Argentina	1,935,491,447	1,796,345,700	1,473,429,572	1,811,692,221	1,962,029,621	2,257,773,820	2,160,502,296	2,019,860,934	1,388,468,253	
China	554,223,746	532,247,376	478,074,449	439,156,256	446,626,030	433,124,631	470,023,757	482,578,308	521,526,152	
India	467,967,763	448,787,552	538,883,104	435,817,026	381,179,144	314,893,509	483,510,348	401,718,872	506,548,648	
Paraguay	274,123,986	305,332,541	159,649,907	333,853,258	366,518,408	325,413,304	336,683,625	385,000,489	405,869,845	
Canada	163,311,049	164,115,736	186,893,156	196,795,583	222,108,318	237,228,350	242,379,817	283,536,435	267,001,770	
Ukraine	61,736,765	83,202,434	88,559,666	101,938,047	142,636,471	144,424,787	157,152,437	143,277,281	163,905,195	
Bolivia (Plurinational State of)	62,208,848	68,381,422	97,808,422	103,864,372	103,408,567	114,123,654	117,726,521	98,144,113	108,104,779	
Russian Federation	44,914,433	60,295,162	61,844,167	55,745,778	86,846,013	99,508,186	115,474,169	133,075,099	147,961,368	
Uruguay	65,881,454	56,622,042	77,610,043	101,596,331	116,212,974	114,236,163	81,130,090	48,354,709	49,016,096	
South Africa	20,796,934	26,088,027	23,883,405	28,825,433	34,833,028	39,315,759	27,263,825	48,354,709	56,585,298	
Indonesia	33,327,675	31,279,397	30,980,561	28,659,792	35,090,123	35,390,907	31,586,832	19,794,897	35,037,727	
Italy	20,300,894	20,746,889	15,510,618	22,941,297	34,287,016	41,042,052	39,732,433	37,470,527	41,850,817	
Nigeria	13,414,390	18,109,206	23,883,405	19,031,767	22,921,271	21,624,513	22,583,854	26,822,901	27,852,937	

Figure 4: Top 5 Countries Yield, Annual Trends

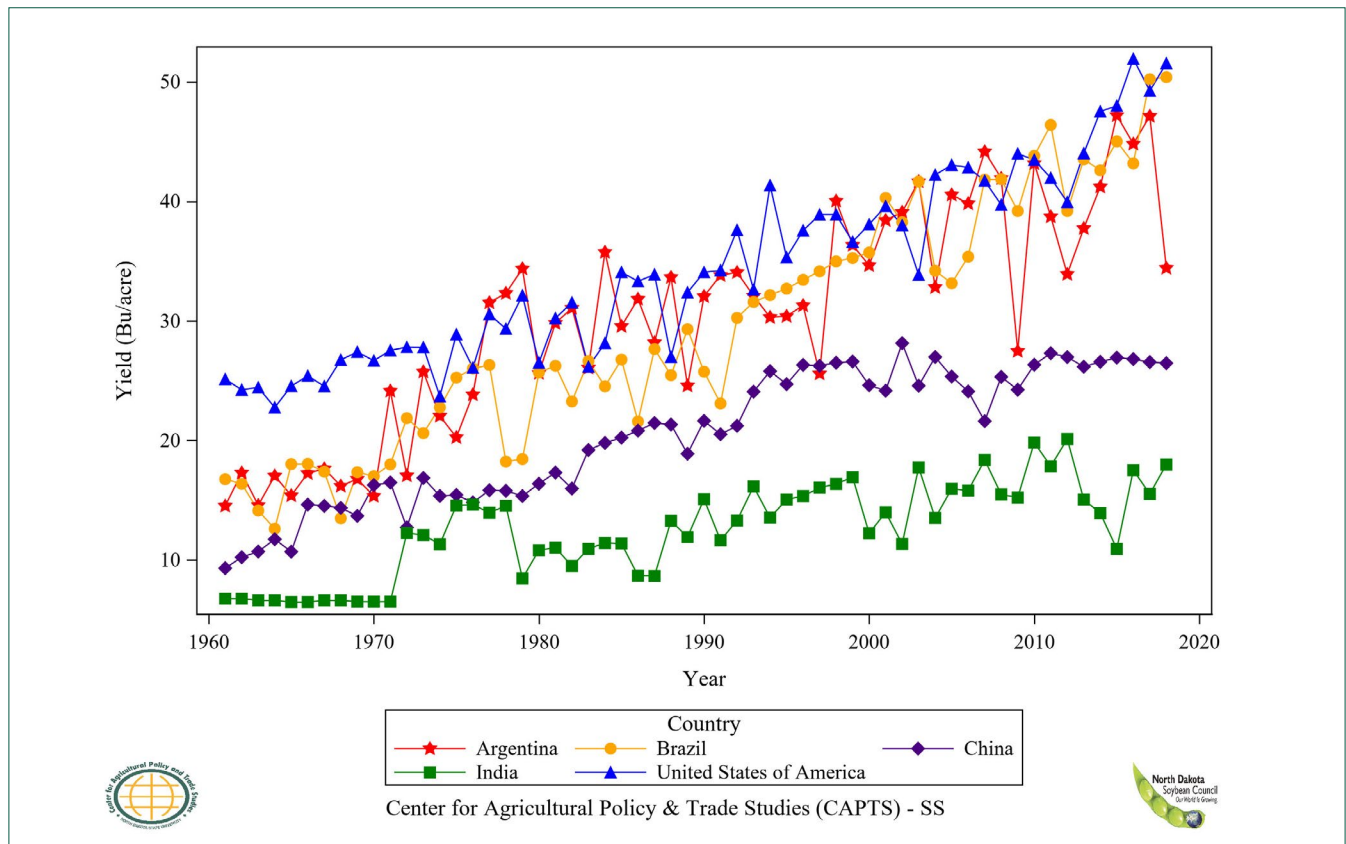


Table 4: Top 15 Countries Yield, Annual Trends

Country	Yield (Bu/acre)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	
U.S.	43.48	41.98	39.95	44.04	47.55	48.01	51.95	49.27	51.57	
Brazil	43.83	46.41	39.20	43.55	42.61	45.03	43.20	50.24	50.41	
Argentina	43.20	38.74	33.92	37.76	41.24	47.21	44.83	47.15	34.43	
China	26.34	27.30	26.98	26.17	26.58	26.93	26.81	26.56	26.47	
India	19.82	17.84	20.12	15.05	13.91	10.92	17.50	15.53	17.98	
Paraguay	41.53	44.04	22.13	43.87	42.38	37.20	40.43	46.10	46.79	
Canada	43.89	42.73	44.62	42.70	39.83	43.00	43.95	39.10	42.55	
Ukraine	24.10	30.33	25.37	30.53	32.20	27.37	34.20	29.26	38.37	
Bolivia (Plurinational State of)	23.17	23.50	30.62	34.37	32.63	34.91	35.66	31.43	32.10	
Russian Federation	17.54	20.55	18.20	18.80	18.34	19.32	22.04	20.93	21.85	
Uruguay	31.41	26.58	35.54	39.16	35.59	34.66	28.80	17.69	18.05	
South Africa	27.02	25.26	20.48	22.59	28.03	23.15	21.94	34.09	29.09	
Indonesia	20.41	20.34	22.09	21.06	23.06	23.33	22.15	22.51	19.59	
Italy	51.51	50.59	41.03	50.42	59.59	53.75	55.82	47.03	51.86	
Nigeria	19.26	12.23	14.46	11.33	14.65	14.36	14.22	14.47	14.44	

Figure 5: Top 5 Countries Revenue, Annual Trends

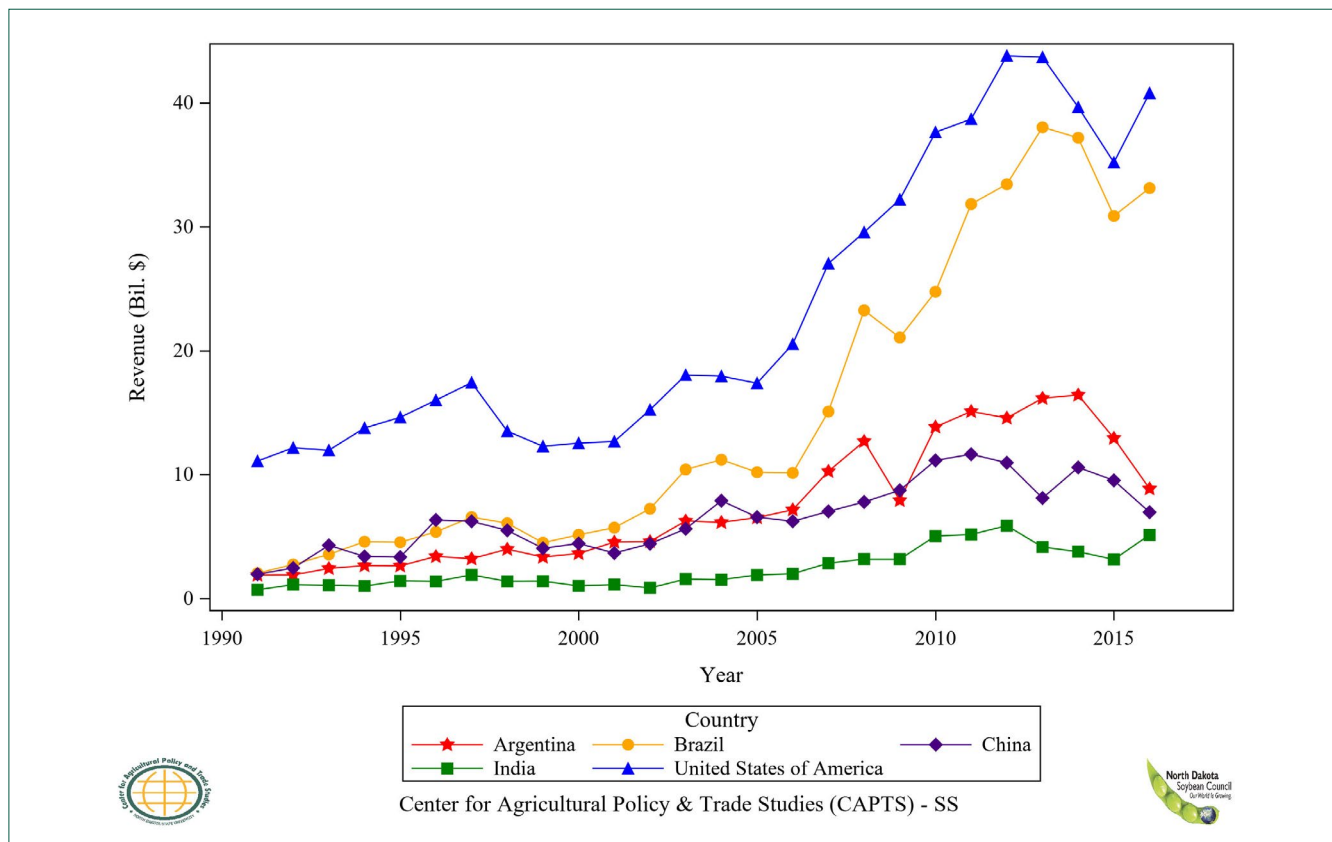


Table 5: Top 15 Countries Revenue, Annual Trends

Country	Revenue (\$)						
	2010	2011	2012	2013	2014	2015	2016
U.S.	37,625,265,350	38,689,752,600	43,796,370,230	43,684,109,300	39,651,689,770	35,187,846,260	40,788,516,240
Brazil	24,751,438,663	31,828,517,781	33,434,737,341	38,030,254,668	37,180,204,490	30,870,151,297	33,120,035,233
Argentina	13,838,834,861	15,095,220,519	14,560,727,056	16,157,462,300	16,421,996,891	12,930,817,306	8,854,366,764
China	11,139,365,316	11,634,938,786	10,944,904,348	8,101,381,170	10,570,443,339	9,524,530,371	6,957,051,748
India	5,035,319,700	5,159,372,838	5,871,081,250	4,142,300,919	3,770,565,092	3,141,983,378	5,129,213,947
Paraguay	2,528,580,953	3,433,818,217	1,997,245,969	3,915,623,198	4,544,666,952	2,855,164,596	3,018,515,075
Canada	1,656,754,086	1,994,448,183	2,517,369,853	2,605,512,311	2,505,228,037	2,100,177,132	1,991,388,011
Ukraine	551,340,676	832,712,856	1,032,120,401	1,203,018,116	1,518,917,620	1,341,226,723	1,488,917,404
Bolivia (Plurinational State of)	486,194,146	562,126,656	837,453,837	906,671,461	1,020,169,399	910,116,246	859,371,948
Russian Federation	458,470,982	645,666,797	713,148,343	714,183,464	1,045,240,251	845,724,531	1,097,004,425
Uruguay	681,203,732	746,396,371	1,154,911,191	1,378,350,913	1,447,845,451	1,040,095,413	808,676,175
South Africa	195,438,413	310,552,123	291,669,811	381,156,720	484,715,650	396,838,892	312,596,576
Indonesia	669,781,228	704,055,418	674,917,330	575,937,920	670,164,957	599,011,715	602,498,500
Italy	183,345,905	213,475,325	182,163,279	293,353,827	369,056,211	333,660,472	325,752,948
Nigeria	155,191,402	213,428,645	290,748,485	230,512,971	280,836,204	188,979,162	117,399,572

Figure 6: Top 5 Countries Price, Annual Trends

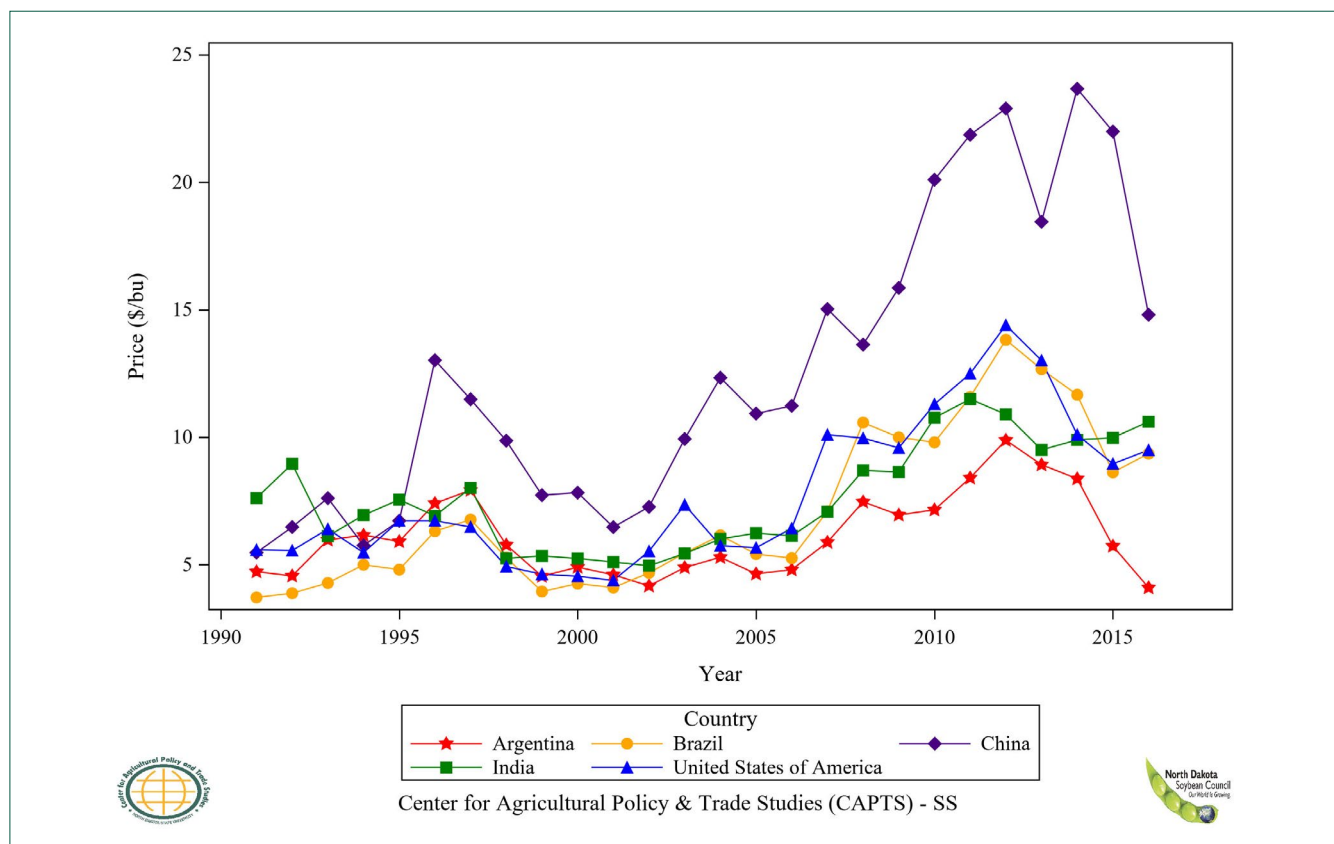


Table 6: Top 15 Countries Price, Annual Trends

Country	Price (\$/acre)						
	2010	2011	2012	2013	2014	2015	2016
U.S.	11.29	12.49	14.40	13.01	10.10	8.95	9.49
Brazil	9.80	11.58	13.82	12.66	11.66	8.62	9.35
Argentina	7.15	8.40	9.88	8.92	8.37	5.73	4.10
China	20.10	21.86	22.89	18.45	23.67	21.99	14.80
India	10.76	11.50	10.89	9.50	9.89	9.98	10.61
Paraguay	9.22	11.25	12.51	11.73	12.40	8.77	8.97
Canada	10.14	12.15	13.47	13.24	11.28	8.85	8.22
Ukraine	8.93	10.01	11.65	11.80	10.65	9.29	9.47
Bolivia (Plurinational State of)	7.82	8.22	8.56	8.73	9.87	7.97	7.30
Russian Federation	10.21	10.71	11.53	12.81	12.04	8.50	9.50
Uruguay	10.34	13.18	14.88	13.57	12.46	9.10	9.97
South Africa	9.40	11.90	12.21	13.22	13.92	10.09	11.47
Indonesia	20.10	22.51	21.79	20.10	19.10	16.93	19.07
Italy	9.03	10.29	11.74	12.79	10.76	8.13	8.20
Nigeria	11.57	11.79	12.17	12.11	12.25	8.74	5.20



Section II

U.S. States Trend and Risk

Figure 7: U.S. Planted Acreage, Harvested Acreage, Production and Yield, Annual Trends

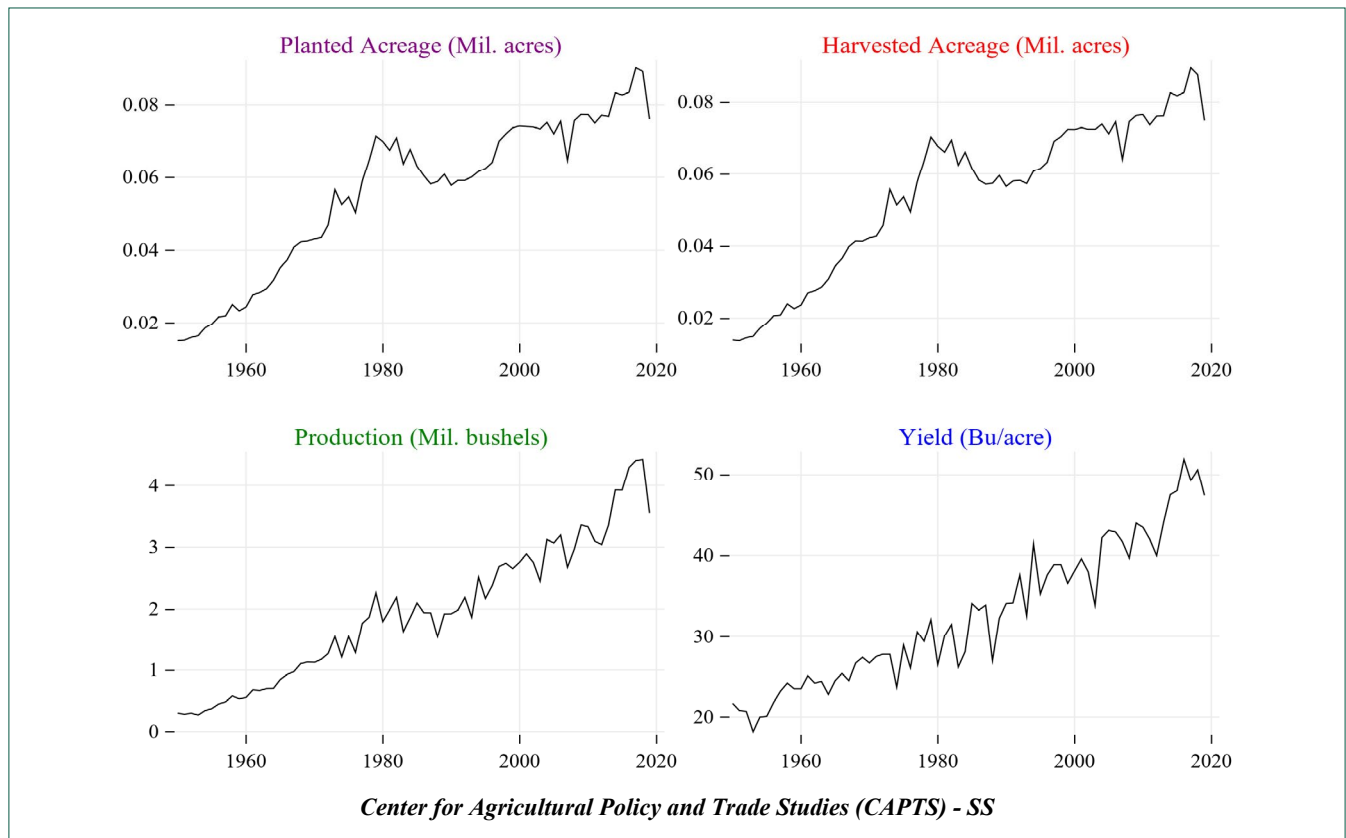


Table 7: U.S. Production Indicators, Annual Trends

Year	Planted (Acres)	Harvested (Acres)	Production (Bushels)	Yield (Bu/acre)
2000	74,266,000	72,408,000	2,757,810,000	38.1
2001	74,075,000	72,975,000	2,890,682,000	39.6
2002	73,963,000	72,497,000	2,756,147,000	38.0
2003	73,404,000	72,476,000	2,453,845,000	33.9
2004	75,208,000	73,958,000	3,123,790,000	42.2
2005	72,032,000	71,251,000	3,068,342,000	43.1
2006	75,522,000	74,602,000	3,196,726,000	42.9
2007	64,741,000	64,146,000	2,677,117,000	41.7
2008	75,718,000	74,681,000	2,967,007,000	39.7
2009	77,451,000	76,372,000	3,360,931,000	44.0
2010	77,404,000	76,610,000	3,331,306,000	43.5
2011	75,046,000	73,776,000	3,097,179,000	42.0
2012	77,198,000	76,144,000	3,042,044,000	40.0
2013	76,820,000	76,233,000	3,357,004,000	44.0
2014	83,296,000	82,611,000	3,928,070,000	47.5
2015	82,660,000	81,742,000	3,926,779,000	48.0
2016	83,453,000	82,706,000	4,296,496,000	51.9
2017	90,162,000	89,542,000	4,411,633,000	49.3
2018	89,167,000	87,594,000	4,428,150,000	50.6
2019	76,100,000	74,939,000	3,551,908,000	47.4

Figure 8: U.S. Revenue and Prices, Marketing and Calendar Year, Annual Trends

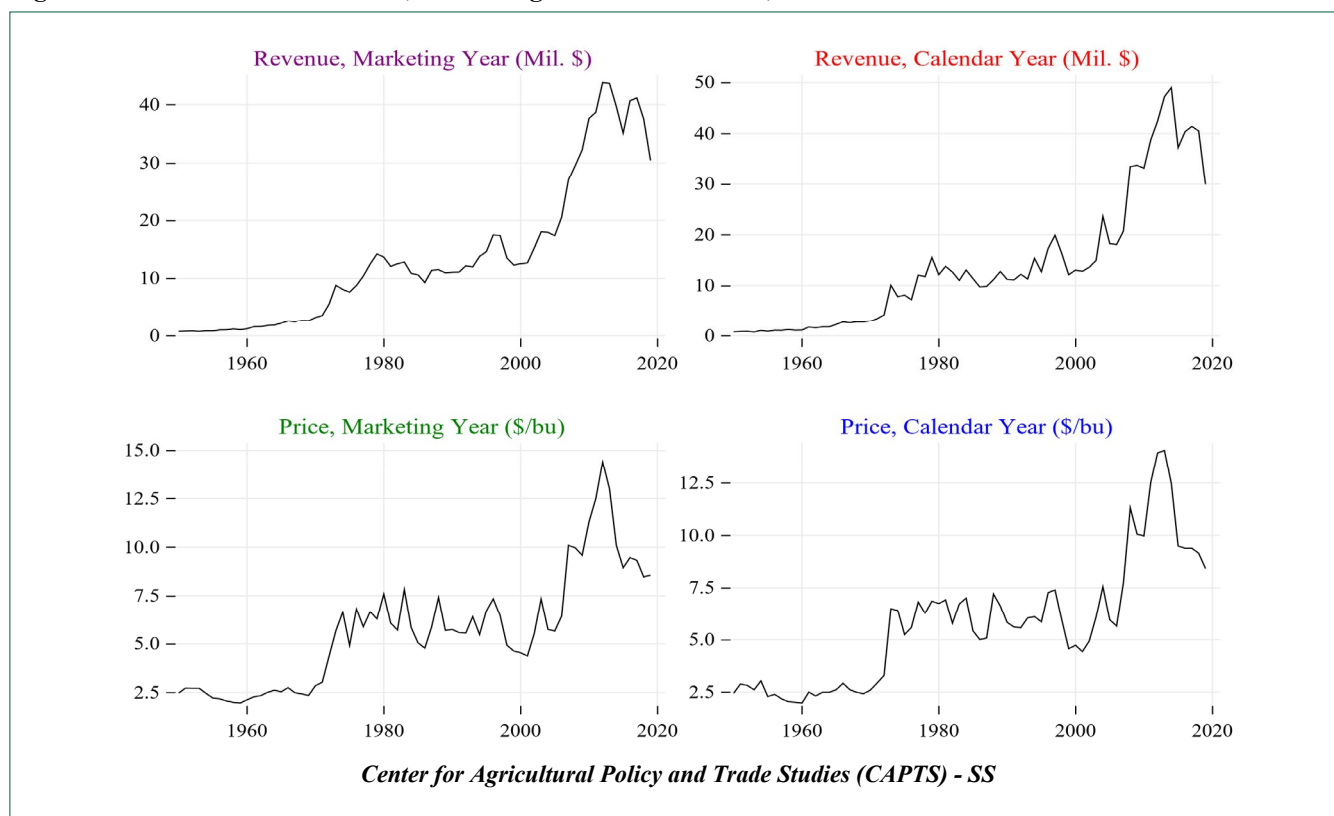


Table 8: U.S. Production Indicators, Annual Trends

Year	Revenue (Marketing) (\$)	Revenue (Calendar) (\$)	Marketing Year Price, MYP (\$/bu)	Calendar Year Price, CYP (\$/bu)
2000	12,520,457,400	13,051,335,825	4.54	4.73
2001	12,661,187,160	12,805,721,260	4.38	4.43
2002	15,241,492,910	13,596,991,867	5.53	4.93
2003	18,011,222,300	14,929,601,954	7.34	6.08
2004	17,930,554,600	23,600,233,450	5.74	7.56
2005	17,366,815,720	18,256,634,900	5.66	5.95
2006	20,554,948,180	18,056,174,023	6.43	5.65
2007	27,038,881,700	20,727,578,373	10.1	7.74
2008	29,581,059,790	33,559,321,676	9.97	11.3
2009	32,231,328,290	33,785,758,878	9.59	10.1
2010	37,643,757,800	33,227,001,262	11.3	9.97
2011	38,714,737,500	38,792,166,975	12.5	12.5
2012	43,805,433,600	42,461,864,167	14.4	14.0
2013	43,641,052,000	47,221,856,267	13.0	14.1
2014	39,673,507,000	48,992,853,075	10.1	12.5
2015	35,144,672,050	37,261,860,394	8.95	9.49
2016	40,687,817,120	40,351,258,267	9.47	9.39
2017	41,160,535,890	41,428,910,231	9.33	9.39
2018	37,550,712,000	40,521,262,625	8.48	9.15
2019	30,439,851,560	29,933,704,670	8.57	8.43

Figure 9: Top 5 States Planted Acreage, Annual Trends

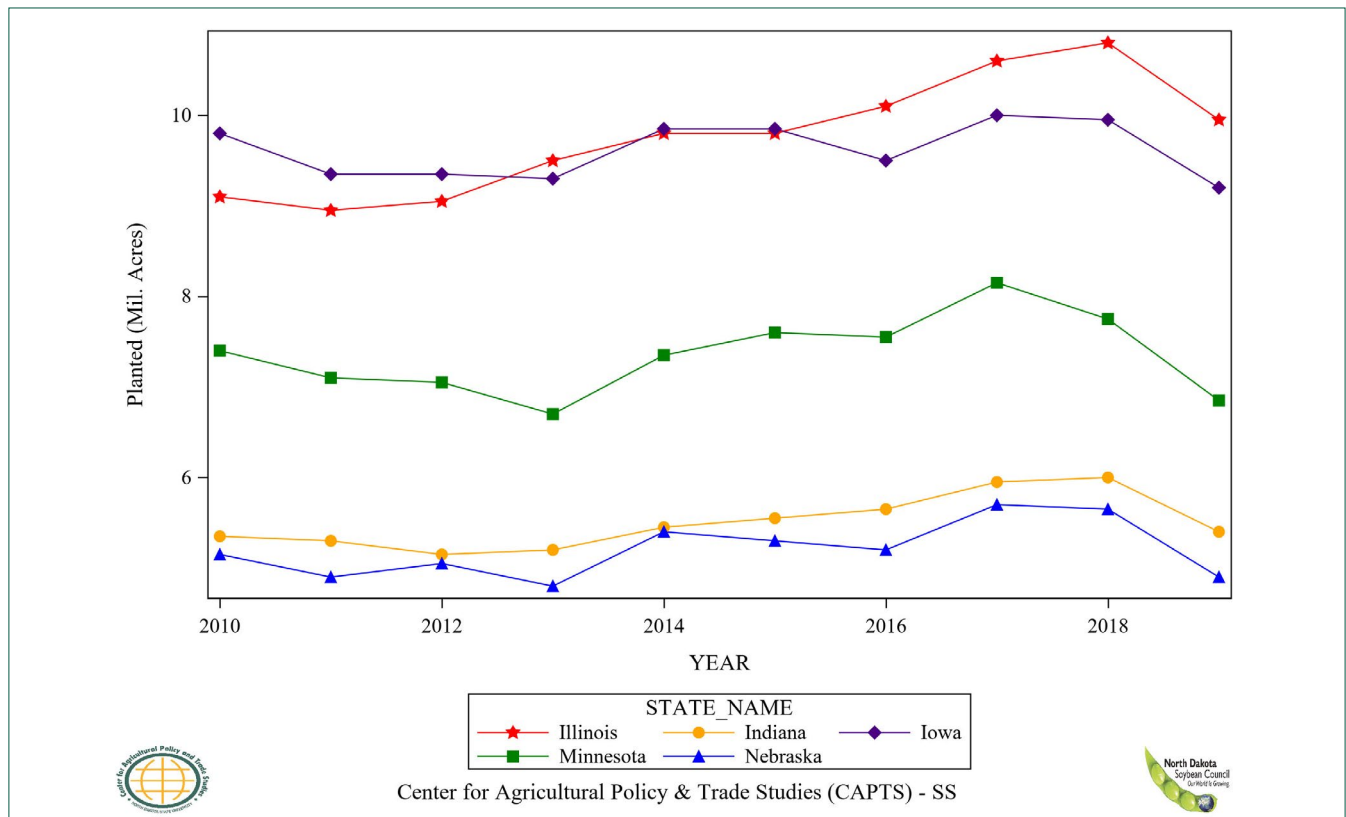


Table 9: Top 15 U.S. States Planted Acreage, Annual Trends

State	Planted (Acres)										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Illinois	9,100,000	8,950,000	9,050,000	9,500,000	9,800,000	9,800,000	10,100,000	10,600,000	10,800,000	9,950,000	
Iowa	9,800,000	9,350,000	9,350,000	9,300,000	9,850,000	9,850,000	9,500,000	10,000,000	9,950,000	9,200,000	
Minnesota	7,400,000	7,100,000	7,050,000	6,700,000	7,350,000	7,600,000	7,550,000	8,150,000	7,750,000	6,850,000	
Nebraska	5,150,000	4,900,000	5,050,000	4,800,000	5,400,000	5,300,000	5,200,000	5,700,000	5,650,000	4,900,000	
Indiana	5,350,000	5,300,000	5,150,000	5,200,000	5,450,000	5,550,000	5,650,000	5,950,000	6,000,000	5,400,000	
Ohio	4,600,000	4,550,000	4,600,000	4,500,000	4,700,000	4,750,000	4,850,000	5,100,000	5,050,000	4,300,000	
Missouri	5,150,000	5,350,000	5,400,000	5,650,000	5,650,000	4,550,000	5,600,000	5,950,000	5,850,000	5,100,000	
South Dakota	4,200,000	4,100,000	4,750,000	4,600,000	5,150,000	5,150,000	5,200,000	5,650,000	5,650,000	3,500,000	
North Dakota	4,100,000	4,000,000	4,750,000	4,650,000	5,900,000	5,750,000	6,050,000	7,100,000	6,900,000	5,600,000	
Kansas	4,300,000	4,000,000	4,000,000	3,600,000	4,000,000	3,900,000	4,050,000	5,150,000	4,750,000	4,550,000	
Arkansas	3,190,000	3,330,000	3,200,000	3,270,000	3,230,000	3,200,000	3,130,000	3,530,000	3,270,000	2,650,000	
Mississippi	2,000,000	1,830,000	1,970,000	2,010,000	2,210,000	2,300,000	2,040,000	2,190,000	2,230,000	1,660,000	
Michigan	2,050,000	1,950,000	2,000,000	1,930,000	2,050,000	2,030,000	2,070,000	2,280,000	2,330,000	1,760,000	
Wisconsin	1,640,000	1,620,000	1,710,000	1,580,000	1,800,000	1,880,000	1,960,000	2,150,000	2,220,000	1,750,000	
Kentucky	1,400,000	1,490,000	1,480,000	1,670,000	1,760,000	1,840,000	1,790,000	1,950,000	1,950,000	1,700,000	
Tennessee	1,450,000	1,290,000	1,260,000	1,580,000	1,640,000	1,750,000	1,660,000	1,690,000	1,700,000	1,400,000	
North Carolina	1,580,000	1,380,000	1,590,000	1,480,000	1,750,000	1,820,000	1,690,000	1,700,000	1,650,000	1,540,000	
Louisiana	1,030,000	1,020,000	1,130,000	1,130,000	1,410,000	1,430,000	1,230,000	1,270,000	1,340,000	890,000	
Pennsylvania	500,000	500,000	530,000	540,000	590,000	590,000	600,000	610,000	640,000	620,000	
Virginia	560,000	560,000	590,000	610,000	650,000	630,000	610,000	600,000	600,000	570,000	
Maryland	470,000	470,000	480,000	485,000	510,000	520,000	520,000	500,000	530,000	480,000	
Alabama	350,000	300,000	340,000	440,000	480,000	500,000	420,000	350,000	345,000	265,000	
New York	280,000	280,000	315,000	280,000	330,000	305,000	330,000	270,000	335,000	235,000	
Oklahoma	500,000	440,000	420,000	345,000	375,000	395,000	485,000	655,000	640,000	465,000	
South Carolina	465,000	370,000	380,000	320,000	450,000	475,000	420,000	400,000	390,000	335,000	
Georgia	270,000	155,000	220,000	235,000	300,000	325,000	260,000	155,000	145,000	100,000	
Delaware	175,000	170,000	170,000	165,000	185,000	175,000	165,000	160,000	170,000	155,000	
Texas	205,000	165,000	125,000	105,000	155,000	130,000	165,000	210,000	175,000	80,000	
New Jersey	94,000	88,000	96,000	90,000	105,000	105,000	100,000	100,000	110,000	95,000	
West Virginia	20,000	20,000	21,000	23,000	27,000	27,000	27,000	27,000	29,000	.	
Florida	25,000	18,000	21,000	32,000	39,000	33,000	31,000	15,000	18,000	.	

Figure 10: Top 5 States Harvested Acreage, Annual Trends

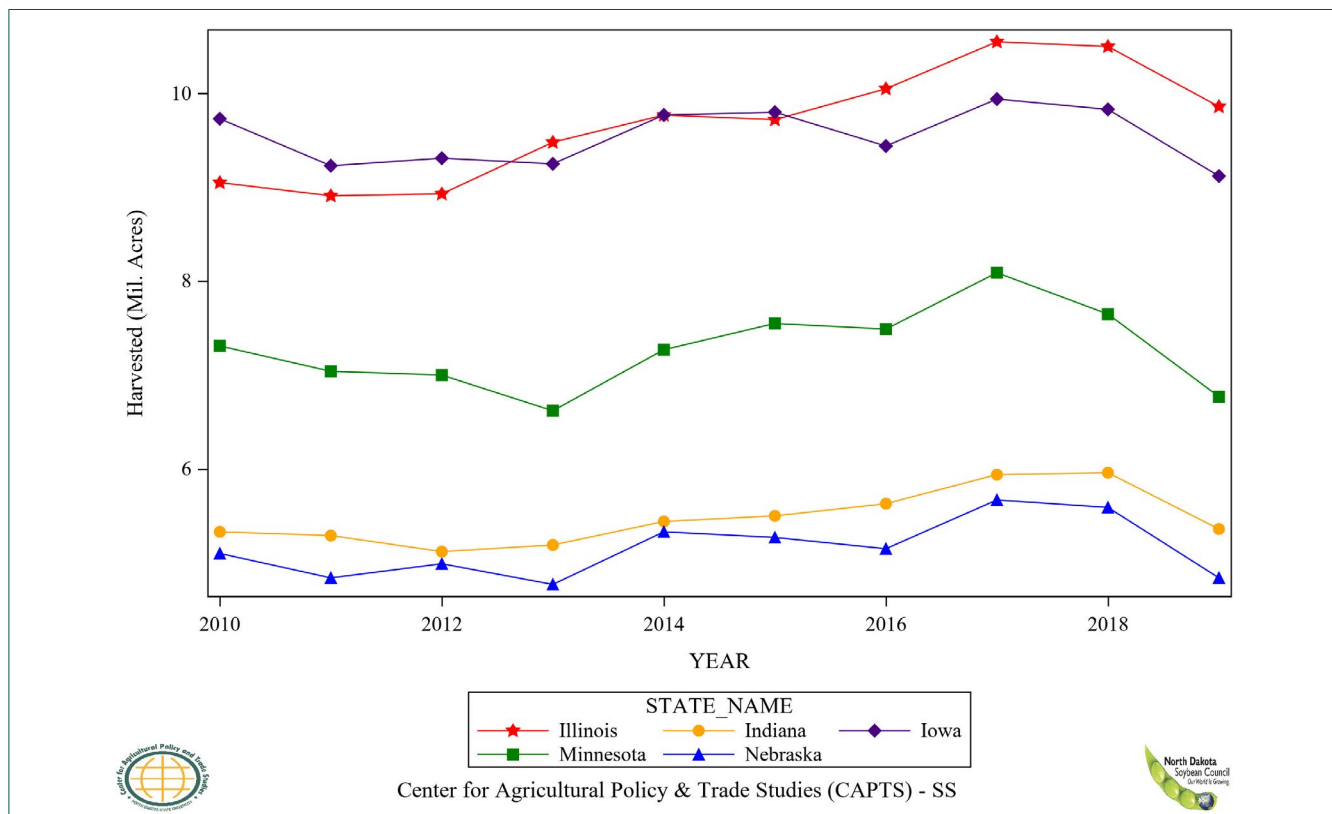


Table 10: Top 15 U.S. States Harvested Acreage, Annual Trends

State	Harvested (Acres)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Illinois	9,050,000	8,910,000	8,930,000	9,480,000	9,770,000	9,720,000	10,050,000	10,550,000	10,500,000	9,860,000
Iowa	9,730,000	9,230,000	9,310,000	9,250,000	9,770,000	9,800,000	9,440,000	9,940,000	9,830,000	9,120,000
Minnesota	7,310,000	7,040,000	7,000,000	6,620,000	7,270,000	7,550,000	7,490,000	8,090,000	7,650,000	6,770,000
Nebraska	5,100,000	4,840,000	4,990,000	4,770,000	5,330,000	5,270,000	5,150,000	5,670,000	5,590,000	4,840,000
Indiana	5,330,000	5,290,000	5,120,000	5,190,000	5,440,000	5,500,000	5,630,000	5,940,000	5,960,000	5,360,000
Ohio	4,590,000	4,540,000	4,590,000	4,490,000	4,690,000	4,740,000	4,840,000	5,090,000	5,020,000	4,270,000
Missouri	5,070,000	5,210,000	5,270,000	5,610,000	5,590,000	4,470,000	5,540,000	5,910,000	5,780,000	5,010,000
South Dakota	4,140,000	4,070,000	4,720,000	4,580,000	5,110,000	5,120,000	5,170,000	5,610,000	5,580,000	3,440,000
North Dakota	4,070,000	3,960,000	4,730,000	4,630,000	5,870,000	5,720,000	5,990,000	7,050,000	6,840,000	5,400,000
Kansas	4,250,000	3,760,000	3,820,000	3,540,000	3,960,000	3,860,000	4,010,000	5,110,000	4,690,000	4,490,000
Arkansas	3,150,000	3,280,000	3,150,000	3,240,000	3,200,000	3,170,000	3,090,000	3,500,000	3,210,000	2,610,000
Mississippi	1,980,000	1,800,000	1,950,000	1,990,000	2,190,000	2,270,000	2,020,000	2,170,000	2,190,000	1,630,000
Michigan	2,040,000	1,940,000	1,990,000	1,920,000	2,040,000	2,020,000	2,060,000	2,270,000	2,310,000	1,720,000
Wisconsin	1,630,000	1,610,000	1,700,000	1,550,000	1,790,000	1,870,000	1,950,000	2,140,000	2,180,000	1,690,000
Kentucky	1,390,000	1,480,000	1,470,000	1,660,000	1,750,000	1,810,000	1,780,000	1,940,000	1,930,000	1,690,000
Tennessee	1,410,000	1,260,000	1,230,000	1,550,000	1,610,000	1,720,000	1,630,000	1,660,000	1,670,000	1,370,000
North Carolina	1,550,000	1,360,000	1,580,000	1,450,000	1,730,000	1,730,000	1,660,000	1,690,000	1,570,000	1,520,000
Louisiana	1,020,000	980,000	1,115,000	1,120,000	1,395,000	1,390,000	1,190,000	1,250,000	1,190,000	860,000
Pennsylvania	495,000	490,000	520,000	535,000	585,000	585,000	595,000	605,000	630,000	610,000
Virginia	540,000	550,000	580,000	600,000	640,000	620,000	600,000	590,000	590,000	560,000
Maryland	465,000	465,000	475,000	480,000	505,000	515,000	515,000	495,000	515,000	475,000
Alabama	345,000	295,000	335,000	430,000	470,000	490,000	410,000	345,000	335,000	260,000
New York	279,000	277,000	312,000	278,000	327,000	301,000	320,000	265,000	325,000	225,000
Oklahoma	475,000	265,000	260,000	335,000	365,000	375,000	470,000	640,000	600,000	440,000
South Carolina	455,000	360,000	370,000	310,000	440,000	370,000	405,000	390,000	330,000	315,000
Georgia	255,000	135,000	215,000	230,000	290,000	310,000	240,000	150,000	130,000	86,000
Delaware	173,000	168,000	168,000	163,000	183,000	173,000	163,000	158,000	168,000	153,000
Texas	185,000	90,000	110,000	92,000	135,000	115,000	145,000	185,000	135,000	73,000
New Jersey	92,000	86,000	94,000	88,000	103,000	103,000	98,000	99,000	107,000	92,000
West Virginia	18,000	19,000	20,000	22,000	26,000	26,000	26,000	26,000	27,000	.
Florida	23,000	16,000	20,000	30,000	37,000	29,000	29,000	14,000	12,000	.

Figure 11: Top 5 U.S. States Production, Annual Trends

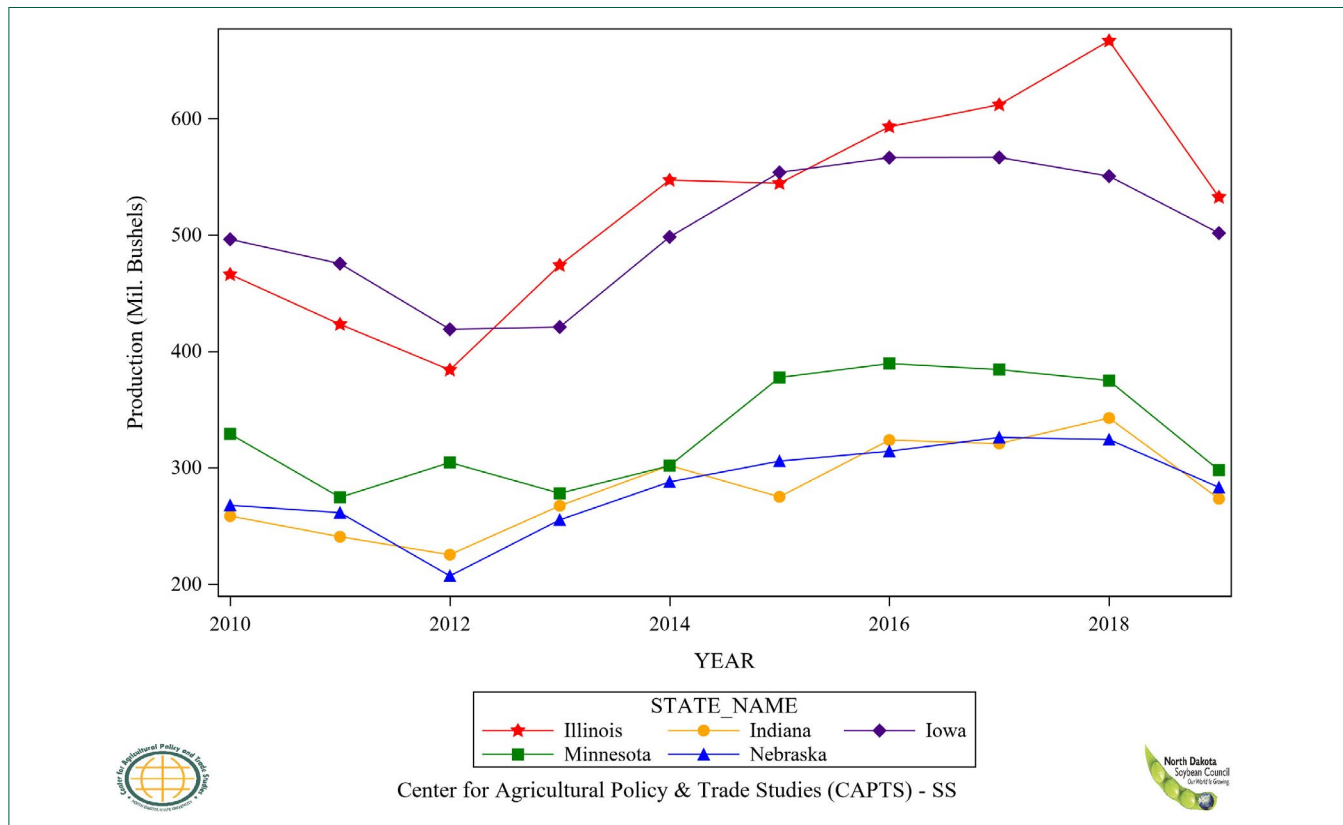


Table 11: Top 15 U.S. States Production, Annual Trends

State	Production (Bushels)										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Illinois	466,075,000	423,225,000	383,990,000	474,000,000	547,120,000	544,320,000	592,950,000	611,900,000	666,750,000	532,440,000	
Iowa	496,230,000	475,345,000	418,950,000	420,875,000	498,270,000	553,700,000	566,400,000	566,580,000	550,480,000	501,600,000	
Minnesota	328,950,000	274,560,000	304,500,000	278,040,000	301,705,000	377,500,000	389,480,000	384,275,000	374,850,000	297,880,000	
Nebraska	267,750,000	261,360,000	207,085,000	255,195,000	287,820,000	305,660,000	314,150,000	326,025,000	324,220,000	283,140,000	
Indiana	258,505,000	240,695,000	225,280,000	267,285,000	301,920,000	275,000,000	323,725,000	320,760,000	342,700,000	273,360,000	
Ohio	220,320,000	217,920,000	206,550,000	222,255,000	246,225,000	237,000,000	263,780,000	251,955,000	281,120,000	209,230,000	
Missouri	210,405,000	190,165,000	158,100,000	201,960,000	259,935,000	181,035,000	271,460,000	292,545,000	257,210,000	230,460,000	
South Dakota	157,320,000	150,590,000	143,960,000	185,490,000	229,950,000	235,520,000	255,915,000	241,230,000	251,100,000	146,200,000	
North Dakota	138,380,000	114,840,000	163,185,000	141,215,000	202,515,000	185,900,000	248,585,000	243,225,000	239,400,000	170,100,000	
Kansas	140,250,000	103,400,000	87,860,000	130,980,000	140,580,000	148,610,000	192,480,000	191,625,000	201,670,000	186,335,000	
Arkansas	110,250,000	126,280,000	137,025,000	140,940,000	158,400,000	155,330,000	145,230,000	178,500,000	162,105,000	127,890,000	
Mississippi	76,230,000	70,200,000	87,750,000	91,540,000	113,880,000	104,420,000	96,960,000	115,010,000	118,260,000	81,500,000	
Michigan	88,740,000	86,330,000	85,570,000	85,440,000	86,700,000	98,980,000	104,030,000	96,475,000	109,725,000	69,660,000	
Wisconsin	82,315,000	75,670,000	71,400,000	60,450,000	78,760,000	92,565,000	107,250,000	101,650,000	104,640,000	79,430,000	
Kentucky	47,260,000	57,720,000	58,800,000	83,000,000	83,125,000	88,690,000	89,000,000	102,820,000	98,430,000	77,740,000	
Tennessee	43,710,000	40,320,000	46,740,000	72,075,000	74,060,000	79,120,000	73,350,000	83,000,000	75,985,000	64,390,000	
North Carolina	40,300,000	41,480,000	62,410,000	48,575,000	69,200,000	55,360,000	58,100,000	67,600,000	51,810,000	53,200,000	
Louisiana	41,820,000	35,280,000	51,848,000	54,320,000	78,818,000	56,990,000	57,715,000	67,500,000	61,285,000	41,280,000	
Pennsylvania	20,790,000	21,560,000	24,960,000	26,215,000	28,665,000	25,740,000	26,180,000	29,040,000	28,035,000	29,890,000	
Virginia	14,040,000	22,000,000	24,360,000	23,100,000	25,280,000	21,390,000	21,600,000	25,960,000	24,780,000	19,040,000	
Maryland	15,810,000	18,135,000	22,325,000	18,960,000	23,230,000	20,600,000	21,373,000	25,245,000	24,463,000	20,900,000	
Alabama	8,970,000	9,735,000	15,075,000	18,705,000	18,800,000	20,090,000	13,120,000	15,870,000	13,400,000	9,360,000	
New York	13,392,000	11,911,000	14,352,000	13,344,000	14,552,000	12,943,000	13,120,000	11,925,000	16,900,000	10,800,000	
Oklahoma	11,875,000	3,445,000	3,900,000	10,218,000	10,220,000	11,625,000	13,630,000	18,560,000	16,800,000	12,760,000	
South Carolina	10,465,000	9,180,000	12,580,000	8,835,000	15,400,000	9,805,000	12,555,000	14,820,000	9,570,000	8,190,000	
Georgia	6,630,000	2,970,000	8,063,000	9,315,000	11,600,000	13,330,000	7,200,000	6,300,000	5,135,000	2,494,000	
Delaware	5,536,000	6,636,000	7,140,000	6,602,000	8,693,000	6,920,000	6,765,000	8,058,000	6,972,000	7,191,000	
Texas	5,550,000	1,710,000	2,860,000	2,346,000	5,198,000	2,990,000	4,495,000	6,845,000	4,253,000	2,044,000	
New Jersey	2,208,000	3,268,000	3,666,000	3,476,000	4,532,000	3,296,000	3,528,000	4,455,000	4,227,000	3,404,000	
West Virginia	540,000	817,000	980,000	1,023,000	1,326,000	1,248,000	1,326,000	1,404,000	1,431,000	.	
Florida	690,000	432,000	780,000	1,230,000	1,591,000	1,102,000	1,044,000	476,000	444,000	.	

Figure 12: Top 5 U.S. States Yield, Annual Trends

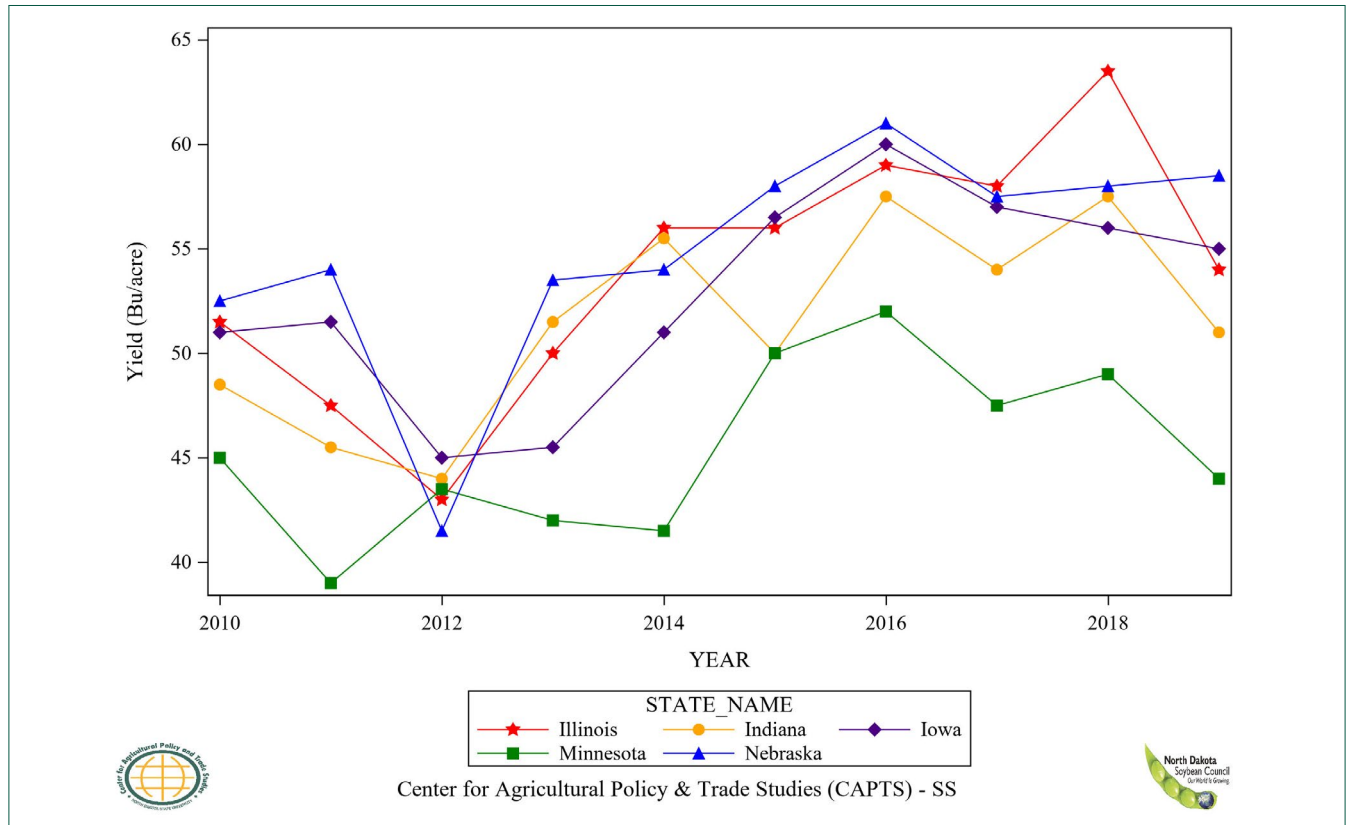


Table 12: Top 15 U.S. States Yield, Annual Trends

State	Yield (Bu/acre)										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Illinois	51.50	47.50	43.00	50.00	56.00	56.00	59.00	58.00	63.50	54.00	
Iowa	51.00	51.50	45.00	45.50	51.00	56.50	60.00	57.00	56.00	55.00	
Minnesota	45.00	39.00	43.50	42.00	41.50	50.00	52.00	47.50	49.00	44.00	
Nebraska	52.50	54.00	41.50	53.50	54.00	58.00	61.00	57.50	58.00	58.50	
Indiana	48.50	45.50	44.00	51.50	55.50	50.00	57.50	54.00	57.50	51.00	
Ohio	48.00	48.00	45.00	49.50	52.50	50.00	54.50	49.50	56.00	49.00	
Missouri	41.50	36.50	30.00	36.00	46.50	40.50	49.00	49.50	44.50	46.00	
South Dakota	38.00	37.00	30.50	40.50	45.00	46.00	49.50	43.00	45.00	42.50	
North Dakota	34.00	29.00	34.50	30.50	34.50	32.50	41.50	34.50	35.00	31.50	
Kansas	33.00	27.50	23.00	37.00	35.50	38.50	48.00	37.50	43.00	41.50	
Arkansas	35.00	38.50	43.50	43.50	49.50	49.00	47.00	51.00	50.50	49.00	
Mississippi	38.50	39.00	45.00	46.00	52.00	46.00	48.00	53.00	54.00	50.00	
Michigan	43.50	44.50	43.00	44.50	42.50	49.00	50.50	42.50	47.50	40.50	
Wisconsin	50.50	47.00	42.00	39.00	44.00	49.50	55.00	47.50	48.00	47.00	
Kentucky	34.00	39.00	40.00	50.00	47.50	49.00	50.00	53.00	51.00	46.00	
Tennessee	31.00	32.00	38.00	46.50	46.00	46.00	45.00	50.00	45.50	47.00	
North Carolina	26.00	30.50	39.50	33.50	40.00	32.00	35.00	40.00	33.00	35.00	
Louisiana	41.00	36.00	46.50	48.50	56.50	41.00	48.50	54.00	51.50	48.00	
Pennsylvania	42.00	44.00	48.00	49.00	49.00	44.00	44.00	48.00	44.50	49.00	
Virginia	26.00	40.00	42.00	38.50	39.50	34.50	36.00	44.00	42.00	34.00	
Maryland	34.00	39.00	47.00	39.50	46.00	40.00	41.50	51.00	47.50	44.00	
Alabama	26.00	33.00	45.00	43.50	40.00	41.00	32.00	46.00	40.00	36.00	
New York	48.00	43.00	46.00	48.00	44.50	43.00	41.00	45.00	52.00	48.00	
Oklahoma	25.00	13.00	15.00	30.50	28.00	31.00	29.00	29.00	28.00	29.00	
South Carolina	23.00	25.50	34.00	28.50	35.00	26.50	31.00	38.00	29.00	26.00	
Georgia	26.00	22.00	37.50	40.50	40.00	43.00	30.00	42.00	39.50	29.00	
Delaware	32.00	39.50	42.50	40.50	47.50	40.00	41.50	51.00	41.50	47.00	
Texas	30.00	19.00	26.00	25.50	38.50	26.00	31.00	37.00	31.50	28.00	
New Jersey	24.00	38.00	39.00	39.50	44.00	32.00	36.00	45.00	39.50	37.00	
West Virginia	30.00	43.00	49.00	46.50	51.00	48.00	51.00	54.00	53.00	.	
Florida	30.00	27.00	39.00	41.00	43.00	38.00	36.00	34.00	37.00	.	

Figure 13: Top 5 U.S. States Revenue (Calendar), Annual Trends

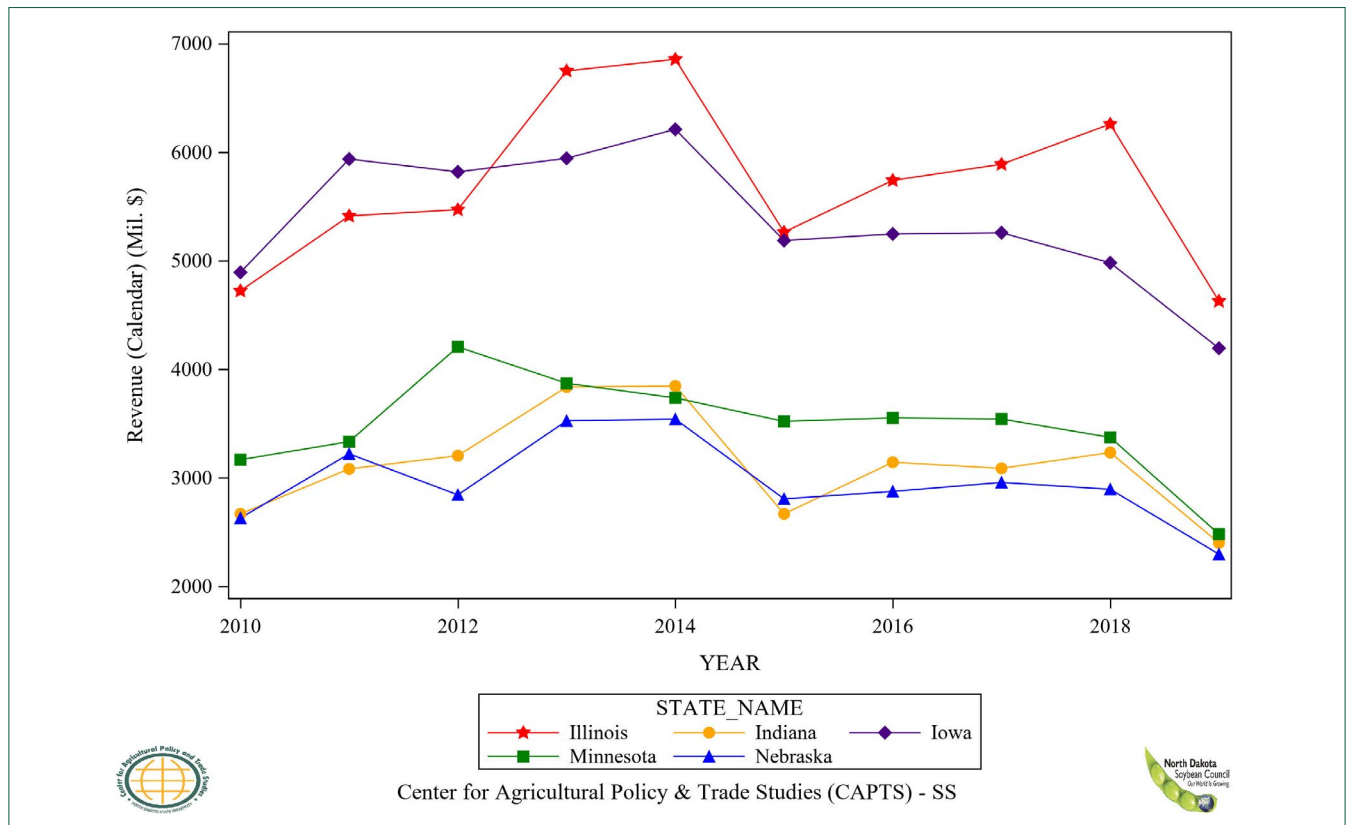


Table 13: Top 15 U.S. States Revenue (Calendar), Annual Trends

State	Revenue_CYP (\$)										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Illinois	4,723,670,125	5,413,753,125	5,471,857,500	6,750,550,000	6,857,237,333	5,264,481,600	5,741,732,500	5,890,047,417	6,259,671,250	4,629,122,100	
Iowa	4,893,654,850	5,937,851,292	5,819,913,750	5,944,859,375	6,211,766,000	5,187,246,167	5,247,696,000	5,259,278,850	4,981,844,000	4,194,630,000	
Minnesota	3,167,788,500	3,333,616,000	4,207,175,000	3,871,707,000	3,737,370,687	3,520,816,667	3,553,355,867	3,542,695,271	3,373,337,625	2,481,588,633	
Nebraska	2,629,528,125	3,221,262,000	2,843,967,333	3,525,944,250	3,541,385,250	2,806,722,950	2,875,781,458	2,958,133,500	2,895,284,600	2,297,209,200	
Indiana	2,668,417,863	3,082,901,792	3,204,608,000	3,837,767,125	3,846,964,000	2,668,416,667	3,143,909,292	3,087,849,600	3,233,374,500	2,400,784,200	
Ohio	2,275,354,800	2,783,928,000	2,936,452,500	3,154,168,875	3,149,628,125	2,306,997,500	2,561,303,800	2,422,547,325	2,640,653,867	1,830,588,142	
Missouri	2,123,687,800	2,419,849,625	2,252,925,000	2,854,368,000	3,281,246,150	1,733,259,263	2,608,504,383	2,780,640,225	2,382,193,283	1,967,936,350	
South Dakota	1,505,421,300	1,835,943,083	1,969,852,667	2,541,213,000	2,741,387,250	2,117,324,800	2,290,652,513	2,159,812,600	2,190,010,500	1,169,600,000	
North Dakota	1,316,801,017	1,381,908,000	2,204,357,375	1,892,281,000	2,332,972,800	1,633,906,083	2,214,478,042	2,147,474,063	2,081,583,000	1,323,094,500	
Kansas	1,402,616,875	1,309,733,333	1,219,789,667	1,812,981,500	1,735,928,700	1,356,313,933	1,786,054,000	1,738,517,813	1,772,343,183	1,503,102,333	
Arkansas	1,094,966,250	1,569,029,000	1,925,201,250	1,989,603,000	2,019,600,000	1,540,744,158	1,423,980,150	1,777,711,250	1,544,050,125	1,100,067,150	
Mississippi	726,957,000	873,405,000	1,176,581,250	1,281,560,000	1,451,970,000	1,052,379,567	963,944,000	1,130,739,983	1,115,388,900	683,581,250	
Michigan	890,505,900	1,068,333,750	1,175,874,417	1,174,088,000	1,088,085,000	943,939,267	984,904,025	921,095,063	1,024,191,438	596,173,500	
Wisconsin	824,384,725	936,416,250	982,345,000	839,751,250	983,187,333	861,857,288	1,003,949,375	957,966,542	961,816,000	662,380,008	
Kentucky	480,634,200	739,297,000	838,880,000	1,172,375,000	1,055,687,500	873,892,133	871,606,667	997,868,100	937,627,775	680,872,833	
Tennessee	444,093,600	508,032,000	657,086,500	1,015,056,250	932,538,833	786,848,400	709,355,625	805,169,167	718,564,817	561,588,117	
North Carolina	414,720,583	538,548,667	888,302,333	678,026,042	882,300,000	529,656,800	555,097,083	653,016,000	480,710,450	455,525,000	
Louisiana	412,269,164	428,358,000	718,526,867	785,376,667	994,420,433	584,432,450	572,196,129	664,368,750	576,436,496	344,963,200	

Figure 14: Top 5 U.S. States Revenue (Marketing), Annual Trends

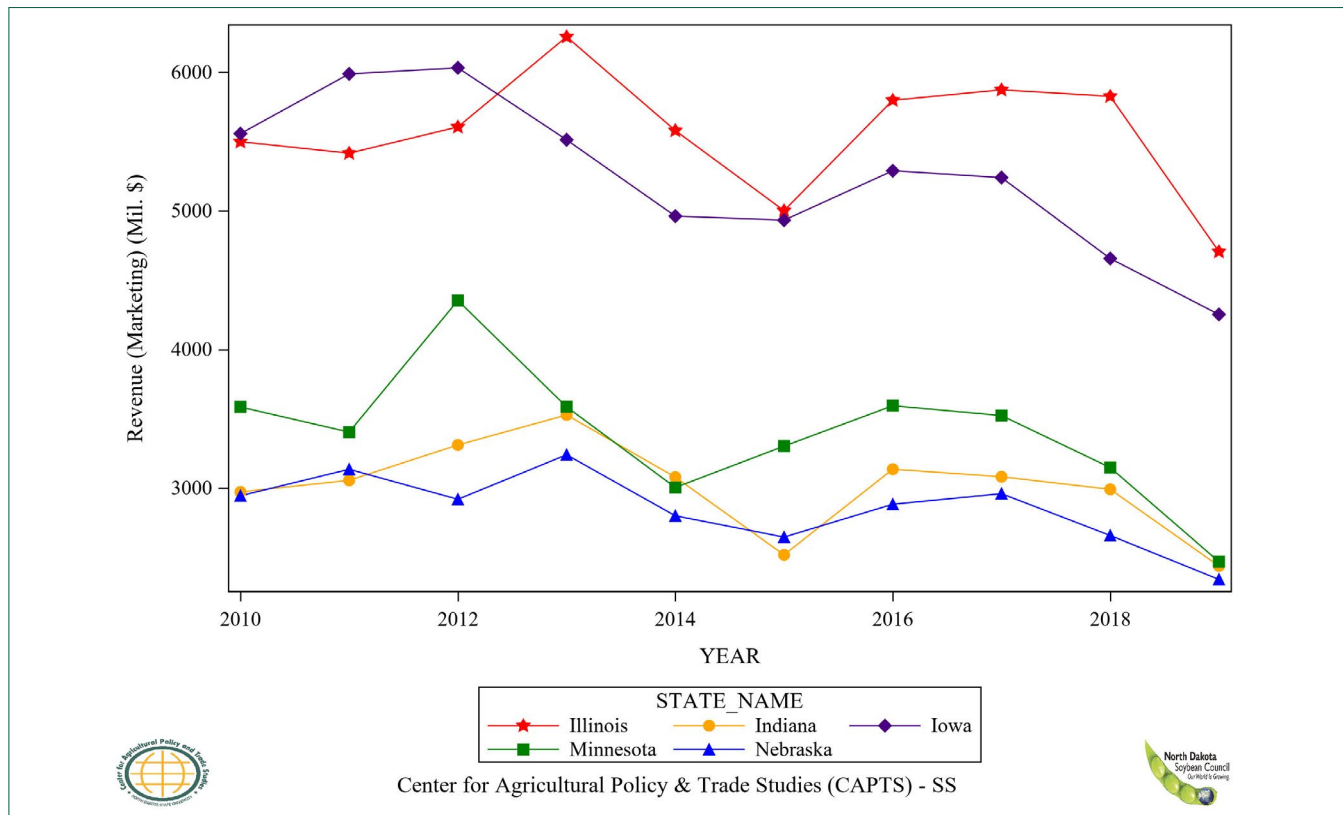


Table 14: Top 15 U.S. States Revenue (Marketing), Annual Trends

State	Yield (Bu/acre)										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Illinois	5,499,685,000	5,417,280,000	5,606,254,000	6,256,800,000	5,580,624,000	5,002,300,800	5,799,051,000	5,874,240,000	5,827,395,000	4,706,769,600	
Iowa	5,557,776,000	5,989,347,000	6,032,880,000	5,513,462,500	4,962,769,200	4,933,467,000	5,290,176,000	5,240,865,000	4,657,060,800	4,253,568,000	
Minnesota	3,585,555,000	3,404,544,000	4,354,350,000	3,586,716,000	3,004,981,800	3,303,125,000	3,594,900,400	3,523,801,750	3,148,740,000	2,469,425,200	
Nebraska	2,945,250,000	3,136,320,000	2,919,898,500	3,240,976,500	2,800,488,600	2,647,015,600	2,883,897,000	2,960,307,000	2,658,604,000	2,341,567,800	
Indiana	2,972,807,500	3,056,826,500	3,311,616,000	3,528,162,000	3,079,584,000	2,519,000,000	3,136,895,250	3,082,503,600	2,991,771,000	2,438,371,200	
Ohio	2,533,680,000	2,832,960,000	3,015,630,000	2,889,315,000	2,536,117,500	2,170,920,000	2,548,114,800	2,423,807,100	2,442,932,800	1,891,439,200	
Missouri	2,461,738,500	2,377,062,500	2,292,450,000	2,645,676,000	2,596,750,650	1,658,280,600	2,606,016,000	2,773,326,600	2,201,717,600	2,016,525,000	
South Dakota	1,714,788,000	1,837,198,000	2,044,232,000	2,318,625,000	2,154,631,500	2,011,340,800	2,310,912,450	2,156,596,200	2,001,267,000	1,201,764,000	
North Dakota	1,508,342,000	1,366,596,000	2,284,590,000	1,751,066,000	1,921,867,350	1,578,291,000	2,229,807,450	2,159,838,000	1,910,412,000	1,348,893,000	
Kansas	1,612,875,000	1,251,140,000	1,256,398,000	1,676,544,000	1,353,785,400	1,272,101,600	1,782,364,800	1,724,625,000	1,599,243,100	1,542,853,800	
Arkansas	1,201,725,000	1,553,244,000	1,959,457,500	1,846,314,000	1,679,040,000	1,469,421,800	1,427,610,900	1,743,945,000	1,428,145,050	1,134,384,300	
Mississippi	792,792,000	842,400,000	1,272,375,000	1,208,328,000	1,252,680,000	1,014,962,400	963,782,400	1,120,197,400	1,046,601,000	717,200,000	
Michigan	985,014,000	1,044,593,000	1,197,980,000	1,102,176,000	875,670,000	873,003,600	989,325,300	905,900,250	935,954,250	613,704,600	
Wisconsin	889,002,000	938,308,000	999,600,000	773,760,000	787,600,000	808,092,450	1,003,860,000	949,411,000	888,393,600	668,800,600	
Kentucky	538,764,000	715,728,000	852,600,000	1,087,300,000	872,812,500	819,495,600	878,430,000	997,354,000	865,199,700	698,105,200	
Tennessee	485,181,000	491,904,000	682,404,000	936,975,000	785,036,000	735,024,800	717,363,000	805,100,000	664,868,750	576,934,400	
North Carolina	483,600,000	501,908,000	873,740,000	636,332,500	705,840,000	480,524,800	569,380,000	642,200,000	448,674,600	463,372,000	
Louisiana	439,110,000	423,360,000	762,165,600	727,888,000	859,116,200	555,082,600	573,109,950	652,725,000	548,500,750	359,136,000	
Pennsylvania	251,559,000	269,500,000	354,432,000	340,795,000	280,917,000	223,680,600	249,757,200	271,233,600	236,054,700	254,065,000	
Virginia	168,480,000	266,200,000	341,040,000	300,300,000	250,272,000	188,232,000	203,040,000	244,024,000	205,674,000	167,552,000	
Maryland	189,720,000	219,433,500	317,015,000	235,104,000	228,118,600	187,666,000	199,410,090	232,254,000	198,639,560	174,515,000	
Alabama	99,567,000	116,820,000	220,095,000	241,294,500	188,000,000	179,805,500	128,969,600	149,654,100	113,900,000	85,176,000	
New York	152,668,800	146,505,300	195,187,200	170,803,200	141,008,880	117,781,300	125,558,400	110,425,500	138,580,000	91,800,000	
Oklahoma	135,375,000	40,995,500	56,160,000	131,812,200	101,178,000	102,300,000	128,122,000	168,896,000	132,552,000	107,822,000	
South Carolina	123,487,000	110,160,000	182,410,000	117,505,500	158,620,000	84,813,250	121,532,400	141,086,400	87,087,000	75,348,000	
Georgia	77,571,000	35,937,000	117,719,800	123,889,500	121,800,000	123,302,500	72,720,000	60,606,000	40,566,500	22,321,300	
Delaware	67,539,200	80,959,200	102,816,000	81,864,800	83,452,800	63,456,400	63,861,600	74,053,020	57,519,000	60,044,850	
Texas	57,720,000	20,520,000	41,756,000	29,559,600	49,640,900	25,116,000	41,174,200	60,920,500	32,280,270	15,738,800	
New Jersey	25,833,600	39,542,800	50,957,400	43,102,400	44,640,200	28,477,440	33,833,520	41,431,500	33,731,460	28,763,800	
West Virginia	6,480,000	10,130,800	14,014,000	13,196,700	13,260,000	10,982,400	12,464,400	13,197,600	12,163,500	.	
Florida	7,590,000	4,752,000	10,920,000	14,514,000	14,159,900	8,816,000	9,135,000	4,212,600	3,596,400	.	

Figure 15: Top 5 U.S. States Calendar Year Price, Annual Trends

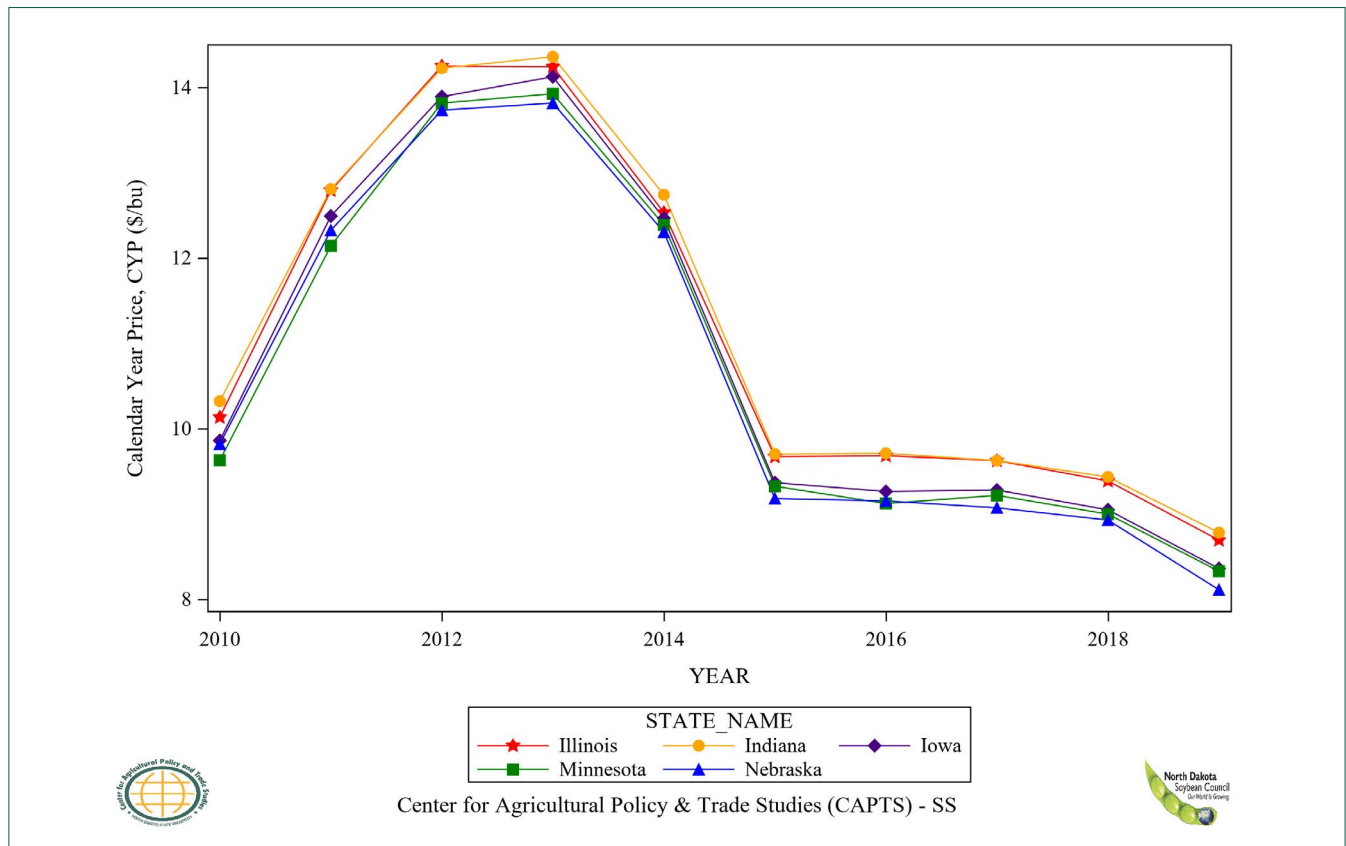


Table 15: Top 15 U.S. States Calendar Year Price, Annual Trends

State	Prices_CYP (\$/Bu)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Illinois	10.14	12.79	14.25	14.24	12.53	9.67	9.68	9.63	9.39	8.69
Iowa	9.86	12.49	13.89	14.13	12.47	9.37	9.27	9.28	9.05	8.36
Minnesota	9.63	12.14	13.82	13.93	12.39	9.33	9.12	9.22	9.00	8.33
Nebraska	9.82	12.33	13.73	13.82	12.30	9.18	9.15	9.07	8.93	8.11
Indiana	10.32	12.81	14.23	14.36	12.74	9.70	9.71	9.63	9.44	8.78
Ohio	10.33	12.78	14.22	14.19	12.79	9.73	9.71	9.62	9.39	8.75
Missouri	10.09	12.73	14.25	14.13	12.62	9.57	9.61	9.50	9.26	8.54
South Dakota	9.57	12.19	13.68	13.70	11.92	8.99	8.95	8.95	8.72	8.00
North Dakota	9.52	12.03	13.51	13.40	11.52	8.79	8.91	8.83	8.70	7.78
Kansas	10.00	12.67	13.88	13.84	12.35	9.13	9.28	9.07	8.79	8.07
Arkansas	9.93	12.43	14.05	14.12	12.75	9.92	9.81	9.96	9.53	8.60
Mississippi	9.54	12.44	13.41	14.00	12.75	10.08	9.94	9.83	9.43	8.39
Michigan	10.04	12.38	13.74	13.74	12.55	9.54	9.47	9.55	9.33	8.56
Wisconsin	10.02	12.38	13.76	13.89	12.48	9.31	9.36	9.42	9.19	8.34
Kentucky	10.17	12.81	14.27	14.13	12.70	9.85	9.79	9.71	9.53	8.76
Tennessee	10.16	12.60	14.06	14.08	12.59	9.95	9.67	9.70	9.46	8.72
North Carolina	10.29	12.98	14.23	13.96	12.75	9.57	9.55	9.66	9.28	8.56
Louisiana	9.86	12.14	13.86	14.46	12.62	10.26	9.91	9.84	9.41	8.36

Figure 16: Top 5 U.S. States Marketing Year Price, Annual Trends

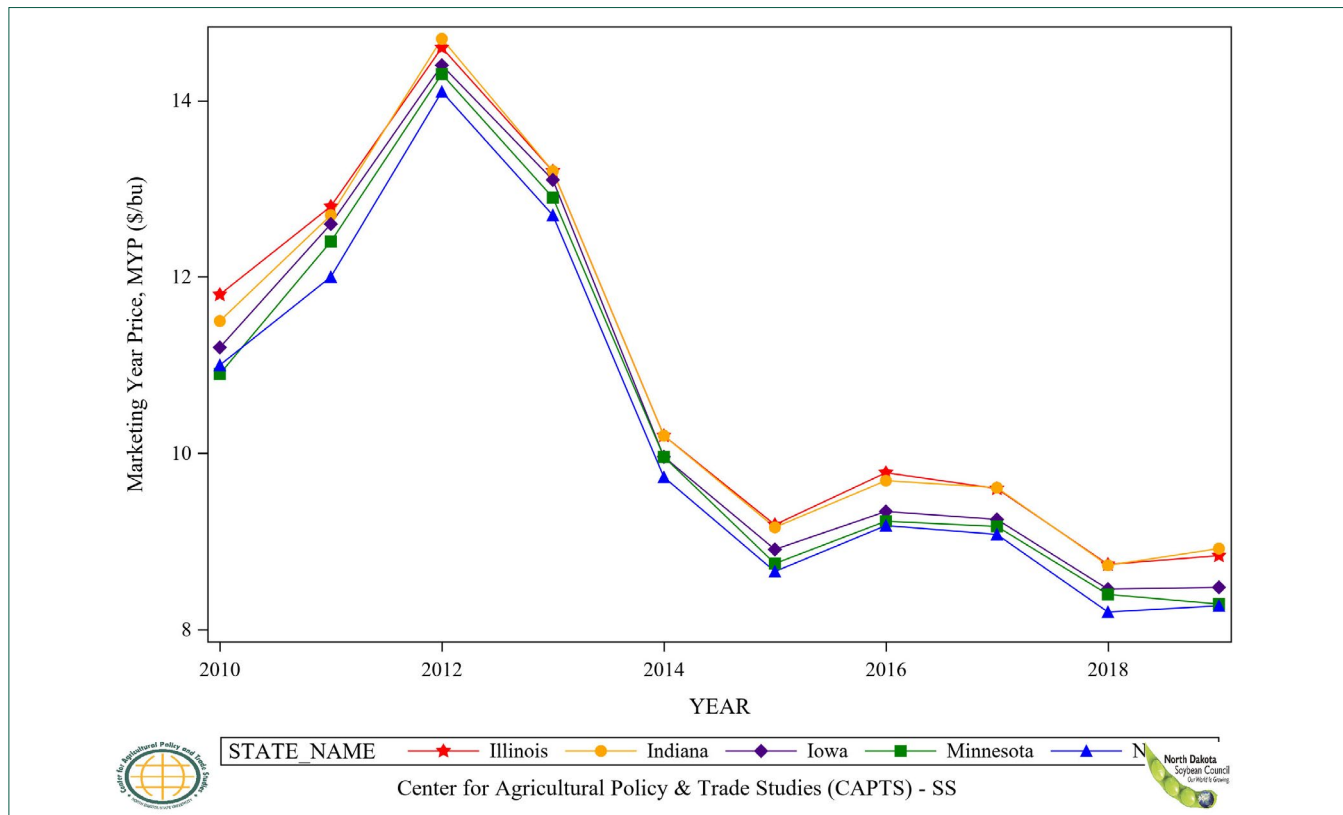


Table 16: Top 15 State Marketing Year Price, Annual Trends

State	Yield (Bu/acre)										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Illinois	11.80	12.80	14.60	13.20	10.20	9.19	9.78	9.60	8.74	8.84	
Iowa	11.20	12.60	14.40	13.10	9.96	8.91	9.34	9.25	8.46	8.48	
Minnesota	10.90	12.40	14.30	12.90	9.96	8.75	9.23	9.17	8.40	8.29	
Nebraska	11.00	12.00	14.10	12.70	9.73	8.66	9.18	9.08	8.20	8.27	
Indiana	11.50	12.70	14.70	13.20	10.20	9.16	9.69	9.61	8.73	8.92	
Ohio	11.50	13.00	14.60	13.00	10.30	9.16	9.66	9.62	8.69	9.04	
Missouri	11.70	12.50	14.50	13.10	9.99	9.16	9.60	9.48	8.56	8.75	
South Dakota	10.90	12.20	14.20	12.50	9.37	8.54	9.03	8.94	7.97	8.22	
North Dakota	10.90	11.90	14.00	12.40	9.49	8.49	8.97	8.88	7.98	7.93	
Kansas	11.50	12.10	14.30	12.80	9.63	8.56	9.26	9.00	7.93	8.28	
Arkansas	10.90	12.30	14.30	13.10	10.60	9.46	9.83	9.77	8.81	8.87	
Mississippi	10.40	12.00	14.50	13.20	11.00	9.72	9.94	9.74	8.85	8.80	
Michigan	11.10	12.10	14.00	12.90	10.10	8.82	9.51	9.39	8.53	8.81	
Wisconsin	10.80	12.40	14.00	12.80	10.00	8.73	9.36	9.34	8.49	8.42	
Kentucky	11.40	12.40	14.50	13.10	10.50	9.24	9.87	9.70	8.79	8.98	
Tennessee	11.10	12.20	14.60	13.00	10.60	9.29	9.78	9.70	8.75	8.96	
North Carolina	12.00	12.10	14.00	13.10	10.20	8.68	9.80	9.50	8.66	8.71	
Louisiana	10.50	12.00	14.70	13.40	10.90	9.74	9.93	9.67	8.95	8.70	
Pennsylvania	12.10	12.50	14.20	13.00	9.80	8.69	9.54	9.34	8.42	8.50	
Virginia	12.00	12.10	14.00	13.00	9.90	8.80	9.40	9.40	8.30	8.80	
Maryland	12.00	12.10	14.20	12.40	9.82	9.11	9.33	9.20	8.12	8.35	
Alabama	11.10	12.00	14.60	12.90	10.00	8.95	9.83	9.43	8.50	9.10	
New York	11.40	12.30	13.60	12.80	9.69	9.10	9.57	9.26	8.20	8.50	
Oklahoma	11.40	11.90	14.40	12.90	9.90	8.80	9.40	9.10	7.89	8.45	
South Carolina	11.80	12.00	14.50	13.30	10.30	8.65	9.68	9.52	9.10	9.20	
Georgia	11.70	12.10	14.60	13.30	10.50	9.25	10.10	9.62	7.90	8.95	
Delaware	12.20	12.20	14.40	12.40	9.60	9.17	9.44	9.19	8.25	8.35	
Texas	10.40	12.00	14.60	12.60	9.55	8.40	9.16	8.90	7.59	7.70	
New Jersey	11.70	12.10	13.90	12.40	9.85	8.64	9.59	9.30	7.98	8.45	
West Virginia	12.00	12.40	14.30	12.90	10.00	8.80	9.40	9.40	8.50	8.50	
Florida	11.00	11.00	14.00	11.80	8.90	8.00	8.75	8.85	8.10	8.10	



Section III

North Dakota Counties Trend and Risk

Figure 17: North Dakota Planted Acreage, Harvested Acreage, Production and Yield, Annual Trends

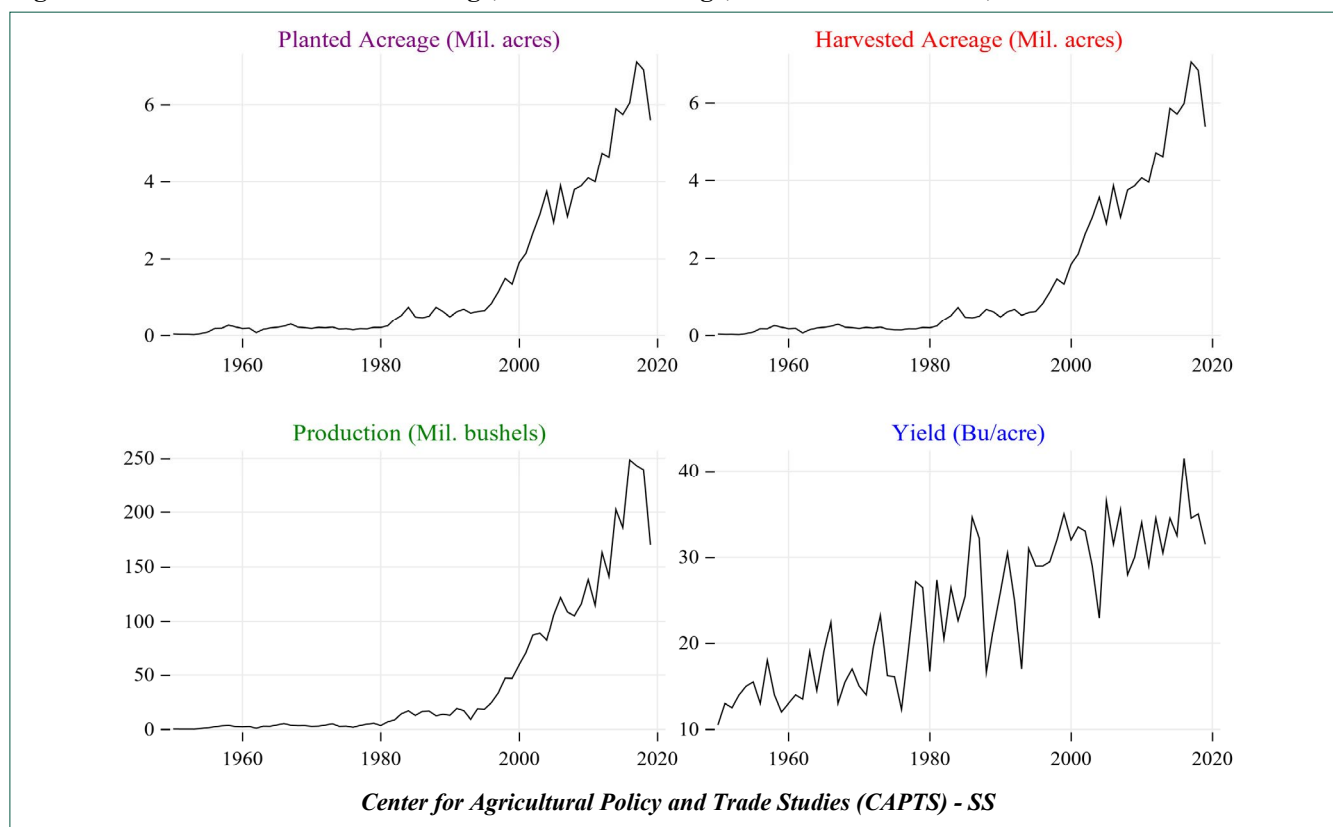


Table 17: North Dakota Production Indicators, Annual Trends

Year	Planted (Acres)	Harvested (Acres)	Production (Bushels)	Yield (Bu/acre)
2000	1,900,000	1,850,000	59,200,000	32.0
2001	2,150,000	2,110,000	70,685,000	33.5
2002	2,670,000	2,630,000	86,790,000	33.0
2003	3,150,000	3,050,000	88,450,000	29.0
2004	3,750,000	3,570,000	82,110,000	23.0
2005	2,950,000	2,900,000	105,850,000	36.5
2006	3,900,000	3,870,000	121,905,000	31.5
2007	3,100,000	3,060,000	108,630,000	35.5
2008	3,800,000	3,760,000	105,280,000	28.0
2009	3,900,000	3,870,000	116,100,000	30.0
2010	4,100,000	4,070,000	138,380,000	34.0
2011	4,000,000	3,960,000	114,840,000	29.0
2012	4,750,000	4,730,000	163,185,000	34.5
2013	4,650,000	4,630,000	141,215,000	30.5
2014	5,900,000	5,870,000	202,515,000	34.5
2015	5,750,000	5,720,000	185,900,000	32.5
2016	6,050,000	5,990,000	248,585,000	41.5
2017	7,100,000	7,050,000	243,225,000	34.5
2018	6,900,000	6,840,000	239,400,000	35.0
2019	5,600,000	5,400,000	170,100,000	31.5

Figure 18: North Dakota Revenue and Prices, Marketing and Calendar Year, Annual Trends

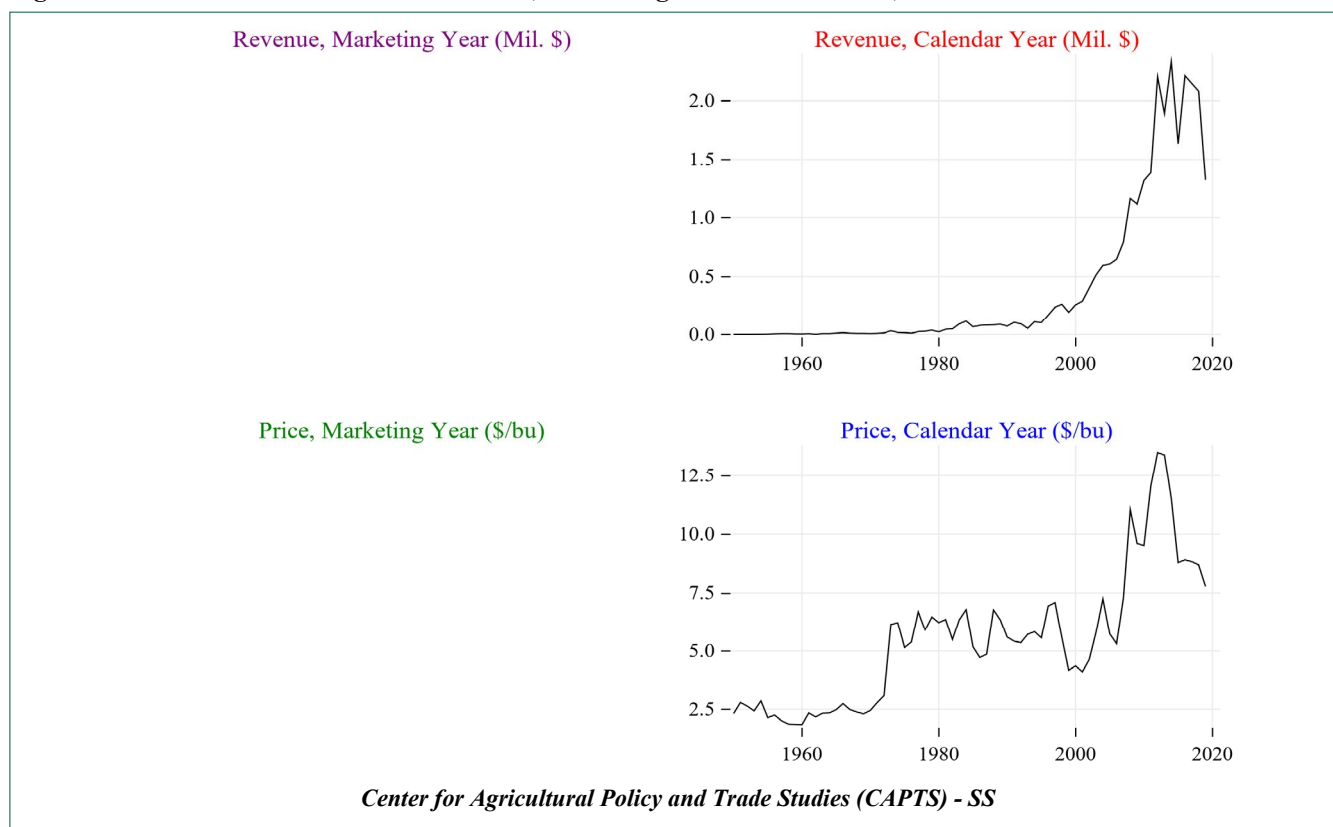


Table 18: North Dakota Production Indicators, Annual Trends

Year	Revenue (Marketing) (\$)	Revenue (Calendar) (\$)	Marketing Year Price, MYP (\$/bu)	Calendar Year Price, CYP (\$/bu)
2000	250,416,000	257,914,667	4.23	4.36
2001	286,274,250	289,690,692	4.05	4.10
2002	461,722,800	401,982,350	5.32	4.63
2003	585,539,000	513,525,958	6.62	5.81
2004	472,132,500	594,955,375	5.75	7.25
2005	568,414,500	606,608,708	5.37	5.73
2006	728,991,900	647,315,550	5.98	5.31
2007	1,046,106,900	792,184,275	9.63	7.29
2008	1,022,268,800	1,162,378,933	9.71	11.0
2009	1,075,086,000	1,115,334,000	9.26	9.61
2010	1,508,342,000	1,316,801,017	10.9	9.52
2011	1,366,596,000	1,381,908,000	11.9	12.0
2012	2,284,590,000	2,204,357,375	14.0	13.5
2013	1,751,066,000	1,892,281,000	12.4	13.4
2014	1,921,867,350	2,332,972,800	9.49	11.5
2015	1,578,291,000	1,633,906,083	8.49	8.79
2016	2,229,807,450	2,214,478,042	8.97	8.91
2017	2,159,838,000	2,147,474,063	8.88	8.83
2018	1,910,412,000	2,081,583,000	7.98	8.70
2019	1,348,893,000	1,323,094,500	7.93	7.78

Figure 19: Top 5 North Dakota Counties Planted Acreage, Annual Trends

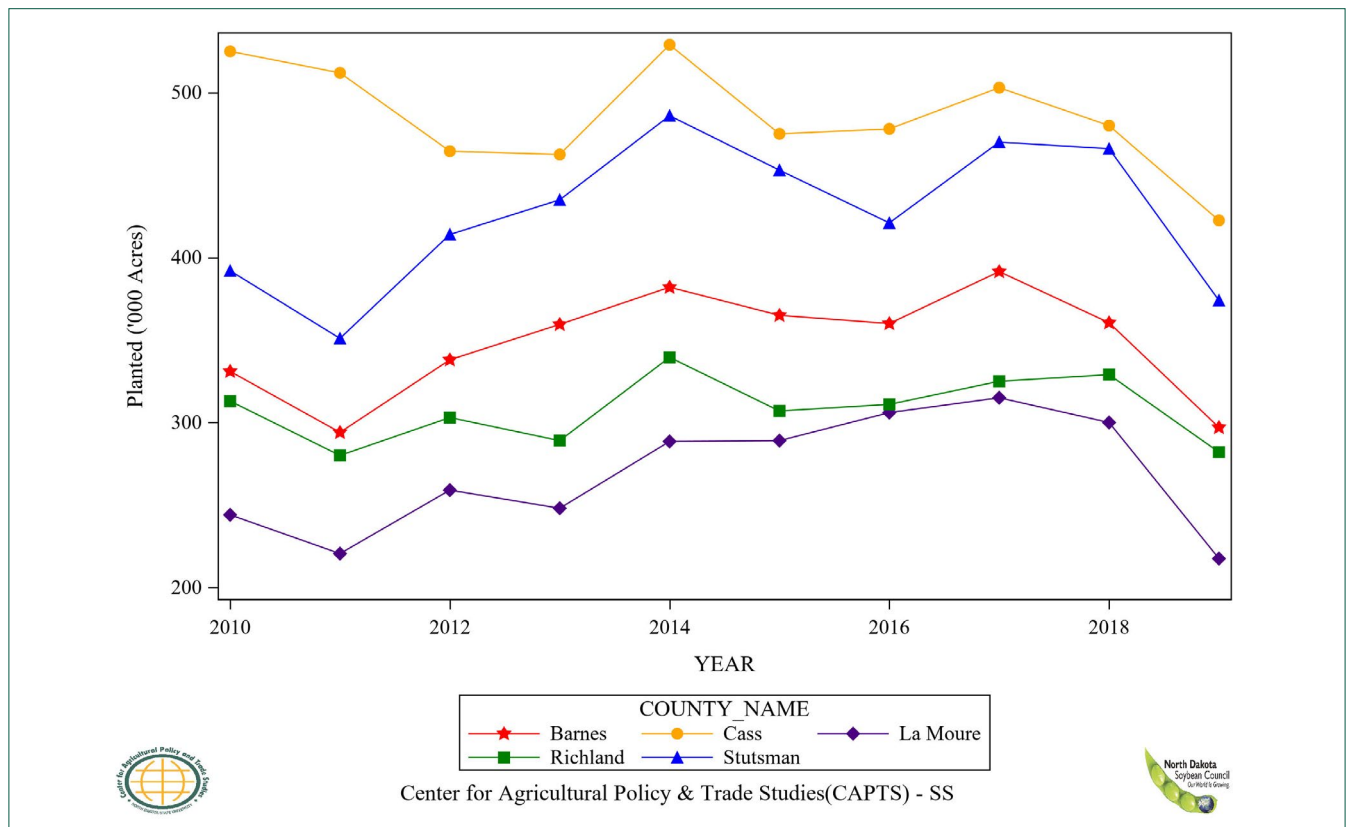


Table 19: Top 15 North Dakota Counties Planted Acreage, Annual Trends

State	Planted (Acres)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cass	525,000	512,000	464,500	462,500	529,000	475,000	478,000	503,000	480,000	422,500
Stutsman	392,000	351,000	414,000	435,000	486,000	453,000	421,000	470,000	466,000	374,000
Barnes	331,000	294,000	338,000	359,500	382,000	365,000	360,000	391,500	360,500	297,000
Richland	313,000	280,000	303,000	289,000	339,500	307,000	311,000	325,000	329,000	282,000
LaMoure	244,000	220,500	259,000	248,000	288,500	289,000	306,000	315,000	300,000	217,500
Traill	191,000	183,500	195,500	183,000	209,500	205,000	203,000	225,500	193,500	162,500
Dickey	147,000	140,000	179,000	183,000	218,000	171,000	194,000	206,000	216,500	137,500
Wells	158,000	173,000	191,500	181,000	223,000	214,500	211,500	235,000	236,000	197,500
Sargent	146,500	137,000	162,500	166,000	178,000	170,500	183,000	190,500	191,000	140,000
Grand Forks	137,000	166,000	170,000	148,000	196,500	191,500	203,000	248,000	226,000	187,500
Steele	145,000	150,000	161,000	158,500	177,500	171,000	160,000	178,500	168,500	144,500
Ransom	106,000	98,500	122,000	.	142,000	133,000	143,000	152,500	150,000	108,000
Pembina	98,000	114,000	124,000	119,000	159,000	148,000	177,500	211,000	162,000	128,000
Benson	123,000	140,000	155,000	127,000	179,000	177,500	176,000	200,000	199,000	.
Griggs	104,000	95,500	125,000	120,500	129,000	117,000	126,000	127,500	128,500	109,500

Figure 20: Top 5 North Dakota Counties Harvested Acreage, Annual Trends

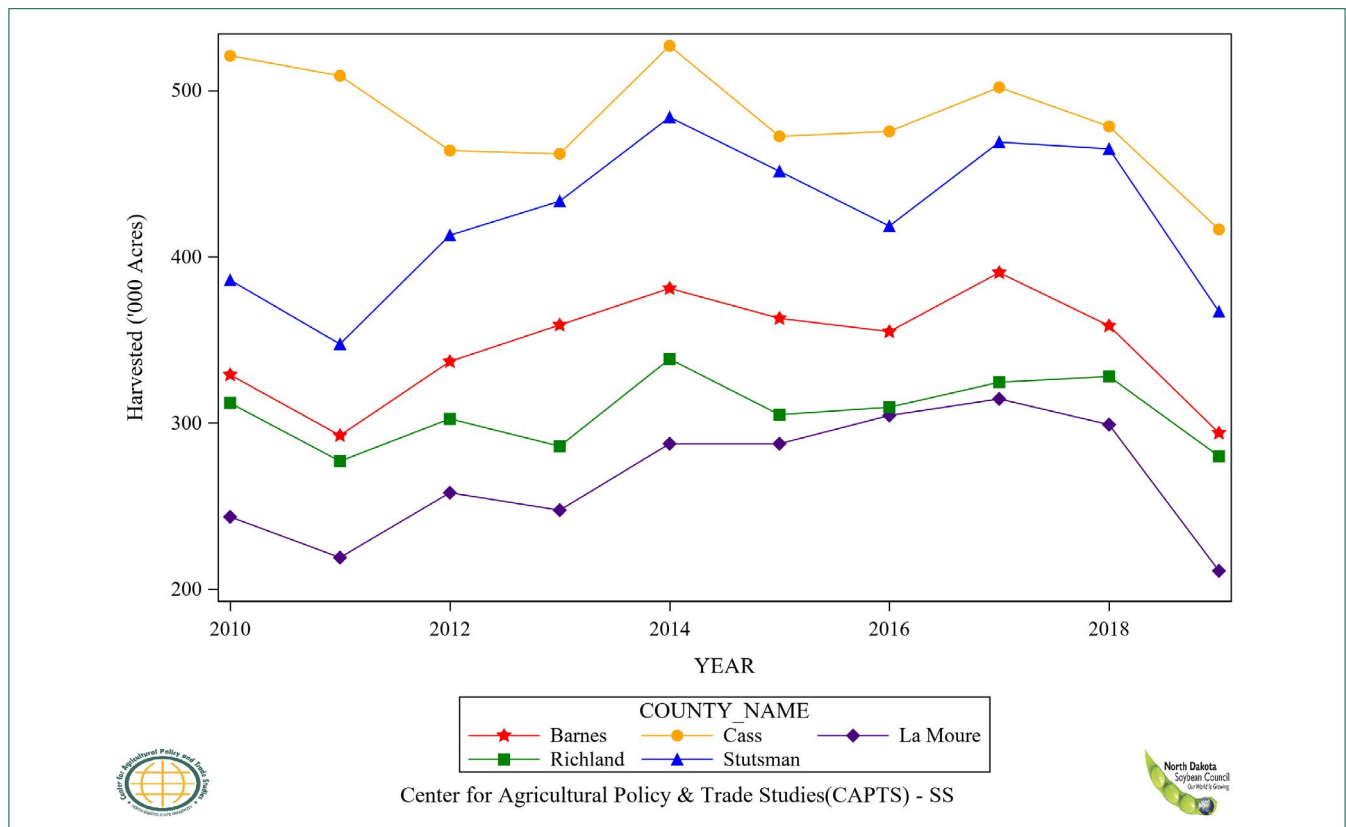


Table 20: Top 15 North Dakota Counties Harvested Acreage, Annual Trends

State	Harvested (Acres)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cass	521,000	509,000	464,000	462,000	527,000	472,500	475,500	502,000	478,500	416,500
Stutsman	386,000	347,500	413,000	433,500	484,000	451,500	418,500	469,000	465,000	367,000
Barnes	329,000	292,500	337,000	359,000	381,000	363,000	355,000	390,500	358,500	294,000
Richland	312,000	277,000	302,500	286,000	338,500	305,000	309,500	324,500	328,000	280,000
LaMoure	243,500	219,000	258,000	247,500	287,500	287,500	304,500	314,500	299,000	211,000
Traill	190,900	182,400	195,300	181,500	208,500	204,000	198,000	225,000	192,500	158,500
Dickey	145,600	138,300	178,100	181,500	217,500	170,100	192,500	205,500	215,500	135,000
Wells	155,500	170,500	191,100	180,700	222,000	213,500	210,000	234,500	234,500	190,000
Sargent	146,300	135,700	162,200	165,000	177,500	169,600	181,800	190,000	190,000	138,000
Grand Forks	136,600	165,300	169,800	147,900	196,000	191,000	201,000	247,500	224,500	184,000
Steele	144,800	149,100	158,600	158,400	177,000	170,000	158,800	178,000	167,500	141,500
Ransom	104,500	96,800	121,900	.	141,500	132,400	141,900	152,000	149,100	107,000
Pembina	97,300	113,500	123,500	118,600	157,700	147,500	175,200	209,000	161,200	123,500
Benson	122,700	139,000	154,500	126,000	178,000	176,800	173,800	199,000	196,500	.
Griggs	103,300	93,000	124,100	120,100	128,500	115,500	124,700	122,500	126,000	105,500

Figure 21: Top 5 North Dakota Counties Production, Annual Trends

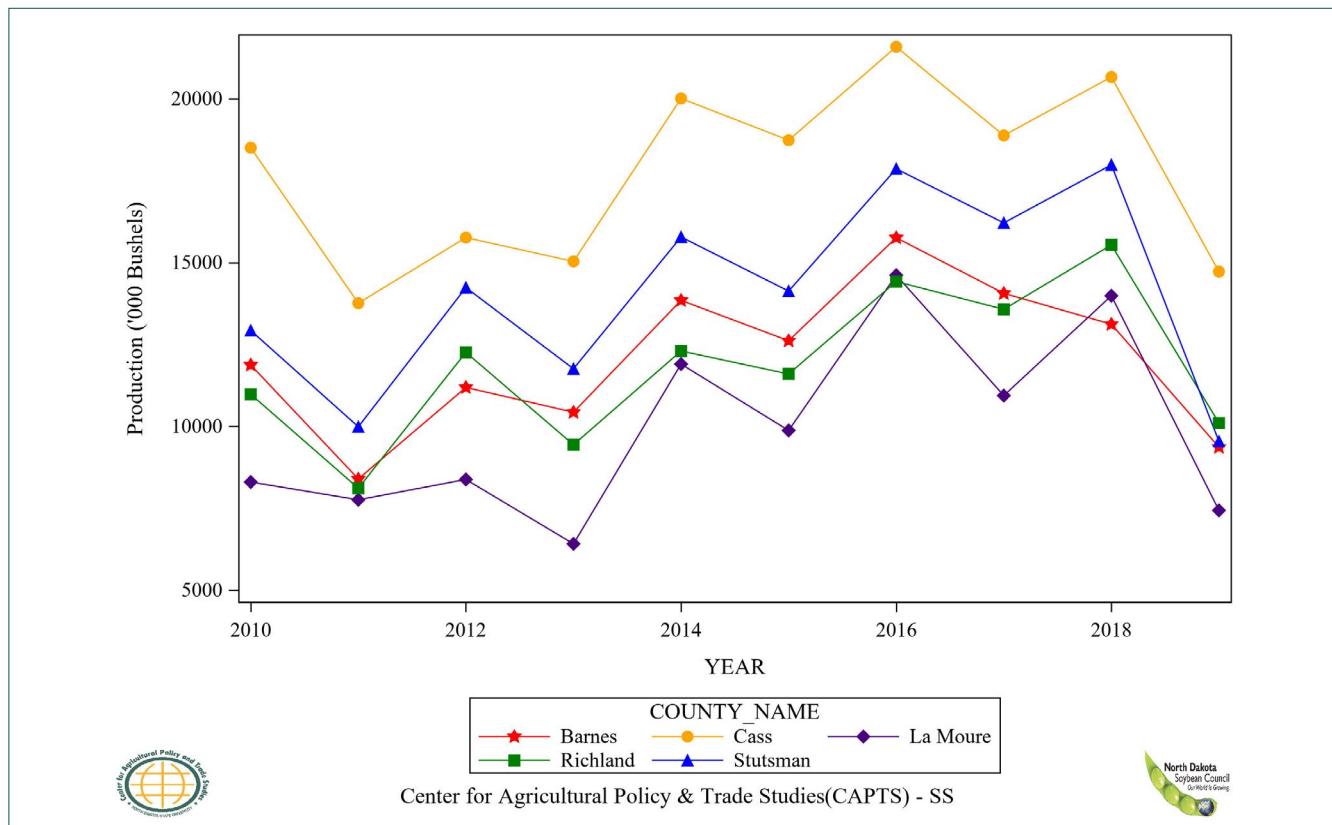


Table 21: Top 15 North Dakota Counties Production, Annual Trends

State	Production (Bushels)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cass	18,505,000	13,760,000	15,763,000	15,036,000	20,011,000	18,735,000	21,586,000	18,880,000	20,666,000	14,724,000
Stutsman	12,927,000	9,987,000	14,236,000	11,757,000	15,782,000	14,128,000	17,863,000	16,210,000	17,984,000	9,542,000
Barnes	11,874,000	8,394,000	11,189,000	10,432,000	13,846,000	12,614,000	15,760,000	14,060,000	13,118,000	9,365,000
Richland	10,980,000	8,110,000	12,259,000	9,438,000	12,300,000	11,598,000	14,420,000	13,572,000	15,540,000	10,102,000
LaMoure	8,300,000	7,758,000	8,379,000	6,412,000	11,900,000	9,875,000	14,614,000	10,939,000	13,986,000	7,434,000
Traill	7,256,000	4,995,000	6,778,000	5,999,000	7,378,000	7,755,000	9,167,000	8,530,000	8,044,000	5,728,000
Dickey	5,028,000	4,194,000	6,083,000	5,359,000	8,379,000	5,705,000	8,858,000	8,303,000	9,327,000	4,789,000
Wells	5,016,000	4,798,000	7,101,000	6,206,000	7,230,000	5,891,000	8,362,000	8,276,000	7,088,000	5,972,000
Sargent	5,232,000	3,950,000	5,858,000	5,666,000	6,881,000	6,076,000	8,671,000	8,360,000	9,175,000	5,493,000
Grand Forks	4,500,000	4,638,000	6,321,000	5,066,000	6,493,000	6,424,000	8,077,000	8,786,000	7,830,000	6,162,000
Steele	5,087,000	3,886,000	5,356,000	5,419,000	5,922,000	6,322,000	6,987,000	6,642,000	6,564,000	4,435,000
Ransom	3,800,000	3,281,000	5,156,000	.	5,856,000	5,028,000	6,993,000	6,709,000	6,901,000	4,369,000
Pembina	3,250,000	3,194,000	4,620,000	3,990,000	4,837,000	5,394,000	6,535,000	7,195,000	5,141,000	2,755,000
Benson	3,834,000	4,095,000	4,975,000	3,936,000	5,584,000	4,517,000	6,673,000	6,593,000	5,778,000	.
Griggs	3,677,000	2,533,000	4,172,000	3,649,000	4,208,000	3,987,000	5,389,000	4,498,000	4,850,000	3,542,000

Figure 22: Top 5 North Dakota Counties Yield, Annual Trends

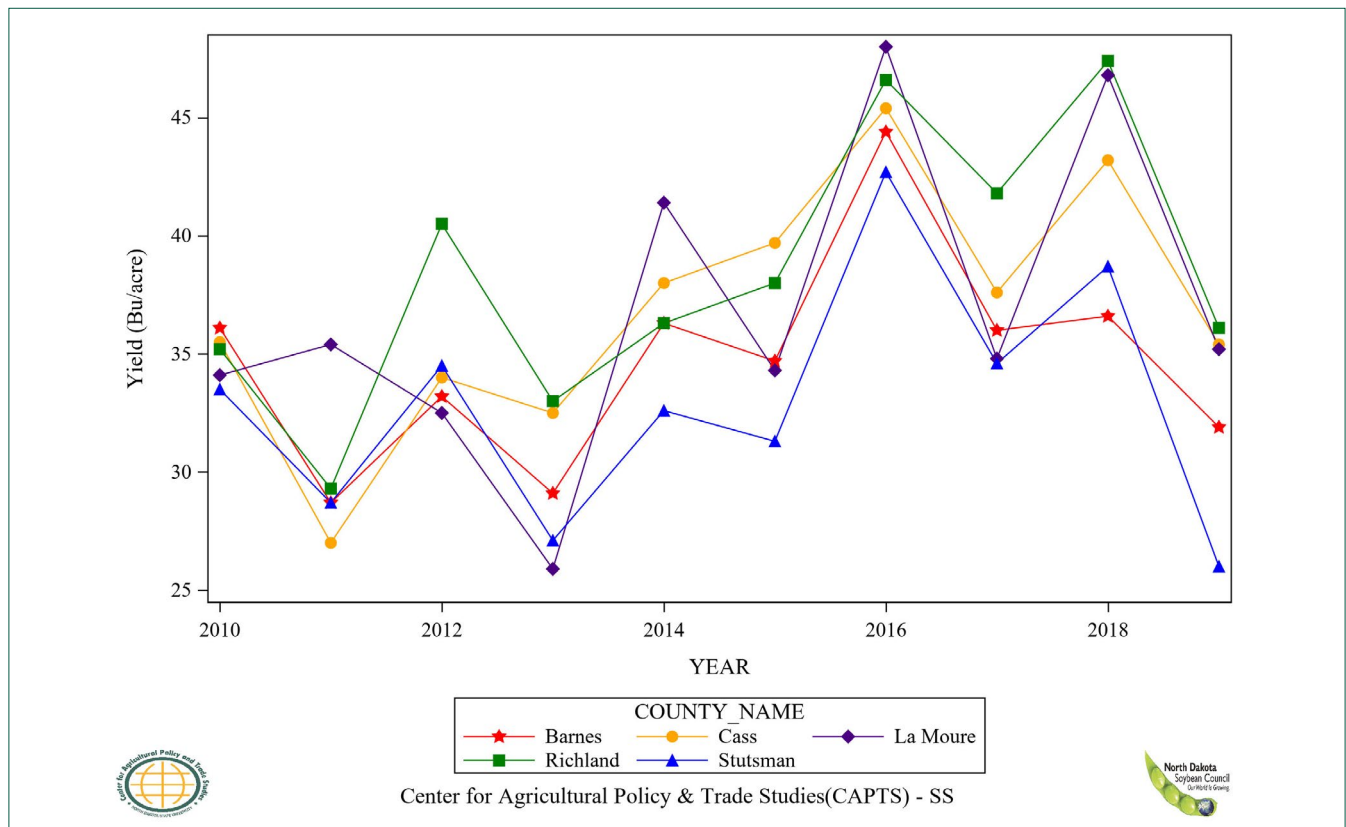


Table 22: Top 15 North Dakota Counties Yield, Annual Trends

State	Yield (Bu/acre)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cass	35.50	27.00	34.00	32.50	38.00	39.70	45.40	37.60	43.20	35.40
Stutsman	33.50	28.70	34.50	27.10	32.60	31.30	42.70	34.60	38.70	26.00
Barnes	36.10	28.70	33.20	29.10	36.30	34.70	44.40	36.00	36.60	31.90
Richland	35.20	29.30	40.50	33.00	36.30	38.00	46.60	41.80	47.40	36.10
LaMoure	34.10	35.40	32.50	25.90	41.40	34.30	48.00	34.80	46.80	35.20
Traill	38.00	27.40	34.70	33.10	35.40	38.00	46.30	37.90	41.80	36.10
Dickey	34.50	30.30	34.20	29.50	38.50	33.50	46.00	40.40	43.30	35.50
Wells	32.30	28.10	37.20	34.30	32.60	27.60	39.80	35.30	30.20	31.40
Sargent	35.80	29.10	36.10	34.30	38.80	35.80	47.70	44.00	48.30	39.80
Grand Forks	32.90	28.10	37.20	34.30	33.10	33.60	40.20	35.50	34.90	33.50
Steele	35.10	26.10	33.80	34.20	33.50	37.20	44.00	37.30	39.20	31.30
Ransom	36.40	33.90	42.30	.	41.40	38.00	49.30	44.10	46.30	40.80
Pembina	33.40	28.10	37.40	33.60	30.70	36.60	37.30	34.40	31.90	22.30
Benson	31.20	29.50	32.20	31.20	31.40	25.50	38.40	33.10	29.40	.
Griggs	35.60	27.20	33.60	30.40	32.70	34.50	43.20	36.70	38.50	33.60



Section IV

Variance Decomposition and Sources of Variation

Figure 23: State Level Variance Decomposition, Planted Acreage Trends

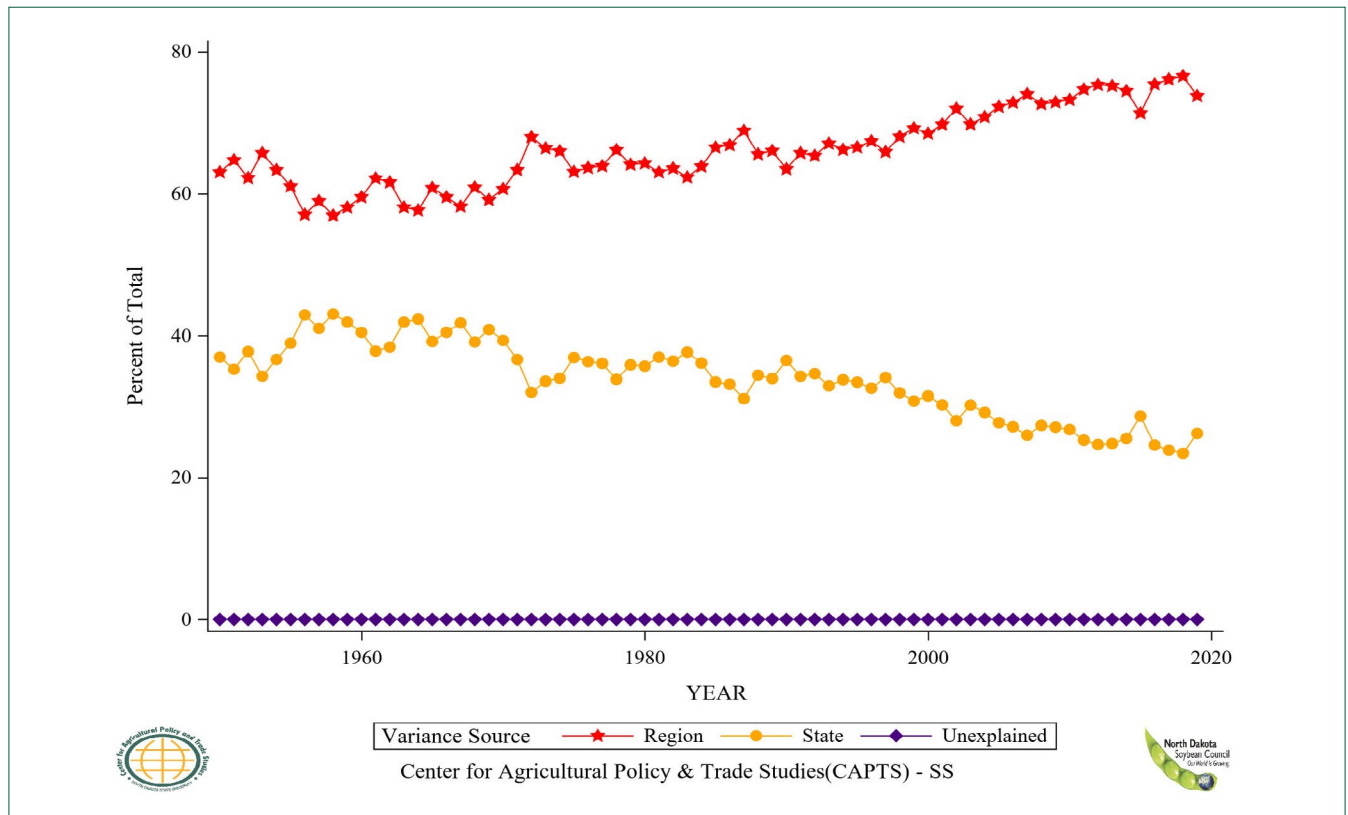


Figure 24: State Level Variance Decomposition, Harvested Acreage Trends

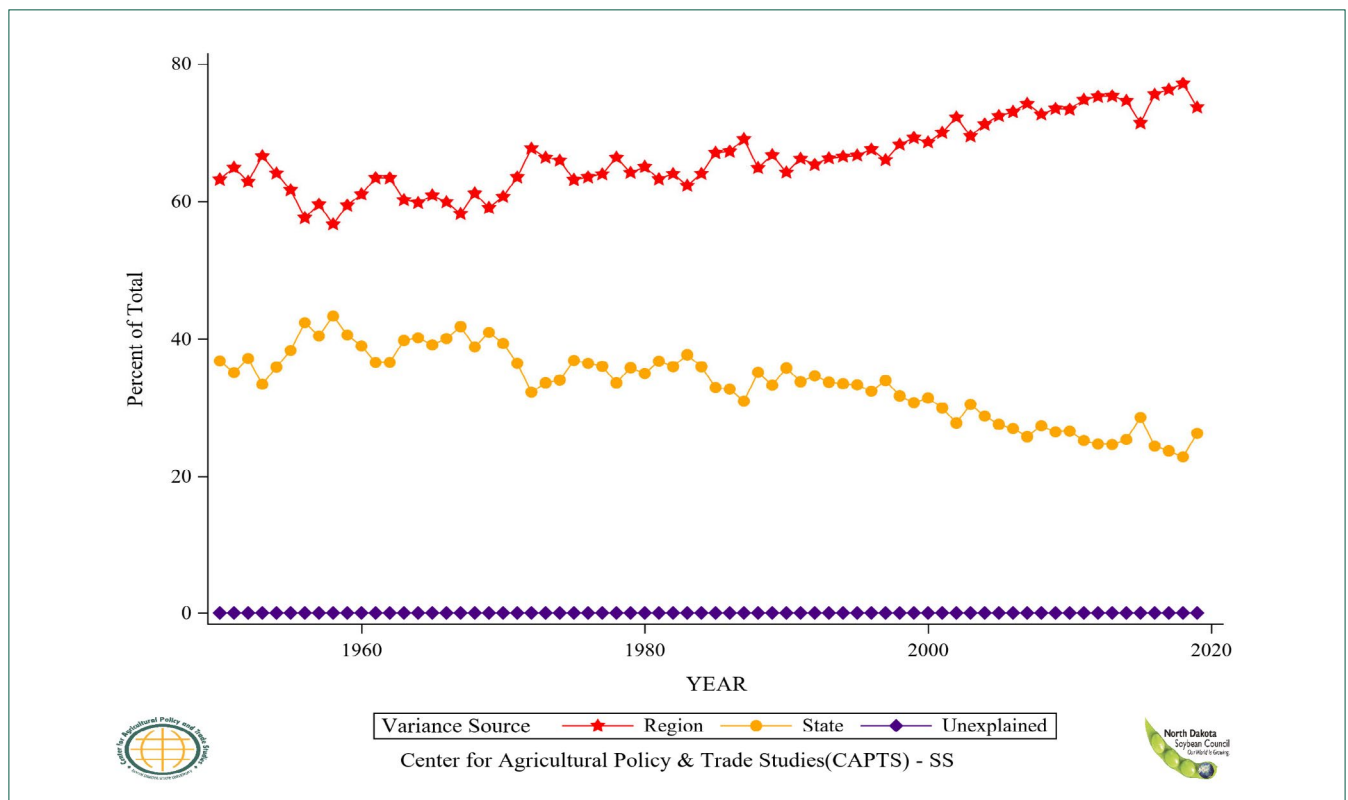


Figure 25: State Level Variance Decomposition, Production Trends

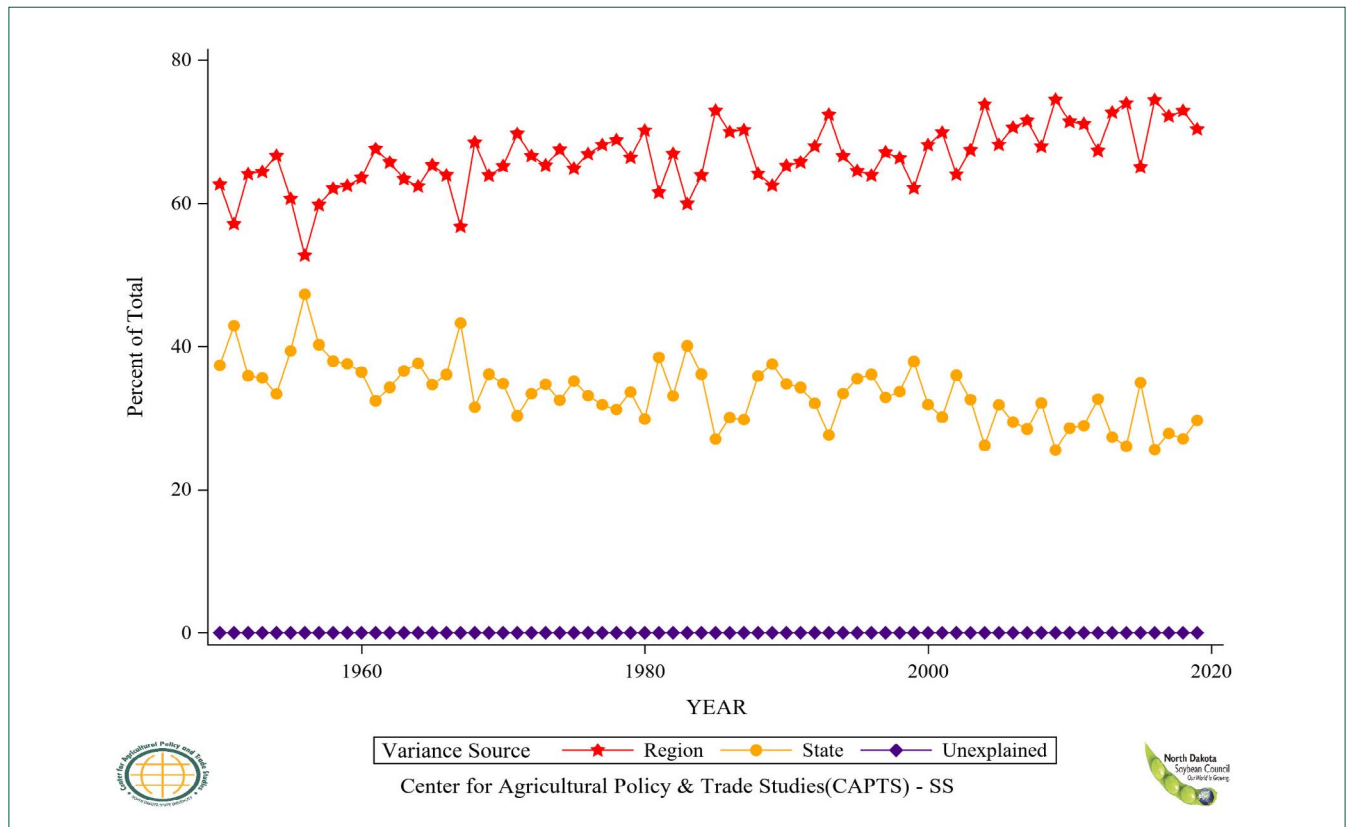


Figure 26: State Level Variance Decomposition, Yields Trends

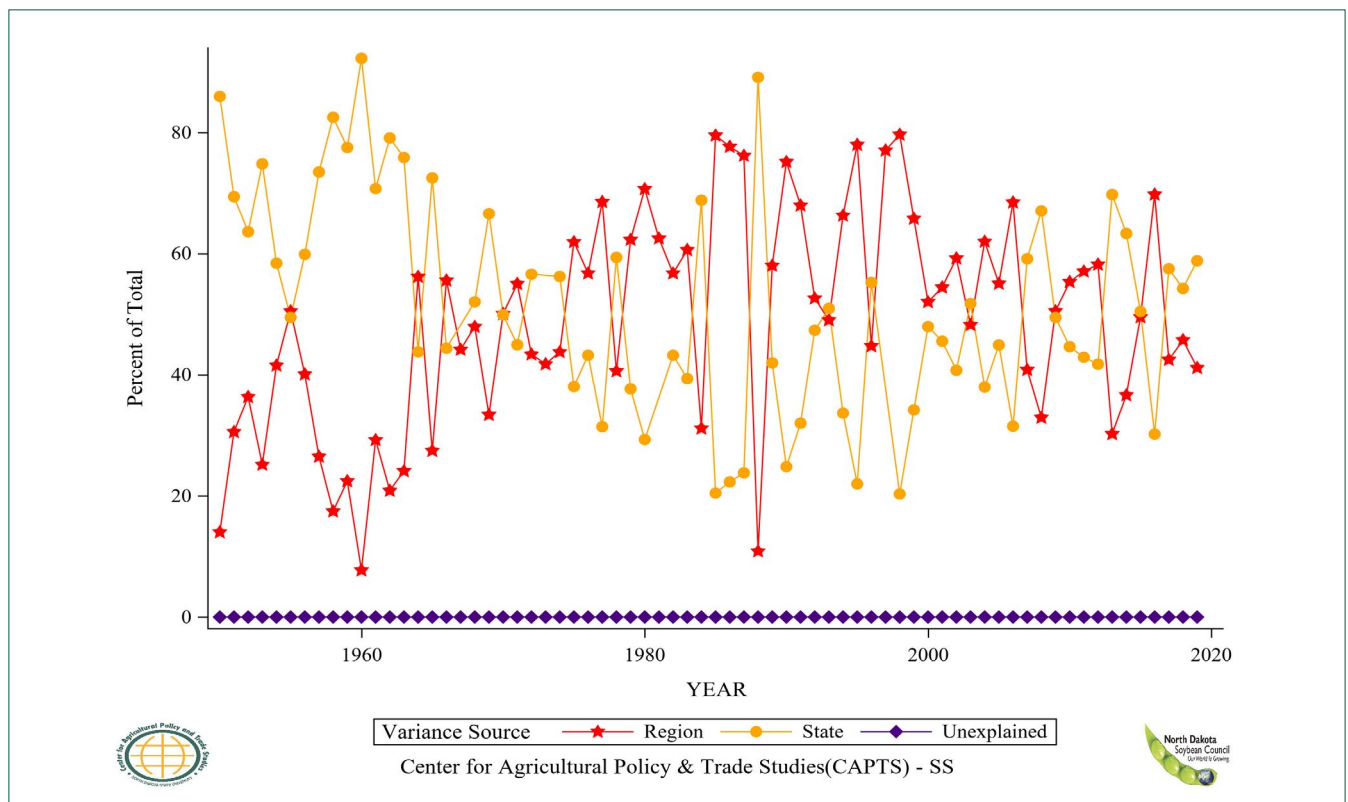


Figure 27: State Level Variance Decomposition, Revenue Trends

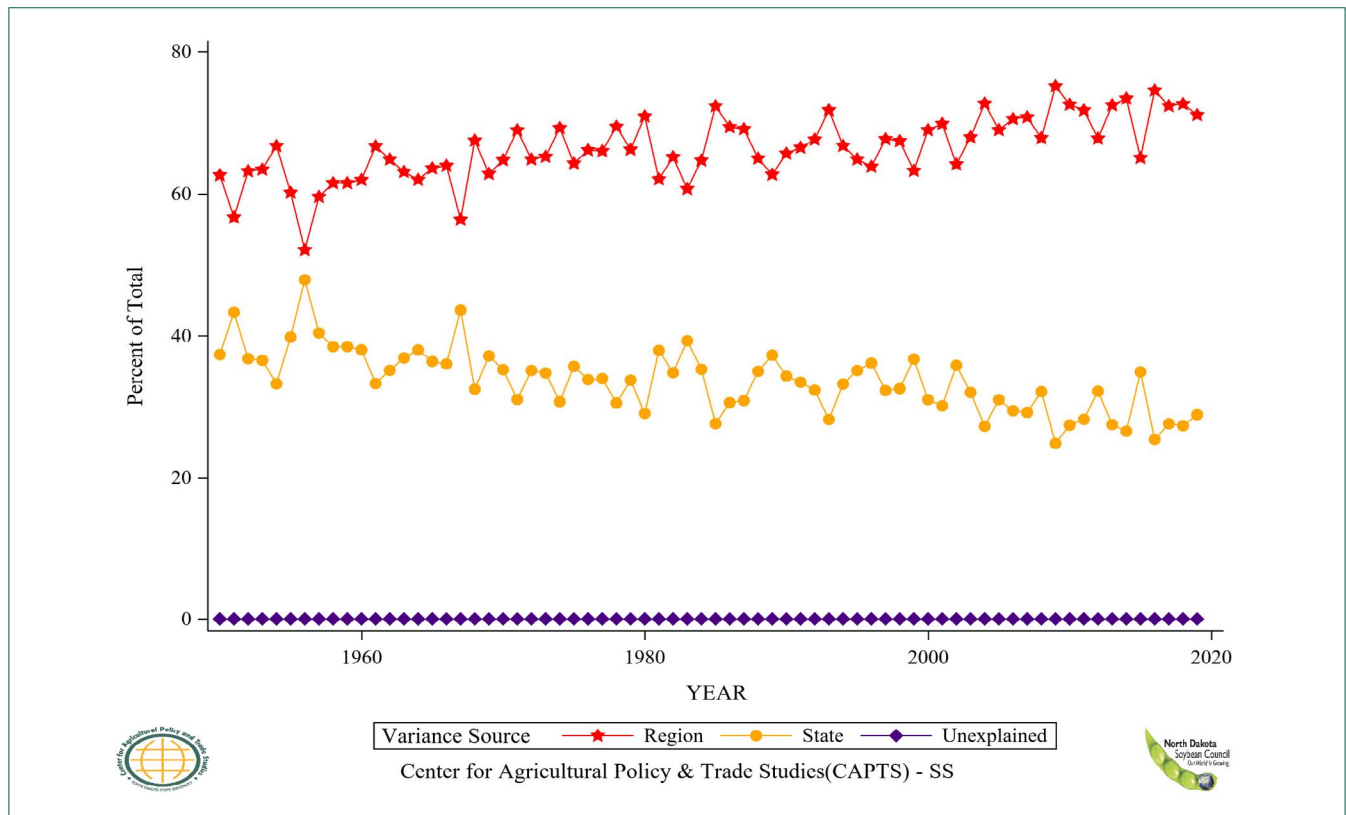


Figure 28: State Level Variance Decomposition, Price Trends

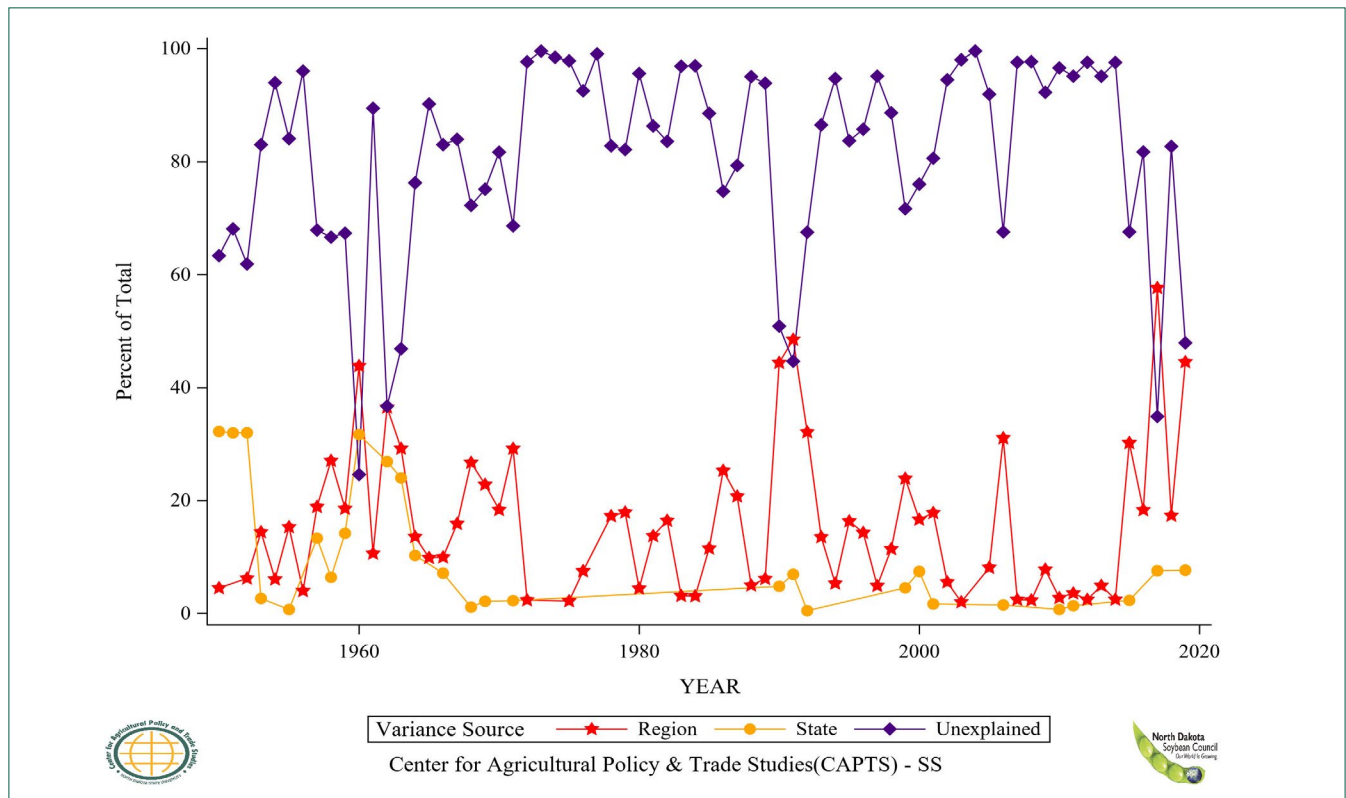


Figure 29: County Level Variance Decomposition, Planted Acreage Trends

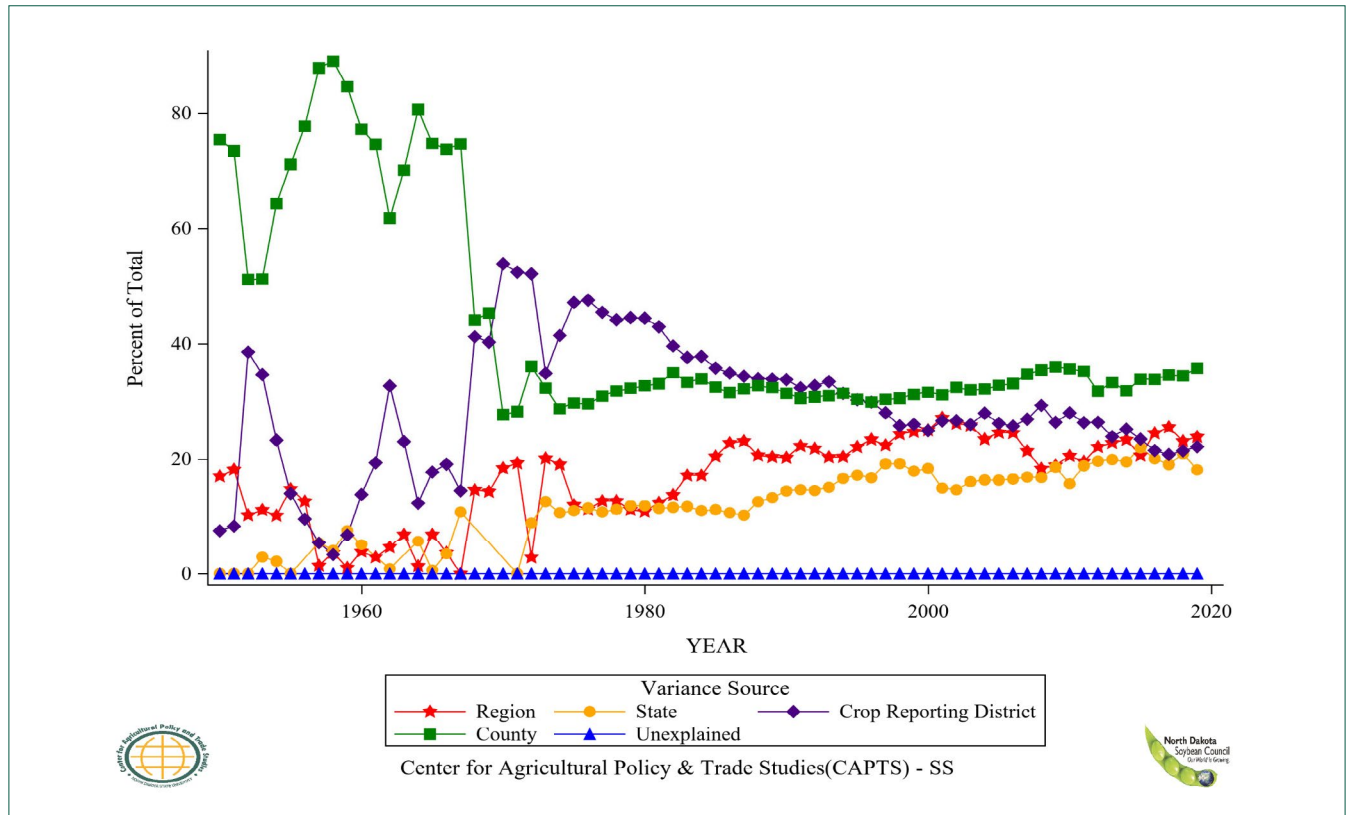


Figure 30: County Level Variance Decomposition, Harvested Acreage Trends

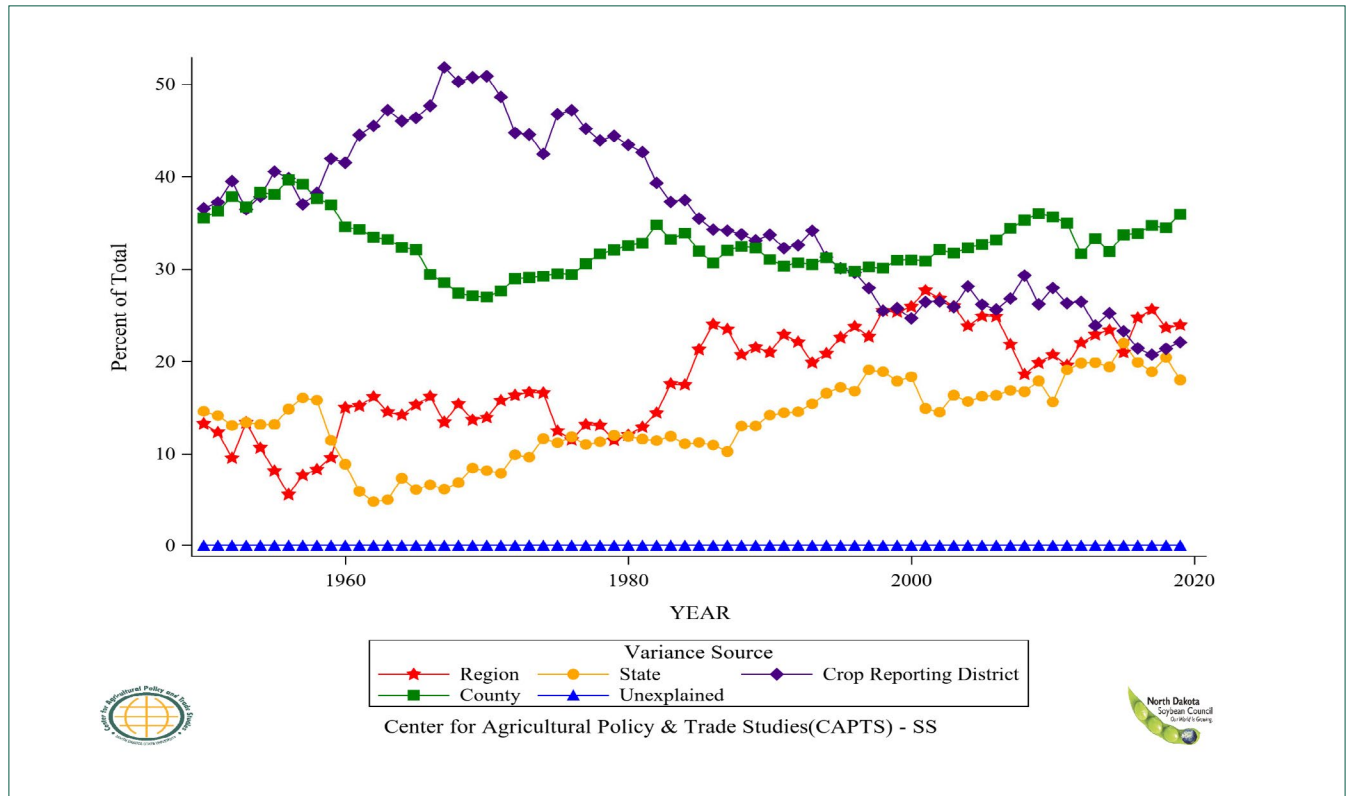


Figure 31: County Level Variance Decomposition, Production Trends

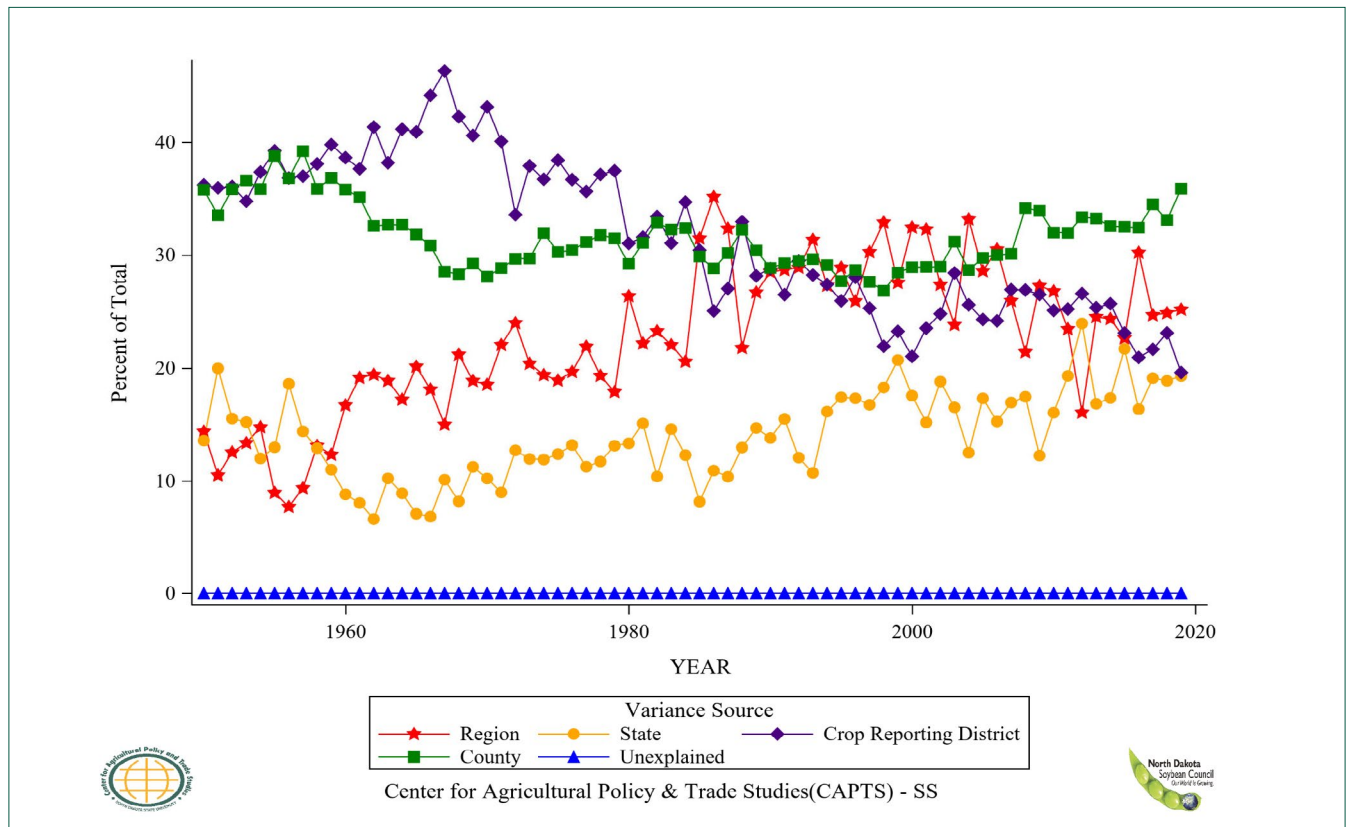
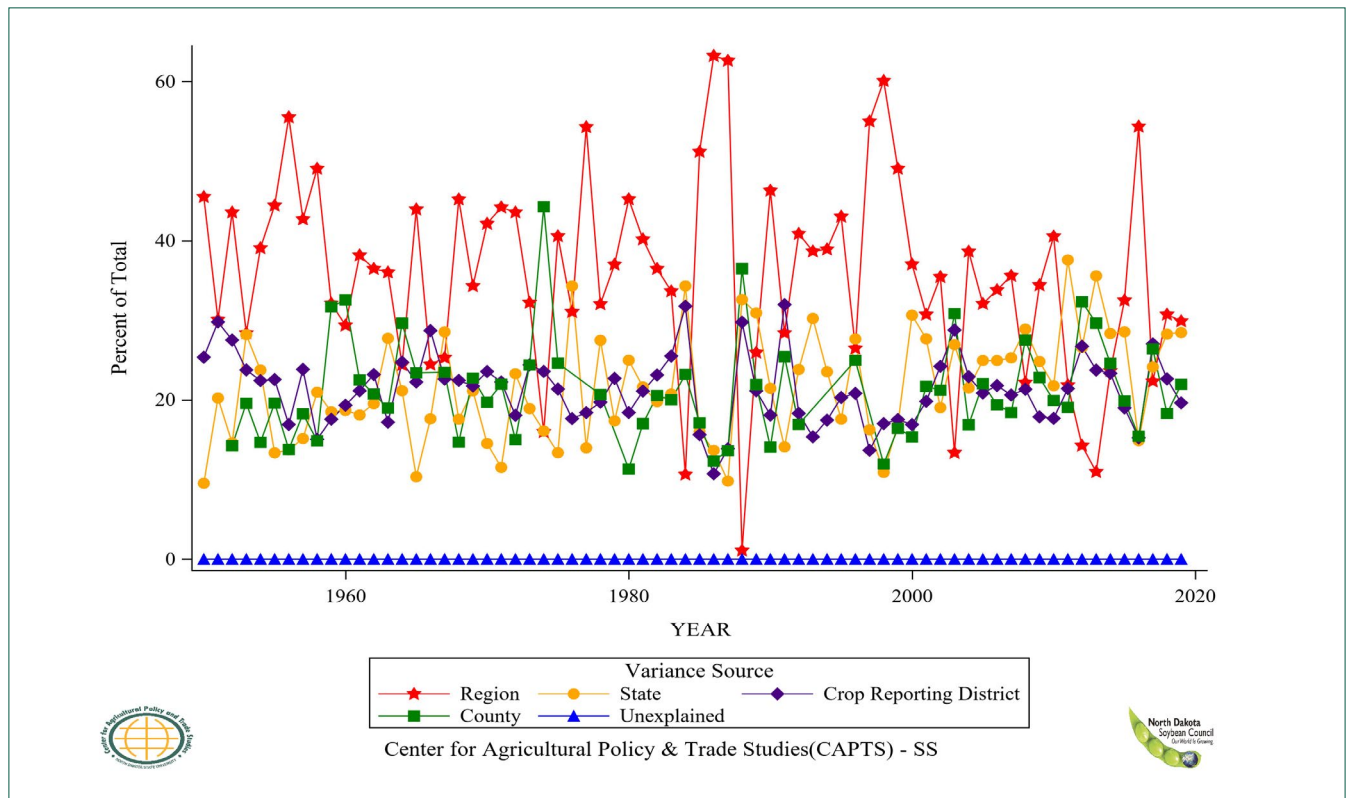


Figure 32: County Level Variance Decomposition, Yield Trends



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