NDSU AGRICULTURAL RISK POLICY CENTER

Are Crop Yields Becoming More Stable and Higher? Evidence from U.S. County-Level Data Since 1980

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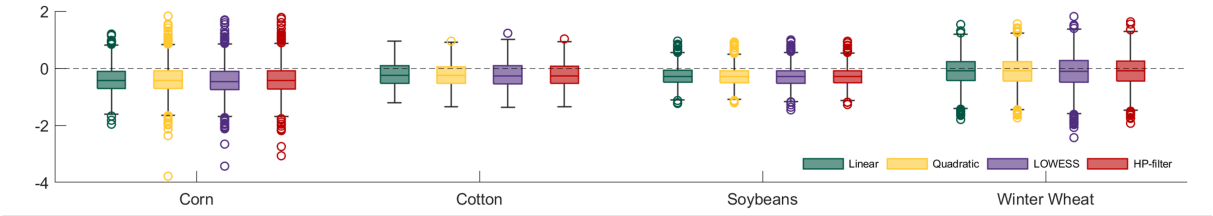
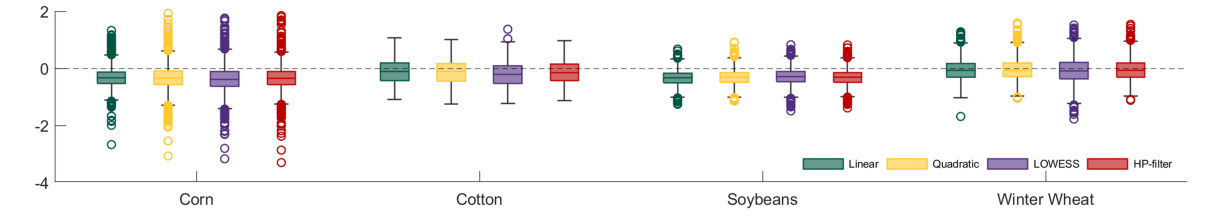
Accurately measuring crop yield volatility, meaning how much crop yields fluctuate from year to year, is essential for agricultural risk management and program design. This work relies heavily on historical yield data to understand crop yield risk and raises the question of whether data from earlier decades still reflect the risks faced under current agricultural production conditions. This brief examines county-level yield volatility across major crops since 1980 and finds substantial changes over time and across regions. These findings highlight potential bias in relying on historical yield data and underscore the need for further research to develop methods that better measure yield risk under current conditions, in order to better support farm revenue analysis and agricultural policy program design for both producers and policymakers.

To examine changes in crop yield volatility, economists at ARPC compiled county-level yield data from 1980 to 2024 from USDA NASS for four major crops: corn, cotton, soybeans, and winter wheat. Following the method in Cooper and Delbecq (2014), we calculated the difference between actual crop yields and model-predicted yields that capture the long-term growth trend. These differences reflect deviations from the trend and capture year-to-year yield volatility. We then divided the full sample into two time periods and compared standard statistical measures of volatility for each county across the two periods.

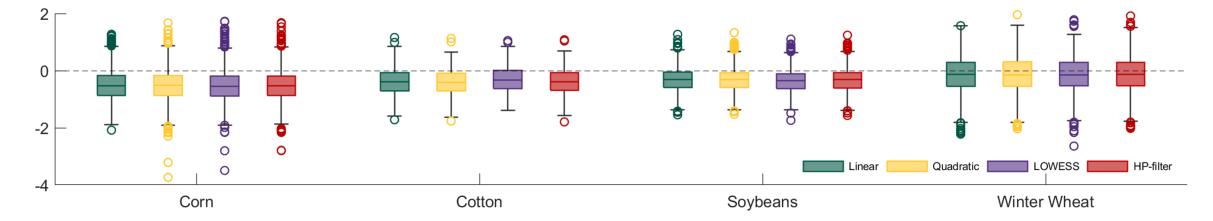
Figure 1: *Declining Volatility in County-Level Yields Across Major Crops*



(a) Standard Deviation



(b) Upper Tail



(c) Lower Tail

Source: Agricultural Risk Policy Center (ARPC), using data from the U.S. Department of Agriculture, National Agricultural Statistics Service (USDA NASS).

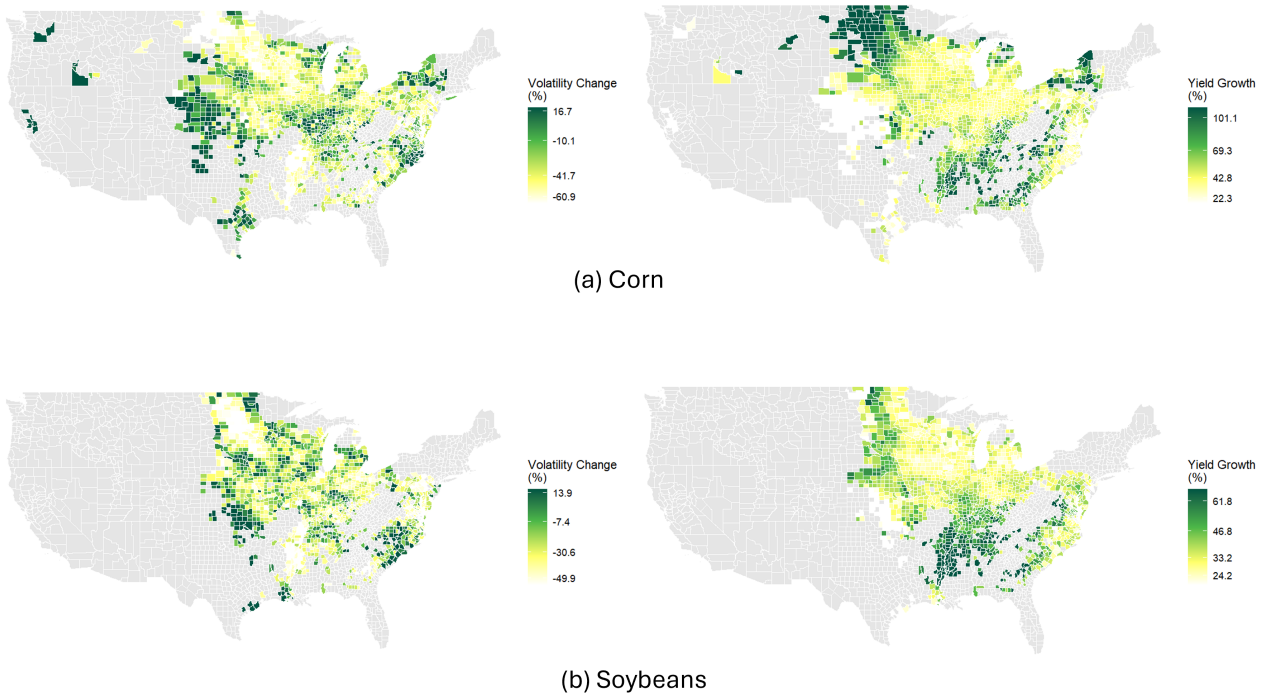
Note: Figure 1 presents boxplots of county-level relative volatility changes between the later and earlier periods. The measure is reported in log form, so that positive values indicate increasing volatility, while negative values indicate declining volatility. Linear, quadratic, LOWESS, and HP-filter represent different methods used to remove long-term trends from yield data.

Across the major U.S. crops, corn, cotton, and soybeans show declining yield volatility. As shown in Figure 1, more than 75 percent of counties growing these crops experienced a decline in yield volatility from the earlier period to the later period. The consistent patterns across different detrending methods indicate that the decline is not driven by the choice of trend method. Similar patterns are observed for both unusually high yields (upper tail) and unusually low yields (lower tail). In contrast, winter wheat shows a much weaker decline over time, suggesting little systematic change in yield volatility for that crop.

To examine how these changes vary across regions, we focus on the two largest U.S. crops, corn and soybeans, and map county-level changes in yield volatility. The results show that changes in yield volatility are clustered geographically, with substantial differences across regions. As shown in Figure 2, the largest declines in volatility appear across the Upper Midwest and central Corn Belt, including parts of the Dako-

tas, Minnesota, Iowa, and Illinois, where yields have become more stable in the later period. In contrast, counties with relatively higher or increasing volatility are more common in outer and climate-exposed regions, including parts of the western and southern Plains such as eastern Colorado, western Kansas, and Nebraska, and Oklahoma, as well as counties along the Southeast Coast and in Texas.

Figure 2: ***Spatial Patterns of Changes in Yield Volatility and Yield Growth for Corn and Soybeans***



Source: Agricultural Risk Policy Center (ARPC), using data from the U.S. Department of Agriculture, National Agricultural Statistics Service (USDA NASS).

Figure 2 also shows a clear geographic relationship between long-term yield growth and declining volatility. Counties that have experienced stronger yield gains over time, especially in the Upper Midwest and central Corn Belt, also tend to show the largest reductions in yield volatility in the later period. In contrast, regions with slower yield growth often show smaller declines in yield volatility or local increases in volatility. Because higher yield growth increases farm revenue while lower yield volatility improves revenue stability, revenue outcomes may become increasingly uneven across regions.

What explains the decline in yield volatility alongside stronger yield growth in major production regions? One possible explanation is the combined influence of changing climate conditions and technological progress. Although this brief does not aim to provide a rigorous causal analysis, the geographic patterns

of technology adoption and weather conditions offer some possible clues. For example, in northern areas such as the Dakotas and Minnesota, warmer temperatures and longer growing seasons in recent years may have increased yield potential and contributed to greater yield stability. In contrast, more severe water shortages in parts of the western Plains, including Colorado, may help explain why yields remain more uncertain in those regions (EPA, 2021). Technological changes may also play an important role. Expanded irrigation in regions such as the Mississippi Delta gives farmers greater control over water conditions and can reduce the likelihood of very low yields (Hrozencik and Aillery, 2021). In addition, the growing adoption of precision agriculture technologies, such as GPS guidance systems across the Upper Midwest and central Corn Belt, may help farmers manage inputs more efficiently and reduce production uncertainty (McFadden et al., 2023).

In summary, this brief finds that county-level yield volatility has declined over time for major crops such as corn, cotton, and soybeans. These changes are not uniform across the country, with substantial regional differences in how yield volatility has evolved. These findings suggest that farm safety net programs should account for recent regional changes in yield volatility, as relying solely on historical records may misstate current risk. Future research is needed to better understand the drivers of these changes and their implications for farm safety net programs as climate conditions and agricultural technologies continue to evolve.

References

Cooper, J., and Delbecq, B. (2014). A Multi-Region Approach to Assessing Fiscal and Farm Level Consequences of Government Support for Farm Risk Management. Bio-Based and Applied Economics, 3(3), 205–227. https://doi.org/10.13128/BAE-14628

EPA. (2021). Seasonality and Climate Change: A Review of Observed Evidence in the United States. U.S. Environmental Protection Agency, EPA 430-R-21-002. www.epa.gov/climate-indicators/seasonality-and-climate-change

Hrozencik, R. Aaron and Marcel Aillery (2021). Trends in U.S. Irrigated Agriculture: Increasing Resilience Under Water Supply Scarcity, EIB-229, U.S. Department of Agriculture, Economic Research Service.

Li, Junkan and Francis Tsiboe (2025). A Horse Race Comparison of County-Level Crop Yield Prediction Methods. ARPC Brief 2025–14. Agricultural Risk Policy Center, North Dakota State University.

McFadden, Jonathan, Eric Njuki, and Terry Griffin (2023). Precision Agriculture in the Digital Era: Recent

Adoption on U.S. Farms, EIB-248, U.S. Department of Agriculture, Economic Research Service

About the Agricultural Risk Policy Center

The Agricultural Risk Policy Center at North Dakota State University conducts independent, evidence-based economic research to inform agricultural policy and strengthen the U.S. farm safety net. The Center's work focuses on evaluating risk management tools such as crop insurance and disaster assistance, analyzing market disruptions, and providing timely insights that support producers, policymakers, and industry leaders.

ARPC Briefs communicate the outcomes of this research by presenting data, methods, and findings in a structured format. Designed to make rigorous analysis accessible, these briefs translate complex economic issues into clear insights that enhance understanding and support evidence-based decisions, contributing to the resilience and long-term prosperity of U.S. agriculture.

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