The Impact of an Aging Farmer Population on Agriculture

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Abstract

This study examines the impact of the increasing average age of farmers on agriculture in the United States. Utilizing data from the Census of Agriculture and the United States Department of Agriculture's (USDA) National Agricultural Statistics Service, this research analyzes trends in production, age distribution, and sales among farmers. By identifying the implications of an aging farming population, this study aims to discuss the effects on agricultural production and the possible broader implications for the future.

1. Introduction

Agriculture is crucial for the U.S. economic system and ensures enough food for the continuously growing populations. Farmers are the backbone and keep the entire agriculture industry afloat. However, trends show that the average age of farmers is increasing. As retirement approaches for the older generation, this study questions the sustainability and effects on agriculture production.

Since 1997, the average age of U.S. farmers has steadily increased from 55.3 to 58.1. The increase suggests several problems regarding production capacity and number of farmers. Questions arise: Can older farmers implement new production techniques, and how efficient can they remain as they age? This study investigates the production of younger farmers compared to older ones through county and national averages.

The agriculture industry was valued at $543.1 in 2022, increasing from $101.4 billion in 2002. This increase demonstrates the importance of understanding the effects of an aging population. Through analysis of age distribution and production trends, this study looks into the future sustainability of U.S. agriculture.

Year	Average Age
2002	55.3
2007	57.1
2012	58.3
2017	57.5
2022	58.1

Table 1: A simple reformatted table of average age of farmers in the U.S

2. Data and Methods

Production data was analyzed using the Census of Agriculture from the National Agricultural Statistics Service (NASS). The data spanned the years: 1997, 2003, 2007, 2012, 2017, 2022. Information such as state FIPS codes, county codes, year, and agricultural land harvested in acres was taken and reformatted. A key challenge was handling the data: agricultural land harvested. That specific data had disclosure values (D), which was undisclosed information about production. To estimate those values, state totals (represented by a 999 FIPs code) had known county production values subtracted from it. The remainder was divided by the count of D values. The result was the average production value for unknown counties. Other values included (z), meaning not statistically significant.

The study used age data from the National Agricultural Statistics Service again. The data spanned 2003, 2007, 2012, 2017, 2022. The data included state FIPS code, county codes, year, and age, which was reformatted into a simplified data frame. Lastly, the mean age was calculated for the states from the data. (Table 1)

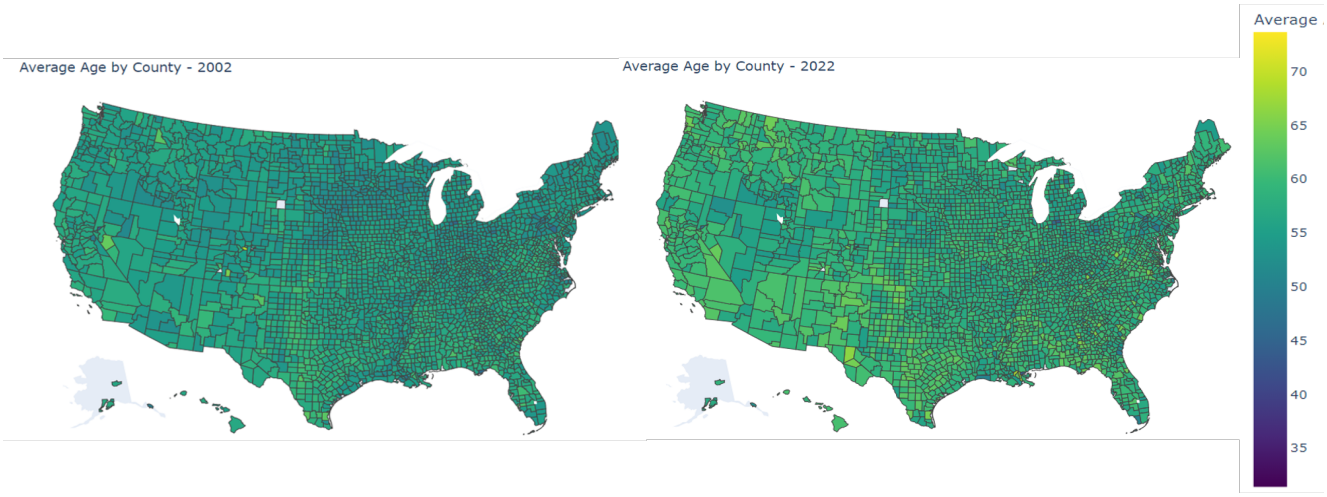

Figure 1: The heat map depicts the average age per county in 2002 and 2022

Both data infrastructures were reformatted through the Python library pandas and then graphed through the Python library plotty. These datasets included FIPS codes, county codes, year, and their respective data.

A relevant distinction in the data is that after 2017, the Census changed the distinction of farmers from operators to producers. Operators include the farm owner and managers, while producers include all farmhands. This reclassification skewed the data in 2017 by introducing younger farm hands. It may explain why the average age increased from 2002 to 2012 but decreased in 2017.

The study also formatted the age data by county. Figure 1 depicts 2002 and 2022 and the age averages per county. The average age by county in 2002 demonstrates an average age of 55.3 nationwide, while in 2022, the national average was 58.1. The lighter the green, the older the average age in the county. From 2002 to 2022, the coloration shows an increase in age. Specifically, the West Coast, a region traditionally known for its agriculture, has seen an increase in the average age of its farming population.

The study performed a comparison of average sales by age group sorted by year (Figure 3 on page 3). The data was pulled from the Census again and created a new data frame. This data frame included the average income of farms and average age. The study used Plotly to create a grouped bar graph representing data from the years 2002, 2007, 2012, 2017, and 2022. The y-axis showed the average age. Each group of bars represented sales categories. This plot shows that younger farmers make more than their older counterparts though it's important to note that the farmer's age remains above 50 for both younger and older.

The study also performed a pearson correlation coefficient. This coefficient is the ratio between the covariance of two variables and the product of their standard deviations. The two variables are the average age per county and the acres harvested per county.

$$\mathrm{R} = \frac{\Sigma\,(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 (y_i - \bar{y})^2}} \tag{1}$$

Coefff: -0.248

1 shows a positive correlation, 0 shows no correlation, and -1 shows a negative correlation. In this study, we

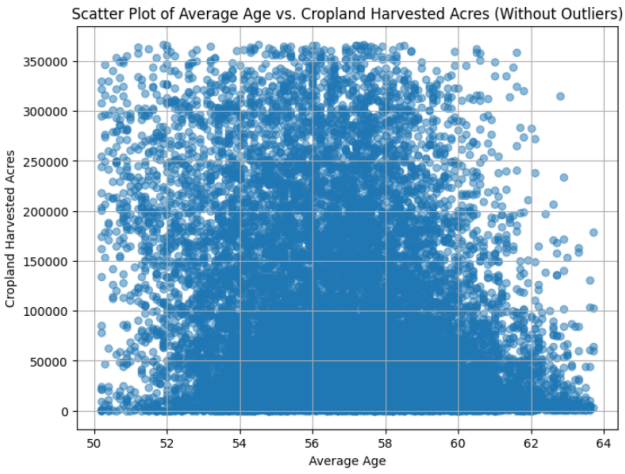

Figure 2: Scatter Plot of Cropland Harvested vs Average Age (outliers removed)

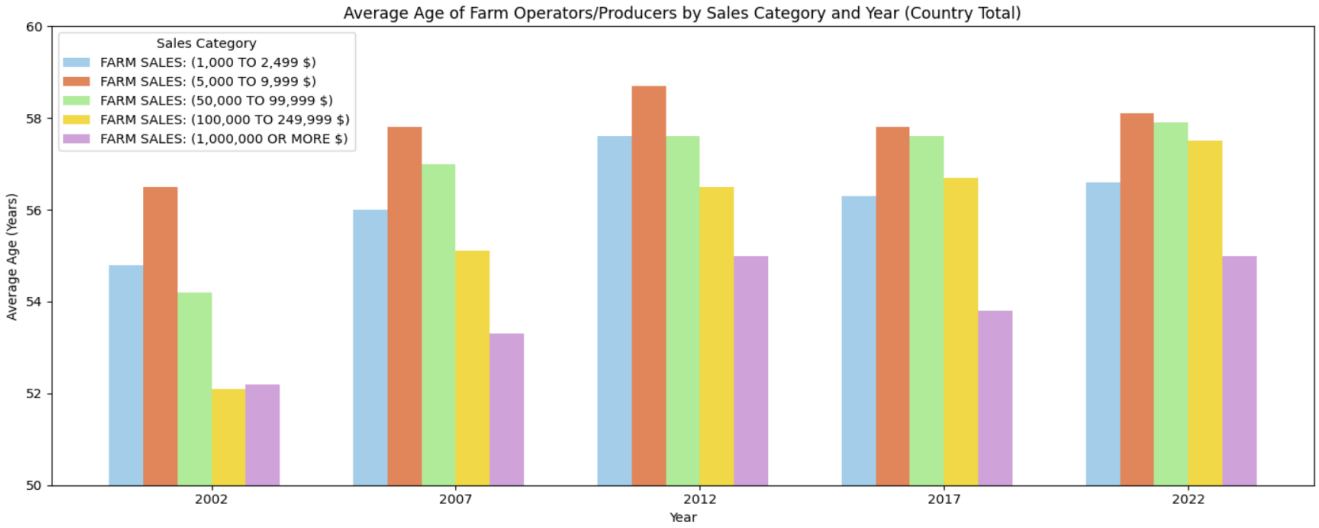

Figure 3: The grouped bar graph depicts the different agriculture sales categories per year and how they relate to age

are sufficiently close to zero and show no correlation between the average age per county and the acres harvested per county.

Lastly, the study created a scatter plot of all the data (Figure 2). Outliers were calculated by finding the upper and lower bounds of the data. The IQR represents the range within which the central 50% of the data lies. Lower and upper bounds are established based on the IQR. Lower bound: Q1 - 1.5 * IQR Upper bound: Q3 + 1.5 * IQR Any data point falling below the lower bound or above the upper bound is considered a potential outlier and thus is removed.

3. Results

The average age of farmers has trended upwards from 1997 to 2022. In 2002, farmers were approximately 55.3 years old on average, rising to about 58.1 years old by 2022 (table 1). Several factors could contribute to this increasing average, such as fewer younger generations entering the farming industry, longer careers within farming, and the financial investments required to start farming for profit.

The data analysis reveals a clear trend: younger farmers, on average, are more productive and achieve higher profitability from their farms. For instance, Figure 3 divides sales numbers into five groups, showing that younger farmers tend to manage the most profitable farms. This partitioning highlights the strong relationship between younger age and increased farm profitability.

To account for inflation, the economic impact of farm production was standardized. Inflation, which refers to the rising cost of goods and services over time, erodes purchasing power. For instance, while $1 could purchase three pieces of corn in 1997, it might only buy one in 2022. Even if production levels remain constant, inflation reduces a farm's economic output. By adjusting for inflation, the comparison of farm impact across years becomes more accurate, allowing for a meaningful evaluation of the economic contribution of farms over time.

As seen in Figure 2, it is clear that there is no relation between average farmer age and acres harvested. Despite this statistic, it is also evident that younger farmers work on more lucrative operations. It suggests that the aging farming population will affect the output if the trends continue.

4. Conclusion

The data indicates that while the farmer population is aging, this trend has not significantly decreased overall production. However, the rising average age raises concerns about the future sustainability of this trend. If the farming population continues to age, the long-term effects on agricultural productivity may become more pronounced. For now, the stable production levels suggest that the current farmer population is managing to offset potential inefficiencies related to age, but a further increase in the average age of farmers may have more noticeable impacts on production in the future.

Please see this link to our Submission Video.

Please see this link to our Google Colab Notebook.

References

[Ser22] USDA National Agricultural Statistics Service. Census of agriculture, 2022. https://www.nass.usda.gov/Statistics_by_Subject/Demographics/index.php.