Top Farms and the Effect of Investing in Machinery

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Introduction

As shown in AgManager paper "What Makes a Top Farm? - Overview" (https://www.agmanager.info/finance-business-planning/research-papers-and-presentations/what-makes-top-farm), we explain the process of determining which farms are the most profitable over the last 10 years by ranking the net farm income per acre each year. In an earlier paper, we showed a clear difference among farms, especially at the top and bottom of the rankings. However, in that analysis, we did not evaluate why these differences might be happening.

We have begun to analyze some of the factors that might explain why some farms rank higher than others. These earlier analyses are:

- Top Farms and the Effect of Farm Size (https://www.agmanager.info/finance-business-planning/research-papers-and-presentations/top-farms-and-effect-farm-size)
- Top Farms and the Effect of Debt (https://www.agmanager.info/finance-business-planning/research-papers-and-presentations/top-farms-and-effect-debt)

This current paper and the analyses to follow will continue to examine factors that might explain why some farms consistently rank higher than other farms.

The purpose of this paper is to evaluate the level of farm machinery investment per acre to see if that might be a factor in explaining why some farms are consistently more profitable than other farms. The farm machinery investment per acre is equal to the average of the beginning and ending remaining values for motor vehicles, listed property, and machinery and equipment used for crop production. The whole farm number is divided by the number of crop acres to get a per acre value. Also, these machinery values are based on management depreciation instead of tax depreciation. Management depreciation is an attempt

by the Kansas Farm Management Association program to have actual changes in machinery value be recorded as depreciation. Thus, the values of machinery in the database should match fairly closely to the actual machinery values. If tax depreciation had been used in the analysis, then the machinery values in the database would likely be much lower than the actual values. The initial hypothesis of this analysis was that higher levels of farm machinery would hamper profitability and lead to lower farm rankings.

We examine data from the Kansas Farm Management Association (KFMA). The KFMA has been helping farmers since the 1930's and actually has computerized farm records back to the early 1970's. There are currently around 2,500 farms in the KFMA system and in any given year about 1,500 of those farms will have records that are useable for research, teaching, and Extension analysis. This is one of the best systems in the country and the data provided by the KFMA can help answer those questions of farmer profitability.

Methods

As in the previous papers referenced above, we examine the machinery investment question in east, central, and western Kansas. The average 10-year farm ranking for each region was used as the dependent variable in a regression analysis where the machinery investment per acre is the independent variable. In addition to the regression analysis, we examine the distribution of machinery investment when the farms are put into deciles of profitability rankings.

Results

Figures 1, 2, and 3 show the trend lines predicting average farm rankings from the machinery investment per acre. The red line is the trend line while the red dotted lines represent the region of the 95 percent confidence band. The confidence band shows how accurate the trend line fits the data. The confidence band does not encompass 95% of the data like a prediction band. For both eastern and central Kansas the slope of the trend line is significantly different from zero while in western Kansas the trend line is not significant. However, the slope is actually backward from the initial hypothesis. That is, the results show that in eastern and central Kansas, having more machinery per acre was actually

beneficial. Keep in mind though that even with a significant slope, the R-squared was very low for these regions.

Figure 4 shows a cumulative distribution for the machinery investment per acre in the three regions of Kansas. At any given machinery investment per acre, the graph shows the percentage of farms that have that particular machinery investment per acre or lower. As indicated on the graph, the regions vary considerable by their machinery investment per acre. The east has the most machinery while the west has the least. This result is entirely expected as rainfall affects how intensively the land can be farmed which in turn drives the machinery needed. In eastern Kansas, 50% of the farms have a machinery investment of $289 or less. In central Kansas, 50% of the farms have a machinery investment of $225 or less while in western Kansas 50% of the farms have a machinery investment of $170 or less.

The rest of the analysis shows the effects of machinery investment when the farms are grouped into deciles of profitability rankings. Each decile contains 10 percent of the farms for a region. Figure 5 shows the average machinery investment per acre for each region for each decile. Figures 6, 7, and 8 use violin graphs to show the variation among farms within a decile. The width of each group is an indication of the number of farms with that particular machinery investment per acre. The solid red bar line in each violin is the mean for that group while the dotted red lines are the 25th and 75th percentiles. As the graphs indicate, there is a fairly wide range of machinery investment levels for each decile of profitability ranking.

The violin graphs tend to echo the trend line analysis. That is, there is not a specific decile that is driving the trend line. The downward slope of the trend line analysis is also seen in the means of the violin graphs. Decile 1 from the eastern region is slightly lower than might be expected but the rest of the deciles show a downward trend.

Conclusions

The results were counter intuitive to our initial hypothesis (that more machinery investment would cause a farm to rank lower) but can be explained with

advanced analysis. Having more machinery did not hurt a farm's profitability ranking and there is some evidence that it helped the ranking. However, it is also likely that the cause and effect relationship may be reversed in some situations. That is, some farms may have more and newer machinery just because they were more profitable. Also, farms with more machinery may be farming their land more intensively which then led to higher profitability. Hopefully, future papers in this series will show some of these other factors at work. Farmers should not look at these results as a justification to buy new and more machinery without considering the other factors that might be in play.

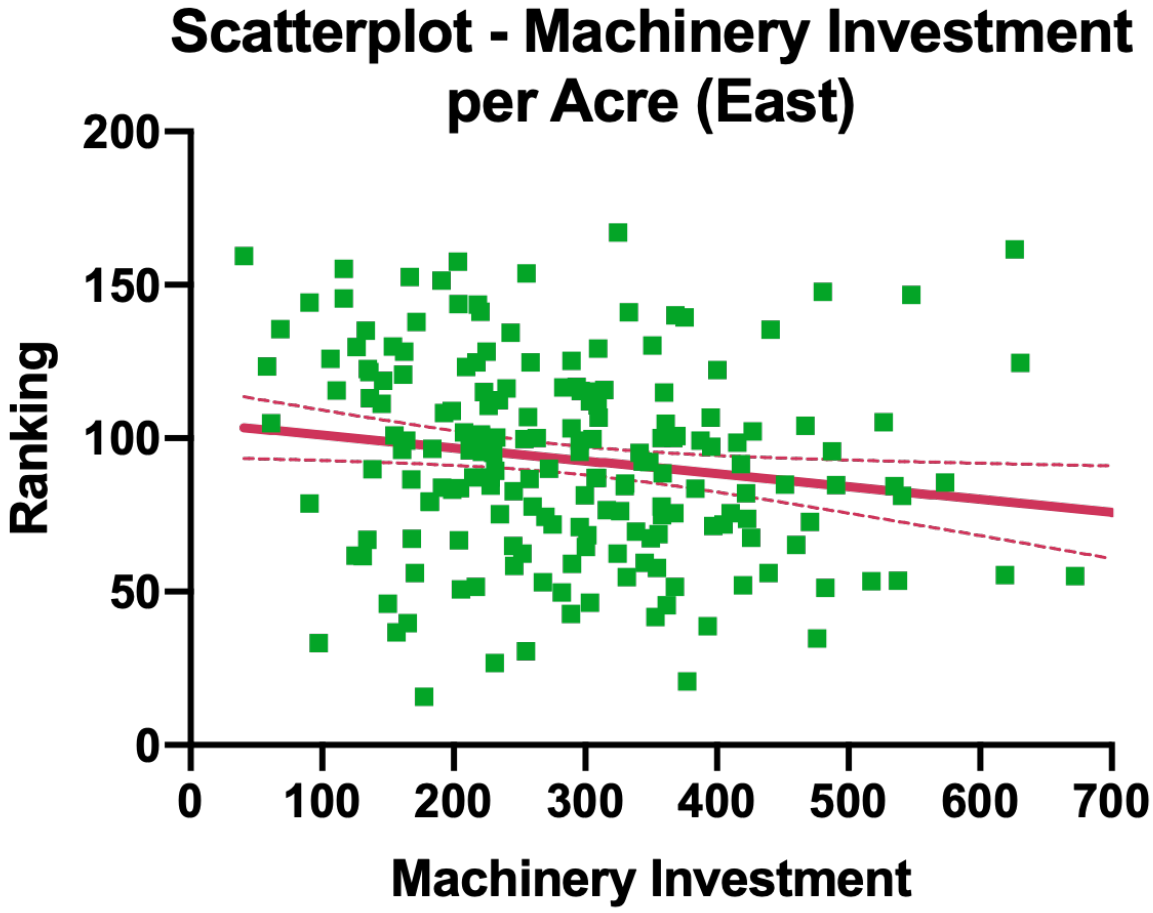

Figure 1. Scatterplot of Farm Rankings by Machinery Investment per Acre for Eastern Kansas

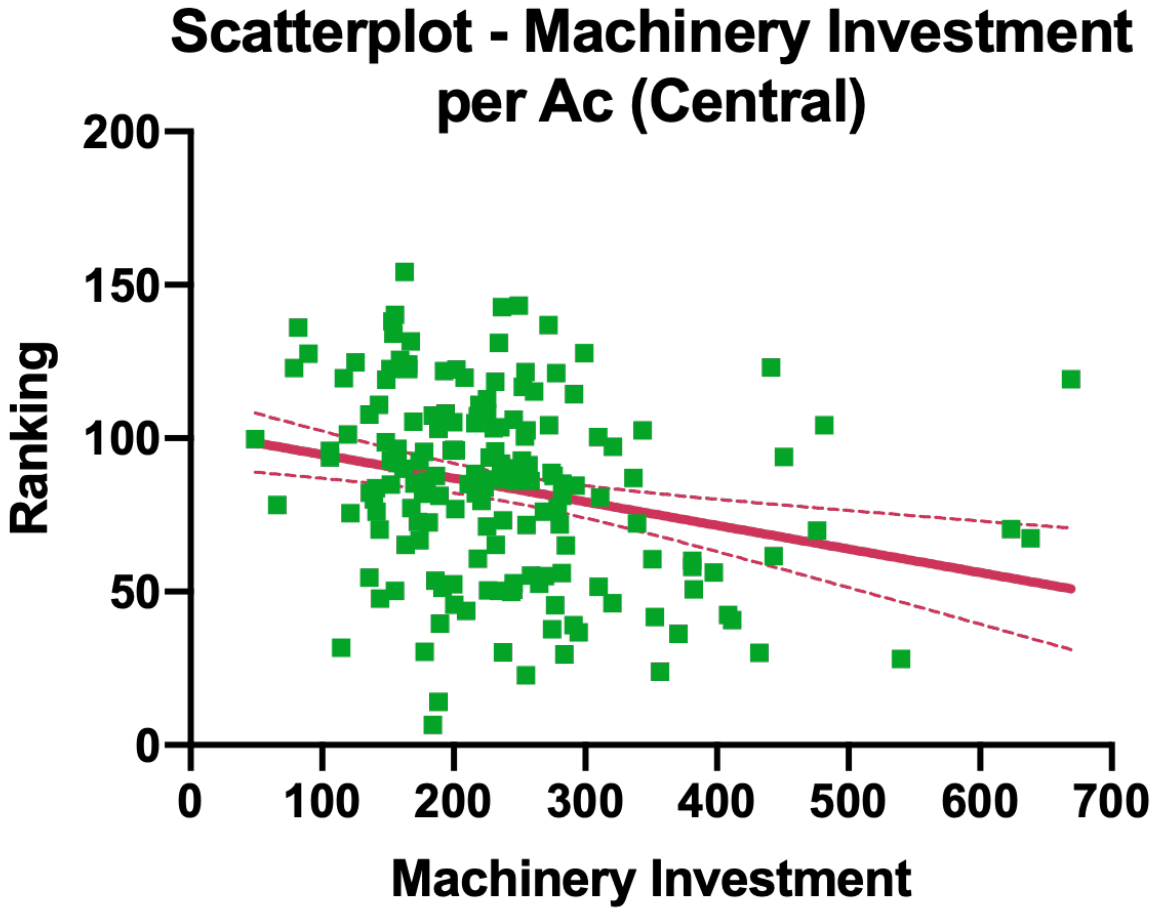

Figure 2. Scatterplot of Farm Rankings by Machinery Investment per Acre for Central Kansas

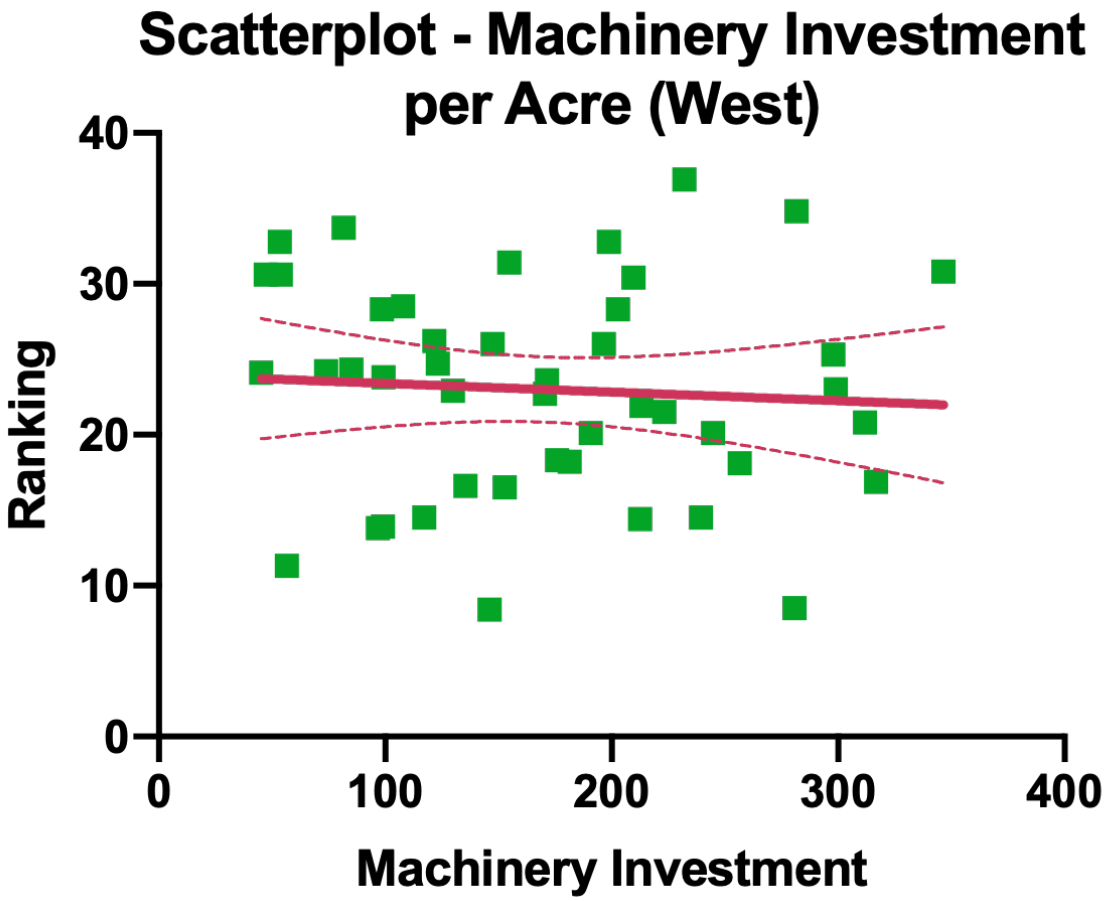

Figure 3. Scatterplot of Farm Rankings by Machinery Investment per Acre for Western Kansas

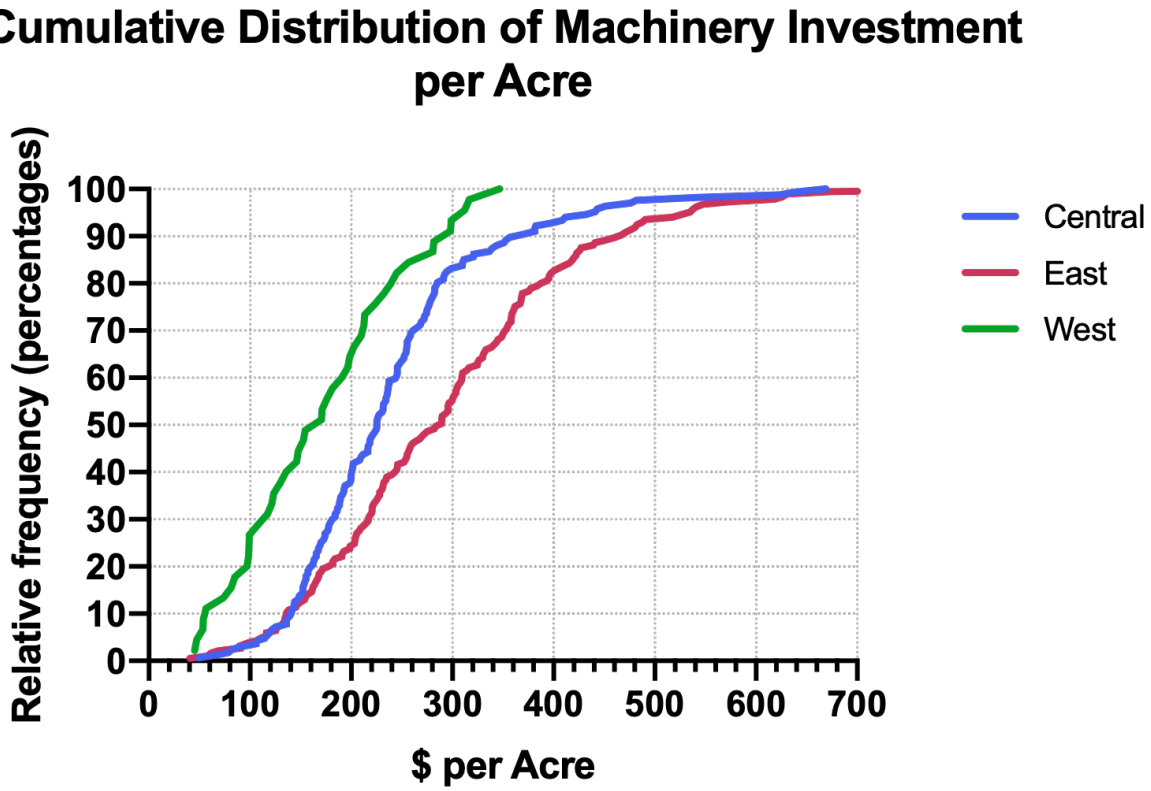

Figure 4. Cumulative Distribution of Machinery Investment per Acre by Region

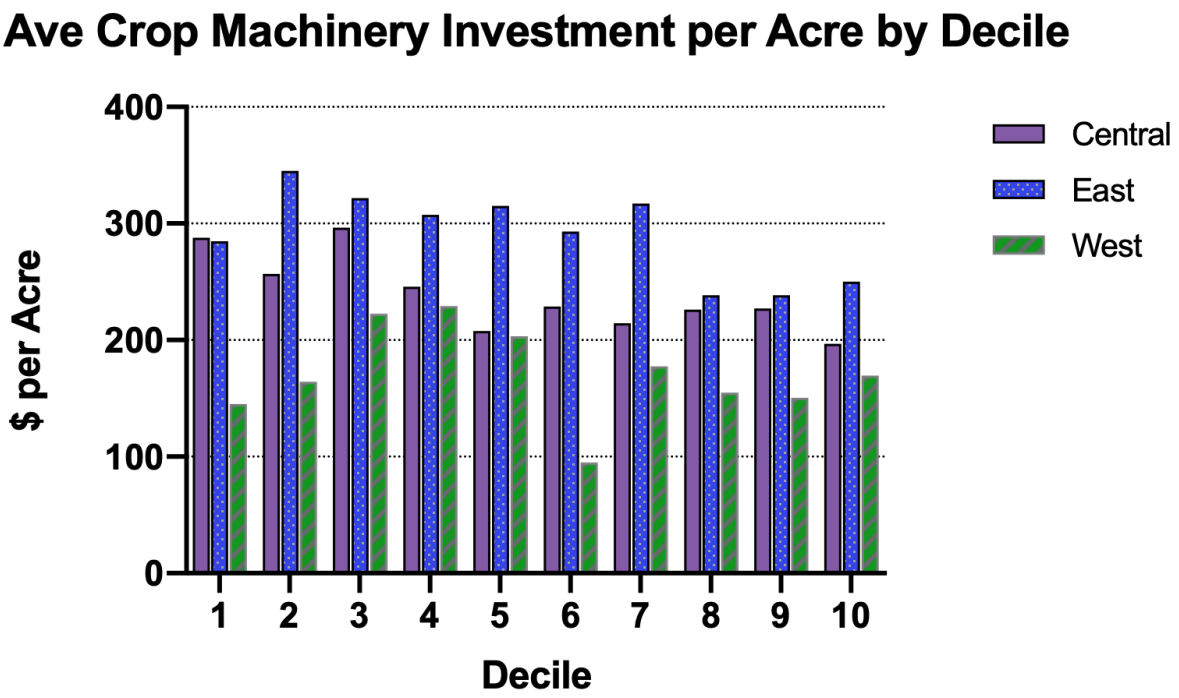

Figure 5. Average Machinery Investment per Acre by Profitability Decile for Central, Eastern, and Western Kansas

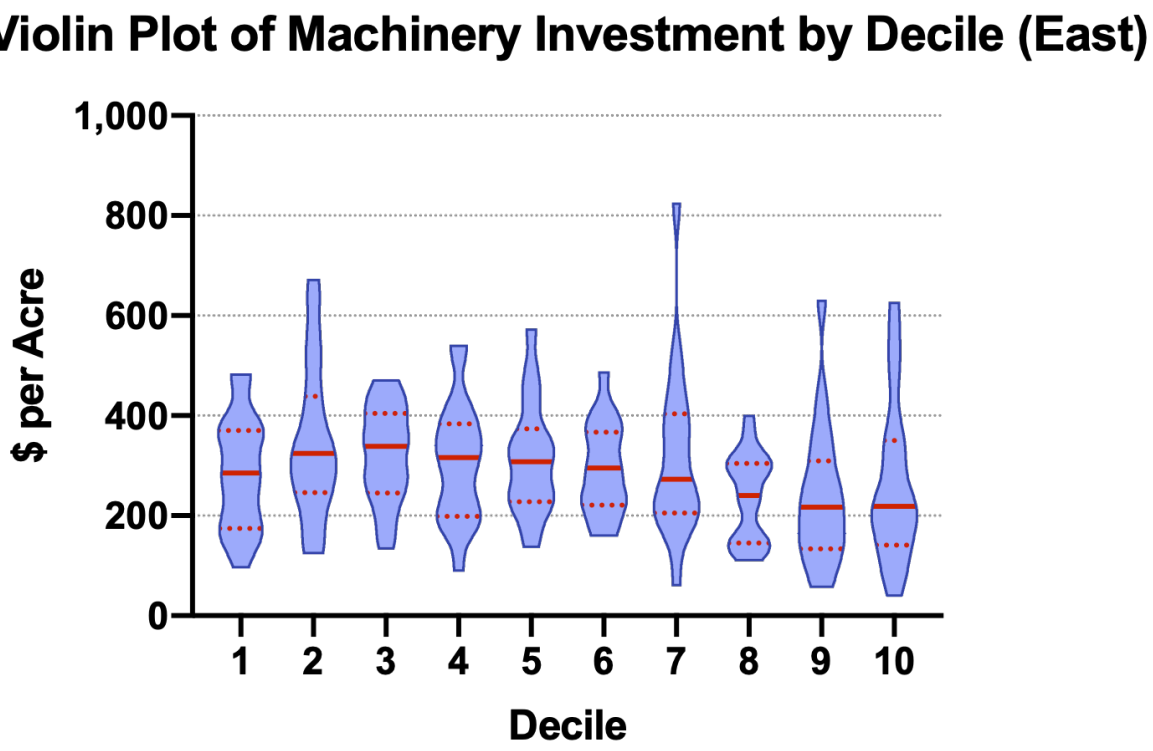

Figure 6. Violin Plot of the Distribution of Machinery Investment per Acre for Each Profitability Decile (East)

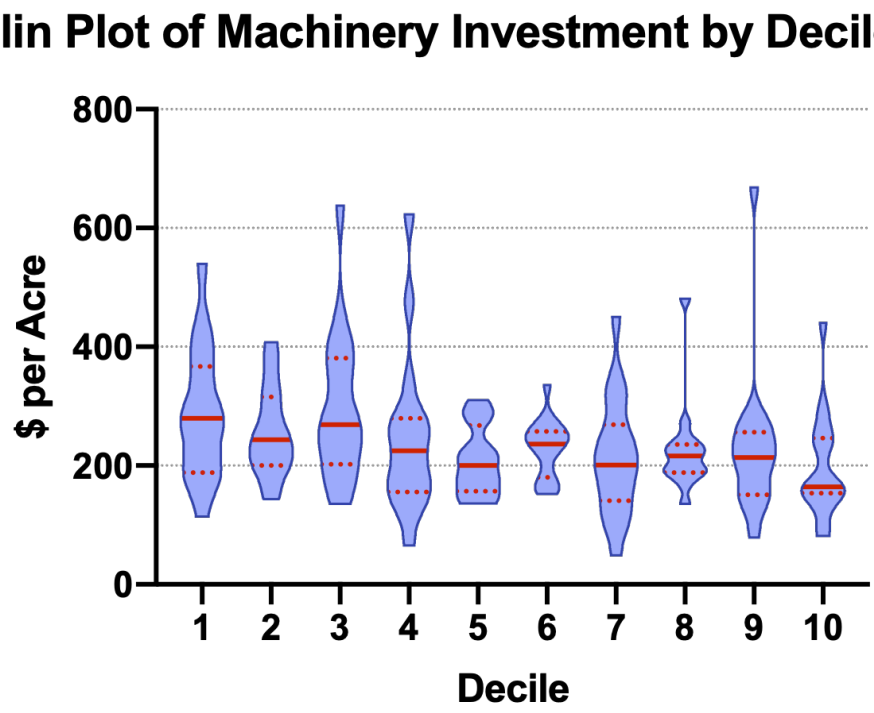

Figure 7. Violin Plot of the Distribution of Machinery Investment per Acre for Each Profitability Decile (Central)

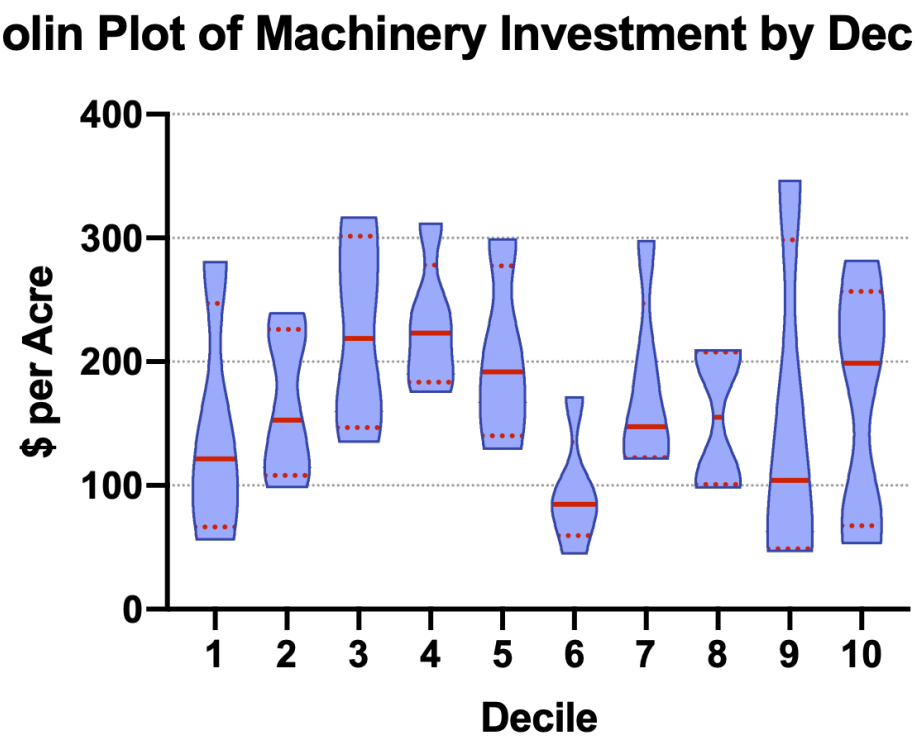

Figure 8. Violin Plot of the Distribution of Machinery Investment per Acre for Each Profitability Decile (West)

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