Factors Affecting Net Farm Income for Row Crop Production in Kansas




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Acknowledgements

The authors are thankful to the KFMA and KMAR for continued collaboration.

Abstract

Low commodity prices combined with high input costs have deteriorated net farm income over the last several years. As a result, management decisions have become extremely important, as any less than optimal decision could result in the farm losing money. Understanding which factors of production have the greatest effect on net farm income can help producers focus their efforts. This study analyzed various factors affecting net farm income to determine those that were most important to the profitability of an operation. Results varied depending upon the set of years analyzed and the region of the state. This may reflect an environment where the factors important to a top farm vary by the overall condition of the farm economy.

INTRODUCTION

American agricultural production has a long history of highly variable net farm income (NFI). After NFI peaked in 2013, there has been a steady decline over the last four years (USDA, ERS). These downward and upward movements in net farm income have made effectively managing farms difficult for producers, as those management choices that affect NFI can be difficult to analyze because of all the income variability that producers face. With current low commodity prices, producers are being forced to be more efficient in other areas of production (machinery, inputs costs, etc.). This has made it even more difficult for producers to determine those management decisions that are important to long-run profitability.

Extension professionals are assisting producers to improve profitability by providing the latest research, guidance for farm decisions, and software tools to aid in their decision-making. However, without a full understanding of specific factors affecting net farm

income, this can be challenging. With increased knowledge, Extension personnel could make better recommendations for farmers or improve overall profitability (Stabel et al., 2017).

Several factors that influence NFI are outside of the producers' control. These include trade, government subsidies, fiscal policy, interest rates, and the weather. Though uncontrollable, these factors are important to consider when making farm-level management decisions. However, there are farm-level decisions that are within the control of producers including, but not limited to: machinery, production management, investment, and financial decisions. Understanding which of these factors has the greatest effect on NFI can aid producers in making farm-level management decisions.

The overall goal of this analysis was to estimate the factors that predict net farm income to help farmers find areas where they can adjust their operations so that they can increase their profitability. Because this is a beginning analysis into this area of farm management decisions, not all management factors are included, and the analysis is limited to a descriptive comparison of farms, years, and region of the state.

DATA

This analysis used data from the Kansas Farm Management Association (KFMA) database. The KFMA has served Kansas producers for over 80 years and currently has nearly 2,500 farmer-members (O'Brien & Yeager, 2017). In a given year, there are approximately 1,500 farms that have useable data. This study analyzed 17 years of data from 2001 to 2016. In all, 476 unique farm observations were evaluated. The variables used in the model are shown in Table 1. This is certainly not a complete list of all variables that might be important, but as this is an initial exploration of factors, it represents a first take. A three-year average of all the variables was used in order to account for weather variations from year to year.

The data were split into three regions, the east, central, and west regions of the state of Kansas. This dividing into regions was necessary to account for the lower NFI per acre as one moves from east to west across the state. Rainfall across Kansas is responsible for this change from east to west. Quintile groups were created based on NFI per acre. To create a quintile, the farms were ranked in order of NFI per acre. The highest NFI quintile was labeled as Quintile 1 with the remaining quintiles labeled in order from Quintile 2 through Quintile 5. These variables included crop acreage, percent of acres rented, corn yield, debt to asset ratio, working capital per acre, and fertilizer cost per acre.

RESULTS AND DISCUSSION

As an initial step in the analysis, pairwise correlations were calculated for all variables from the 2016 data. Correlations above 0.5 or below −0.5 were further evaluated. The variables with the highest positive correlation were machinery cost and machinery investment. Machinery investment was defined as the average of the beginning and ending remaining basis values for all machinery and equipment used in crop production. Machinery cost was defined as the variable costs of production with respect to machinery (repair and maintenance, fuel, oil, etc.). These variables had a correlation of 0.83 indicating that the capital invested in machinery is also expressed in the costs associated with machinery use.

The second highest correlated set of variables were machinery cost and crop production costs with a correlation of 0.79. This shows us how highly impactful machinery costs are on overall crop production costs. The third highest correlated set is crop production costs and fertilizer costs, with a correlation of 0.72. Similar to machinery costs, this depicts the significance of fertilizer costs on overall crop production costs. Lastly, debt to asset ratio and working capital per acre had a correlation of −0.54 meaning they were negatively correlated. This indicates that there is a give and take between paying off debt and keeping cash on hand in working capital. Plots of these correlations can be seen in the Appendix.

The next step in the analysis was to examine selected factors of production by quintiles at various time points and regions of Kansas. Average crop acres for the top quintile in 2016 for the central region were 1,190 acres compared to 1,637 acres for the bottom quintile. In 2001 acreage levels were 1,254 acres for Quintile 1 and 1,141 acres for Quintile 5, a reversal of which quintile had more acres. During the 16 years examined for the central region, the middle quintile tended to have the most acres. The top quintile tended to have either the fewest or the second fewest acres. Thus, it is difficult to make any conclusions about the number of crop acres having an impact on overall profitability. Certainly, crop acres are not the driving factor behind net farm income. This is demonstrated in Figure 1.

In the eastern region of the state, Quintile 5 is consistently and significantly below the rest of the quintiles (Figure 2). In 2016, Quintile 1 had 1,750 acres

while Quintile 5 had 1,331. Similarly, in 2001 the top quintile has 1,166 acres and the bottom quintile has 876 acres. There is consistently higher variation in the western portion of the state. In 2016 the top quintile has an average of 3,382 acres while the bottom quintile has 2,459. In 2001 the bottom quintile had higher acreage at 1,945 acres versus 1,917 for the top quintile.

For the central and eastern portions of Kansas, the percent of land rented for Quintile 1 were consistently a lower percentage of acres than Quintile 5 and the other quintiles as well (Figures 3 and 4). The western portion of the state was more variable in the movement between quintiles, and it is not clear that the most profitable farms own more crop acres. This would indicate that in the eastern two-thirds of the state, owning more of your farmland is more profitable.

Figures 6 and 7 are used to show how yields affect profitability. Quintiles for corn yields in the central and eastern portion of the state are highest for the most profitable farms and lowest for the least profitable farms. The yield ranking actually matches the quintile ranking for most years. In 2016 Quintile 1 in the central region had an average corn yield of 115 bushels per acre compared to approximately 90 bushels per acre for Quintile 5. Without statistical analysis we can still see that this is a significant difference in yields between quintiles. This indicates that yields are a driving factor for net farm income because Quintile 1 consistently had the highest yields. However, identifying what production factors, such as irrigation, tillage, seed selection, and land quality, affect yields needs to be further considered. This ranking of quintile by yields occurs with other crops as well.

Figures 8, 9, and 10 are used to show how the amount of debt affects profitability. Again, the western region does not agree with the eastern two-thirds of the state. In general, for the eastern and central region of the state, less debt means more profitability. There is a clear trend that at each lower profitability quintile, the amount of debt is higher. This holds true for most of the years. This holds true in the western region as well from 2007 to present. However, from 2001–2004 Quintile 1 has the highest debt to asset ratio. After discussion with producers this variance could be attributed to expansion in the early 2000s that was paid off quickly because of high commodity prices from 2007 onward. However, a more in-depth analysis would be needed to confirm.

The next to last measure examined was the working capital per acre. Across all regions it is shown that working capital per acre is consistently higher for Quintile 1 as opposed to Quintile 5. This is demonstrated in Figures 11 through 13. There is more variation in the western region between the quintiles; however, it is noted that Quintiles 1 through 3 are consistently higher than Quintiles 4 and 5.

The final measure examined was fertilizer cost. These quintiles don't show very much separation until the late 2000's. However, across all regions there is a noticeable separation in the quintiles from 2007 to present. This is shown in Figures 14 through 16. Low commodity prices combined with a continued increase/non-decreasing input prices could explain some of this separation however, further analysis would need to be done to confirm.

CONCLUSION

This preliminary analysis has indicated that owning more land and having less debt could be important to overall profitability. However, getting to that point could be difficult. One point not examined is the age of producers. As producers age, they tend to pay down debt and perhaps own more of their land as well.

Another key factor was the yields. Our preliminary analysis shows that the most profitable farms had the best yields. Whether this was from better soil or high input use is not totally clear. The most profitable farms tended to use more fertilizer, but whether this was from producers pushing their land harder or because they had better soil and fertilized more cannot be determined. Further investigation is needed to see the soil types of each farm.

Lastly, the higher levels of working capital among the most profitable farms presents another "chicken and egg" situation. Do the most profitable farms have higher working capital because they are making higher profits or do the higher levels of working capital give the top farms more flexibility to make better decisions? Again, more research is needed.

REFERENCES

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Table 1: Description of Variables	
Crop Acres	**The number of acres on a given farm**
Operator Age	Age of operator on a given farm
Percent of acres rented	The number of cash and share rent acres divided by the total crop acres
Soybean Yield	Soybean yield in bu/acre
Corn Yield	Corn yield in bu/acre
Wheat Yield	Wheat yield in bu/acre
Sorghum Yield	Sorghum yield in bu/acre
Debt to Asset Ratio	Total liabilities divided by total assets
Machinery Investment	Average of the beginning and ending remaining basis values
Working Capital per acre	Current assets minus current liabilities divided by total acres
Machinery Cost	Crop share of machinery repairs, gas-fuel-oil, auto expense, motor vehicle depreciation, listed property depreciation, and machinery and equipment depreciation plus crop machine hire expense plus an opportunity interest charge on crop machinery investment minus machine work income
Total Crop Production Cost	Equal to total crop expense plus opportunity cost charge on listed property, motor vehicles, machinery and equipment, and buildings minus unpaid family and operator labor minus interest paid minus cash farm rent minus opportunity cost charge on net worth minus machine work income
Total Capital Managed	Total farm assets plus value of rented land
Fertilizer Cost	Represents the operator's share of accrual fertilizer and lime expense

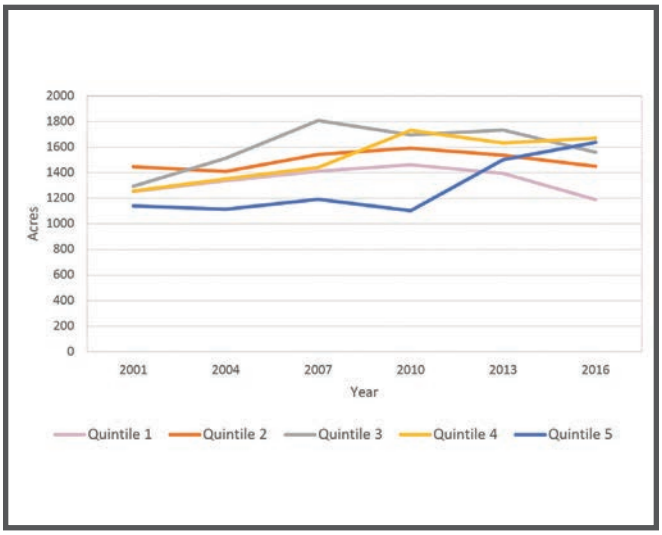

Figure 1: Crop Acres for the Central Region

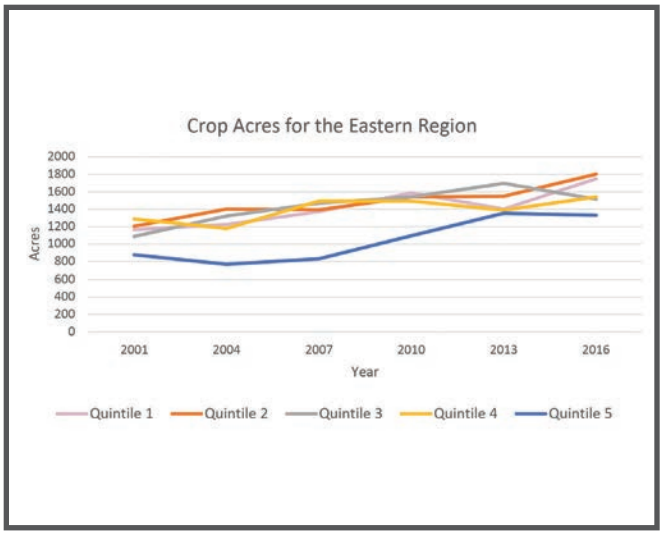

Figure 2: Crop Acres for the Eastern Region

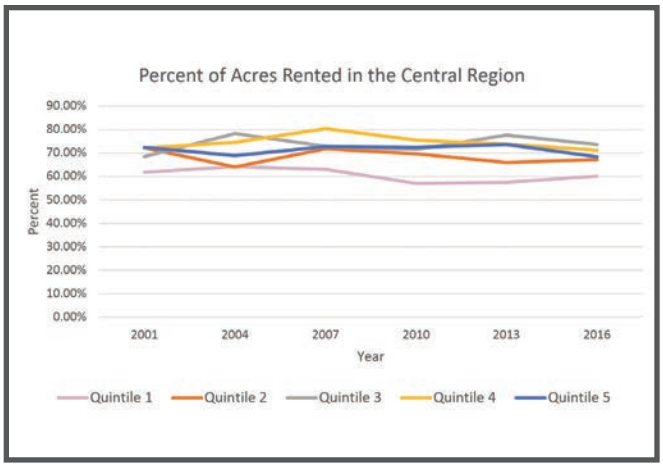

Figure 3: Percent of Acres Rented in the Central Region

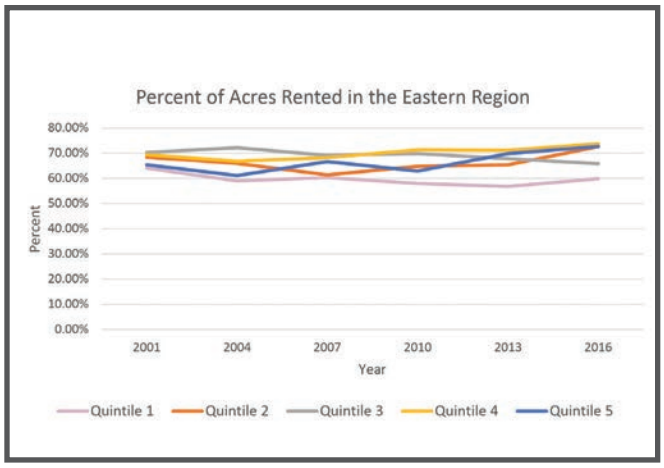

Figure 4: Percent of Acres Rented in the Eastern Region

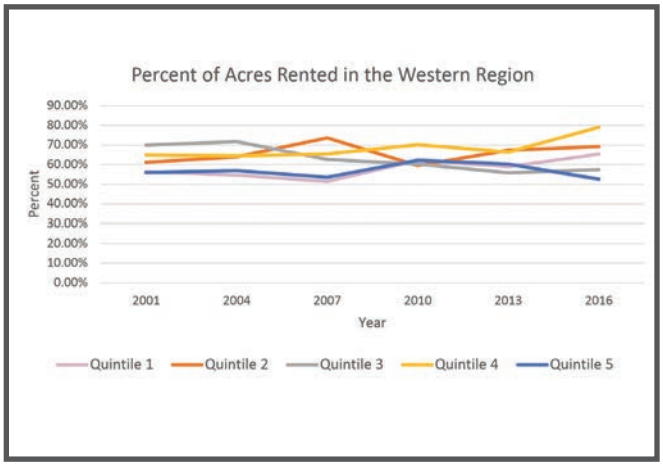

Figure 5: Percent of Acres Rented in the Western Region

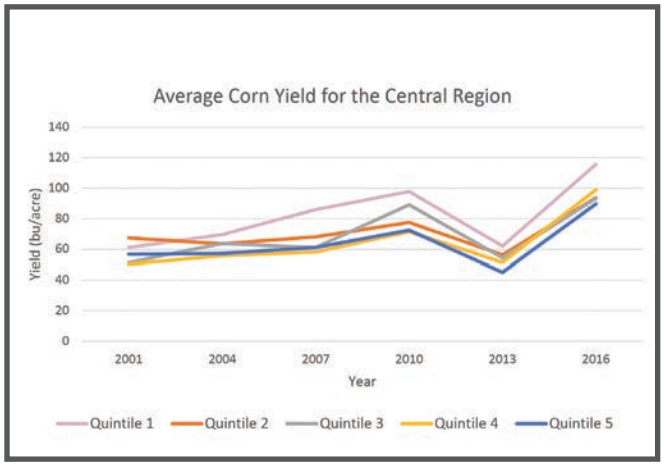

Figure 6: Corn Yields for the Central Region

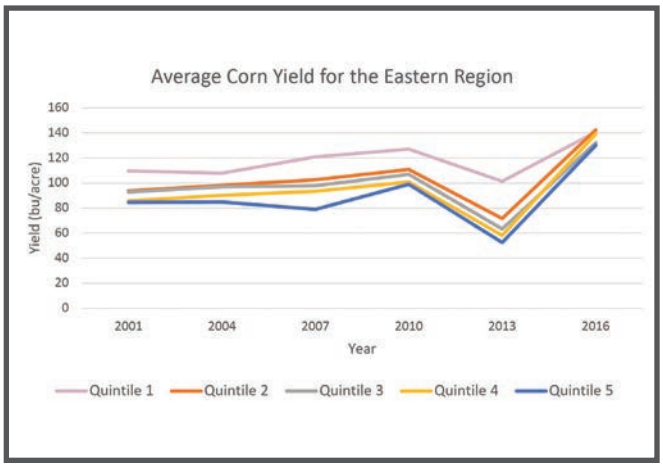

Figure 7: Average Corn Yields for the Eastern Region

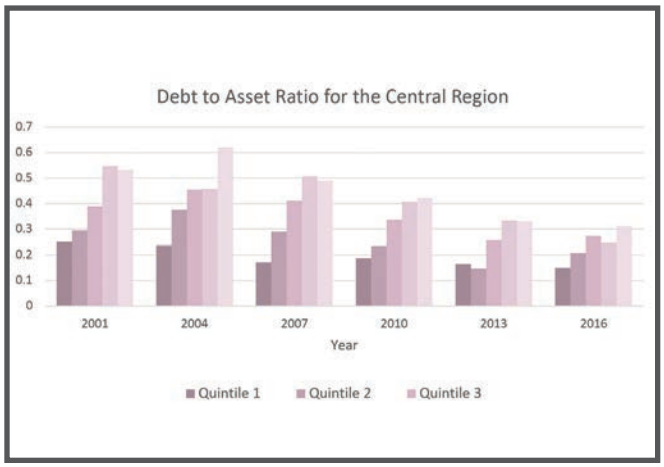

Figure 8: Debt to Asset Ratio for the Central Region

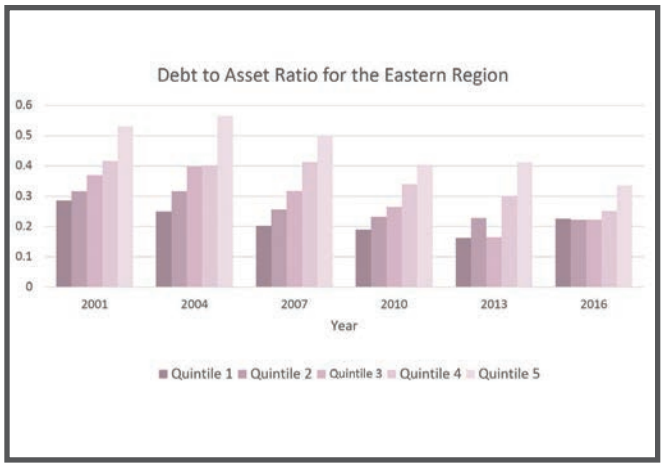

Figure 9: Debt to Asset Ratio for the Eastern Region

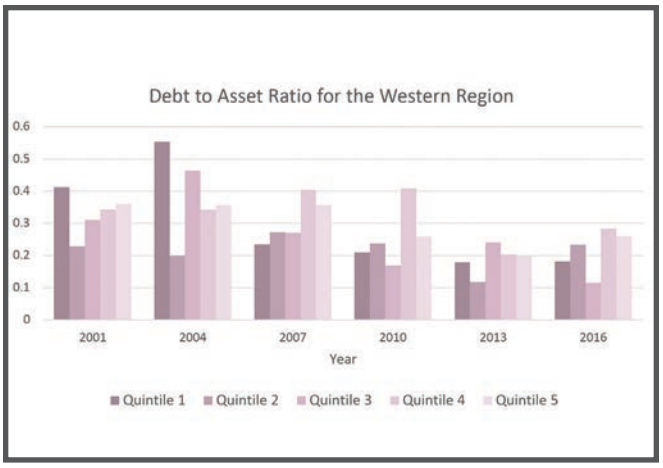

Figure 10: Debt to Asset Ratio for the Western Region

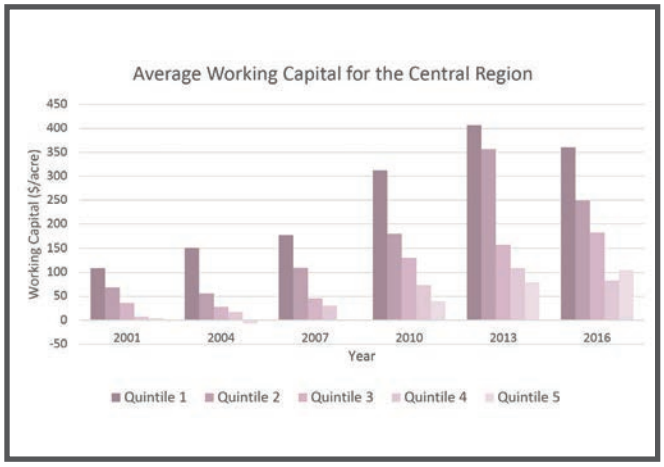

Figure 11: Working Capital per acre for the Central Region

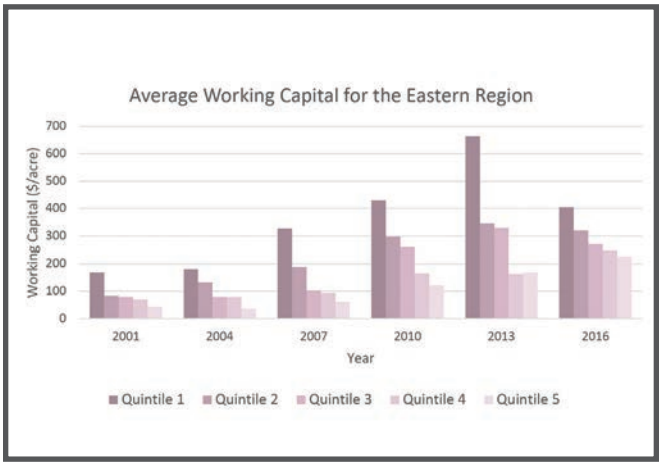

Figure 12: Working Capital per acre for the Eastern Region

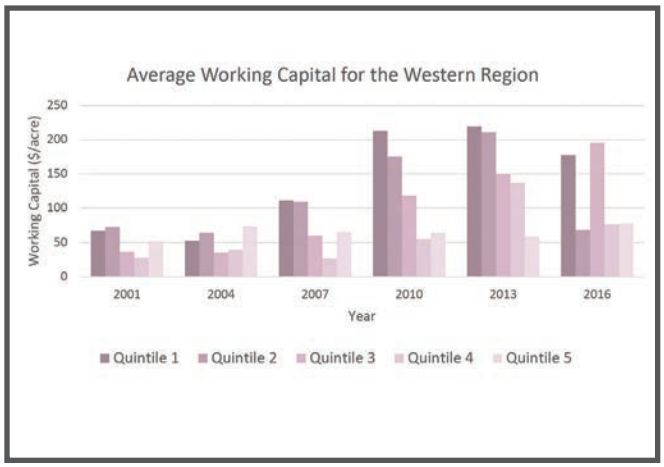

Figure 13: Working Capital per acre for the Western Region

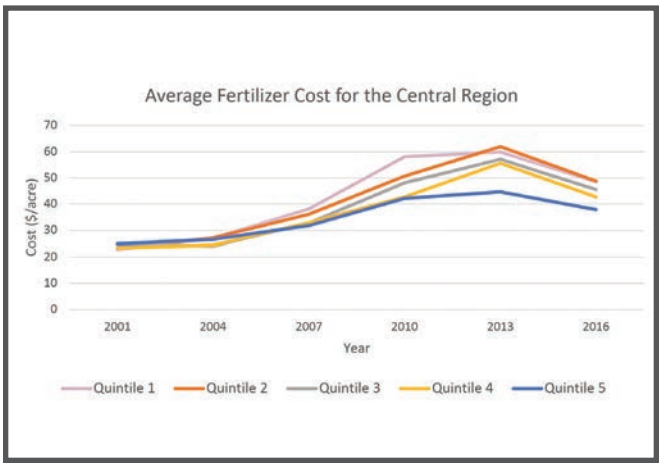

Figure 14: Fertilizer Cost for the Central Region

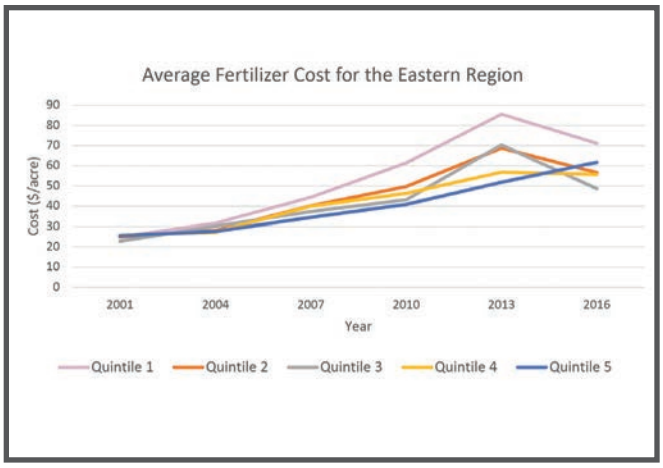

Figure 15: Fertilizer Cost for the Eastern Region

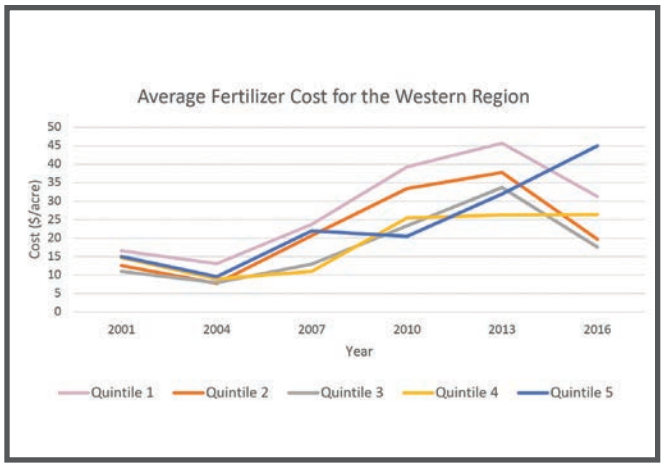

Figure 16:Fertilizer Cost for the Western Region