CROP YIELD AND PROFITABILITY TRENDS IN SOUTHERN HIGH PLAINS OF TEXAS

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Abstract

The Southern High Plains (SHP) is the most important cotton producing region in Texas. SHP also has considerable acreage of corn, winter wheat, and grain sorghum. Even though the productivity of these crops show increase over time, there are considerable differences in productivity trends among these crops and between irrigated and dryland production practices of the same crop. This study analyzed the trends in irrigated and dryland productivity of cotton, corn, winter wheat, and grain sorghum in SHP using historical production data. Since the profitability trends may not align with the productivity trends due to changes in commodity prices and costs, historic prices and production costs were used along with crop yields to estimate and compare returns above variable cost (RAVC) of the crops. To avoid the effect of inflation in the trend analysis, the nominal profits were converted to real profits using farm machinery price index. The results revealed that the annual yield increase was higher under irrigated production compared to dryland production for all crops. Comparison among the irrigated productivity of the four crops indicated that cotton (2.05%) had the largest annual percentage yield increase, followed by corn (0.97%). Wheat (0.87%) and grain sorghum (0.05%) showed relatively smaller increase. All crops showed a negative trend in RAVC with cotton registering the smallest annual decrease (-$0.69). The real returns also showed a negative trend for all crops. The average decrease of real RAVC was 9.77, 20.74, 7.37, and 9.03 $/acre for irrigated cotton, corn, grain sorghum, and wheat, respectively.

Introduction

The Southern High Plains (SHP) of Texas is comprised of 16 counties in the lower west side of the Texas Panhandle (USDA NASS, 2015b). This region is the most important cotton growing region in Texas and plays the primary role in maintaining Texas as the number one cotton producing state in the US. The irrigated cotton acreage in this region exceeded one million acres for every year in the last decade (USDA NASS 2015a). Corn, winter wheat, and grain sorghum are other major crops grown in this region. The average irrigated acreage for the last decade planted to corn, winter wheat, and grain sorghum were approximately 80,000, 130,000, and 200,000 acres, respectively (USDA NASS 2015a). Since this is a low rainfall region that receives less than 10 inches of seasonal rainfall for summer crops (Lascano, 2000), the irrigated crop production in this region is dependent solely on the Ogallala Aquifer. The diminishing water supply from the Ogallala Aquifer is forcing several producers to move towards deficit irrigation or dryland farming (McGuire et al., 2003). Since crop productivity and profitability are important determinants of crop choice, it is essential to assess the trends in yield and profitability of major crops in this important agricultural region of Texas.

Even though crop productivity of all major crops increased over time, changing climatic conditions and differing management practices can lead to significant differences among regions and crops (Lobell and Asner, 2003). Some crops like corn and sorghum follow the C_4 photosynthetic pathway and hence are genetically more efficient than C_3 crops such as cotton and wheat (Jones, 1983; Pearcy and Ehleringer, 1984). However, this yield potential will become reality only if the producers adopt scientific agronomic management practices and key resources like water do not limit the production process. For example, most of the productivity gains in corn come from intensive management of a larger plant population in the same cropped area, which is evident from the fact that the typical plant population for corn increased from 12,000 plants per acre in the 1930s to 31,600 plants per acre in the 1990s (Duvick and Cassman, 1999). The average corn yields in the US increased from about 30 to 150 bushels per acre in a century from 1900 to 2000 (Egli, 2008). There were significant yield increases in other crops also. Wheat yields in developing countries increased by about three times from 1960 to 2000, spurred by the "Green Revolution" (Evenson and Gollin, 2003).

The technological advances and increased adoption of scientific crop management practices by the progressive producers in the region have resulted in considerable improvements in crop productivity. This, however, may not indicate increases in profitability due to fluctuations in commodity prices and increases in the cost of production with time. Hence, analysis of profitability trends is important to understand the changes in profitability of these crop enterprises over time. Since inflation also influences commodity prices and the cost of production, it is important to index the values to compare real profits. Therefore, the objectives of the study were to: 1) Estimate average annual productivity change of corn, cotton, grain sorghum, and winter wheat in SHP and compare the productivity gains under irrigated and dryland conditions; 2) Compare the productivity gains among the four crops (under irrigated conditions); 3) Assess the profitability (returns above total variable cost) trends of these crops (under irrigated conditions).

Materials and Methods

Historic productivity for corn, cotton, grain sorghum, and winter wheat under both irrigated and dryland conditions were collected (USDA NASS, 2015a) for SHP from 1973 to 2014. However, only data for 1981 to 2006 was available for corn. Simple linear regressions (OLS) were used to estimate the annual productivity increase for each crop under each condition to compare the productivity gain of the same crop under irrigated and dryland conditions.

Since the units of productivity and prices are different for these crops, crop yields were converted to relative yields to have meaningful comparisons. Relative yield was calculated for each crop in each year by dividing the reported yield in that year by the average yield of that crop from 1975 to 2015, and then converting it to a percentage. Simple Linear Regression was then used to estimate the yield trend line over time for each crop.

The yield data for the four crops in Texas SHP were used along with corresponding prices (USDA NASS, 2015a), and costs of production (Texas A&M AgriLife, 2015) to calculate Returns Above Variable Cost (RAVC) for the crops. Total revenue for cotton was calculated by adding revenues from cotton lint and seed. The cotton seed yield was estimated from the lint yield based on the lint-seed ratio reported in the crop budgets for each year. The revenue from wheat grazing reported in the crop budgets (Texas A&M AgriLife, 2015) was added to the revenue from the grain sales to find the total revenue for wheat. Farm machinery price index (USDA NASS, 2015a) was used to convert nominal profit to real profit for the 4 crops from 1990 to 2014, using 2011 as a base. Simple Linear Regressions were then used to estimate trends in profitability (both nominal and real) for each crop.

Results and Discussion

The descriptive statistics of the yield data for cotton, corn, sorghum, and wheat under irrigated conditions are presented in Table 1. The descriptive statistics show that cotton yields showed very high year to year variability compared to the grains. Corn had the highest productivity and variability among the grains. Average RACV was the highest for corn ($152.87/acre) followed by cotton ($45.99/acre). However, cotton had much higher variability in profits compared to corn (Table 1). The average RAVC was negative for grain sorghum and wheat. It should be noted that the RAVC was calculated based on the production and price, without taking into account any possible government payments.

Table 1. Descriptive Statistics of irrigated yield and profit data for cotton corn, wheat, and sorghum

	Yield/acre (lbs. for cotton and bu. for the rest)				Returns above variable cost ($/acre)			
	Cotton	Corn	wheat	sorghum	Cotton	Corn	wheat	sorghum
Mean	652.71	173.15	45.35	87.02	45.99	152.87	-26.83	-59.77
Minimum	260.00	135.40	20.20	68.40	-185.58	127.60	-180.83	-195.79
Maximum	1188.00	213.10	61.90	102.60	283.94	201.10	82.47	88.33
Standard Deviation	253.19	22.31	8.5	8.92	109.11	18.61	65.25	70.64

The regression analysis of the irrigated and dryland productivity data (not shown) indicated that average increase in corn yield was 1.34 bu. per acre per year in the SHP. The average annual yield increase was 9.5 and 2.32 lbs. per acre for irrigated and dryland cotton, respectively. Irrigated winter wheat yields increased by 0.23 bu. per acre, whereas dryland winter wheat yields showed only 0.06 bu. per acre annual increase. Grain sorghum productivity was essentially stagnant over the years studied (0.03 and 0.06 bu. per acre per year for irrigated and dryland, respectively).

A comparison of the relative yields of the four crops (all irrigated only) is presented in Figure 1. The trend analysis of the relative yields showed that cotton (2.05%) had the largest percentage annual yield increase, followed by corn (0.97%). Wheat yields increased by 0.87% on average each year, whereas grain sorghum yields were stagnant over this time period with only 0.05% annual increase (Figure 1).

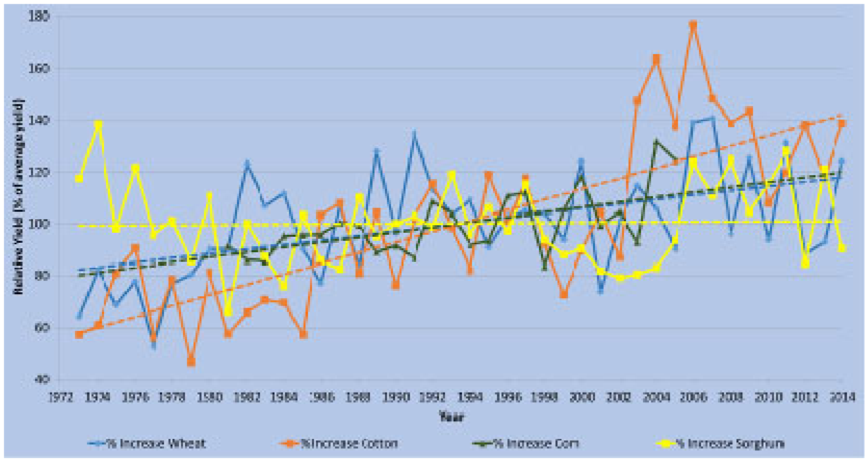

Figure 1. Relative yields of irrigated crops in SHP (% of average yield for each crop)

The trends in nominal profit (RAVC) for the four crops are shown in Figure 2. Even with a positive trend in yields over time, all crops showed a negative trend in nominal RAVC. Irrigated wheat, corn, and grain sorghum, showed 3.57, 3.69, and 3.97 $/acre average annual decrease in RAVC. Cotton producers had the highest success in maintaining profitability, as irrigated cotton showed only $0.69 annual decrease in RAVC (Figure 2). Even though the time trend is negative, cotton and corn showed positive RAVC in a majority of the years. However, the RAVC of winter wheat and grain sorghum was negative for the majority of the years.

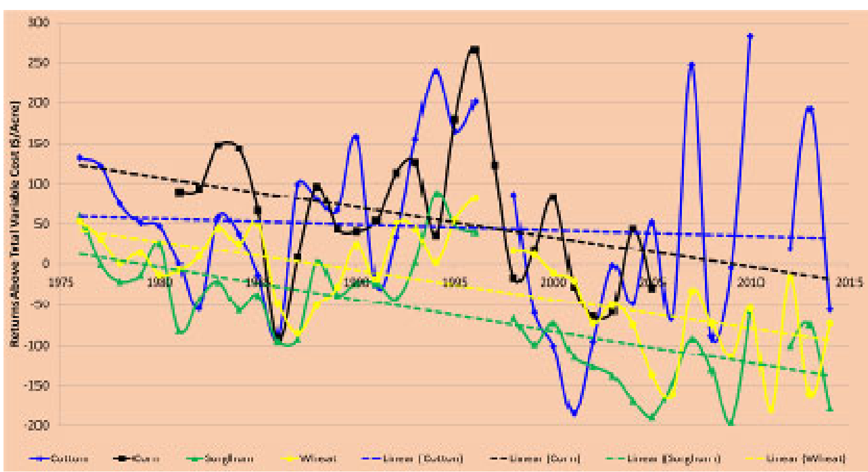

Figure 2. Returns above total variable cost (nominal) for irrigated crops in SHP

All crops showed a negative trend in real returns above variable cost (RAVC). The average decrease of real RAVC was 9.77, 20.74, 7.37, and 9.03 $/acre for irrigated cotton, corn, grain sorghum, and winter wheat, respectively (Figure 3). The real returns showed higher annual decrease for all crops compared to nominal returns. The base year for calculating the real returns was 2011. Hence, the returns in earlier time periods received a larger percentage increase to adjust for inflation. It should be also noted that because of limitations in data availability, data for the 25 year time period from 1990 to 2014 was used to estimate trends in real returns, whereas data for a much longer time period (1976 to 2014) was used to estimate trends in nominal returns.

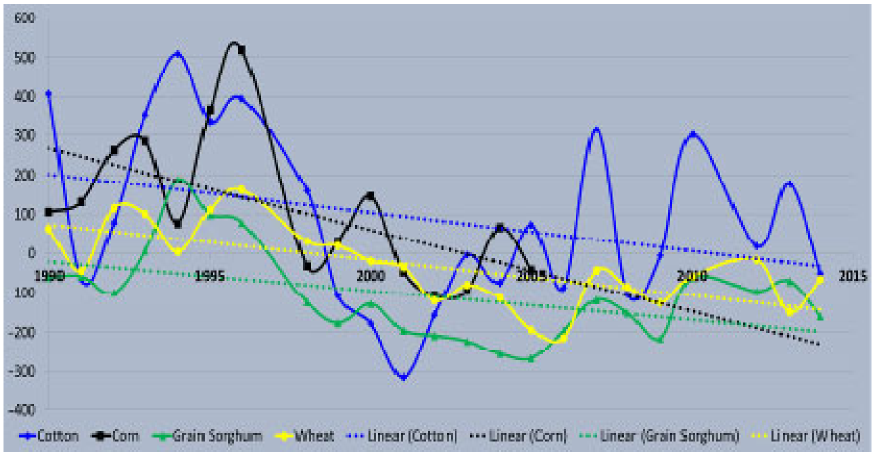

Figure 3. Returns above total variable cost (real) for irrigated crops in SHP

Conclusions

Productivity of irrigated corn, cotton, sorghum, and wheat increased over time in SHP with cotton showing the highest percentage yield increase. The percentage annual yield increase for cotton, corn, grain sorghum, and wheat were 2.05, 0.97, 0.87, and 0.05%, respectively. Even with this positive time trend in yields, all crops showed a negative trend in Returns Above Variable Cost. Cotton producers succeeded in maintaining the profitability with only a slight decrease in nominal profits ($0.69 per acre per year), whereas RAVC decreased by more than $3 per acre per year for corn, sorghum, and winter wheat. However, all crops showed negative time trend in real RAVC. The real RAVC decreased by $20.75/year for corn while the annual decrease in real profit was less than $10 for the other three crops.

The results indicate that the gain in productivity over time does not translate into increasing time trend in profitability for major crops in Texas SHP. However, it should be noted that the revenue was calculated based on yield and price received by the producers. No government payments were considered for revenue calculation. Government payments may have enhanced the profitability of the crops, especially in years with low commodity prices. We also did not consider the quality of cotton lint, which also may have an impact on profitability.

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