

DOES IRRIGATION PAY DURING THE HOTTEST AND DRIEST SUMMER IN TEXAS HISTORY? A CASE STUDY OF IRRIGATED COTTON FARMS IN THE SOUTHERN HIGH PLAINS

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Abstract

The Great Texas Drought of 2011 left many Southern High Plains cotton growers questioning their irrigation practices in the face of such harsh conditions. Typically, producers only rely on irrigation as a supplement to adequate subsoil moisture, timely rainfall and moderate summer temperatures. The 2011 growing season broke records for temperature extremes and duration, as well as lack of rainfall. In this scenario most irrigated producers were unable to keep up with the water demand of typically planted cotton acres. As the growing season progressed, it became obvious that some fields had adequate irrigation capacity to meet the demands of the cotton crop, while many others did not. The objective of this study was to determine what level of irrigation proved to be profitable in 2011 and whether or not that strategy would generate sustainable long term returns. This was accomplished by interviewing Texas Southern High Plains cotton producers that achieved near normal crop production. Financial and production information was gathered from these individuals to develop comparative budgets. Additionally, this information was used to update the FARM Assistance Strategic Analysis Model developed for a previous irrigation study completed in 2006. It was determined that where adequate irrigation was applied to attain “normal” yields, higher than average cotton prices allowed producers to make positive net returns. Long term risk analysis revealed that the optimal strategy would be irrigating to full expected yield potential by either cutting back acreage or developing more capacity by drilling new wells where feasible.

Introduction

Texas has experienced the worst single year drought in state history in 2011 (Fannin 2011, Nielsen-Gammon 2011), leaving many cotton producers questioning their irrigation practices in the face of such harsh conditions. Typically, Southern High Plains cotton farmers depend on irrigation as a supplement to adequate subsoil moisture (Almas 2007), timely rainfall and moderate summer temperatures. The 2011 growing season has seen records broken for temperature extremes and duration, as well as lack of rainfall as illustrated in Figure 1. In this scenario most irrigated producers have been unable to keep up with the water demand of typically planted cotton acres.

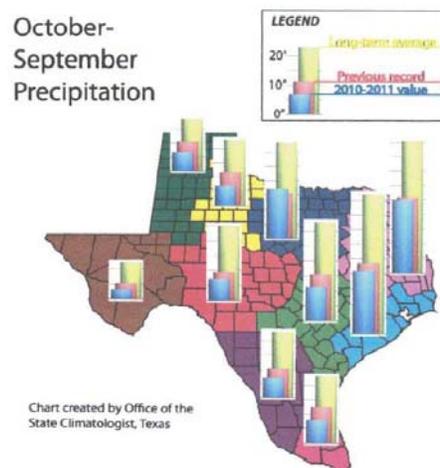


Figure1. October 2010 through September 2011 Precipitation Totals by Texas Region (Nielsen-Gammon 2011).

As the summer of 2011 progressed it became obvious that some fields had adequate irrigation capacity to meet the demands of the cotton crop, while many others did not. In desert regions of the Western United States producers only plant what they can fully irrigate, assuming there will be little to no rain during the growing season. At current prices these operations appear to be profitable as evidenced by the 32% increase in planted acreage in 2011 (NASS 2011). Traditionally, it has worked well in the Southern High Plains to stretch water resources to their limit and count on rainfall for a large portion of crop needs (Yates 2006). As we move into the future, producers need to know which irrigation strategy will be most likely to succeed. Therefore, a group of cotton producers and researchers cooperated to develop case studies based on recent experiences to evaluate the various irrigation alternatives facing growers in coming seasons. Those alternatives were analyzed and compared for relative profitability.

Materials and Methods

Texas Southern High Plains cotton producers were identified by industry contacts and from Texas AgriLife Research and Extension cooperators that achieved near normal crop production during the devastating 2011 growing season. Financial and production information from these individuals and AgriLife trials were gathered to develop comparative budgets using Microsoft Excel spreadsheets developed as a part of the South Plains Cotton Profitability project funded by Cotton Incorporated Texas State Support. These budgets were modified to compare alternative cropping systems represented by the producers cooperating in the analysis. Additionally, the information gathered from cooperators was used to update the analysis performed earlier for the paper presented at the 2006 Beltwide Cotton Conferences (Yates 2006). The long-term analysis was performed using the FARM Assistance Strategic Analysis system developed by the Texas AgriLife Extension Service. The base year for the analysis is 2012, and projections are carried through 2021. FARM Assistance provides an evaluation of the baseline scenario and the three alternative scenarios for the ten-year planning horizon. The baseline analysis maintains the status quo in the operation. Alternative 1 looks at irrigating half of the commonly irrigated cotton acreage and maintaining the other half as dryland cotton. Alternative 2 looks at irrigating two-thirds of the commonly irrigated cotton acreage and maintaining the other one-third as dryland cotton. Alternative 3 looks at irrigating all of the commonly irrigated cotton acreage by drilling enough new wells to restore capacity to greater than 3 gallon per minute per acre at a cost of \$40,000 per 125 acre pivot system. Commodity price trends follow projections provided by the Food Agricultural Policy Research Institute (FAPRI) with costs adjusted for inflation over the planning horizon.

Results and Discussion

Information regarding yield and actual expenses from each of the cooperating sites was entered into spreadsheets developed for the South Plains Cotton Profitability project. The yield, returns above direct expenses and net farm profit were summarized and plotted against irrigation water applied on scatter diagrams and a simple regression line was fit to the data. Figure 1 shows the relationship of irrigation water applied to yield for the 2011 growing season.

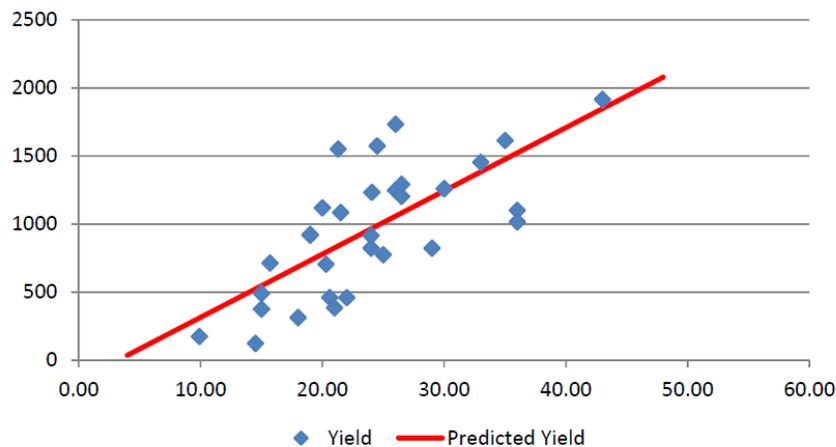


Figure 1. 2011 Cotton Yield (lbs./acre) Versus Irrigation Water Applied (acre inches)

Figure 2 shows the relationship of irrigation water applied to returns above direct costs for the 2011 growing season with \$0.90 per pound cotton price and \$9 per acre inch irrigation fuel cost. The points on the graph where returns above direct costs exceeded \$400.00 per acre were all systems with more than four gallons per minute per acre system capacity.

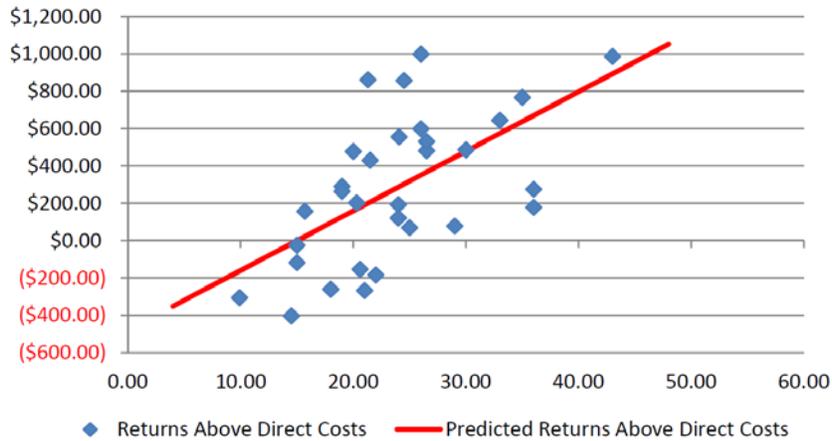


Figure 2. 2011 Returns Above Direct Costs (\$/acre) Versus Irrigation Water Applied (acre inches) with \$0.90/lb Cotton Price and \$9 per Acre Inch Irrigation Fuel Cost.

Figure 3 shows the relationship of irrigation water applied to net profit for the 2011 growing season with \$0.90 per pound cotton price and \$9 per acre inch irrigation fuel cost. The points on the graph where net profits exceeded \$200.00 per acre were all systems with more than four gallons per minute per acre system capacity.

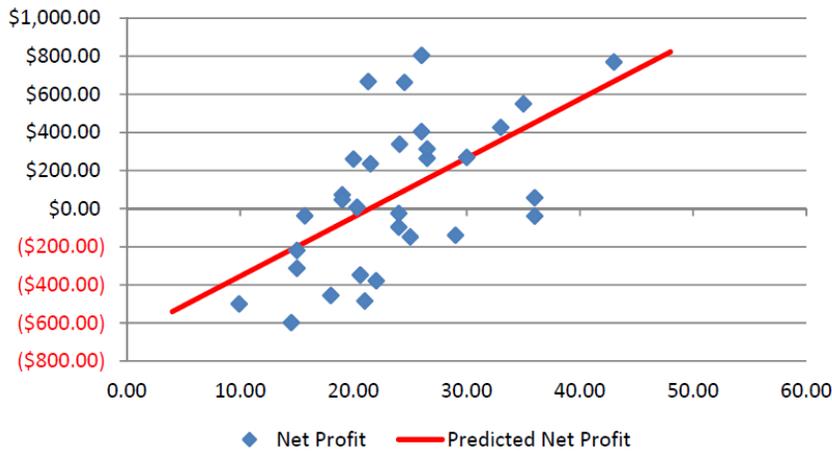


Figure 3. 2011 Net Farm Profit (\$/acre) Versus Irrigation Water Applied (acre inches) with \$0.90/lb Cotton Price and \$9 per Acre Inch Irrigation Fuel Cost.

Figure 4 shows the relationship of irrigation water applied to returns above direct costs for the 2011 growing season with \$0.52 per pound cotton price and \$9 per acre inch irrigation fuel cost. Only four systems were able to produce positive returns above direct costs when cotton price is lowered to the loan rate with all other variables constant.

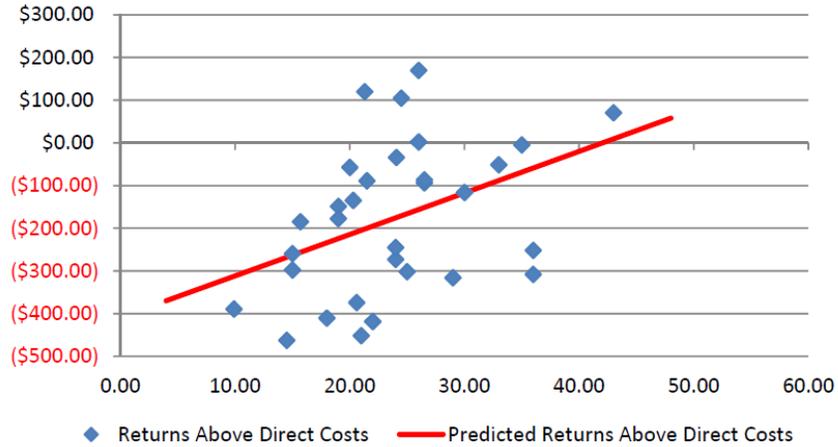


Figure 4. 2011 Returns Above Direct Costs (\$/acre) Versus Irrigation Water Applied (acre inches) with \$0.52/lb Cotton Price and \$9 per Acre Inch Irrigation Fuel Cost.

Figure 5 shows the relationship of irrigation water applied to net profit for the 2011 growing season with \$0.52 per pound cotton price and \$9 per acre inch irrigation fuel cost. No systems were able to produce positive net farm profits when cotton price is lowered to the loan rate with all other variables constant.

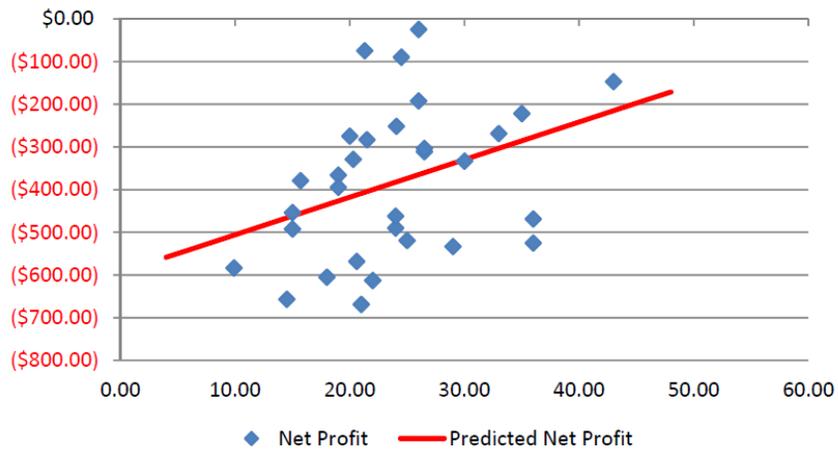


Figure 5. 2011 Net Farm Profit (\$/acre) Versus Irrigation Water Applied (acre inches) with \$0.52/lb Cotton Price and \$9 per Acre Inch Irrigation Fuel Cost.

Figure 6 shows the relationship of irrigation water applied to returns above direct costs for the 2011 growing season with \$0.90 per pound cotton price and \$15 per acre inch irrigation fuel cost. Raising the irrigation fuel price to the highest level observed over the past several years results in very little difference in returns compared to the \$9 per acre inch level with all other variables constant.

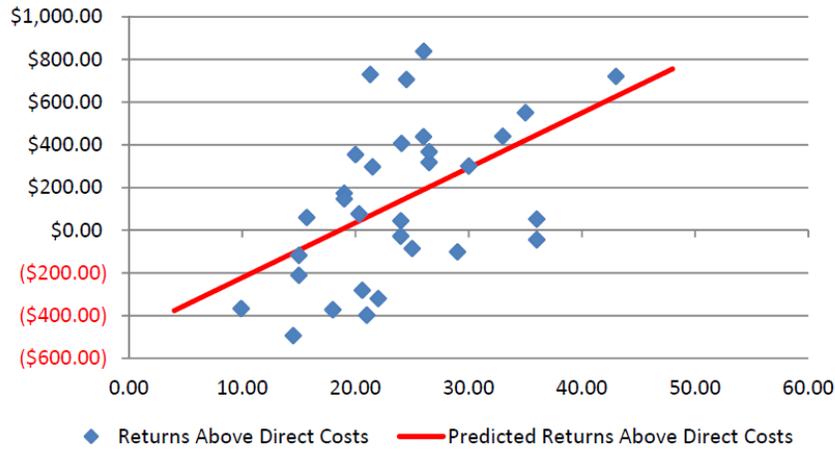


Figure 6. 2011 Returns Above Direct Costs (\$/acre) Versus Irrigation Water Applied (acre inches) with \$0.90/lb Cotton Price and \$15 per Acre Inch Irrigation Fuel Cost.

Figure 7 shows the relationship of irrigation water applied to net profit for the 2011 growing season with \$0.90 per pound cotton price and \$15 per acre inch irrigation fuel cost. Raising the irrigation fuel price to the highest level observed over the past several years results in very little difference in returns compared to the \$9 per acre inch level with all other variables constant.

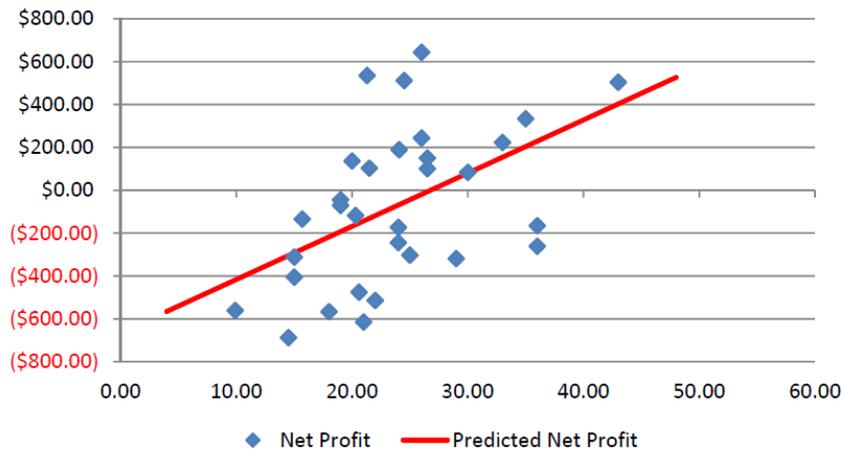


Figure 7. 2011 Net Farm Profit (\$/acre) Versus Irrigation Water Applied (acre inches) with \$0.90/lb Cotton Price and \$15 per Acre Inch Irrigation Fuel Cost.

Figure 8 shows the projected variability in net farm income (NFI) for 2012 through 2021 in thousands of dollars for the baseline, which is watering full pivots with a capacity of 300 gallons per minute per 125 acre pivot system (2.4 gpm/acre). The shaded area indicates a range that contains 50% of the projected NFI values. Over the ten-year period, the analysis indicates a 50% likelihood that NFI could be between a loss of \$36,330 and a profit \$379,560, with an average of \$187,730 (Table 2).

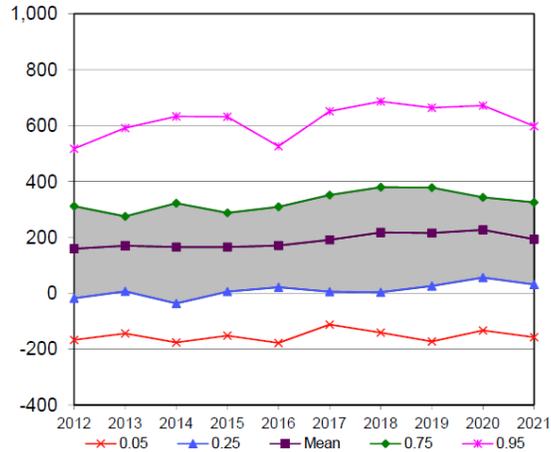


Figure 8. Projected Variability in Net Farm Income (\$1,000) 2012-2021 for Baseline – Water whole pivots with 300 gpm per pivot.

Figure 9 shows the projected variability in net farm income (NFI) for 2012 through 2021 in thousands of dollars for alternative 1, which is watering half pivots with a capacity of 300 gallons per minute per 125 acre pivot system (4.8 gpm/acre) and planting the other half to dryland cotton. The shaded area indicates a range that contains 50% of the projected NFI values. Over the ten-year period, the analysis indicates a 50% likelihood that NFI could be between a loss of \$14,620 and profit of \$429,810, with an average of \$216,480 (Table 2).

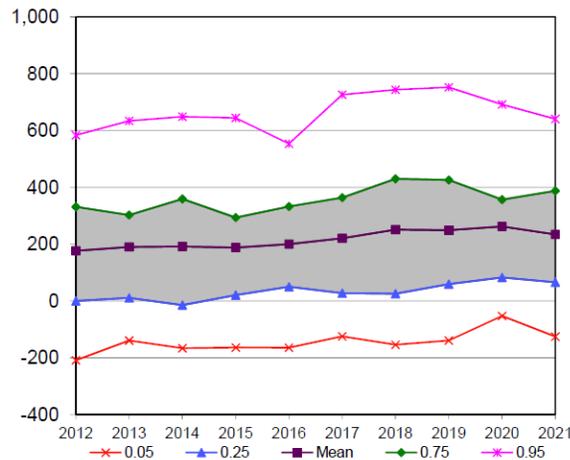


Figure 9. Projected Variability in Net Farm Income (\$1,000) 2012-2021 for Alternative 1 – Water half pivots, plant the rest to dryland cotton.

Figure 10 shows the projected variability in net farm income (NFI) for 2012 through 2021 in thousands of dollars for alternative 2, which is watering two-thirds pivots with a capacity of 300 gallons per minute per 125 acre pivot system (3.6 gpm/acre) and planting the other one-third to dryland cotton. The shaded area indicates a range that contains 50% of the projected NFI values. Over the ten-year period, the analysis indicates a 50% likelihood that NFI could be between a loss of \$23,460 and a profit \$419,270, with an average of \$205,580 (Table 2).

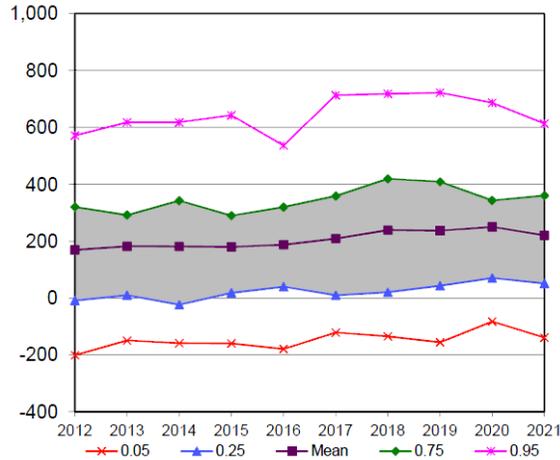


Figure 10. Projected Variability in Net Farm Income (\$1,000) 2012-2021 for Alternative 2 – Water two-thirds pivots, plant the rest to dryland cotton

Figure 11 shows the projected variability in net farm income (NFI) for 2012 through 2021 in thousands of dollars for alternative 3, which is drilling new wells to allow watering full pivots with a capacity of 600 gallons per minute per 125 acre pivot system (4.8 gpm/acre). The shaded area indicates a range that contains 50% of the projected NFI values. Over the ten-year period, the analysis indicates a 50% likelihood that NFI could be between a loss of \$31,030 and profit of \$586,390, with an average of \$301,380 (Table 2).

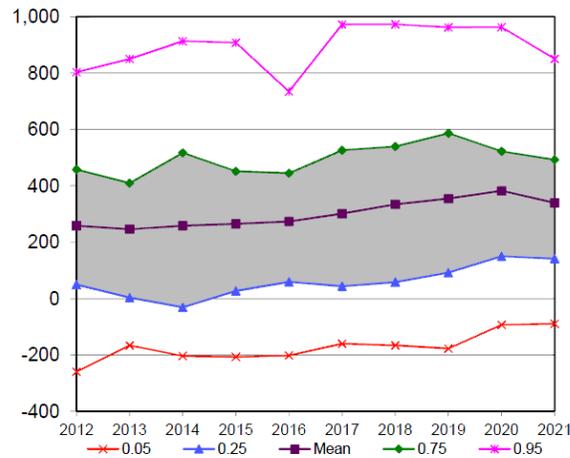


Figure 11. Projected Variability in Net Farm Income (\$1,000) 2012-2021 for Alternative 3 – Drill new wells to fully irrigate entire pivots 600 gpm.

Figure 12 shows the growth in ending cash reserves in thousands of dollars, which represents the capacity of the firm to meet cash flow needs. Additionally Figure 12 illustrates the probability being short at the end of the year and having carryover debt for each of the four alternatives analyzed. Alternative 3, with increased profitability over the other alternatives (Table 2), generates significantly higher ending cash reserves over the ten-year period as represented by the orange line in Figure 12. However, Alternative 3 has a higher chance of falling short of cash flow needs than Alternative 1 in 2012 (23% versus 21%) and all other alternatives in 2013 (14% versus 13% Baseline, 12% Alternative 1 and 12% Alternative 2) due to the capital expenditure related to drilling new wells at a cost of \$40,000 per 125 pivot system.

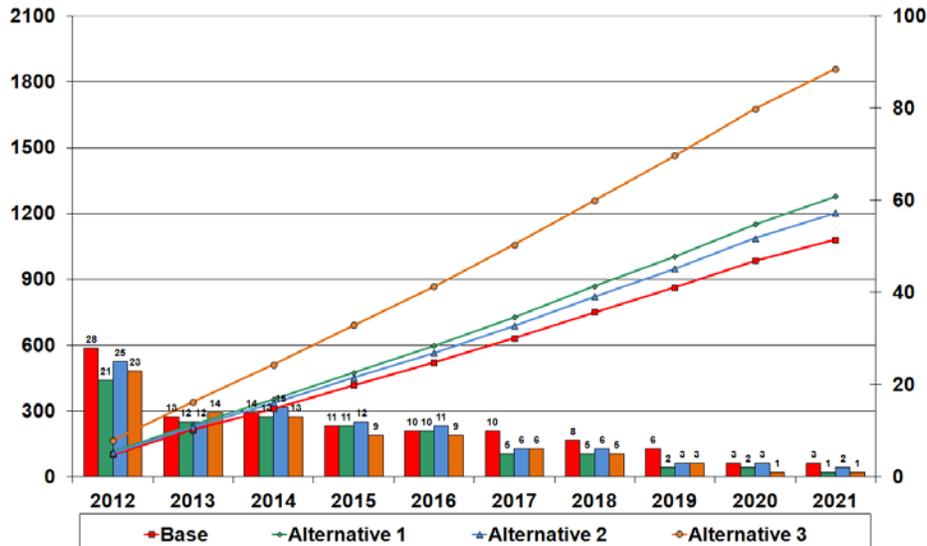


Figure 12. Ending Cash Reserves (\$1,000) and Probability of Having to Refinance (%) 2012-2021.

Table 1 contains the percent change in net worth for the baseline and each of the three alternatives analyzed from the beginning of 2012 to the end of 2021. Alternative 3 had significantly higher net worth growth than the baseline and all other alternatives. Tables 2 and 3 contain the ten-year averages for net farm income and probability of cash reserves being less than zero, respectively. Alternative 3 had significantly higher net farm income than the baseline and all other alternatives. Additionally, Alternative 3 had a lower probability of negative cash than the baseline but not lower than the other alternatives due to the high cost of drilling new wells.

Table 1. Percent Change in Real Net Worth from 2012 to 2021.

Alternative Analyzed	Change
Baseline – Water whole pivots with 300 gpm per pivot	299.19%
Alternative 1 – Water half pivots, plant the rest to dryland cotton	345.47%
Alternative 2 – Water two-thirds pivots, plant the rest to dryland cotton	327.73%
Alternative 3 – Drill new wells to fully irrigate entire pivots 600 gpm	507.44%

Table 2. 2012-2021 Average Net Farm Income.

Alternative Analyzed	Net Profit
Baseline – Water whole pivots with 300 gpm per pivot	\$187,730
Alternative 1 – Water half pivots, plant the rest to dryland cotton	\$216,480
Alternative 2 – Water two-thirds pivots, plant the rest to dryland cotton	\$205,580
Alternative 3 – Drill new wells to fully irrigate entire pivots 600 gpm	\$301,380

Table 3. 2012-2021 Average Probability of Cash Reserves Less Than Zero.

Alternative Analyzed	Probability
Baseline – Water whole pivots with 300 gpm per pivot	10.6%
Alternative 1 – Water half pivots, plant the rest to dryland cotton	8.2%
Alternative 2 – Water two-thirds pivots, plant the rest to dryland cotton	8.4%
Alternative 3 – Drill new wells to fully irrigate entire pivots 600 gpm	8.4%

Conclusions

Analysis of the 2011 crop showed that with virtually no sub-soil moisture or rainfall during the growing season, it took at least 4 gallons per minute per acre to make a profitable cotton crop. Long term analysis shows that systems with the ability to deliver less than 3 gallons per minute per acre would be more profitable cutting irrigated acreage back to that level. Adjusting prices for cotton and irrigation energy showed that profitability is more sensitive to low cotton prices than high energy prices. As this study only looked at one year of cotton production on the

observed sites, no research was done as to the effect of previous crop rotation on the yield results for 2011. Prior research (Bordovsky 2011) indicates that cotton following sorghum had significantly higher yields than continuous cotton where irrigation quantities were very limited. The results of the long term analysis validates the earlier study (Yates 2006) that limiting irrigated acreage to what can be maintain at least 75% ET replacement in an average rainfall year produces the optimal level of profitability. It was concluded that at the current and projected higher than long-term average cotton price scenario, it would be the most profitable to increase irrigation capacity within the confines of the current irrigation system back to a level of at least 3 gallons per minute per acre in locations where it is feasible or at least cut back on acres irrigated to achieve that capacity.

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