REGIONAL ECONOMIC IMPACT OF IRRIGATED VERSUS DRYLAND AGRICULTURE IN THE TEXAS HIGH PLAINS

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Abstract

The Texas High Plains has a long history of generating significant economic activity through agricultural production that is highly dependent on the water resources of the Ogallala Aquifer. Ground water supplies in the region are declining to the point where irrigated agriculture may not be present in the future of many communities in the region. This study evaluates the economic impact of irrigated agriculture in the region compared with dryland and minimally irrigated production. Data collected for crop years 2005 through 2008 from the project, "An Integrated Approach to Water Conservation for Agriculture in the Texas Southern High Plains," were summarized and grouped into high, low and no irrigation data sets. The economic and employment impacts were then calculated using the IMPLAN input-output model. As was expected, the impacts generated by irrigated agriculture in the study area were considerable. The highly irrigated land in the study area had a gross output $240/acre more than the minimally irrigated and $482/acre more than the dryland. Expanding the results to the entire Texas High Plains yields similar results with a $479/acre reduction in gross output going from irrigated to dryland and a corresponding loss of nearly 7,300 jobs. These results indicate that as the availability of irrigation water from the Ogallala continues to decline, shifts in economic activity are possible. Additionally, any movements in economic base within the Texas South Plains will not be homogeneous as the crop mix, climate, and hydrologic characteristics vary greatly within the region.

Introduction

The Texas High Plains has a long history of generating significant economic activity through agricultural production that is highly dependent on the water resources of the Ogallala Aquifer. Ground water supplies in the region are declining to the point where irrigated agriculture may not be present in the future of many communities in the region. In September of 2004 the project "An Integrated Approach to Water Conservation for Agriculture in the Texas Southern High Plains" was approved by the Texas Water Development Board. This multidisciplinary and multi-entity demonstration project is run by a producer board, elected by producers in Hale and Floyd Counties. The Texas AgriLife Extension Service FARM Assistance program has collected income and expense information from the demonstration sites each year from 2005 through 2008. The predominant crop in the study area is cotton, but there is a wide variety of crops from corn and sorghum for grain and silage to wheat and perennial grasses for grain, hay, seed and grazing. Sites in the project have many levels of irrigation from fully irrigated drip and pivot systems to minimally watered pivots and furrow as well as some which are completely dryland. It should be noted that in a previous study of the Southern High Plains it was found that "the drawdown over 50 years did not exceed 50% of initial saturated thickness in 12 of the 19 counties" (Johnson 2009). Therefore, the most likely scenario for most communities would be the reduction of irrigation capacity, rather than total elimination.

Materials and Methods

The Texas Alliance of Water Conservation (TAWC) project is a multi-faceted effort including the Texas Water Development Board, Texas Tech University, Texas AgriLife Extension, the United States Department of

Agriculture, the High Plains Underground Water Conservation District #1, and the producers of Floyd and Hale counties. It is designed to demonstrate water conservation methods while maintaining or improving agricultural production and economic opportunities within communities. The project focuses on maximizing the efficiency of irrigation water pumped from Ogallala Aquifer, while also looking at methods which allow for water conservation with a minimum economic impact to producers.

Since the inception of the Texas Alliance for Water Conservation (TAWC) project, FARM Assistance, a program of the Texas AgriLife Extension Service, has maintained a working relationship with the cooperating producers. Production records are maintained by each producer for each farm (site) that he has in the program. FARM Assistance personnel deliver those record books early each year, and by way of individual contact several times each year, gather the producer information that is vital to the success of the demonstration project. The data collected are the basis for the results calculated in this study.

The study area is comprised of twenty-nine farm sites in Hale and Floyd Counties in the High Plains of Texas. Cost and return data were collected for the sites during the 2005 through 2008 growing seasons during which the cooperators planted an average of 4,212 acres per year, of which 3,516 were irrigated and 697 acres were dryland. For the purpose of evaluating the effect of reducing, but not eliminating irrigation, the irrigated acres were divided into two groups according to the level of irrigation used. The low water group spent less than $100 per acre for irrigation fuel, representing 10 acre-inches or less applied and the high water group spent $100 per acre or more, representing more than 10 acre-inches applied. On average, there were 1,318 acres in the high water group and 2,197 in the low water group.

Regional impact of irrigation was calculated by extending cost and return data to all acres in the Texas High Plains counties represented by Texas AgriLife Extension Service Districts 1 and 2. According to the 2007 Census of Agriculture (USDA 2009) there were 3,372,968 acres of irrigated land versus 4,048,800 acres of dryland in the region. No reliable information was found to split the irrigated acreage into two categories, as was done in the study area. Therefore, the analysis for the entire Texas High Plains region was completed using the data for all irrigated and dryland acres only.

The average 2005-2008 regional income and cost data were calculated in terms of costs per dollar of cash receipts. Each cost category was matched to an industry sector in the IMPLAN input-output model (Minnesota IMPLAN Group, 2004). For example, farmers' beef production costs were matched to the agriculture support, animal feed manufacturing, and veterinary services sectors of IMPLAN. Value added components (e.g., employee compensation, proprietor's income, other property income, and indirect business taxes) were also grouped into sectors recognized by IMPLAN. The costs per dollar of cash receipts were entered into IMPLAN to determine the economic contribution of each water use system to the region.

Impact analysis is based on the idea that a dollar spent in a region stimulates additional economic activity, or multiplies as it circulates through the economy. This multiplier effect recognizes that the total effect on output, employment, personal income, and government revenue in the region is greater than the initial dollar spent. Of course, some of the original expenditure leaks out of the regional economy, for example as inventory is imported from other regions, employees commute from other regions, and businesses and households pay state and federal taxes. The portion of the money that remains in the local economy throughout these transactions constitutes the net economic gain. Larger regions contain more economic linkages and less leakages, which is why multi-county regions generally have larger multipliers than do smaller territories.

Input-output models use a direct effect, such as industry sales, to estimate indirect and induced effects based on purchasing relationships between industries and households. The direct effect on the economy is the initial change in final demand, or sale to final users. The direct effect results in two types of secondary effects. The indirect effect results from the purchase of inputs among local industries. The induced effect results from the expenditure of institutions such as households and governments benefitting from increased activity among local businesses. IMPLAN estimates backward linkages through the economy. For example, the inputs to cotton farming include fertilizer and fuel for tractors, but not ginning (a forward-linked process). The model assumes Leontief (fixed proportion) production functions, constant prices, and elastic input supplies.

Results and Discussion

Table 1 contains the results calculated from the IMPLAN model for the twenty-nine farm sites in the TAWC project averaged over the four years of study in total nominal dollars. Since acreage among the three water use levels differs, Table 2 contains the results on a per acre basis. For comparison sake, both Table 1 and Table 2 have results calculated for all irrigated acres combined. Table 3 presents the difference between irrigated and dryland practice for the entire Texas High Plains region as represented by Texas AgriLife Extension Service Districts 1 and 2 (Figure 1).

Table 1. Hale and Floyd Counties Total Dollar Impact for the Twenty-nine Farm Sites.

Gross Output				
	All Irrigated	High Water	Low Water	Dryland
Direct	1,310,122	654,723	654,027	72,308
Indirect	186,647	97,496	88,940	8,617
Induced	93,730	46,655	46,953	5,756
Total	1,590,498	798,874	789,920	86,680
Total Value Added				
Direct	390,784	201,096	189,310	22,002
Indirect	89,440	46,406	42,873	4,304
Induced	54,759	27,257	27,431	3,363
Total	534,982	274,759	259,614	29,668
Labor Income				
Direct	190,570	93,963	96,409	12,292
Indirect	49,111	25,302	23,701	2,452
Induced	27,031	13,455	13,541	1,660
Total	266,712	132,720	133,651	16,404
Employment				
Direct	5.5	2.7	2.8	0.4
Indirect	1.1	0.5	0.5	0.1
Induced	1.0	0.5	0.5	0.1
Total	7.6	3.7	3.8	0.5

Table 2. Hale and Floyd Counties Dollar per Acre Impact for the Twenty-nine Farm Sites.

Gross Output	All Irrigated	High Water	Low Water	Dryland
Direct	373	497	298	104
Indirect	53	74	40	12
Induced	27	35	21	8
Total	452	606	360	124
Total Value Added				
Direct	111	153	86	32
Indirect	25	35	20	6
Induced	16	21	12	5
Total	152	208	118	43
Labor Income				
Direct	54	71	44	18
Indirect	14	19	11	4
Induced	8	10	6	2
Total	76	101	61	24

Table 3. Total Dollar Impact for the Texas High Plains.

Gross Output	All Irrigated	Dryland
Direct	1,678,383,596	608,648,330
Indirect	426,243,712	165,896,341
Induced	233,177,309	91,171,091
Total	2,337,804,640	865,715,761
Total Value Added		
Direct	563,201,567	198,518,385
Indirect	200,840,631	77,599,826
Induced	127,324,903	49,783,502
Total	891,367,100	325,901,710
Labor Income		
Direct	271,045,428	105,937,427
Indirect	115,208,234	45,217,832
Induced	68,977,863	26,969,914
Total	455,231,524	178,125,171
Employment		
Direct	6,751.6	2,848.1
Indirect	2,188.8	891.4
Induced	2,173.5	849.8
Total	11,113.9	4,589.3

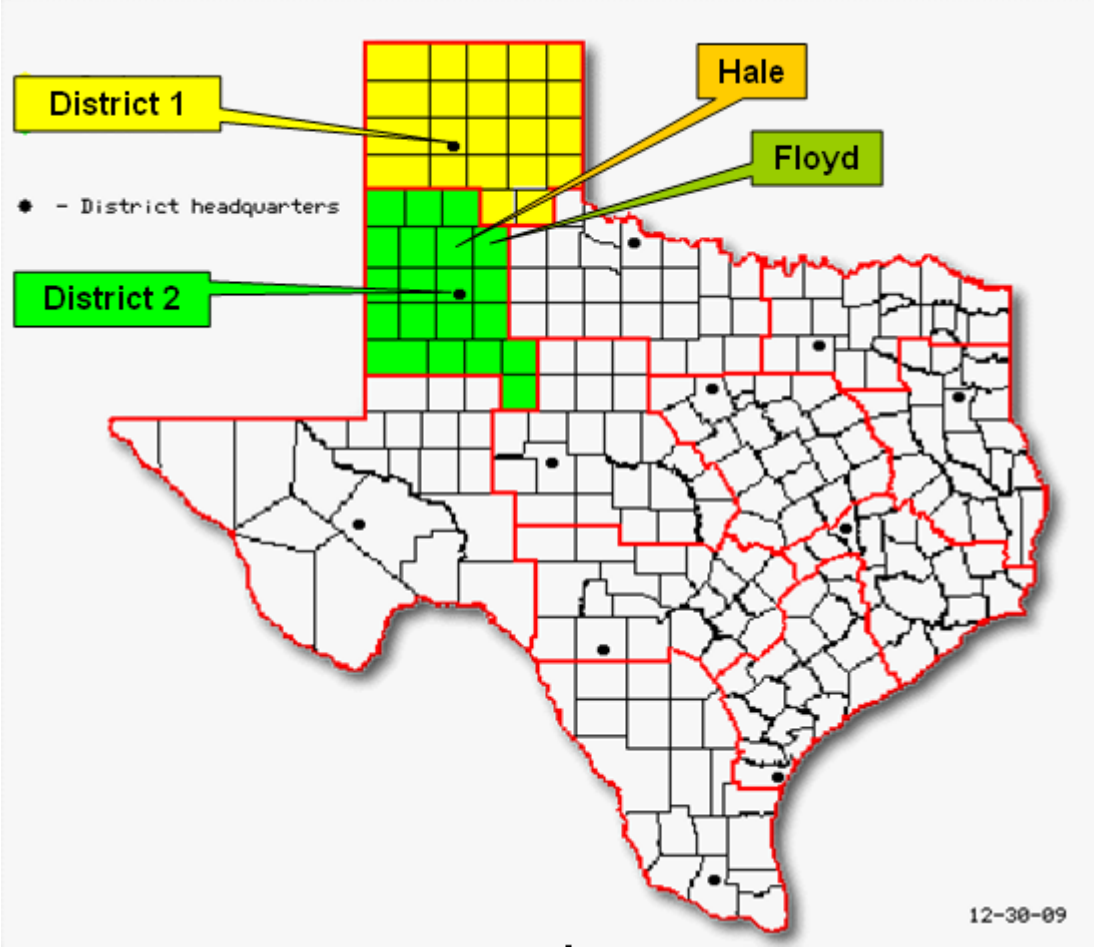

Figure 1. Texas AgriLife Extension Service Districts 1 and 2.

Economic contributions reported in Tables 1 through 3 use IMPLAN multipliers based on a social accounting matrix (Type SAM) that incorporates household income. Four types of impacts were calculated from the Type SAM model: output (gross sales), value-added, labor income, and employment. Output or sales multipliers measure the effect of external spending on overall economic activity in the region. The output multiplier provides the largest economic impact value and therefore is reported in many studies; however, the output multiplier says nothing about how the event affects the welfare of households or the profitability of businesses.

The value-added multiplier measures an industry's contribution to regional gross domestic product (GDP). In other words, it is the value added to the regional economy or the return to local resources used in the production of the event. Value-added includes labor income, proprietor's income, other property income, and indirect business taxes. The labor income or personal income multiplier is a key component of the value-added multiplier that is often reported alone. The labor income multiplier measures the effect of final demand spending on the incomes of households in the region and is appropriate for discerning the benefit of an event to a region's residents. The employment multiplier measures the effect of final demand expenditures on regional employment. Calculation of the employment multiplier assumes that existing employees are fully occupied and does not distinguish between full-time and part-time workers.

Conclusions

The purpose of this study was to take real-world observations from specific farms over a period of multiple years to demonstrate the economic importance of irrigation to the Texas High Plains. As was expected, the impacts generated by irrigated agriculture in the study area were considerable. The highly irrigated land in the study area

had a gross output $240/acre more than the minimally irrigated and $482/acre more than the dryland. Expanding the results to the entire Texas High Plains yields similar results with a $479/acre reduction in gross output and $184/acre reduction in value added going from irrigated to dryland with a corresponding loss of nearly 7,300 jobs. The total dollar regional impact of converting all irrigated acres to dryland would be a net loss of $1,616,595,500 of gross output and $616,865,400 of value added. It can be concluded from these results that the reduction from highly irrigated agriculture to minimally irrigated would substantially shrink the rural economy of the Texas High Plains, but the total elimination of irrigation would be devastating. As the dynamics of irrigated agriculture on the Southern Plains continues to evolve, irrigated producers within the region could shift to more dryland intensive operations. Given the current profitability structure of dryland enterprises, economies of scale will occur, forcing regional farmers to increase the size of their operations. During this transition, local communities and infrastructure will be impacted as fewer producers are involved in the process of production agriculture. While it is not likely that irrigation will disappear overnight, which could result in a $2.2 billion loss in regional economic activity, it is possible that through time the Texas High Plains will change the quantity and means by which economic stimulus is generated through the production agricultural industry.

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