The Importance of Irrigated Crop Production to the Texas High Plains Economy

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The Ogallala Aquifer is the primary source of water for irrigation in the Texas High Plains. Depletion of the aquifer concerns stakeholders as agriculture is a major driver in the regional economy. This study examines the contribution of irrigation to income, economic output, and employment in the region.

Key Words: economic impacts, irrigation, Ogallala Aquifer, water policy

JEL Classifications: Q18, Q32, Q38

The Ogallala Aquifer is the primary source of water for irrigated agricultural production in the Texas High Plains. The depletion of the aquifer, as pumping far exceeds the slow rate of recharge, is creating concern among stakeholder groups within the region. Currently, agriculture is estimated to account for more than 90 percent of water usage (Freese and Nichols Inc., 2010; Llano Estacado Regional Water Planning Group, 2010). At the same time, agriculture serves as a major economic driver to the region's economic activity. This raises concern among decision makers who must determine how to allocate water to agricultural, industrial, and municipal uses. Policymakers need information about the value of agricultural irrigation in order to develop optimal water management strategies to cope with declining water supplies while minimizing the impact on the regional economy.

The overall objective of this study is to estimate the contribution of irrigated agriculture to the Texas High Plains economy. Specifically, this study estimates the economic contribution of irrigated crop production to communities in the region in terms of income, economic output, and employment. In addition, the value of water used for irrigation purposes is estimated.

IMPLAN

Many studies that have quantified the economic impacts of irrigated agricultural production on a region have utilized IMPLAN (Impact Analysis for PLANning) which is an economic input-output model. This computer-based system was originally developed by the United States Department of Agriculture's Forest Service to assist in land and resource management planning. The most current version of IMPLAN (MIG, 2009a) provides access to comprehensive and detailed data coverage of the entire U.S. by county. IMPLAN datasets are compiled from a wide variety of sources including the U.S. Bureau of Economic Analysis, the U.S. Bureau of Labor, and the U.S. Census Bureau. One advantage of the IMPLAN model is that it allows the incorporation of user-supplied data throughout the model building process. This aspect makes the model more flexible and enhances the accuracy of impact results(MIG, 2009b). The IMPLAN model is the primary tool used in this study to measure regional economic impacts of irrigation on the Texas High Plains Region.

The socioeconomic model, IMPLAN, uses multipliers to estimate the response of a region's economy to a "shock" of some type. The estimated multiplier effects are broken down into three components including direct, indirect, and induced effects. Direct effects represent the direct final demand changes. Indirect effects represent the impacts caused by industries buying from industries to supply inputs for irrigated production. Induced effects represent the response of all local industries caused by the change in household income/spending generated by the direct and indirect effects of final demand changes (MIG, 2009b). For example, say a producer switches from irrigated corn to dryland sorghum due to restricted water use. They will not purchase as much fertilizer (direct effect). The fertilizer dealer will not purchase as much fertilizer for the store room (indirect effect). Now, both the producer and the fertilizer dealer do not have as much profit, so they cannot spend as much at the local grocery store (induced effect).

There are basically three measures of economic activity that can be estimated through IMPLAN including industry output, value added, and employment. Industry output is the value of total production of an economy or the total economic activity that occurs in a region. Value added is the income or "wealth" portion of industry output that includes employee compensation, proprietary income, other property income, and indirect business taxes. Finally, employment is simply the number of jobs in an economy (MIG, 2009b). These are the measures reported in this study.

Data and Methods

The study area was the portion of the Texas High Plains Region which overlies the Ogallala Aquifer, Figure 1. In this region, there are over 3.4 million acres of irrigated crop production. The major irrigated crops include corn, cotton, peanuts, sorghum, and wheat at 889,633 acres, 1,426,767 acres, 130,700 acres, 300,133 acres, and 706,667 acres, respectively, Table 1 (National Agricultural Statistics Service, 2013).

Two scenarios were evaluated in order to estimate the overall economic contribution of irrigated agriculture and the value of water used for irrigation purposes. A baseline, in which producers operate in an unregulated manner, analyzed the overall contribution of irrigated crop production to the regional economy. Then, an alternative scenario was estimated which assumed all irrigated acreage is converted to dryland. The value of water used for irrigation was estimated as the difference between irrigated production and dryland production, which was assumed to be the next best alternative. Thus, the value that irrigation adds above and beyond dryland agricultural crop production was evaluated by comparing the two scenarios. The overall value of groundwater used for irrigation on all crops was calculated in dollars per acre-feet using the difference in regional economic impacts between the baseline irrigated scenario and the alternative dryland scenario.

There were five main crops analyzed in this study including corn, cotton, peanuts, sorghum, and wheat. The gross receipts by crop were calculated using a three year average of irrigated crop acreage, price, and yield obtained from the National Agricultural Statistics Service (National Agricultural Statistics Service, 2013). The dryland alternatives assumed in the second scenario were the relative dryland crops with the exception of corn which was assumed to be converted to sorghum and peanuts which were assumed to be converted to cotton.

The gross receipts were then input into the regional economic input-output model, IMPLAN, in order to estimate the effect on the economy. Analysis-by-parts was used in which individual crop production functions were entered into the IMPLAN model. Texas A&M AgriLife Extension budgets were utilized for calculating crop budgets using a three year average (Texas A&M AgriLife Extension Service, 2010). This method allowed for more specific results for irrigated and dryland crops. Multipliers estimated backward-linked economic effects in terms of direct, indirect, and induced effects for economic indicators including industry output, value added, and employment. In addition, forward-linked impacts were estimated which include the effects of locally produced commodities on processing sectors in the region.

Results

Results indicate that irrigated agriculture contributes approximately $6.6 billion in industry output and $2.1 billion in value added to the Texas High Plains economy which supports 58,900 jobs in the region, Table 2. A portion of this impact would be made up by the conversion of the irrigated acreages to their dryland alternatives. The irrigated acreage which is converted to their relative dryland alternatives would generate $2.2 billion in industry output and $717 million in value added, supporting 24,200 jobs, Table 3. Thus, relative to the current situation, a completely dryland production system in the region would result in economic decline of approximately $4.3 billion in industry output and $1.4 billion in value added affecting more than 34,600 jobs, Table 4.

With these results, it is possible to estimate the regional economic value that is generated in the Texas High Plains economy per acre-inch of water applied. The difference in industry output between the irrigated and alternative dryland scenario of $4.3 billion was used to estimate the regional economic value of water used for irrigation purposes per acre-inch of water applied. An average total of approximately 54 million acre-inches were applied to irrigated crops in the region. Thus, the value of water used for irrigation purposes is approximately $80 per acre-inch of water applied. This estimate indicates the value that irrigation adds above and beyond dryland production, which is assumed to be the next best alternative.

Discussion and Conclusion

The availability of water from the Ogallala Aquifer utilized for irrigation purposes in the Texas High Plains Region directly provides higher revenues for producers through increased productivity. The direct impact to producers results in indirect and induced socioeconomic impacts to communities within the region. For an industry that contributes so much to the region, losing this value would have serious negative consequences to the region.

In this study, it is assumed that producers simply moved from the irrigated form of a crop to the dryland version. In reality, very little is known about how producers would respond. In many cases, the assumption made in this study is probably reasonable. However, additional research about producer responses to reduced water is needed to better predict eventual changes in production practices and the requisite impacts on the overall economy.

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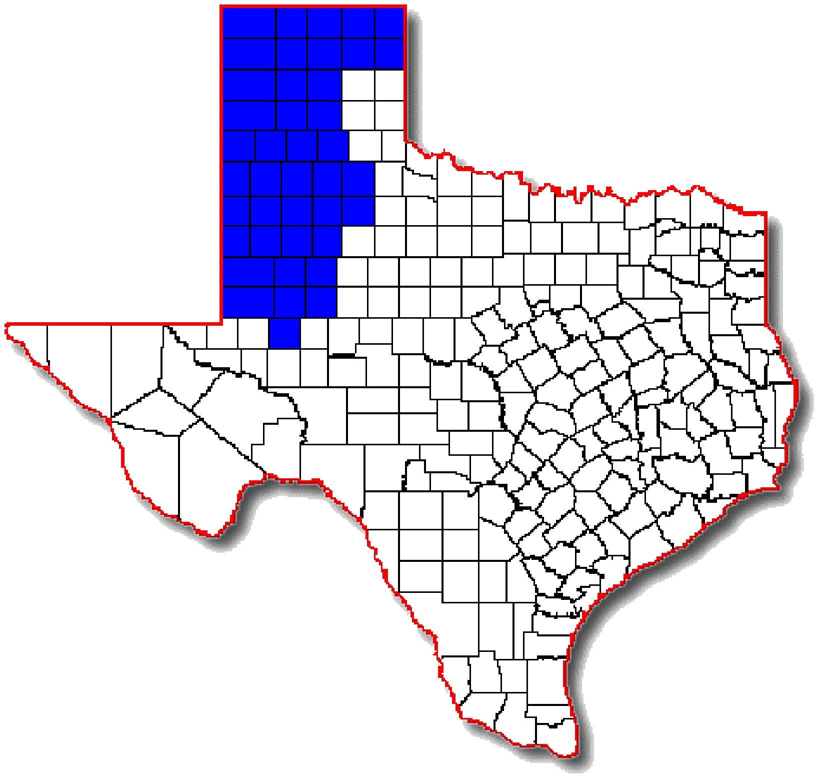

Figure 1. Texas High Plains Study Region.

Table 1. Average Irrigated Crop Acres in the Texas High Plains, 2008-2010.

Commodity	Acres
Corn	889,633
Cotton	1,426,767
Peanuts	130,700
Sorghum	300,133
Wheat	706,667
Total	3,453,900

Table 2. Average Economic Contribution of Irrigated Crop Production (millions of dollars), 2008-2010.

Economic Indicator	Direct	Indirect	Induced	Total
Output	$3,446	$2,546	$624	$6,556
Value Added	$904	$1,081	$360	$2,149
Employment	30,238	23,524	5,668	58,870

Table 3. Average Economic Contribution when Irrigated Crop Acreage is Converted to Dryland (millions of dollars).

Economic Indicator	Direct	Indirect	Induced	Total
Output	$966	$960	$283	$2,213
Value Added	$89	$452	$163	$717
Employment	9,789	11,936	2,518	24,228

Table 3. Difference in Average Economic Contribution between the Baseline Irrigated Crop Production Scenario and the Alternative Conversion to Dryland Scenario (millions of dollars).

Economic Indicator	Direct	Indirect	Induced	Total
Output	$2,480	$1,586	$341	$4,343
Value Added	$816	$629	$197	$1,432
Employment	20,449	11,588	3,150	34,642