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Impact of New Irrigation Technology on the Texas High Plains: 1980-2020

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- Full Text

Crop production on the Texas High Plains is constrained by limited and erratic rainfall, hence irrigation is important. Presently, 6 million acres, or 50% of regional cropland, are irrigated annually. Irrigation water is drawn from the Ogallala Aquifer, which has a recharge rate near zero, and is being depleted at the present rate of use.

Future crop production is dependent on technology, as well as the resources available. Because water is a major limiting resource, technologies that increase plant available water, such as advanced irrigation distribution systems and soil moisture conserving tillage methods, are of particular interest, and are the focus of this study.

Two levels of analysis were included. The first, a farm level analysis based upon representative counties showed the similarities and differences of response given particular resource endowments, technological options and price situations. Part of the analysis considers the impact of annual qroundwater withdrawal constraints on discounted net present value for a forty year planning horizon. The discounted net revenue was higher for lower discount rates, better commodity prices, and more advanced technology. However, alternative discount rates, prices, and technology did not change the optimum annual withdrawal limit. Lower initial groundwater resources reduced the revenue level and the optimal annual groundwater decline limit.

The other part of the farm firm analysis covers expected costs, returns and cropping patterns for a single period. Prices have a significant influence on production, but a far greater impact on net returns. The value of production is 64% to 85% higher for normal prices versus low prices, while net returns are

from 8 to 30 times higher. The amount of available groundwater was not as important as price in the determination of production levels, but it too had a significant impact on net returns. Comparing across representative counties, with prices, technology and groundwater situations held constant, the value of production varied more than $150 per acre, but net returns changed very little. The value of production increases 17% with advanced technology, but net revenue more than doubles.

The second level of analysis, a regional analysis, addressed expected changes in cropland use, groundwater pumpage, production levels, input demand, and farm income over the next forty years, under select technology and price assumptions. Water availability and hence use, drops over time, reducing irrigated cropland, gross returns and net revenue. The demand for other inputs does not decline as quickly as water usage, indicating input substitution. Further, the decline in net revenue is greater than the reduction in gross returns or variable costs of production. The intensity of crop production declines and the mix of crops changes, reducing purchased input demand and lowering regional farm income.

Advanced technology enhances the value of the groundwater resource, increasing water use especially in the later periods of the time horizon. Nontheless, over the whole 40 years, technologies which improve dryland, as well as irrigated, crop production, such as limited tillage and crop rotations, have a greater impact than advanced irrigation technology.

While advanced technology enhances productivity and increases net returns, technology is not a substitute for irrigation. Nor does technology save groundwater resources in the large, since the increased value of the water, given advanced technology, encourages greater use, overall. Advanced technology, however, is important to the future of crop production in the region, since it increased the level of production, and net revenue. Further, the impact of technology was proportionally greater under the low commodity price scenarios than for average prices.