THE FUTURE OF IRRIGATION IN THE TEXAS HIGH PLAINS

by

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Irrigation in the Texas High Plains has a very uncertain future. Unless a means can be found to supplement declining groundwater supplies, irrigated agriculture in the High Plains will shortly start a decline that will end in oblivion in less than a century. Best current estimates are that peak production from irrigated agriculture will be reached in about a decade, although the peak has long since passed in the southernmost portion of the area.

Irrigation is a mainstay of the High Plains economy, but it is not essential to the practice of agriculture. Indeed, a prosperous agricultural economy developed in the period from about 1900 to about the late 1930's without irrigation, and more than half the cultivated land on the High Plains is still farmed on a dryland basis. Hence, while the decline of irrigated agriculture that will inevitably result from a failure to provide a supplemental source of imported water to the High Plains will result in a decline of net income to farm operators and managers, this decline will not be great enough to put any but marginal operators out of business. Of far greater significance will be the decline of secondary and tertiary benefits to other sectors of the economy. Secondary and tertiary benefits associated with irrigation have been estimated to range from about four times the primary benefits in a dry year to about seven times the primary benefits in a reasonably wet year.(1)

CURRENT IRRIGATION PRACTICES IN THE HIGH PLAINS

The Texas Water Development Board estimates that approximately 5.1 million acres of land are currently under irrigation in the High Plains.(2) The accuracy of this estimate depends upon the definition of irrigated land.

Irrigated land appears to be very simple and straightforward to define. Nearly anyone would agree, for example, that a farm unit containing adequate supplies of water and adequate numbers of pumping units and associated items of distribution equipment to furnish, say, thirty inches of water to all cropland throughout the year is irrigated land. A large but unknown fraction of the farms included in the 5.1 million acres of land reported to be irrigated have that capacity, but a significant fraction do not. Does a farm with enough water for a preplant irrigation of all the land in the spring, but only enough to irrigate a portion of the crops during the growing season qualify as irrigated land? Some farmers are not able to irrigate all their land under present irrigation practices, but would be able to irrigate all of it if more efficient methods of applying the water were used. Is their land irrigated?

About sixteen thousand playa lakes dot the High Plains area. A farmer who owns a fairly large playa lake may be able to irrigate much of his land from the lake during a year in which the rainfall is above average. In combination with groundwater then, he may have an irrigated farm in wet years and a largely dryland farm in dry years. How do you classify his farm?

Regardless of the definition used for irrigated land, it is a fact that declining water tables throughout the High Plains force a large and growing number of farmers to choose between alternatives for use of available water each year rather than being able to apply as much water as they desire to all their land.

In broad general terms, irrigation in the High Plains area is slowly migrating from areas where it was first practiced to other areas. At this time, new areas are being brought under irrigation more rapidly than irrigated areas are reverting to dryland, resulting in a net annual increase in irrigated acreage. That is, land is being brought under irrigation for the first time in the northern areas of the plains at the same time that formerly irrigated land in the southern plans is reverting to dryland. The increase in irrigated acreage has been projected to continue until about 1980, after which time the total irrigated acreage is expected to begin to decline.

It is a fact that the water table in the High Plains is declining, but generalizations about the rate of decline are largely meaningless and misleading. Hence, it is commonly said that the "average" decline of the water table in the area is about three or four feet, but the actual decline tends to be a direct function of the saturated thickness of the aquifer. Since more water can be produced and is produced from thicker sections of saturated aquifer than from thinner sections, the water table declines much faster where abundant supplies exist than where poor supplies exist. By the same token, irrigation wells do not normally suddenly go "dry". Rather the quantity of water that can be produced from a given well decreases as the saturated thickness of the aquifer decreases until an economically feasible quantity of water can no longer be produced. The land then reverts to dryland production.

It has been estimated that the Ogallala Aquifer originally contained approximately 280 million acre-feet of economically recoverable water, and that the total annual production from this aquifer may be about 7.5 or 8 million acre-feet. (3) These figures indicate that about 18 inches of water are being applied to each acre of irrigated land each year. Assuming a storage coefficient of about 16 percent and no recirculation of water to the aquifer, the withdrawal of 18 inches of water from beneath a tract of land should lower the water table by about nine feet. Such declines are not uncommon in small areas where good water exists, but they are not usually over widespread areas.

VALUE OF IRRIGATION TO HIGH PLAINS ECONOMY

Even in the High Plains area, few people are aware of the dollar value of irrigation to farm operators, and still fewer are aware of the secondary

and tertiary benefits to the economy of the region that are associated with irrigated agriculture.

The input-output model being developed for the State under the supervision of Dr. Herbert W. Grubb of Texas Tech University will shed much light on the importance of irrigated agriculture in the High Plains to the economy of the High Plains region and to all other areas of the State. This model will prove conclusively whether or not importation of water to the High Plains is economically feasible from the viewpoint of the State as a whole. In a study completed in 1966, Dr. Grubb attempted to analyze the present economic importance of irrigation in the Texas High Plains and, on the basis of present importance, to project irrigation benefits at each ten year interval for the period 1970-2020. (4) Primary, secondary, and tertiary benefits associated with irrigated agriculture were computed for the study period on the basis of the best information available. Since this is the most comprehensive study presently available on this subject, a review of Dr. Grubb's findings is in order.

In preparing Texas Water Development Board Report 11, Dr. Grubb made the following definitions and assumptions: (4)

1. Primary benefits are defined as the additional net farm income derived from irrigation.
2. Secondary benefits to irrigation are defined as the payment to local resources employed in marketing the agricultural product added by irrigation in the High Plains.
3. Tertiary benefits are described as those benefits to the non-agricultural sectors which are induced by irrigation. Tertiary benefits are separated into two major parts, a) Tertiary beneifts associated with agricultural inputs and, b) Tertiary benefits associated with consumption.
4. A composite irrigated acre is the representative or average irrigated acre of land in the High Plains in 1959, adjusted to reflect some shift in irrigation to the North Plains. The adjusted composite irrigated acre includes 32 percent cotton, 38 percent grain sorghum, and 21 percent wheat.
5. Irrigation output is the yield per composite irrigated acre above that which would be expected on the same acre farmed dryland.
6. The composite irrigated acre remains constant with time.
7. Irrigation output remains constant with time but irrigation water use efficiency increases with time.
8. Prices of agricultural products, agricultural inputs, and consumption items remain constant at the 1959 level.
9. Maximum irrigation development in the High Plains area is achieved by 1980 and, due to declining water, the total number of irrigated acres declines after this date.
10. High Plains irrigated land would be farmed on a dryland basis with no significant change in the kinds of crops produced.

11. High Plains farm managers are qualified to carry out irrigated agricultural production.
12. The composite consumer dollar remains constant with time.
13. The present level of High Plains livestock feeding will not be affected by declines in irrigated acreage between 1965 and 2020.
14. Income generated by irrigation is consumed in the local High Plains area.
15. Locally owned High Plains resources are used to market irrigation output and to merchandize and otherwise service agricultural inputs and consumer items used in the High Plains as a result of irrigation.

The difficulty of assigning an average value to irrigation in the High Plains is illustrated by Osborn's paper which was referred to earlier. (1) However, since average values constitute the only reasonable basis for projections, Grubb used 1959 as an average year and based all his projections on that year. He found that, in 1959, dryland cotton produced an average yield of about one-half bale per acre, and irrigated cotton produced slightly more than one bale per acre. Irrigated grain sorghum yields were about 1.6 tons per acre compared to 0.7 tons per acre without irrigation. Irrigated wheat yielded an average of 28 bushels per acre while dryland wheat yielded an average of 11 bushels per acre. All these values are considered by Grubb and by the author to be average yields for these crops in 1959, although yields of all crops have shown a steady increase since then.

Based on these averages, the contribution of irrigation to agricultural production is shown in Table 1

TABLE 1. TEXAS HIGH PLAINS TOTAL CROPLAND, IRRIGATED CROPLAND DRY CROPLAND, AND VALUE OF PRODUCTION FROM EACH, 1959.(4)

Cropland	Thousands of Acres	Gross Value of Crop Production (1000)	Percent of Total Value
Total Cropland	8,355	$ 482,340	100
Irrigated Cropland	3,695	343,976	71
Dry Cropland	4,660	138,364	29
Water Contribution	3,695	190,580	39

Cotton, grain sorghum, wheat, and soybeans used 92.9 percent of the composite irrigated acre and accounted for 89.3 percent of the gross irrigation output in 1959, Table 2.

TABLE 2. GROSS FARM INCOME FROM IRRIGATION, TEXAS HIGH PLAINS, 1959.(4)

Crop	Unit	Irrigation Output (per acre)	Price Per Unit	Revenue From Irrigation-Output (per acre)	Proportion of Composite Irrigated Acre (percent)	Gross Value of Composite Irrigated Acre Output
Cotton	Bales	0.59	$142.50	$ 92.86	32.504	30.18
Grain Sorghum	Pounds	1,734.00	.0157	27.22	38.466	10.47
Wheat	Bushels	16.65	1.76	29.30	20.897	6.12
Soybeans	Bushels	7.40	1.86	13.76	1.077	.15
				TOTAL	92.945	46.92

The cost of producing irrigation output of a composite irrigated acre was calculated to be $26.91. Subtracting this value from the gross value of a composite irrigated acre output yields a net primary benefit of $20.00 per composite irrigated acre. Based on a value of $20.00 per irrigated acre, the projected irrigated acres and projected primary beneifts to irrigation in the High Plains are shown in Table 3.

TABLE 3. PROJECTED IRRIGATED ACRES AND PROJECTED PRIMARY BENEFITS TO IRRIGATION, TEXAS HIGH PLAINS, 1970-2020.(4)

Projection Points	Projected Thousands of Irrigated Acres*	Projected Primary Benefits (millions of dollars)
1959	3,695	74
1970	5,294	106
1980	5,816	116
1990	4,475	90
2000	3,584	72
2010	2,931	59
2020	2,191	44

*In 1965 the rate of water application used per acre irrigated was 1.1 acre-feet. This rate was reduced uniformly to 9 acre-inches per acre irrigated by 1990, and held at 9 acre-inches per acre irrigated to 2020.

The secondary and tertiary benefits to irrigation in the High Plains far outweigh the primary benefits. Hence, the value of irrigation to the High Plains economy cannot be estimated on the basis of the value to irrigators alone, Table 4.

TABLE 4. PROJECTED TOTAL BENEFITS TO IRRIGATION, IN MILLIONS OF DOLLARS, TEXAS HIGH PLAINS, 1970-2020.(4)

Projection	Projected Thousands of Irrigated Acres	Primary Benefits	Secondary Benefits	Agricultural Inputs Tertiary Benefits	Consumer Items Tertiary Benefits	Total Benefits
1959	3,695	74	68	63	125	330
1970	5,294	106	97	89	178	470
1980	5,816	116	107	98	196	517
1990	4,475	90	82	76	151	399
2000	3,584	72	66	60	121	319
2010	2,931	59	54	49	99	261
2020	2,191	44	40	37	74	195

Values shown in Table 4 indicate that, while farmers would not be able to pay more than about $20.00 per acre-foot plus the cost of pumping for water, secondary and tertiary beneficiaries of irrigation in the High Plains would be able to pay substantially more for irrigation water. That is, the total benefits associated with irrigation in the High Plains area alone amount to less than $100.00 per acre-foot of water. Hence, from a purely economic point of view, non-agricultural sectors of the High Plains economy could afford to pay almost $80.00 per acre-foot for the importation of water. It is extremely unlikely that, from a political standpoint, these sectors of the economy could ever be convinced that they should subsidize 80 percent of the cost of imported water.

By the same token, the non-regional benefits to irrigation in the High Plains would probably at least double any economic limits on the price that could be paid for irrigation water required to maintain the present High Plains economy.

PRESENT COST OF IRRIGATION WATER IN THE HIGH PLAINS

In the study extensively referred to earlier, Grubb assumed that the cost of pumping irrigation water in the High Plains was $8.74 per composite irrigated acre, or $9.20 per acre-foot of water pumped. In a study released on September 1, 1968, the Agricultural Engineering Department at Texas Technological College, found that on an average, High Plains farmers were paying $15.61 per acre-foot of water lifted to the ground surface.(5) This study is of considerable significance in that it reported on physical measurements of the efficiencies of irrigation equipment actually in use in a wide area of West Texas and Eastern New Mexico.

The study indicated that the cost of pumping water varied from a low of about $2.00 per acre-foot to a high of about $73.00 per acre-foot, with an average value of $15.61 per acre-foot. If this average value ($15.61) is added to the $20.00 value developed by Grubb, the maximum price that High Plains farmers could afford to pay for irrigation water at the surface of the ground on their farms is approximately $36.00 per acre-foot.

An important question left unanswered by both Grubb's and Ulich's work is the question of the value of irrigation water available in practically unlimited quantities at the specific time that farmers could best utilize it. It seems likely that such water would be worth considerably more per unit quantity than the quantity that is currently available from irrigation wells in much of the area.

Much work remains to be done on the cost and on the value of irrigation water to High Plains irrigators and to the High Plains economy. Nevertheless, it seems apparent that irrigation water will be worth more than $30.00 per acre-foot to High Plains irrigators, and more than $100.00 per acre-foot to the High Plains economy within the next twenty or thirty years. Hence, there does not seem to be any economic reason why water cannot be imported to the High Plains to sustain and enhance the present level of irrigated agriculture in the area.

CONCLUSIONS

The economy of the High Plains of West Texas is strongly dependent upon irrigated agriculture. Not only farm operators but also the merchants, suppliers, processors of agricultural products, bankers, and the general population depend upon the output from irrigated agriculture to supply the capital and operating expenses to maintain the economy.

Agriculture will not collapse if imported water is not made available to replace the declining supplies available from the Ogallala. Rather, agriculture based businesses will be the primary targets of a decline in agricultural production. Since these businesses are a mainstay of the economy of the High Plains, it is apparent that the general economy of the area will decline with a decline in irrigated agricultural production. The non-agricultural segment of the High Plains area should therefore be willing to subsidize to a major extent the importation of water required to sustain the present level of High Plains irrigated agriculture. Neither the State of Texas nor the Nation can afford to lose the production and consumption associated with the present and projected levels of High Plains irrigated agriculture.

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