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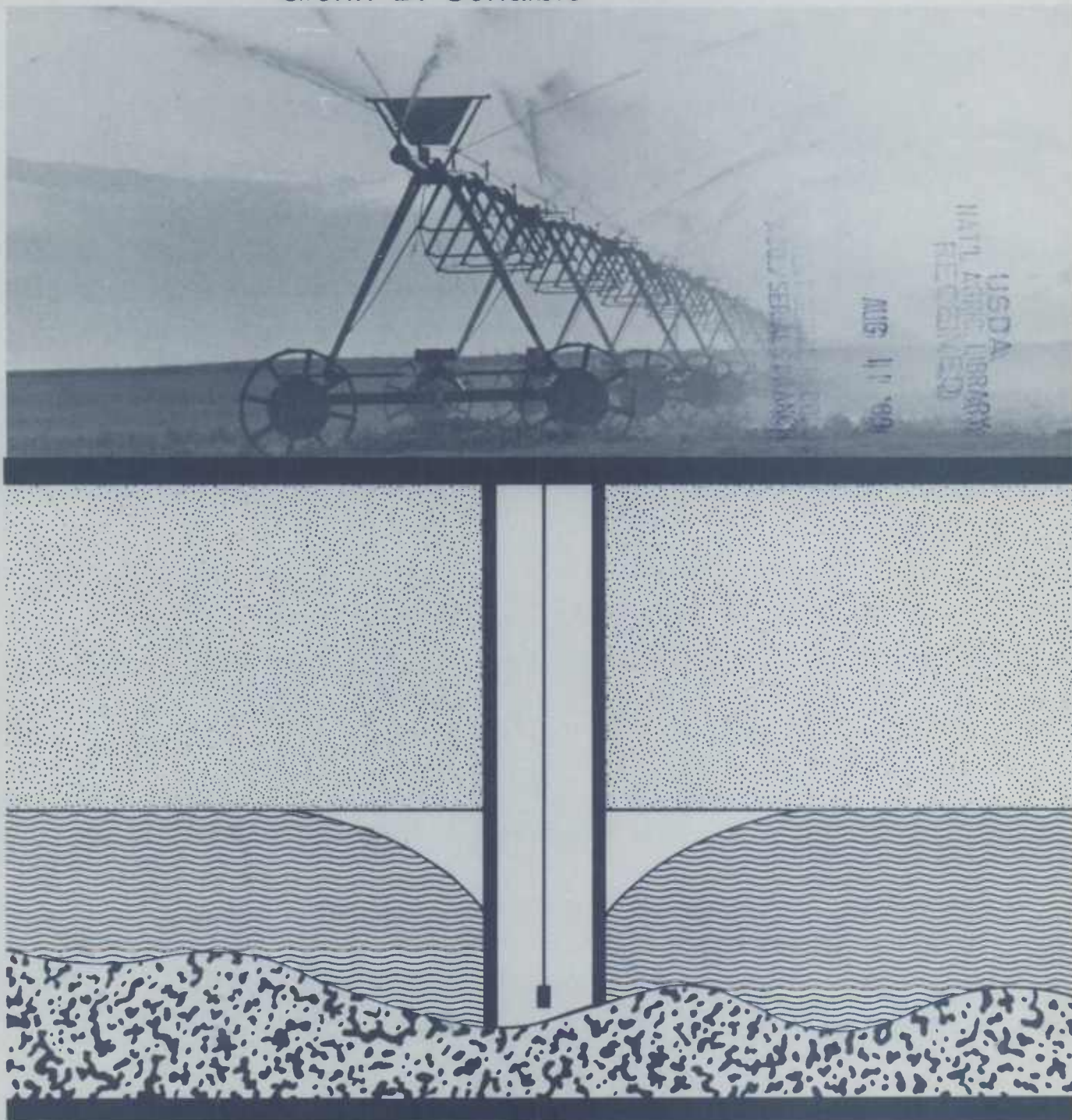
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Irrigated Acreage in the Conservation Reserve Program

Glenn D. Schaible



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Abstract

Marginal irrigated acreage enrolled in the Conservation Reserve Program (CRP) through 1987 represent less than 2 percent of the 23 million acres enrolled nationwide. Marginal irrigated acreage is irrigated land that results in low net returns because of high energy costs (due to high pump lifts and/or low pump capacities) or low productivity. Most of the enrolled irrigated acreage is in 17 Western States, with 68 percent of it in Nebraska and Texas. This report identifies the extent of marginal irrigated acreage enrolled in the CRP through 1987 and the potential enrollment in the CRP under two rates of enrollment, the historical and half the historical rate. This report also examines why producers would enroll irrigated land in the CRP and estimates cost savings and other benefits to remaining irrigators in Nebraska and Texas over a 40-year period.

Keywords: Conservation Reserve Program, economic benefits, water use conservation, highly erodible land, supply control, erosion control

Acknowledgments

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Summary

The marginal irrigated acreage enrolled in the Conservation Reserve Program (CRP) through 1987 represents less than 2 percent of the 23 million acres enrolled nationwide. Most of the enrolled irrigated acreage is in 17 Western States, 68 percent of which is in Nebraska and Texas. Marginal irrigated acreage is irrigated land that results in low net returns because of high energy costs due to high pumping lifts and/or low pump capacities, or because the acreage is low-productivity land.

This report identifies the extent of marginal irrigated acreage enrolled in the CRP through 1987 and the potential enrollment in a 45-million acre CRP under two rates of enrollment, the historical and half the historical rate. This report also examines why producers would enroll irrigated land in the CRP and estimates cost savings and other benefits to remaining irrigators in Nebraska and Texas over a 40-year period.

If total CRP enrollment increases to 45 million acres by 1990, enrollment of marginal irrigated land could increase to about 698,000-852,000 acres if irrigators continue to enroll at the historical rate, that is, the rate of enrollment of marginal irrigated land through 1987. Irrigated land in the CRP would increase to only 540,000-661,000 acres if irrigators continue enrolling at half the historical rate.

Low well yields and high pumping lifts directly affect the potential amount of CRP enrollment of irrigated land. Irrigating from lifts over 200 feet and from wells with low yields requires high energy outlays and reduces irrigation returns. These factors identify the pool of marginal irrigated acres available for CRP enrollment. About 2.5 million irrigated acres used to produce Government program crops in the 17 Western States have lifts over 200 feet. The most likely candidates for enrollment in the CRP, however, are the 824,000 acres in the West planted to program crops and irrigated with lifts over 300 feet.

Economic factors and physical characteristics of aquifers encourage enrollment of irrigated cropland in the CRP. Producers irrigating from an aquifer near economic exhaustion (where high pumping lifts increase costs and eliminate profits) or with low well yields, old and costly irrigation systems, and low crop price expectations could capture the higher per acre CRP rental payments instead of reverting to higher risk dryland production. Producers using limited irrigation (applying less than full crop water requirements due to constraints of well capacity) might enroll some of their irrigated land and apply full water requirements to the remaining acreage.

CRP rental rates also encouraged enrollment of marginal irrigated land. The average CRP rental rates in Kansas, Oklahoma, and Texas were nearly equal to or greater than 1986 average cash rents (received in the land rental market) for irrigated acreage. However, it is unlikely that significant irrigated acreage will

be enrolled in the CRP because the pool of highly erodible marginal irrigated acres most likely to enroll is relatively small. Using different CRP rental rate structures for enrollment of dryland and irrigated cropland (based on productivity differentials), therefore, would likely have resulted in fewer acres of dryland enrollment. The loss in dryland acreage enrolled would have been more than what would have been gained in irrigated acreage enrollment.

Idling highly erodible irrigated cropland saves scarce groundwater resources. Pumping less groundwater increases incomes for remaining irrigators by reducing lifts, energy consumption, and pumping costs. Due to present enrollment in the CRP, the present value of annual savings in pumping costs over a 40-year period translates into a \$10.4-million increase in net farm income for remaining irrigators in Nebraska and Texas. That figure increases to \$14.3 million if the CRP increases to 45 million acres by 1990 with irrigated land being enrolled at half the historical rate after 1987. Net farm income in Nebraska and Texas could increase by \$18.1 million if irrigated land continues to enroll at historical rates and if the CRP increases to 45 million acres.

Irrigated Acreage in the Conservation Reserve Program

Glenn D. Schaible

Introduction

Enrolling highly erodible irrigated acreage in the Conservation Reserve Program (CRP) reduces commodity stocks and erosion of valuable topsoil. There are also economic benefits associated with pumping less groundwater for crop production. Reduced pumping associated with irrigated cropland enrolled in the CRP means that pump lifts for the remaining irrigated crop acreage are reduced relative to pump lifts without the CRP. Reduced pump lifts reduce energy requirements and, therefore, save pumping costs, which translates into higher net farm incomes. With slowly recharging aquifers, groundwater savings today extend the life of the aquifer, assuming no increase in groundwater-irrigated acreage or in water application rates. For areas nearing economic exhaustion of the aquifer (the point at which pumping lift increases costs and eliminates returns), extending the aquifer's life also gives rural communities more time to adjust to reduced irrigation output and eases the transition to a dryland-based agricultural economy.

The CRP is planned for expansion to 45 million acres by the end of 1990 (see box for a brief explanation of the CRP). At the end of 1987, 23 million acres had been accepted for enrollment in the CRP (4).^{1/} Approximately 15.2 million acres (66 percent of the U.S. total) were enrolled from 17 Western States, with most of the acreage in the West enrolled from the Plains States (58.4 percent). In the Southern Plains States, much of the acreage was located in areas with declining groundwater levels (see figure).

This report identifies the conditions under which producers might enroll irrigated acreage into the CRP and estimates irrigated acreage enrolled in 17 Western States as of the end of 1987 (base scenario). This report also examines the potential irrigated acreage that might enroll by the end of 1990, into a 45-million acre program, under historical (scenario 1) and reduced enrollment rates (scenario 2). Benefits due to pumping-cost savings are estimated for irrigated acreage enrolled in Nebraska and Texas for each scenario. (No attempt was made to quantify benefits associated with extending the life of the aquifer.) Differentials in CRP average rental rates across dryland and

^{1/} Underscored numbers in parentheses refer to literature cited in the References section.

The Conservation Reserve Program

The CRP is a cropland reserve established to protect the Nation's most highly erodible and fragile cropland. Congress authorized the program in December 1985 under the Conservation Title (Title XII) of the Food Security Act of 1985 (P.L. 99-198) (10). The CRP assists farm and ranch owners and operators of highly erodible cropland in conserving and improving soil and water resources. Taking highly erodible cropland out of production and enrolling it in the CRP reduces sedimentation, improves water quality, creates a better habitat for fish and wildlife, curbs production of surplus crops, and provides needed income support for farmers. The program was created to place 40-45 million highly erodible cropland acres in a reserve by the end of 1990.

The program requires participating farm owner/operators to establish a conservation plan for their enrolled acreage. Farm owner/operators must establish a permanent cover of grasses and/or trees on land enrolled in the CRP. Once enrolled, farms are restricted from harvesting, grazing, or making any commercial use of forage on land in reserve (except for cases, such as a drought, that require explicit approval from the Secretary of Agriculture).

Farm owner/operators enroll highly erodible cropland by entering into 10-year contracts with the Secretary of Agriculture. Eligible cropland is considered for the reserve during specific signup periods between 1986 and 1990.

Farm owner/operators receive annual rental payments in exchange for enrolling highly erodible cropland. Annual rental payments are determined upon approval of sealed bids (on rental values) submitted by farmers to their county Agricultural Stabilization and Conservation Service (ASCS) office. Bids are transmitted to the State and national ASCS headquarters. The Secretary of Agriculture reviews all bids and determines the "maximum acceptable rental rate (bid cap) for predesignated areas (State and sub-State pools)"(5). Pools are a group of counties in a State that have comparable production and erosion characteristics. Pools may include all counties in a State or a subset of counties in a State. State ASCS offices select those farm owner/operator bids less than or equal to the bid cap.

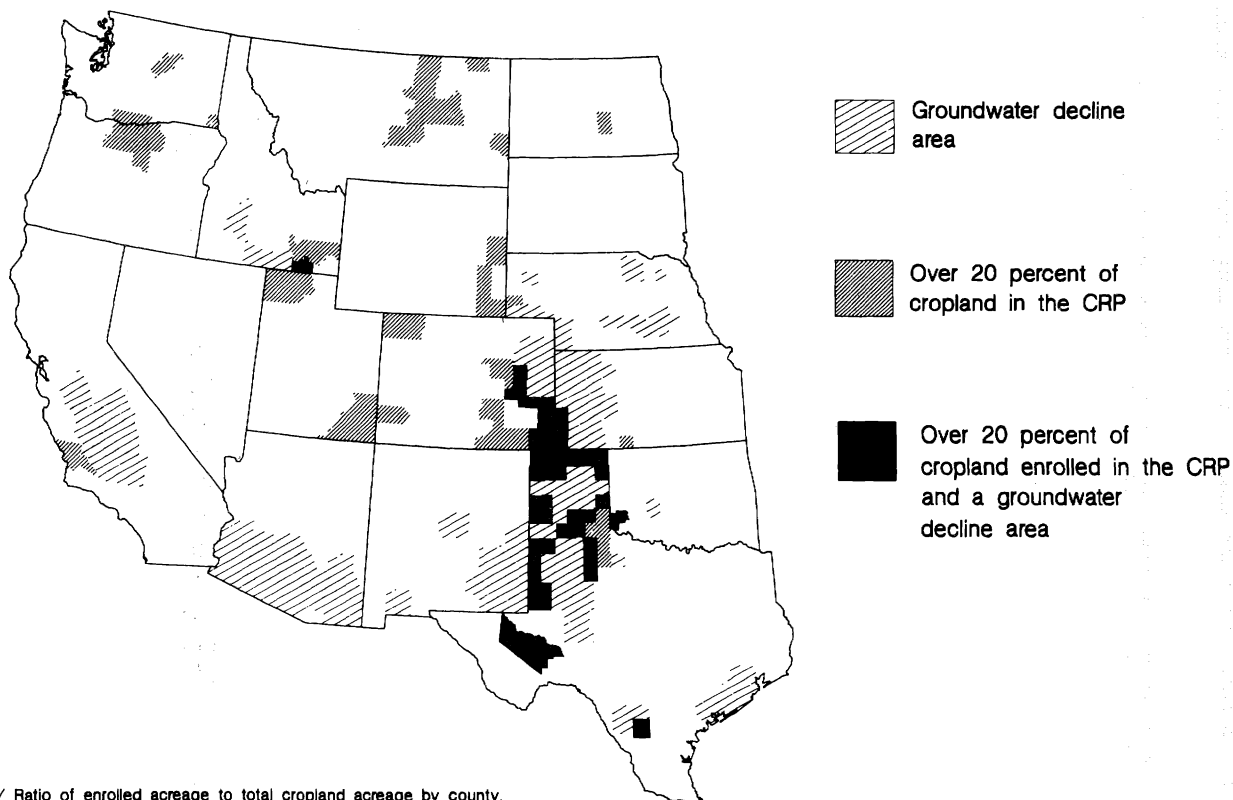
irrigated acreage and across States are examined to identify regional economic incentives for enrolling irrigated acreage in the CRP.

Reasons To Enroll

In 1984, 17 Western States accounted for 85 percent of U.S. irrigated acreage for crop production (39.1 million acres), and about 90 percent of water used for irrigation in the United States (14). Sloggett and Dickason estimated that 13.8 million irrigated acres were located in groundwater decline areas in 1983 (areas experiencing at least a 6-inch average annual decline in the level of the aquifer water table). The greatest share of this acreage (67.5 percent) was in Nebraska, Kansas, Oklahoma, and Texas.

Producers would normally be expected to enroll their less productive dryland acreage in the CRP. However, there are several economic factors and physical characteristics of aquifers that encourage producers to enroll marginal irrigated cropland in the CRP. Marginal irrigated acreage is irrigated land that results in low net returns because of high energy costs due to high pumping lifts and/or low pump capacities, or because the acreage is low productivity land. Therefore, producers with low current profits, low crop price expectations, substantial pumping lifts,

CRP enrollment and groundwater decline areas¹



and a declining static water level may find CRP enrollment a viable economic alternative to reverting to dryland production. Pumping lift, in general, refers to the depth (in feet) from the level of the aquifer water table to the surface. Static water level, at a point in time, refers to the level at which the aquifer water table settles after withdrawals.

In addition, enrolling irrigated acreage in the CRP is believed to be especially attractive to producers who find themselves in one or more of the following situations:

- **Pumping water from an aquifer near economic exhaustion.** For some areas, especially the Southern Plains States, groundwater-irrigated agriculture has been a significant part of the agricultural base for several decades. Some wells, while still capable of producing, may be near economic exhaustion; that is, the static water level for an area has reached a depth that results in significant pumping costs and near zero returns for irrigated crop production. Irrigators in this situation may prefer the CRP as an alternative to reverting to higher risk dryland production.
- **Using old irrigation systems.** Irrigators pumping with high lifts may view the CRP as a viable option, especially if faced with major capital expenditures to revitalize old irrigation systems.
- **Irrigating at rates below full crop water-consumption requirements.** Wells that have been in use for a number of years, while still capable of producing, experience declining output in gallons per minute per acre (well capacity). As a result, an operator may be practicing limited (deficit) irrigation; that is, irrigating the original base acreage at levels substantially less than the full evapotranspiration (ET) crop water requirement (full ET crop water requirements refer to the water application level required to maximize yield). However, the CRP now offers the option of enrolling a portion of the irrigated base in the CRP and subsequently applying near-full ET application levels to the remaining irrigated acreage.
- **Irrigating marginally productive acreage.** Higher crop prices of the 1970's encouraged expansion of irrigated acreage, especially in the Plains States. Some of this expansion resulted in irrigation systems being placed on acreage with lower productive potential. With expectations of continued high crop prices and added fertilizer and water inputs, lower productive acreage was transformed into profitable irrigated cropland. However, the profit margins quickly dissipated with the fall of agricultural prices and rising input prices. The CRP offered an alternative for this acreage, or a way out of a financial crisis.

The CRP bidding structure may also have influenced the level of the CRP bid caps (maximum rental rates) and may have encouraged the enrollment of irrigated acreage (see box). A variety of factors are considered in establishing maximum rental rates,

including average cash rental rates for cropland, estimated program costs, and eligible program acreage. However, the productivity differential between dryland and irrigated cropland was not explicitly a criterion until after the fifth program signup period in January 1988. For pool areas with a significant irrigated cropland base, the use of average cash rental rates as a criterion would result in CRP rental rates higher than average dryland cash rental rates for cropland. The differential between CRP rental rates and average cash rental rates for irrigated cropland, therefore, may encourage enrollment of marginal irrigated acreage.

Method

This section presents the approach used to estimate enrollment of irrigated acreage in the CRP through 1987 and for two scenarios of expanded enrollment. Since only marginal irrigated acres are likely to enroll, it is assumed that enrolled irrigated acres used groundwater. Surface irrigated acres are not likely to enroll in the CRP because surface irrigation generally uses less energy, has lower variable costs, and, therefore, provides larger returns than groundwater irrigation. This section also discusses the estimation procedure used to measure economic benefits (increases in producers' incomes) from enrolled irrigated acreage.

Present Enrollment of Irrigated Acreage

Irrigated acreage enrolled in the CRP as of the end of 1987 (base scenario) was estimated using USDA's Economic Research Service (ERS) and ASCS data file on the CRP and a lower bound irrigated-yield criterion for each crop by State (table 1). The CRP data file includes CRP contract information such as bid rates, crop acreage enrolled, base farm yields, rates of erosion, land capability classes, and soil-loss tolerance levels.

If the base farm yield (established by ASCS for program participants) reported for each CRP contract was greater than the lower bound yield criterion, the contract acreage by crop was classified as enrolled irrigated acreage. Lower bound yield criteria were established for each crop, by State, based on the differential between State average dryland and irrigated yields for 1984. Irrigated acreage and yields were acquired from the 1984 Farm and Ranch Irrigation Survey (FRIS), while dryland acreage and yields were estimated using 1984 acreage and production data in Agricultural Statistics, 1986 as control totals (14, 12).

Potential Enrollment of Irrigated Acreage

Potential irrigated acreage that might enroll as the CRP expands to 45 million acres by 1990 was estimated for two scenarios. Scenario 1, the historical enrollment scenario, assumes that irrigated acreage would continue to enroll in the CRP through 1990 at the same rate enrolled through 1987. This scenario holds the ratio of irrigated acreage in the CRP to total CRP enrollment

constant. Scenario 1 represents a maximum estimate of enrolled irrigated acreage, given that enrollment criteria and incentives remain the same. Scenario 2 assumes that irrigated acreage would continue to enroll, but at half the historical rate. Scenario 2 also assumes that most marginal irrigated land likely to enroll in the CRP was already enrolled during the initial CRP signup periods (prior to September 1987).

Both scenarios were based on the assumptions that the existing bid structure and enrollment procedures would continue through 1990, and that enrollment of irrigated acreage was subject to an upper bound. The upper bound consisted of irrigated acreage used to produce program crops (corn, grain sorghum, wheat, cotton, oats, and barley) with pumping lifts greater than 200 feet. For most producers, the differential in returns between irrigated and

Table 1--Lower bound yield criteria used to estimate irrigated acreage enrolled in the CRP, by crop and State

State	Corn	Grain sorghum	Wheat	Cotton	Oats	Barley
	- Bushels per acre -			Pounds per acre	Bushels per acre	
California	120	65	75	528*	75	75
Oregon	100	NA	75	NA	55*	75
Washington	100	NA	75	NA	75	75
Idaho	95	NA	70	NA	65	65
Montana	95	NA	45	NA	NA	65
Wyoming	95	NA	45	NA	50	65
Nevada	95	NA	45*	NA	NA	55*
Utah	95	NA	50	NA	40*	65
Colorado	95	60	50	NA	50	65
Arizona	95	45*	45*	432*	NA	55*
New Mexico	95	70	45	432*	NA	55*
North Dakota	90	NA	50	NA	70	65
South Dakota	90	80	40	NA	58	55
Nebraska	110	80	42	NA	58	45
Kansas	110	80	50	NA	70	50
Oklahoma	110	70	45	456	48	38
Texas	110	70	45	456	48	45

NA = Not applicable (no irrigated land for the crop).

* These are low yield criteria because all acreage for these crop/State combinations should be irrigated acres (based on 1984 Agricultural Statistics and the 1984 Farm and Ranch Irrigation Survey) (12,14).

dryland production is expected to warrant continued irrigation. However, the irrigated acreage likely to be enrolled in the CRP will come from producers with high pumping lifts and low returns.

Benefits Due to Reduced Pumping Costs

Economic benefits from groundwater savings associated with enrolling irrigated acreage in the CRP occur as a result of reduced pumping costs to remaining irrigators and as an extension in the life of the aquifer. Reduced pumping costs reflect the effect of reduced lifts. Benefits from extending the life of the aquifer occur as remaining irrigators can irrigate for additional years beyond the normal life of the aquifer (the life of the aquifer without the CRP). This report measures benefits associated only with reduced pumping costs for the remaining irrigated acreage, because aquifer extension benefits do not occur until the distant future (2).

The present value (as of 1987) of annual savings in pumping costs was estimated using the methodology developed by Supalla and Comer (9). These benefits were estimated for a 40-year period for 19 Nebraska counties and 28 Texas counties, where irrigated enrollment for the base scenario (enrollment as of the end of 1987) was greater than 1,000 acres. Benefits were estimated for the base scenario and for the two expanded enrollment scenarios. The present value of benefits received over 40 years from reduced pumping costs can be represented by the following two equations:

$$PCB = \sum_{t=1}^{40} \frac{PLtW_t}{(1 + r)^t} \quad (1)$$

$$L = \frac{R}{SA} \quad (2)$$

where:

t = 1, . . . 40 years,

r = Real discount rate,

PCB = Present value of pumping-cost savings,

P = Average pumping cost per acre-foot pumped, per foot of lift,

Lt = Cumulative annual change in lift, in feet per year (L is estimated by equation 2),

W_t = Quantity of water pumped by remaining irrigators, in acre-feet, in the affected area (A) with the CRP in effect in year t,

R = Quantity of water saved, in acre-feet, with the CRP,

S = Average long-term aquifer storage coefficient (reflects the quantity of water stored per square unit of aquifer), and

A = Affected land area (the land area in acres for each of the 19 Nebraska counties and 28 Texas counties).

Pumping costs per acre-foot per foot of lift (P) were estimated using the 1984 FRIS updated to 1986 dollars (15).^{2/} These costs were estimated to be \$0.14 and \$0.12 per acre-foot per foot of lift for Nebraska and Texas, respectively. Pumping costs were held constant for the 40-year period.

The long-term storage coefficients were assumed to be 0.25 and 0.15 for Nebraska and Texas, respectively. The Nebraska coefficient was used by Supalla and Comer and estimated by Cady and Ginsberg for a portion of the Upper Big Blue natural resources district in east central Nebraska (9, 3). Nieswiadomy and Kim, Hanchar, and Moore used the Texas coefficient for the southern portion of the Texas High Plains (7, 6).

The quantity of water saved (R) for each county and scenario was computed by multiplying State average water application rates per crop, from FRIS (14), by the number of irrigated acres enrolled in the CRP by crop. The quantity of water pumped on the remaining irrigated acreage in the affected area with the CRP in effect (W_t), for each county and scenario, was computed by multiplying the number of 1982 county-level groundwater-irrigated acres (13) by FRIS State average water application rates, less the quantity of groundwater saved with the CRP.^{3/} The affected land area (A) for each county was the approximate land area (in acres) as provided by the 1982 Census of Agriculture (13).

Results

Irrigated acreage enrolled in the CRP as of the end of 1987 is small relative to total CRP enrollment. Expanding the CRP to 45 million acres is not expected to significantly affect the relative share of irrigated acreage in the CRP in any region. But, the quantity enrolled and the benefits of enrolled irrigated acreage have local significance.

^{2/} These and other statistics referred to are special statistics prepared by the U.S. Department of Commerce's Bureau of the Census for ERS using the 1984 Farm and Ranch Irrigation Survey. ERS specified and accepts responsibility for the statistical methods used to generate these special statistics.

^{3/} The 1982 Census of Agriculture provided estimates of groundwater-irrigated acres by county and State. Irrigated acreage in farms with wells was the best proxy for groundwater-irrigated acreage. These estimates were not unduly biased due to surface-water-irrigated acreage because the counties involved in the estimation of benefits had primarily groundwater-irrigated acreage.

The quantity of marginal irrigated acres available for potential CRP enrollment is relatively small and unlikely to provide a sufficient pool from which to enroll a significant number of highly erodible cropland acres. Given that the more critical marginal irrigated acres would have enrolled during the initial CRP signup periods, future enrollment of irrigated acres in the CRP is likely to be considerably less than in the past.

The pool of marginal irrigated acres available for potential CRP enrollment is largest in the Southern Plains. Therefore, CRP rental rates greater than dryland cash rental rates had a greater effect on the enrollment of marginal irrigated acres in the Southern Plains.

Irrigated Acreage Enrolled for the Base Scenario

Less than 2 percent of the 23 million acres enrolled in the CRP (across all States) as of the end of 1987 (the fifth signup period) are irrigated acres (table 2). For the 17 Western States, irrigated acreage for program crops accounts for less than 3 percent of the West's enrolled acreage, while less than 4 percent (about 345,000 acres) of the Plains States' enrollment are irrigated acres. About 81.6 percent of total irrigated acres enrolled are from the Plains States, with Texas and Nebraska accounting for 83.8 percent (about 212,000 and 77,000 acres, respectively) of the Plains States' enrollment.

The Plains States dominate the enrollment of irrigated acreage because the Pacific and Mountain States have relatively fewer marginal irrigated acres. Higher profit margins and climatic conditions in the Pacific and Mountain States allocate a larger

Table 2--Estimated irrigated acres enrolled in the CRP through 1987 in 17 Western States, by crop and region

Region	Grain						Total
	Corn	sorghum	Wheat	Cotton	Oats	Barley	
<u>1,000 irrigated acres 1/</u>							
Pacific	2	LT	3	1	2	4	12
Mountain	21	6	14	4	2	19	66
Northern Plains	97	12	5	NA	9	2	125
Southern Plains	48	65	30	67	5	5	220
Total for 17							
Western States	168	83	52	72	18	30	423

LT = Fewer than 500 acres.

NA = Not applicable (no irrigated land for the crop).

1/ Based on the ERS/ASCS CRP contract data file as of March 1988, which included CRP enrollment information on signup periods prior to September 1987 (11).

share of groundwater to produce nonprogram crops such as forage, fruits and vegetables, and nuts. Irrigated acres devoted to such program crops as rice and cotton in these regions are generally not produced in the areas with higher lifts. In addition, a significant share of feed grain production in these regions is produced for onfarm use and not for use as a cash grain crop. Therefore, fewer program crop acres in the Pacific and Mountain States are likely to be enrolled. However, because marginal irrigated acres in the Plains States consist of program crop acres, irrigated acreage enrolled in the CRP in these States consists of program crop acres.

Most of the irrigated acreage enrolled for program crops was irrigated corn acreage, 39.7 percent, with an additional 36.6 percent enrolled from irrigated grain sorghum and cotton acreage. Nearly all of the enrolled irrigated cotton acreage, 91.3 percent, was from Texas. Lower well yields for the higher pump lifts in Texas result in more producers practicing limited (deficit) irrigation.^{4/} Lower net returns to cotton in Texas, relative to Arizona and California, result in more irrigated cotton acreage enrolled in Texas.

Reliability of these estimates depends on the degree to which CRP dryland and irrigated yield distributions are unique (table 3). Dryland acreage would be falsely identified as enrolled irrigated acreage in each State if the area under the dryland curve (greater than three standard errors above the mean) intersects the area under the irrigated curve above the lower bound yield criteria. (Means and standard errors for crop yields were computed separately for enrolled irrigated acreage and for all remaining CRP acreage, by crop and State, using the ERS/ASCS CRP data file.) The area under the dryland curve does not intersect the area under the irrigated curve above the lower bound yield criteria in any State except Washington, where the intersection occurs for corn. However, the estimated enrolled irrigated corn acreage in Washington was negligible.

Potential Irrigated Acreage in the CRP

If the CRP expands to 45 million acres by the end of 1990, total irrigated acreage enrolled is likely to be limited by the number of irrigated acres that are highly erodible and by the amount of marginal irrigated acres (measured by pumping lifts). Approximately 12 million irrigated acres are highly erodible in the 17 Western States, and 13.4 million are in areas with declining groundwater levels (table 4). However, considerably fewer groundwater-irrigated acres for program crops have high lifts. Approximately 824,000 acres have lifts greater than 300 feet, and 2.5 million acres have lifts greater than 200 feet (table 4). These acres serve as upper bounds on the pool of irrigated acres

^{4/} Well yields in terms of gallons per minute (GPM) of pumping capacity for wells with greater than 300 feet of lift range between 775 and 825, 1,100 and 1,200, and 1,250 and 1,300 GPM for Texas, Arizona, and California, respectively (15).

Table 3--CRP base acreage yields in the 17 Western States

State	Corn		Grain sorghum		Wheat	
	Irrigated acreage	Dryland acreage	Irrigated acreage	Dryland acreage	Irrigated acreage	Dryland acreage
<u>Bushels per acre</u>						
California	132	117	71	62	94	28
Oregon	142	73	--	55	97	33
Washington	122	97	--	--	93	33
Idaho	103	85	--	68	78	30
Montana	99	46	--	41	50	25
Wyoming	101	69	--	22	78	26
Nevada	--	--	--	--	--	--
Utah	102	78	--	28	54	22
Colorado	120	46	67	22	76	23
Arizona	--	--	--	--	--	--
New Mexico	118	67	95	28	75	16
North Dakota	111	50	--	33	54	24
South Dakota	102	52	--	36	78	22
Nebraska	118	82	85	63	45	32
Kansas	128	67	87	42	58	30
Oklahoma	114	85	83	30	47	25
Texas	134	70	90	35	51	21

	Oats		Barley		Cotton	
	Irrigated acreage	Dryland acreage	Irrigated acreage	Dryland acreage	Irrigated acreage	Dryland acreage
<u>-----Bushels per acre-----</u>				<u>Pounds per acre</u>		
California	101	47	81	40	815	--
Oregon	71	41	80	39	--	--
Washington	78	46	89	40	--	--
Idaho	79	46	80	33	--	--
Montana	--	41	67	35	--	--
Wyoming	71	29	72	32	--	--
Nevada	--	--	68	--	--	--
Utah	59	29	79	37	--	--
Colorado	61	30	78	30	--	--
Arizona	--	--	--	--	--	--
New Mexico	--	32	70	24	580	249
North Dakota	74	43	69	38	--	--
South Dakota	62	42	62	34	--	--
Nebraska	60	44	51	39	--	--
Kansas	73	41	54	36	--	--
Oklahoma	51	36	47	29	529	275
Texas	61	30	59	28	514	273

-- = No irrigated or dryland acreage for the program crop was enrolled in the CRP.

Table 4--Acreage constraints imposing limits on irrigated acreage enrolled in the CRP in the 17 Western States

Region	Irrigated acreage enrolled in the CRP for the base scenario <u>1/</u> (1)	<u>Irrigated acreage</u>				Estimated in ground- water decline areas <u>4/</u> (6)	Highly erodible <u>5/</u> (7)
		<u>By groundwater</u>					
		<u>All crops</u>		<u>Program crops <u>3/</u></u>			
		<u>Total</u>	<u>With lifts over 300 feet <u>2/</u></u>	<u>With lifts over 300 feet</u>	<u>With lifts over 200 feet</u>		
		(2)	(3)	(4)	(5)		
<u>1,000 acres</u>							
Pacific	12	3,857.3	260.6	78.5	136.4	2,068	1,045.8
Mountain	66	3,816.6	322.5	161.7	452.4	1,979	3,912.3
Northern Plains	125	7,369.1	167.2	146.1	549.2	4,219	2,284.1
Southern Plains	220	4,375.9	504.9	437.9	1,326.7	5,088	4,737.7
Total for 17 Western States	423	19,418.9	1,255.2	824.2	2,464.7	13,354	11,979.9

1/ Includes acreages for corn, grain sorghum, wheat, cotton, oats, and barley. Estimated using the ERS/ASCS CRP contract database (as of September 1987) (11).

2/ Estimated using the 1984 Farm and Ranch Irrigation Survey database (15).

3/ Includes only groundwater-irrigated acreage for all crops listed in 1/ plus soybeans (15).

4/ As estimated by Sloggett and Dickason (8).

5/ Provided by Dan Colacicco, Resources and Technology Division, ERS (summarized from the 1982 Natural Resources Inventory database).

available for enrollment with the current CRP. The bounds were estimated to avoid unrealistically assuming the upper bound at either 12 or 13.4 million acres.

Assuming that irrigated cropland enrolls in an expanded CRP at the historical rate, subject to the CRP baseline estimates made by Dicks (4), approximately 698,000-852,000 irrigated acres in the 17 Western States would enroll by the end of 1990 (table 5). The greatest share (approximately 82.5 percent) would enroll from the Plains States. Irrigated acreage would still account for less than 2 percent of total CRP enrollment. Less than 3 percent

Table 5--Present and potential enrollment of irrigated acreage in the CRP and associated groundwater savings

Region	Irrigated acreage enrolled for the base scenario	Potential irrigated acreage enrolled by 1990 <u>1/</u>	
		Scenario 1: Historical enrollment rate <u>2/</u>	Scenario 2: Reduced enrollment rate <u>3/</u>
<hr/>			
		<u>1,000 acres 4/</u>	
Irrigated acreage in:			
Pacific	12	20-24	15-19
Mountain	66	103-125	81-99
Northern Plains	125	207-253	160-196
Southern Plains	220	368-450	284-347
Total for 17			
Western States	423	698-852	540-661
		<u>1,000 acre-feet</u>	
Annual groundwater savings in:			
Pacific	23	50-61	37-48
Mountain	98	162-198	127-157
Northern Plains	144	231-284	179-220
Southern Plains	266	448-549	346-424
Total for 17			
Western States	531	891-1,092	689-849

1/ Based on CRP baseline estimates by region as provided by Dicks (4).

2/ The historical enrollment rate assumes that irrigated acreage will continue to enter the CRP at the rate entered prior to September 1987, but with an upper limit set at groundwater-irrigated acreage for program crops with pumping lifts greater than 200 feet (see table 4).

3/ Assumes that irrigated acreage will enter the CRP at half the historical enrollment rate.

4/ Point estimates for scenarios 1 and 2 were adjusted to reflect an assumed margin of error of ± 10 percent.

of CRP enrollment for the 17 Western States would be irrigated. (Dicks, Llacuna, and Linsenbigler's baseline estimates for CRP enrollment by the end of 1990 are 45 million and 27.53 million acres for the United States and the 17 Western States, respectively (6).)

If irrigated land enrolls in a 45-million acre CRP at half the historical rate (because most of the marginal irrigated land likely to enroll already enrolled during the initial signup periods), then only about 540,000-661,000 irrigated acres would enroll by the end of 1990 (table 5). As with the historical rate scenario, the greatest share enrolled would be from the Plains States.

Benefits of Irrigated Acreage in the CRP

Estimated annual groundwater savings range from 0.5 million acre-feet for enrolled acreage for the base scenario to 1.1 million acre-feet for the historical enrollment rate scenario (table 5). The Southern Plains States receive the greatest share of these savings. It is cumulative groundwater savings, however, that ultimately result in measurable economic benefits. The cumulative groundwater savings from presently enrolled irrigated acreage for only Nebraska and Texas translate into a present value (in 1987) of benefits of \$10.4 million for Nebraska and Texas. These benefits represent an increase in net farm income to remaining irrigators over the 40-year period (table 6). Benefits for Nebraska and Texas will increase by as much as \$18.1 million if producers continue to enroll irrigated acreage at the historical enrollment rate until the CRP expands to 45 million acres.

The magnitude of benefits across scenarios is proportional to the quantity of groundwater saved and the irrigated acreage enrolled, primarily because pumping costs were assumed to remain constant across scenarios. On average, the present value of benefits associated with pumping-cost savings over 40 years is \$40 per acre (table 6) for Nebraska and Texas (assuming a 4-percent real discount rate). Larger per acre benefits for Texas (\$48) relative to Nebraska (\$13) reflect a lower long-term aquifer storage coefficient for Texas. A lower aquifer storage coefficient means that less water is stored per unit of aquifer. For a given quantity of water pumped, the aquifer water table will decline more in Texas than in Nebraska. Conversely, for a given quantity of water saved, Texas incurs a larger effect on pumping lift, larger pumping-cost savings, and larger benefits.

These benefits are small from a national perspective but are significant from a local perspective. Additional benefits accrue to both remaining irrigators and to rural communities due to an extension of the life of the aquifer. For rural areas facing economic exhaustion of groundwater supplies, extending the aquifer's life eases the transition to a dryland-based agricultural economy.

CRP Rental Rate Incentives to Enroll

Average rental (bid) rates for CRP contracts involving irrigated acreage and contracts involving only dryland acreage are not significantly different (table 7). Therefore, a CRP contract involving formerly irrigated acreage probably did not influence the accepted bid rate. However, pool bid caps for the Plains States, prior to the sixth signup period, were established at levels that provided an economic incentive for producers to enroll marginal irrigated acreage.

The bid structures/caps, especially for the Southern Plains States, influenced enrollment of marginal irrigated acreage. Average CRP rental rates for Kansas, Oklahoma, and Texas are nearly equal to or greater than 1986 average cash rents for irrigated acreage (table 7). Producers with high pumping lifts and a declining static water level realized the opportunity to take advantage of an acceptable alternative to dryland production. In addition, because CRP rental rates were higher than dryland cash rental rates, dryland operators also enrolled at rates higher than likely under a differential bid structure. The incentive to enroll irrigated acreage after the fifth signup period, however, will decline. This decline occurs because

Table 6--Present value of benefits from reduced pumping costs associated with irrigated acreage enrolled in the CRP ^{1/}

State	For irrigated acreage enrolled for the base scenario <u>2/</u>	<u>For potential irrigated acreage enrolled by 1990</u>	
		Scenario 1: Historical enrollment rate	Scenario 2: Reduced enrollment rate
<hr/>			
<u>Million dollars <u>3/</u></u>			
Nebraska	0.73	1.27	1.00
Texas	9.67	16.81	13.32
Total	10.40	18.08	14.32
 <u>Dollars per acre</u>			
Nebraska	13.05	12.51	12.76
Texas	49.99	46.93	48.18
Total	41.70	39.35	40.35

^{1/} Benefits were estimated for 19 Nebraska counties and for 28 Texas counties.

^{2/} Includes benefits for irrigated acreage enrolled through September 1987.

^{3/} Values are expressed in 1986 dollars using a real discount rate of 4 percent, and represent benefits over a 40-year period.

Table 7--CRP rental rates and average cropland cash rental values

State	Average CRP rental rates <u>1/</u>			1986 Average cash rents <u>2/</u>	
	Contracts involving irrigated acreage	Contracts involving only dryland acreage	All contracts	Irrigated cropland	Dryland cropland
<u>Dollars per acre</u>					
California	49	48	48	123	29
Oregon	51	49	49	101	43
Washington	50	49	49	97	41
Idaho	48	45	45	87	31
Montana	43	37	37	53	21
Wyoming	39	38	38	45	15
Nevada	40	--	40	64	--
Utah	42	40	40	54	13
Colorado	41	41	41	63	13
Arizona	--	--	--	126	--
New Mexico	39	38	38	69	14
North Dakota	40	38	38	69	31
South Dakota	52	39	39	62	27
Nebraska	56	54	55	87	43
Kansas	50	52	52	55	27
Oklahoma	42	42	42	39	27
Texas	40	39	39	45	22

-- = No irrigated or dryland acreage for the program crop was enrolled in the CRP.

1/ Rental rates for contracts involving irrigated acreage were estimated as the weighted average rental value over all contracts that included irrigated acreage for a crop.

2/ Estimates from an annual land value survey (1).

productivity differentials between dryland and irrigated cropland were incorporated as a criterion in accepting bid offers since the fifth signup period.

A differential bid structure in dryland/irrigated areas would most likely have reduced CRP program costs. However, the program savings must be weighed against increased administrative costs of a differential bid structure. An insufficient pool of highly erodible marginal irrigated acreage exists to offset the decrease in enrollment of highly erodible dryland acreage with a differential bid structure. Table 4 indicates that the pool of highly erodible marginal irrigated acreage in the Southern Plains is less than 1.3 million acres. Given this upper limit of available irrigated acres, the tradeoff between enrollment of dryland or irrigated acreage would depend on how low the bid cap was set for dryland acres. It is most likely, however, that a differential bid structure would have resulted in a higher loss in enrollment of dryland acreage than the gain in enrollment of irrigated acreage under the present bid structure.

Conclusions

This report estimated irrigated acreage in the CRP, groundwater savings, and economic benefits associated with reduced pumping costs to remaining irrigators in Texas and Nebraska. The irrigated acreage enrolled is small relative to total enrollment (less than 2 percent), but the benefits have regional significance.

Pumping-cost savings were estimated at greater than \$10 million over the next 40 years for irrigated acreage enrolled as of the end of 1987 in Nebraska and Texas combined. However, these benefits do not include the additional benefits associated with the value of extending the life of the aquifer, nor do they account for increased efficiencies in irrigation-application rates over time.

The CRP bid caps for the first five signup periods provided a sufficient economic incentive to enroll some marginal irrigated acreage. However, the 2.5 million irrigated acres with high lifts serve as an upper bound on the pool of acres from which to draw highly erodible irrigated land for CRP enrollment. This pool is relatively small. Therefore, it is unlikely that significant irrigated acreage will enroll in the CRP, especially since the CRP bid process after the fifth signup period accounts for productivity differentials between dryland and irrigated cropland. The pool of highly erodible marginal irrigated acreage most likely to enroll in the CRP is probably not sufficiently large to have justified a differential bid structure between dryland and irrigated cropland. The loss in enrollment of dryland with a differential bid structure would likely have been greater than any gain in enrollment of highly erodible irrigated acreage.

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