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South Dakota's Big Sioux and Vermillion River Basins: Economic Value of Irrigation Water

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South Dakota's Big Sioux and Vermillion river basins:

Economic value of irrigation water

Agricultural Experiment Station • South Dakota State University • Brookings, South Dakota 57007

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South Dakota's Big Sioux and Vermillion river basins:

Economic value of irrigation water

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In response to periods of drought and the ensuing instability of income many farmers in the Big Sioux and Vermillion river basins of eastern South Dakota are shifting from dryland farming to irrigation. Irrigation helps the farmer to stabilize crop yields and farm income.

Irrigation in the Big Sioux Basin grew from about 8,000 acres to over 26,000 acres from 1970 to 1976. During this same period, the number of acres irrigated in the Vermillion River Basin increased from approximately 5,100 acres to over 11,500 acres. Due to this rapid development of irrigation, demand for water has increased substantially.

Historically, water has been used as a free good; an abundant, replenishable resource with no market price attached to it. In economic terms, supply has exceeded demand at all positive prices. Can this continue?

In addition to irrigation growth, the demand for water is increasing due to such things as natural population growth and industrial expansion. At the same time, pollution from numerous sources is decreasing the supply of clean, pure water available for domestic, industrial, and agricultural consumption.

Most scarce resources are assigned a price through the functioning of the private market and free enterprise system. However, water is a common property resource (not owned or controlled by private persons or firms), with rights to its use assigned through governmental policy.

The free market system is therefore unable to assign a price to it. Without a specific price it is difficult to determine the optimum allocation of water among its many competing uses.

For a number of reasons it is necessary to be able to estimate a value for water used in irrigation. An important goal of efficient allocation of water in its alternative uses is to maximize long run social benefits. This objective can be achieved only if water can be assigned a value in each of those uses.

Once such a value is estimated for water used in irrigation, it can be compared to estimated values for other uses. Through this comparison, improved allocation can be accomplished. Given estimates of water value, policy makers will have at their disposal many of the tools necessary to establish water pricing and preference systems.

The individual producer can also use estimates of water value. Should the South Dakota legislature decide on a comprehensive state water policy that includes a system of water pricing policies, the producer can then use an estimated value of water for agricultural production as a limit on the price which it would be profitable for him to pay to use water in irrigation. Estimates of the value of water for various crops or crop rotation patterns may also provide guidelines for agricultural producers concerning what crops could profitably be irrigated under various water pricing policies.

PROCEDURE

The analytical procedure used in this study was comparative budgeting. Composite acre costs of production (except for management) were subtracted from revenue per composite acre to derive return to management for dryland farming and return to management and water for irrigated farming. Then a management charge was subtracted from irrigated return to management and water to derive an estimate of the value of water used per composite acre. The following sections give a more detailed description of the procedure.

<u>Description of the Study Area</u>

The study area consisted of the two river basins draining the far eastern portion of South Dakota. The Big Sioux and Vermillion river basins drain an area covering most of the two eastern tiers of counties in South Dakota (Figure 1).

The Big Sioux River starts in northeastern South Dakota in the southwestern tip of Roberts County, and drains most of the counties along the eastern border of the state as well as several counties in southwestern Minnesota and northeastern Iowa.

The northern portion of this basin formed the northern rainfall region discussed in this study. That northern area receives approximately 20 inches of precipitation annually. Yearly temperature extremes range from a low of 30 or more degrees below zero in the winter to highs of over 100 degrees in the summer. Farmers in this region can expect approximately 130 frost-free days annually. The growing season normally runs from mid May to mid September.

The soils found in this region consist of loamy or silty soils, some of which lie over gravelly or sandy substrata.

The southern portion of this basin is part of the study area referred to in later chapters as the southern rainfall region. This area receives approximately 24 inches of precipitation annually. Temperature extremes similar to those described for the remainder of the Big Sioux Basin are common in this region. The growing season is normally about 150 days long, running from the first week of May to approximately the first week of October.

Upland soils found in the region consist mainly of loamy or silty soils, whereas alluvial or clayey-loam soils

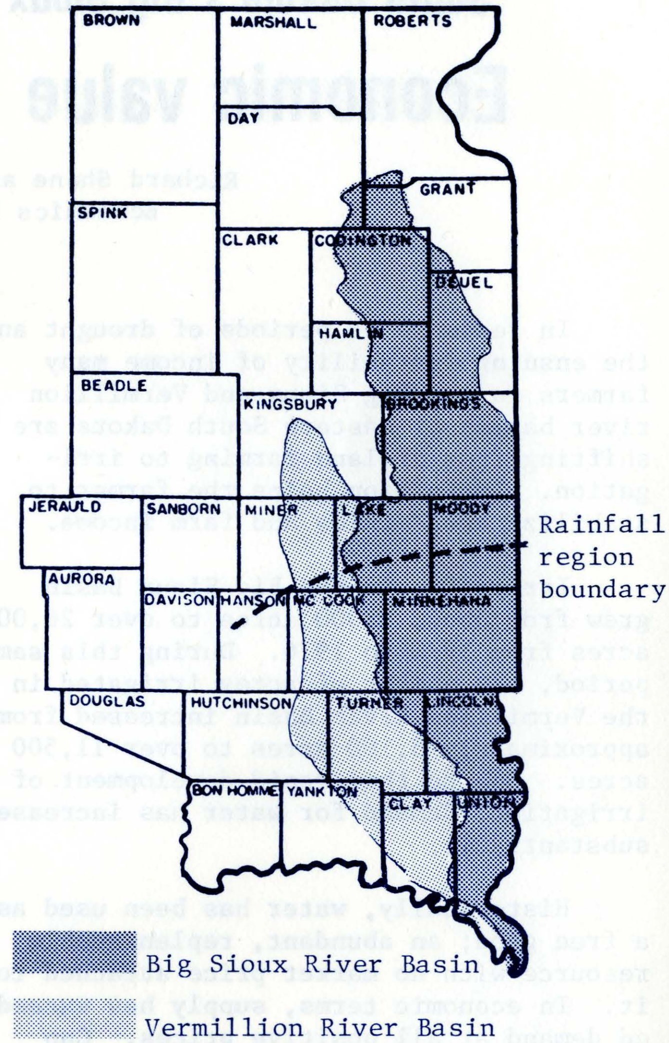

Fig. 1. Location of Big Sioux and Vermillion river basins in eastern South Dakota

Sources: Resource Inventory of the Big Sioux River Basin, Division of Resources Management, and Resource Inventory of the Vermillion River Basin, Thomas W. Lowe.

lying over gravelly or sandy substrata are prevalent in low lying areas.

The Vermillion River Basin is located adjacent to the western border of the central and southern portions of the Big Sioux Basin. The river itself drains an area extending south from the center of Kingsbury County through portions of 10 more counties until it empties into the Missouri River southeast of Vermillion, South Dakota. The majority of this basin is located in the southern rainfall area and has characteristics described above for that rainfall region.

The majority of the irrigation in the Big Sioux and Vermillion river basins is from ground water applied using center pivot irrigation systems.

The lack of level land conducive to gated pipe irrigation and the lower labor intensity of pivots in comparison with other forms of irrigation have contributed to the popularity of center pivots.

Irrigation is an older more familiar farming practice in the southern rainfall area.

One county in each rainfall area was selected as representative of irrigation practices in the region. Brookings County was selected to represent the northern rainfall area, and Turner County was selected to represent the southern rainfall region. These counties were chosen because of their central location in their respective rainfall areas and because each contained a large group of irrigators.

A random sample of approximately 25% of the irrigators in each county was interviewed personally. The interviews were designed to obtain the data necessary to derive irrigated crop budgets for the study area. Dryland crop budgets for the two counties were taken from existing publications (Derscheid, Aanderud and Allen, 1977).

Budget Derivation

Primary budget data for 1977 were gathered through personal interviews with irrigators in both county areas of the study region. Soil maps were used to further categorize irrigators by soil type within each rainfall region.

Variable Costs

Estimates of most of the variable costs associated with irrigated crop production were obtained directly from the irrigators. Cost estimates obtained directly included seed, fertilizer, chemicals, drying, system power and repair, machine repair, and custom hire. Other costs not as readily estimated were fuel and lubricants, overhead, and interest on operating expenses.

Fuel costs were computed by applying engineering fuel requirement estimates and 1977 fuel prices to cultural practice and equipment size and speed information provided by farmers for each crop. Lubrication costs were assumed to be equal to 5% of fuel costs.

Miscellaneous or overhead costs such as farm organization membership fees, magazine subscriptions, record keeping fees, and legal fees were assumed to be 5% of operating costs. Interest on operating expenses was based on a 9% annual rate. Operating expense loans were assumed to average 6 months in duration.

Fixed Costs

Fixed cost estimates were obtained indirectly from the irrigators. Costs which fall in this category are depreciation, taxes, insurance, and interest on investments.

Depreciation

Depreciation on farm machinery, irrigation systems and storage facilities was computed by applying the straight line method and actual investment figures supplied by the irrigators. Storage facilities were assumed to have a useful life of 20 years and a salvage value equal to 10% of their original costs. Only those facilities used for storage of irrigated crops were depreciated.

Estimates of annual depreciation of farm machinery were based on the nature of its use in the farming operation. Farm equipment, including tractors, plows, and discs, generally used on all cropland was depreciated over the total acres of dryland and irrigated cropland. Specialized machinery, like combines, corn planters, corn cultivators, swathers, and balers, was depreciated only over the acres of those crops with which it could be directly associated. All farm machinery was assumed to have a 10 year life and a salvage value equal to 10% of original cost.

Irrigation systems were depreciated only over the acres each covered. They were assumed to have 15 year useful lives and salvage values equal to 10% of original cost.

Interest

Interest on investment in storage facilities, farm machinery, and irrigation systems was computed at a rate of 7% of average annual investment using purchase prices supplied by the irrigators. Interest on land was calculated using a rate of 6% of current (1977) market value. Estimates of value of irrigated land obtained from current sales were $1,000 per acre for the northern rainfall region and $1,200 per acre in the southern rainfall region.

Other Fixed Costs

Information on the costs of insuring farms and irrigation systems, and on personal property and real estate taxes was gathered directly through the survey. Estimates of total costs of these items were reduced to a per acre basis by dividing them by the total acres of dryland and irrigated cropland farmed.

Returns

The return or revenue from each crop produced was estimated by multiplying yield times price. Yields per acre used were those reported by the irrigators interviewed. Prices used were average annual prices received by South Dakota farmers as reported by the South Dakota Crop and Livestock Reporting Service.

Estimation of Composite Acre Net Returns

A composite acre of irrigated land or dryland is comprised of the proportions of total cropland devoted to each major crop in each region, such that the sum totals 100% The irrigated composite acre was defined using data obtained from the irrigators interviewed. The dryland composite acre was derived using average acres of major crops planted in each county as reported by the South Dakota Crop and Livestock Reporting Service. After the composite acres were defined the net return per acre for crops were multiplied times the appropriate percentage of the composite and summed to derive an estimate of composite acre net returns for both dryland and irrigated farming.

Value of Water Used in Irrigation

The final step in the estimation of a value for water used in irrigation involved comparisons of the dryland and irrigated net returns to management and water per composite acre in each rainfall region.

Labor charges (at 1977 wage rates) based on estimated labor requirements per composite acre were deducted from net returns leaving a residual representing returns to water and management. A management charge equal to 10% of the variable costs per composite acre was then assessed.

The final residual to dryland crop production was considered non-distributed returns due to imperfections in the model. Assuming these undistributed returns equal in each form of farming the difference in residuals between dryland and irrigated composite acres was imputed as the value of total water applied per composite acre.

To estimate the value of water on a per unit of application basis, average application rates were obtained for each river basin from farmers and from the South Dakota Department of Natural Resource Development. By dividing the value of total water applied per composite acre by the units of water applied, an estimate of value per unit (acre inch) was calculated.

Finally, to estimate the value of water in irrigation over several years, costs of production were deflated to represent the years 1970-1977 using USDA indexes for prices paid by farmers for farm real estate. Average yields and prices for dryland farming were obtained from the South Dakota Crop and Livestock Reporting Service to estimate revenues for 1970-1977. Irrigated production was assumed constant at 1977 levels with average prices used as above with dryland. Given these data, residuals to water were calculated for each year from 1970-1977 to estimate the value of water used in irrigation over time.

RESULTS

Crop Production Budgets

The initial step in the procedure for estimating the value of water used in irrigation was the construction of irrigated and dryland budgets for the two rainfall regions of the study area. Tables 1, 2, and 3 contain budgets for the major crops grown in each of these regions.

Corn

Most of the variable costs of producing irrigated corn were similar in both rainfall regions. However, there were some noteworthy cost differences, as shown in Table 1.

For example, seed corn costs averaged $14.50 per acre in the southern region in comparison with $11.50 per acre in the northern rainfall region. Fertilizer costs for irrigated corn averaged over $52 per acre in the south compared to $38.60 per acre in the north.

These heavier planting and fertilization rates used in the southern region were reflected in a 16 bushel per acre difference in yield. Irrigated corn yielded 145 bushels per acre in the southern region compared to 129 bushels per acre yields in the north. Also, the longer growing season of the southern rainfall region allowed farmers to plant higher yielding, later maturing corn varieties which normally result in higher yields per acre.

Another variable cost that was substantially higher in the southern region was crop insurance. Hail insurance averaged approximately $8.50 per acre in the southern region in comparison with $1.70 per acre in the northern rainfall region. This large difference in cost was primarily due to the higher risk of hail in the south and the fact that many farmers in the north did not carry hail insurance.

Drying costs incurred by producers of irrigated corn in the north averaged $11.15 per acre compared to $5.25 in the southern rainfall region. Shortness of growing seasons and the probability of adverse weather conditions at harvest often forced corn producers in the north to harvest corn earlier and wetter than was desirable.

One variable cost of production item that may have been understated in the budgets presented in this chapter was the cost of repairs for irrigation systems.

Repair costs were found to be $.20 per acre in the northern rainfall region and $.60 in the south. Many of the irrigators surveyed stated that they incurred no repair costs for their irrigation systems. In most cases, that was because their irrigation systems were relatively new and still under manufacturer or dealer warranty.

A more realistic long run estimate of annual system repairs would be approximately $1.00 to $1.50 per acre.[1]

Finally, it can be observed in Table 1 that the corn price necessary for irrigators in the northern rainfall region to break even was substantially less than that of dryland farmers in the same region. Irrigators in 1977 needed only $1.78 per bushel to cover both total fixed and variable costs, whereas dryland farmers needed to receive $2.25 per bushel. The break even prices of corn

[1] This estimate was suggested by a representative of Farmer's Implement and Irrigation of Brookings, South Dakota, in a personal interview conducted on March 21, 1979.

Table 1. Dryland and Irrigated Corn Enterprise Budgets for the Northern and Southern Rainfall Regions for 1977

Input	Northern Rainfall Region Costs Per Acre Dryland	Northern Rainfall Region Costs Per Acre Irrigated	Southern Rainfall Region Costs Per Acre Dryland	Southern Rainfall Region Costs Per Acre Irrigated
Variable Costs				
Seed	$ 7.80	$ 11.50	$ 8.95	$ 14.50
Fertilizer	14.20	38.60	18.00	52.25
Chemicals	13.80	13.90	12.50	12.15
Crop Insurance[1]	3.20	1.70	3.50	8.55
Machine Repair	4.60	7.10	4.30	6.55
Fuel & Lube[2]	6.75	4.20	6.85	4.45
Drying	4.60	11.15	6.25	5.25
Storage[3]	2.00	1.30	2.75	---
Overhead	3.00	5.40	3.00	6.05
Subtotal	$ 59.95	$ 94.85	$ 66.10	$109.75
System Power	---	13.10		13.70
System Repair	---	.20		.60
Custom Hire	---	4.60		3.20
Subtotal	$ ---	$ 17.90	$ ---	$ 17.50
Int. on Op. Cap.	2.70	5.10	3.00	5.75
Total Var. Costs	$ 62.65	$117.85	$ 69.10	$133.00
Fixed Costs				
Int. on Invest.	$ 5.25	$ 18.30	$ 4.80	$ 24.10
Deprec., Tax, Ins.	19.70	33.80	20.75	40.90
Land Charge	36.00	60.00	45.00	72.00
Total Fixed Costs	$ 60.95	$112.10	$ 70.55	$137.00
Total Cost	$123.60	$229.95	$139.65	$270.00
Yield	55 bu.	129 bu.	75 bu.	145 bu.
Breakeven Price	$ 2.25	$ 1.80	$ 1.85	$ 1.85

[1]Actual farmer interviews have indicated that few farmers in the North insured their crops. The dryland budget procedure assumed insurance costs.

[2]Fuel and lubrication costs appear low for irrigated crop production because some of this expense for harvest is contained in custom hire and for trucking in overhead.

[3]Most of the costs for storing irrigated corn are included in the fixed costs.

Table 2. Dryland and Irrigated Corn Silage Enterprise Budgets for the Northern and Southern Rainfall Regions for 1977

Input	Northern Rainfall Region Costs Per Acre		Southern Rainfall Region Costs Per Acre	
	Dryland	Irrigated	Dryland	Irrigated
Variable Costs				
Seed	$ 7.80	$ 12.45	$ 8.95	$ 13.20
Fertilizer	14.20	42.50	18.00	46.15
Chemicals	13.80	16.00	12.50	15.40
Crop Insurance[1]	3.20	.90	3.50	4.90
Machine Repair	4.60	4.00	4.30	7.40
Fuel & Lube	4.75	5.10	6.40	6.85
Drying	---	---	---	---
Storage	---	---	---	---
Overhead	2.30	4.65	2.55	5.20
Subtotal	$ 50.65	$ 85.60	$ 56.20	$ 99.10
System Power	---	11.30	---	12.10
System Repair	---	.20	---	.40
Custom Hire[2]	---	.80	---	---
Subtotal	$ ---	$ 12.30	$ ---	$ 12.50
Int. on Op. Cost	2.00	4.40	2.40	4.95
Total Var. Costs	$ 52.65	$102.30	$ 58.60	$116.55
Fixed Costs				
Int. on Invest.	$ 6.35	$ 22.25	$ 6.40	$ 26.75
Deprec., Tax, Ins.	20.65	38.40	24.75	50.00
Land Charge	36.00	60.00	45.00	72.00
Total Fixed Costs	$ 63.00	$120.65	$ 76.15	$148.75
Total Cost	$115.65	$222.95	$134.75	$265.30
Yield	13.0 tons	18.4 tons	13.3 tons	20.7 tons
Breakeven Price	$ 8.90	$ 12.10	$ 10.15	$ 12.80

[1] Surveys indicated that many farmers did not carry insurance on crops. The dryland budgets assumed insurance coverage.

[2] The low average custom charges for the north is indicative of the fact that very little custome work is hired for silage production.

Table 3. Dryland and Irrigated Alfalfa Enterprise Budgets for the Northern and Southern Rainfall Region for 1977

Input	Northern Rainfall Region Costs Per Acre		Southern Rainfall Region Costs Per Acre	
	Dryland	Irrigated	Dryland	Irrigated
Variable Costs				
Seed	$ 2.20	$ 4.50	$ 3.60	$ 4.10
Fertilizer	7.20	16.65	9.60	22.95
Chemicals	1.55	---	1.55	---
Crop Insurance	---	---	---	---
Machine Repair	8.40	8.30	12.55	7.45
Fuel & Lube[1]	4.45	3.45	6.75	5.60
Drying	---	---	---	---
Storage	---	---	---	---
Overhead	3.00	2.50	3.00	2.90
Subtotal	$ 26.80	$ 35.40	$ 37.05	$ 43.00
System Power	---	11.70	---	13.35
System Repair	---	.45	---	.40
Custom Hire	---	5.00	---	3.70
Subtotal	$ ---	$ 17.15	$ ---	$ 17.45
Int. on Op. Cap.	1.20	2.40	1.65	2.70
Total Var. Costs	$ 28.00	$ 54.95	$ 38.70	$ 63.15
Fixed Costs				
Int. on Invest.	$ 3.15	$ 14.25	$ 3.45	$ 31.60
Deprec., Tax, Ins.	12.70	33.20	17.60	57.30
Land Charge	36.00	60.00	45.00	72.00
Total Fixed Costs	$ 51.85	$107.45	$ 66.05	$160.90
Total Cost	$ 79.85	$162.40	$104.75	$224.05
Yield	2.5 tons	4.6 tons	3.5 tons	5.9 tons
Breakeven Price	$ 31.95	$ 35.30	$ 29.95	$ 38.00

[1]Part of the fuel and lube costs for irrigated alfalfa production is included in the charge for custom hire.

for both dryland and irrigated corn producers in the southern region were approximately equal to $1.85 per bushel.

This seeming disparity occurred because dryland corn yields are much higher in the southern rainfall region, giving irrigation a smaller advantage when compared to the northern rainfall region.

Corn Silage

The variable costs incurred in corn silage production were similar to those of corn for grain production (Table 2).

Machinery repair costs were greater for irrigated corn silage than for irrigated corn. This may have been because there was more wear and tear on silage harvesters than on combines or corn pickers used to harvest corn for grain.

Most other variable costs were lower for corn than for corn silage. However, total variable costs were less for silage than for corn mainly because no in-town storage or drying costs were incurred in the production of corn silage.

Fixed costs associated with the production of corn silage were greater than for the production of corn for grain, mainly due to the need for specialized harvesting equipment for corn silage. Silage choppers, wagons, and blowers are often used exclusively for corn silage harvest, although on some farms they are used for alfalfa haylage. In contrast, combines are used for all types of grain harvest, including corn. Consequently, annual depreciation and interest charges are spread over more acres of land.

Yields of corn silage for the two regions were comparable, averaging 18.4 tons per acre in the north and 20.7 tons per acre in the south. Since farmers producing corn silage in the north faced lower fixed costs than farmers in the southern region, their breakeven price was lower--$12.10 per ton compared to $12.80.

Differences in several of the variable costs between the regions also contributed to the higher breakeven price in the southern region. Seed, fertilizer, crop insurance, machinery repair, and fuel costs were substantially higher in the southern region.

Because the breakeven price for dryland corn silage in each rainfall region was found to be less than that for irrigated corn silage, one could advocate dryland corn silage production over irrigated production. But irrigation did increase per acre yields and allowed farmers to devote less acres of cropland to its production. This allowed the irrigator more flexibility in his crop rotation plans.

Alfalfa Hay

As an irrigated crop, alfalfa is similar to corn silage in that it is quite responsive to the application of additional water (Table 3).

In the northern rainfall region irrigated alfalfa yielded 4.6 tons per acre compared to 2.5 tons on dryland. In the south, irrigated alfalfa yielded 5.9 tons, and the dryland yield was 3.5 tons per acre.

Irrigation in conjunction with the application of additional fertilizer, especially during the late summer growing season, often allowed the irrigator to harvest at least one more cutting of alfalfa hay than his dryland counterpart.

The increased cost of fertilizer necessary to complement additional amounts of water accounted for most of the difference in variable costs between dryland and irrigated alfalfa production.

Fertilizer costs for irrigated alfalfa were calculated at $16.65 per acre in the northern region and $22.95 in the south. This compared to $7.20 and $9.60 per acre, respectively, for dryland. The per acre fertilizer cost difference between the regions was the result of heavier fertilization rates in the southern rainfall region.

In addition to differences in land charges between dryland and irrigated cropland, differences in fixed costs were noted in depreciation and interest charges on specialized harvesting machinery and storage facilities used by irrigators. Numerous irrigators producing high quality alfalfa hay forage have invested in relatively expensive air tight silos to maintain the quality of their haylage. Personal property taxes, real estate t-xes, and insurance costs contributed relatively minor amounts to the difference in fixed costs.

As in the case of corn silage, a lower breakeven price was noted for dryland alfalfa hay than for irrigated hay in 1977. Dryland breakeven prices were $31.95 per ton in the northern region and $29.95 per ton in the south. Irrigated breakeven prices were $35.30 in the northern rainfall region and $38.00 in the southern region.

Again, application of water to alfalfa hay allowed the irrigator to devote fewer acres to the production of necessary forage and more to cash grains or complementary feed grains. The entire rotation would have to be evaluated before deciding whether alfalfa should be irrigated or not.

Soybeans

Soybeans proved to be one of the most profitable of the irrigated crop enterprises in the northern rainfall region.

One of the primary reasons was that irrigated soybeans do not require large amounts of fertilizer in comparison to dryland beans (Table 4). When soybeans followed corn in annual crop rotation plans, they often thrived on the residual essential elements left in the soil from the previous year's crop. Additional fertilizer did not increase soybean yields significantly.

The increased need for larger storage capacity for the expanded volume of soybeans grown under irrigation resulted in higher interest costs and depreciation charges per acre than for dryland.

In 1977, the breakeven prices for dryland and irrigated soybeans grown in the southern rainfall region were nearly equal at approximately $4.40 per bushel. Irrigated beans were more profitable than dryland beans in the northern region, with a breakeven price of $4.15 per bushel for irrigated and $5.10 for dryland beans.

All Crop Budgets

As can be observed in the enterprise budgets for all crops presented in this chapter, fixed costs per acre were always higher in the southern rainfall region than in the northern rainfall region.

Larger investments in capital equipment, including farm machinery and storage facilities, accounted for most of the differences in interest costs and depreciation charges. Real estate and personal property taxes were also generally higher in the southern rainfall region. This occurred because the average market value of cropland was higher in the southern than the northern region.

Net Returns for Irrigated Corn and Alfalfa by Soil Type and Rainfall Region for 1977

To determine whether or not soil type had a major influence on per acre net returns for the major irrigated crops in each rainfall region, all survey respondents' farms were soil typed through the use of regional soil survey maps (F.C. Westin, et. al., 1959 and USDA Soil Conservation Service, unpublished preliminary map, 1979). Crop production budgets were averaged by soil type group whenever a sufficient number of budgets could be grouped into a general soil category.

In the northern rainfall region, two major groups of soil associations were evident. The first of these groups consisted of loamy or silty soils with a sandy or gravelly substrata. Soil associations represented in this group were

Table 4. Dryland and Irrigated Soybean Enterprise Budgets for the Northern and Southern Rainfall Regions for 1977

Input	Northern Rainfall Region Costs per Acre		Southern Rainfall Region Costs Per Acre	
	Dryland	Irrigated	Dryland	Irrigated
Variable Costs				
Seed	$ 10.00	$ 9.25	$ 10.00	$ 10.40
Fertilizer	3.90	4.20	3.90	11.70
Chemicals	7.00	7.20	8.30	9.00
Crop Insurance	2.35	---	2.35	6.25
Machine Repair	3.70	5.40	3.50	7.00
Fuel & Lube [1]	5.50	3.75	5.70	3.80
Drying	---	---	---	---
Storage [2]	2.30	---	3.00	.90
Overhead	3.00	2.60	3.00	3.25
Subtotal	$ 37.75	$ 32.40	$ 39.75	$ 52.30
System Power	---	12.60	---	11.60
System Repair	---	.10	---	1.00
Custom Hire	---	9.50	---	5.00
Subtotal	$ ---	$ 22.20	$ ---	$ 17.60
Int. on Op. Cap.	1.70	2.45	1.80	3.05
Total Var. Costs	$ 39.45	$ 57.05	$ 41.55	$ 72.95
Fixed Costs				
Int. on Invest.	$ 4.60	$ 14.80	$ 4.30	$ 20.50
Deprec., Tax, Ins.	17.10	25.60	18.35	36.35
Land Charge	36.00	60.00	45.00	72.00
Total Fixed Costs	$ 57.70	$100.40	$ 67.65	$128.85
Total Cost	$ 97.15	$157.45	$109.20	$201.80
Yield	19 bu.	38 bu.	25 bu.	46 bu.
Breakeven Price	$ 5.10	$ 4.15	$ 4.35	$ 4.40

[1] Portions of the fuel and lube costs for irrigated production are included in custom hire.

[2] Most of the costs of storage for irrigated production are included in the fixed costs.

Renshaw-Fordville, Fordville-Estelline, and Hecla sandy loam soils.

The second major group of soil associations represented loamy and silty soils without the sandy or gravelly base. These soils generally exhibited better moisture holding capacities than those with a gravelly or sandy base. Soil associations contained in this broad group included Estelline and Poinsett silty loams, Fordville, Kranzburg, and Vienna loams and Lamoure alluvial soils.

Abbreviated budget forms, including information on per acre crop yields, total variable costs, total costs, and net returns for corn and alfalfa in each soil type group in the northern rainfall division are presented in Tables 5 and 6. (Complete crop production budgets for irrigated corn and alfalfa by soil type can be found in Everson, 1979.)

As can be seen in the first column of Table 5, irrigated corn yields were greater on silty and loamy soils, averaging 135 bushels per acre compared to a 118 bushel average on those soils with the gravelly substrata. Because of the difference in yields, net returns per acre were greater for the corn grown on soils not located over gravelly substrata.

It is important to note, however, that net returns to corn enterprises grown on the sandy based soil would likely have been much lower with no irrigation because of the lack of moisture holding capacity of sandy soils. In dry years, it is not uncommon for corn yields for that type of soil to be very low, hence net returns would likely be negative.

In contrast to the corn enterprise, alfalfa yields were greater on the gravelly based soil than on soils with a less porous base.

Alfalfa on the gravel based soil yielded an average 4.9 tons of hay per acre compared to 4.2 tons on the heavier soil.

One possible explanation for this lies in the characteristics of the alfalfa plant itself. Because corn needs large amounts of nitrogen to yield well, and the nitrogen applied to sandy or gravelly based soil tends to leach out faster than on heavier soil, corn yields were lower on sandier soil. Alfalfa, on the other hand, is a nitrogen-fixing legume, hence the leaching problem is lessened.

Whatever the reason, net returns for the higher yielding alfalfa crops were over $19.00 per acre in 1977 compared with $-7.90 per acre on heavier soil.

In the southern rainfall region, two major groups of soil associations were delineated as well. The first of these groups consisted of silty and loamy soils that were fairly well drained. Soil associations contained in this group included Egan-Chancellor, Egan-Wentworth-Clarno, and Egan-Wentworth-Viborg. Irrigated corn was the only crop for which a budget could be calculated for this soil association group.

The second major soil group found in the southern rainfall region represented clayey-loam and alluvial soils with sandy or gravelly substrata. Soil associations contained in this group were Delmont-Enet and Delmont-Graceville-Talmo.

As in the northern region, corn yields were higher on the soils without the gravelly substrata. Irrigated corn yielded 152 bushels per acre on the silty and loamy soils with the less porous base and 135 bushels per acre on the sandy based soil.

Corn on sandy based soils yielded higher in the southern rainfall region than in the northern region, probably because of heavier fertilization, longer growing season, and more natural precipitation.

Per acre net returns in 1977 averaged $9.90 per acre on the heavier soil. This was $35.00 greater than the negative -$25.05 return on the sandy based ground.

Alfalfa on the sandy based soil yielded 5.9 tons per acre on the average in 1977. The resulting net returns to management, labor, and water were near

Table 5. Abbreviated Irrigated Corn Enterprise Budgets Per Acre by Soil Type for the Northern and Southern Rainfall Regions for 1977[1/]

Northern Rainfall Region		Southern Rainfall Region	
Soil Type A		**Soil Type C**	
Yield	= 135 bu.	Yield	= 152 bu.
Total Variable Cost	= $123.05	Total Variable Cost	= $132.15
Total Cost	= $239.60	Total Cost	= $268.25
Net Return	= $7.45	Net Return	= $9.90
Soil Type B		**Soil Type D**	
Yield	= 118 bu.	Yield	= 135 bu.
Total Variable Cost	= $110.20	Total Variable Cost	= $134.00
Total Cost	= $215.00	Total Cost	= $272.10
Net Return	= $.95	Net Return	= $-25.05
All Soil Types		**All Soil Types**	
Yield	= 129 bu.	Yield	= 145 bu.
Total Variable Cost	= $117.85	Total Variable Cost	= $137.00
Total Cost	= $229.95	Total Cost	= $270.00
Net Return	= $5.75	Net Return	= $-4.70

1/ Corn price used was $1.83 per bushel.

Soil Type A: Loamy and Silty Soils - heavy base

Soil Type B. Loamy and Silty Soils - sand or gravel substrata

Soil Type C: Loamy and Silty Soils - heavy base

Soil Type D: Clayey-loam and Alluvial Soils - sand or gravel substrata

zero. Lack of a sufficient number of respondents growing alfalfa on soils with a denser base prevented a comparison between soil types.

Composite Acre Net Returns for Each Rainfall Region 1970-1977

Composite Acre

Net returns were computed on a composite acre basis. The composition of the composite acres for dryland and irrigated crop production is shown in Table 7.

The interpretation of the percentages for irrigated land in the northern region is that for every 100 acres of cropland the farmer produces 66.9 acres of corn, 14.4 acres of silage, 14.5 acres of alfalfa, and 4.2 acres of soybeans. Similar interpretations can be made for the remaining composite acres presented. In each case other crops were grown but comprised less than 1%.

Table 6. Abbreviated Irrigated Alfalfa Enterprise Budgets Per Acre by Soil Type for the Northern and Southern Rainfall Regions for 1977

Northern Rainfall Region		Southern Rainfall Region	
Soil Type A		Soil Type C*	
Yield	= 4.2 tons	Yield	= ---
Total Variable Cost	= $59.75	Total Variable Cost	= $ ---
Total Cost	= $163.30	Total Cost	= $ ---
Net Return	= $-7.90	Net Return	= $ ---
Soil Type B		Soil Type D	
Yield	= 4.9 tons	Yield	= 5.9 tons
Total Variable Cost	= $50.90	Total Variable Cost	= $65.70
Total Cost	= $162.20	Total Cost	= $218.30
Net Return	= $19.10	Net Return	= $0.00
All Soil Types		All Soil Types	
Yield	= 4.6 tons	Yield	= 5.9 tons
Total Variable Cost	= $54.95	Total Variable Cost	= $63.15
Total Cost	= $162.40	Total Cost	= $224.05
Net Return	= $7.60	Net Return	= $-5.70

Soil Type A: Loamy and Silty Soils - heavy base

Soil Type B: Loamy and Silty Soils - sand or gravel substrata

*Soil Type C: Loamy and Silty Soils - heavy base, not a sufficient number of observations to compute a reliable average.

Soil Type D: Clayey-loam and Alluvial Soils - sand or gravel substrata

Net Returns to Labor, Management, and Water

The irrigated and dryland composite acre net returns to labor, management, and (in the case of irrigation) water were calculated in each region for the years 1970-1977 to give a time series over which to compare returns. Dryland and irrigated net returns and differences between the two appear in columns 1, 3, and 5 of Tables 8 and 9. Labor costs per composite acre were then deducted from those net returns in order that net returns to management and (in the case of irrigation) water could be presented (columns 2, 4 and 6 of Tables 8 and 9).

Composite irrigated acre net returns to labor, management, and water for each rainfall region ranged from $12.05 in 1977 to $202.00 in the northern region. For the southern region, the range was from a low of $4.75, also in 1977, to $216.45 in 1974.

Table 7. Composite Acre Composition by Rainfall Region[1/]

Crop	Northern Rainfall Region Irrigated	Northern Rainfall Region Dryland	Southern Rainfall Region Irrigated	Southern Rainfall Region Dryland
	(%)		(%)	
Corn	66.9	29.0	71.0	42.0
Corn Silage	14.4	10.0	4.6	8.7
Alfalfa	14.5	13.4	7.6	9.6
Soybeans	4.2	3.3	16.8	12.7
Oats	--	29.2	--	27.0
Barley	--	2.7	--	--
Wheat	--	4.6	--	--
Flax	--	7.8	--	--

1/ The difference in composition of the composite acre between dryland to irrigated production is caused primarily by the availability of water.

For dryland farmers, net returns to labor and management reached their peaks in 1973 at $43.30 per composite acre in the northern region and $42.20 in the southern region (column 3 of Tables 8 and 9). As could be expected, dryland net returns to labor and management reached their lows in the drought year of 1976 when they were $-44.25 per composite acre in the north and $-30.20 in the southern rainfall region.

The difference between composite irrigated acre net returns to labor, management, and water and dryland net returns to labor and management did not reach its maximum level in 1976 as might be expected during a time of drought. The 1976 differences per composite acre (shown in column 5 of Tables 8 and 9) between irrigated and dryland net returns were $167.10 in the northern region and $105.80 in the south.

The maximum difference between irrigated and dryland net returns occurred in 1974 in each region, with that difference being $175.20 in the northern region and $182.35 in the south. The minimum differences between irrigated and dryland composite acre net returns occurred in 1977 when that difference equalled $17.90 per composite acre in the north and $8.80 in the southern rainfall region.

The most obvious reason for dryland returns reaching their low point in each region in 1976 was the occurrence of an extreme drought in eastern South Dakota which caused yields of all dryland crops included in the composite acre to be extremely low. Returns of labor, management, and water were smallest in 1977, primarily due to the low price of corn. The average annual price of corn for 1977 in South Dakota hovered near $1.80 per bushel. This low price proved to be the major factor that depressed the net returns of the corn intensive composite irrigated acre.

As a result of the pronounced drought that occurred in 1976, many dryland farmers made the move to irrigation in eastern South Dakota in 1977. But 1977 was not a particularly good year for irrigators. Since crop prices did not improve much in 1978, that year was not

Table 8. Composite Acre Net Returns
Northern Rainfall Region 1970-1977

	Irrigated		Dryland		Difference	
	Ret to L,M,W	Ret to M&W	Ret to L&M	Ret to M	Ret to L,M,W	Ret to M&W
1970	$ 38.45	$ 32.45	$ -4.75	$ -7.75	$ 43.20	$ 40.20
1971	19.10	12.70	-11.45	-14.65	30.55	27.35
1972	45.20	38.40	3.90	.50	41.30	38.90
1973	142.95	135.55	43.30	39.60	99.65	95.95
1974	202.00	193.80	26.80	22.70	175.20	171.10
1975	117.00	108.60	11.35	7.15	105.65	101.45
1976	128.85	119.85	-38.25	-42.75	167.10	162.60
1977	12.05	2.25	-5.85	-10.75	17.90	13.00
Avg.	$ 88.20	$ 80.45	$ 3.15	$ -.75	$ 85.05	$ 81.30

L = Labor, M = Management, W = Water

Table 9. Composite Acre Net Returns
Southern Rainfall Region 1970-1977

	Irrigated		Dryland		Difference	
	Ret to L,M,W	Ret to M&W	Ret to L&M	Ret to M	Ret to L,M,W	Ret to M&W
1970	$ 38.45	$ 33.20	$-14.65	$-17.65	$ 53.10	$ 50.85
1971	18.95	13.35	-11.85	-21.05	30.80	34.40
1972	53.85	47.90	18.00	14.60	35.85	33.30
1973	156.75	150.25	42.20	38.50	114.50	111.75
1974	216.45	209.25	34.10	30.00	182.35	179.25
1975	113.40	106.05	.25	-3.95	113.15	110.00
1976	81.60	73.70	-24.20	-28.70	105.80	102.40
1977	4.75	-3.85	-4.05	-8.95	8.80	5.10
Avg.	$ 85.50	$ 78.75	$ 5.00	$ .35	$ 80.55	$ 78.40

L = Labor, M = Management, W = Water

much better. It could be expected that those who became irrigators after 1976 have experienced more financial difficulties than those who were irrigating during the early 1970's.

Composite acre net returns to management, labor, and water for irrigated crops peaked in 1973, when they surpassed the $200 mark (column 1, Tables 8 and 9). Those large net returns were primarily due to corn prices in South Dakota that topped $3.00 per bushel and soybean prices that reached over $6.50 per bushel.

Dryland composite acre net returns to management and labor in each rainfall region achieved their maximums for the 8 year period in 1973 at $42.20 in the south and $43.30 in the north. Corn, soybean, and small grain prices were excellent in 1973 and 1974. Dryland crop yields were generally higher in 1973 compared to 1974 in both regions as well.

In summary, net returns to labor, management, and water averaged $88.20 per composite irrigated acre in the northern region and $85.50 for the southern rainfall region over the 8 year period. Average dryland returns to labor and management were $3.15 per composite acre in the north and $5.00 in the south.

It should be noted in column 1 of Tables 8 and 9 that net returns to labor, management, and water per irrigated composite acre were never negative during the 8 year period in either rainfall region. At the same time, dryland composite acre returns to labor and management were negative 50% of the time in each rainfall region. The question could be raised concerning how dryland operators losing money half of the time on their crop enterprises stayed in business.

One possible explanation was that they have been accepting a lower ate of return on their investment in land and equipment than the rate used in the crop budgets. By accepting returns of as low as 2% the crop enterprises would have exhibited positive net returns.

It is also possible that the cash flow being generated by farmers' livestock enterprises during that period were more than enough to offset the losses incurred in the crop enterprises.

Finally, the net returns presented in Tables 8 and 9 are average figures. Actual net returns of individual dryland farmers would be scattered at intervals both above and below that average. Therefore, it can be concluded that not all dryland farmers lost money on their crops 50% of the time and that some of the farmers lost money more than 50% of the time. Farmers in that lower part of the profits scale would likely be the ones forced out of business by a drought year like 1976.

Many of the same comments can be made about the irrigators. Some irrigators in the southern rainfall region likely netted less than $5.00 per composite acre in 1977 and others probably fared better. By the same token, a number of irrigators probably netted more than $200.00 in 1974 and some less.

At any rate, irrigators have received a more stable and financially sound level of income from their crop enterprises over time than their dryland counterparts. Irrigation has reduced the natural risks involved in crop production and has resulted in an improved borrowing position for the irrigator. In that context, it is difficult to place a value on water used for irrigation.

Net Returns to Management and Water

Labor costs were deducted from returns to labor, management, and water to estimate the residual return to management and water.

Dr. Wallace Aanderud of the Economics Department at SDSU provided estimates of the hours of labor normally employed in the production of the crops included in the composite dryland and irrigated acres for each rainfall region. The estimated labor requirements per composite irrigated acre provided by Dr. Aanderud were 4.0 hours in the northern rainfall region and 3.5 hours in the southern region. Dryland composite acre labor requirements were 2.0 hours in each rainfall region.

It was assumed that all of the labor necessary could be hired at the average wage rate being paid to farm labor during the appropriate time period. The wage rates used to calculate labor charges were averages of hourly wage rates paid to farm laborers in South Dakota for the months of April through October (South Dakota Crop and Livestock Reporting Service, 1973, p. 61, 1976, p. 91 and unpublished data, 1979).

The wage rate ranged from $1.50 per hour in 1970 to $2.45 per hour in 1977. The resulting labor charges per composite irrigated acre ranged from $6.00 in 1970 to $9.80 in 1977 in the northern rainfall region. In the southern region, the labor charge per composite irrigated acre was $5.25 in 1970 and $8.60 in 1977. Deducting these labor charges from the returns shown in column 1 of Tables 8 and 9 yielded the composite irrigated acre returns to management and water for each rainfall region listed in column 2.

Returns to water and management ranged from $-3.85 to $209.95 per composite irrigated acre in the southern rainfall region and from $2.25 to $193.80 per composite acre in the northern region. Average returns over the 8 year period were $78.75 in the southern rainfall region and $80.45 in the northern region.

Dryland returns to management ranged from $-28.70 to $38.50 per composite acre in the south and from $-42.75 to $39.60 in the northern region. Average dryland returns per composite acre over the 8 year period were very close to zero, with the northern region's being slightly positive and the southern's slightly negative.

Net Returns to Water

The value of water used in irrigation was estimated by deducting a management charge from the returns to management and water. To accomplish this step it was assumed that management was paid at a rate of 10% of variable costs per composite acre.

The management charges ranged from $3.30 in 1970 to $6.00 in 1977 per composite acre in the northern rainfall region and from $3.70 in 1970 to $6.30 in 1977 in the southern rainfall region. Table 10 contains the resultant water values.

The estimated value of water per composite acre ranged from $7.00 in 1977 to $166.00 in 1974 in the northern rainfall region and from -$5.40 in 1977 to $174.25 in 1974, in the southern rainfall region.

The peak years are those in which crop prices were exceptionally good and the low years are those in which corn sold for $1.80 per bushel. Over the 8 year period the average estimated returns to water were $76.60 and $73.90 per composite acre in the northern and southern rainfall regions, respectively.

According to the South Dakota Department of Natural Resource Development (Table 10) water application rates per composite acre varied from 6.2 to 14.5 acre inches in the northern rainfall region, and from 12.1 to 19.0 acre inches per year in the south. Using these water application rates the value of water per acre inch applied on a composite acre was calculated.

The northern region value of water per acre inch ranged from $.75 in 1977 to $16.45 in 1974 and averaged $7.50 per acre inch for the 8 year period. Water's value per acre inch was lower in the southern rainfall region as it ranged from $-.45 in 1977 to $11.30 in 1974 and averaged $5.25 per acre inch.

It is interesting to note that the value of water was quite high in each region during the drought year of 1976. The value of water per composite acre approached $11.00 in the northern rainfall region and exceeded $5.00 in the southern region in 1976.

The large differential between the two regions can be partly explained by the fact that the drought was more pronounced in the northern region than in the southern one. The difference in yields between

Table 10. Composite Acre Value of Water in the Northern and Southern Rainfall Regions, 1970-1977

Year	Northern Rainfall Region			Southern Rainfall Region		
	Return to Water	Water* Applied	Value of Water	Return to Water	Water* Applied	Value of Water
	$/Acre	Acre Inches	$/Acre Inch	$/Acre	Acre Inches	$/Acre Inch
1970	36.90	11.0	3.35	47.15	12.7	3.70
1971	23.85	10.9	2.20	30.80	14.0	2.20
1972	35.30	6.2	5.70	29.50	12.6	2.35
1973	91.55	10.5	8.70	107.15	14.5	7.40
1974	166.00	10.1	16.45	174.25	15.4	11.30
1975	95.85	8.8	10.90	104.30	12.5	8.35
1976	156.70	14.5	10.80	96.40	19.0	5.05
1977	7.00	9.6	.75	-5.40	12.1	-.45
8 yr. avg.	76.60	10.2	7.50	73.90	14.1	5.25

*South Dakota Department of Natural Resources Development. 1970-1977.

dryland and irrigated crops was larger in the northern region than in the southern one, accounting for greater returns to water in the northern region.

It is important to note that the returns to water above are average returns. Individual irrigators had lower and higher returns to water than those presented. It is also important to note that the value of water as calculated here is highly dependent on the labor wage rate and management allowances charged. Increases in either of these cost variables could significantly lower the estimated value of water.

SUMMARY

Low or untimely precipitation in eastern South Dakota often leads to depressed or unstable crop production and farmer incomes. In an attempt to lessen the risk of water shortage many farmers have turned to irrigated crop production. This increases the demand for a finite quantity of water and gives rise to questions of proper water allocation among competing end uses. To efficiently distribute water among its many uses the value of water in competing productive and consumptive processes must be known.

The primary objective of this study was to estimate the value of water used for irrigation in the Big Sioux and Vermillion river basins of eastern South Dakota. These estimates were made by imputing a residual value to water. Data were acquired through personal interviews with irrigators in the study area which was partitioned into two rainfall regions and two soil areas per rainfall region. Crop enterprise budgets were derived from the data and used to calculate net returns to management and water. These figures were compared with net returns to management from dryland farming obtained from secondary sources to arrive at the final water value estimates.

Based on average crop production budgets for each rainfall region, irrigated corn compared quite favorably with its dryland counterpart. The average yield of irrigated corn was 129 bushels per acre in the northern rainfall region and 145 bushels in the southern region. Dryland yields were 55 bushels per acre in the northern region and 75 bushels per acre in the southern rainfall region.

The price farmers had to receive in order to cover all costs of producing corn in 1977 was $2.25 per bushel for dryland corn and $1.80 for irrigated in the northern region. In the southern rainfall region, the breakeven price for both irrigated and dryland corn crops was $1.85 per bushel.

The breakeven prices calculated for irrigated and dryland corn silage indicated that dryland was the more favorable alternative in 1977.

In the northern rainfall region, breakeven price for irrigated corn silage was calculated to be $12.10 per ton while dryland's was $8.90 per ton. In the southern region, $12.80 per ton was the price necessary for irrigated corn silage producers to break even. The dryland breakeven price was $10.15 per ton.

The major advantage of producing irrigated corn silage, however, was that it yielded more tonage per acre than dryland, allowing producers to devote fewer acres to the production of feed necessary for their cattle feeding operations. Irrigated corn silage yielded 5.4 more tons per acre than dryland in the northern region and 7.4 more in the southern rainfall region.

The breakeven prices calculated for irrigated alfalfa in 1977 were $38.00 per ton in the southern rainfall region and $35.30 per ton in the north. Comparable prices calculated for dryland alfalfa were $29.95 per ton in the south and $31.95 in the northern rainfall region.

As was the case with corn silage, the major advantage of irrigating alfalfa was that fewer acres needed to be devoted to the production of hay necessary for feeding operations. Irrigated alfalfa grown in the southern region yielded 5.9 tons per acre compared to 3.5 tons on dryland. In the northern rainfall region, 4.6 tons per acre were found to be the average yield for irrigated alfalfa, while the dryland average yield was 2.5 tons per acre.

Irrigated soybeans proved to be a profitable alternative in the northern region with a breakeven price of only $4.15 per bushel compared to $5.10 for dryland beans. This was primarily because irrigated soybeans yielded an average of 38 bushels per acre while dryland soybeans yielded 19 bushels per acre.

In the southern rainfall region, irrigated soybean yields averaged 46 bushels per acre while dryland averaged 25 bushels per acre. Breakeven prices for dryland and irrigated beans were virtually equal at $4.35 and $4.40 per bushel, respectively.

The primary results of this study indicated that irrigators' net returns to labor, management, and water were positive through the study period and were greater each year than returns to producers of dryland crops. In the northern rainfall region estimated net returns to labor, management and water from 1970 to 1977 ranged from $12.05 to $202.00 per composite irrigated acre. Dryland returns to labor and management during that same period in the northern region ranged from $38.25 to $43.30 per composite acre.

In the southern rainfall region, estimated net returns to labor, management, and water ranged from $4.75 to $216.45 per composite irrigated acre from 1970 to 1977, while dryland returns to labor and management reached a low of $-4.05 and peaked at $42.20 per composite acre. The 8 year average differences between irrigated returns to labor, management, and water and dryland returns to labor and management were $85.05 per composite acre in the northern rainfall region and $80.55 per composite acre in the southern region.

By deducting labor charges from the annual returns estimates, returns to management and water per irrigated acre and returns to management per dryland acre were determined. Returns to management and water ranged from $2.25 to $193.80 per irrigated acre in the northern rainfall region and from $-3.85 to $209.25 per irrigated acre in the southern region. Dryland returns to management ranged from $-42.75 to $39.60 per composite acre in the north and from $-28.70 to $38.50 in the south.

Estimates of values for water used for irrigation ranged from $7.00 in 1977 to $166.00 in 1974 per irrigated acre in the northern rainfall region and from $-5.40 in 1977 to $174.25 in 1974 per irrigated acre in the southern rainfall region. The estimated average return to water per irrigated acre over the years 1970-1977 was approximately $77.00 in the northern region and $74.00 in the southern rainfall region.

Note that these were average returns to water and that a range of returns to water existed within each area for each year.

The estimates of value of water per acre inch applied ranged from $.75 in 1977 to $16.45 in 1974 in the northern rainfall region and from $-.45 in 1977 to $11.30 in 1974 for the southern rainfall region. The averages for the northern and southern rainfall regions were $7.50 and $5.25 per acre inch, respectively.

It is important to remember that these are averages and residuals and are highly dependent on the rates at which labor and management are paid and the rate of return on the farmer's land investment. Changes in any of these cost variables would result in changes in the estimates of value of water used for irrigation in eastern South Dakota.

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