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ECONOMIC IMPACT OF IRRIGATION
IN THE BUFORD-TRENTON
IRRIGATION DISTRICT IN 1990

James F. Baltezore, Dean A. Bangsund,
Jay A. Leitch, and F. Larry Leistritz

Department of Agricultural Economics
North Dakota Agricultural Experiment Station
North Dakota State University
Fargo, North Dakota

Project Report to the
Upper Missouri Lake Sakakawea Planning Committee
1302 Davidson Drive
Williston, North Dakota 58801

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Highlights

The purpose of this report was to estimate the economic impacts of a hypothetical change from irrigation to dry cropland farming in 1990 in the Buford-Trenton Irrigation District of North Dakota. Approximately 9,000 acres of cropland were irrigated in the district in 1990. The method used to estimate economic change involved comparing an irrigated cropland composite acre with a dry cropland composite acre. Economic impacts were estimated at both the farm and state levels.

The economic on-farm impact was a decline of \$197 per acre in returns to unpaid labor and management. The state-level impact was a decline of over \$10 million in total business activity and 130 fewer jobs in 1990 in North Dakota.

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Introduction

The purpose of this report is to estimate the economic impacts of changing from irrigation to dry cropland farming in 1990 in the Buford-Trenton Irrigation District. Approximately 9,000 acres of cropland were irrigated in the district in 1990. A switch from irrigation to dry cropland production implies different production inputs, commodity yields, and on-farm net returns. Changes in economic activity at the farm level translate into secondary impacts on regional and state economies in retail trade sales, personal income, total business activity, and secondary employment. This study estimates the potential differences in on-farm net returns, state economic activity, and secondary employment given a hypothetical switch in 1990 from irrigation to dry cropland farming in the Buford-Trenton Irrigation District.

Method

The method used to estimate economic changes involved comparing an irrigated cropland situation with a dry cropland situation. This required estimating irrigated and dry cropping patterns, commodity yields and prices, and production costs. These values were determined using published statistics, conversations with producers and Williston Experiment Station personnel, and Buford-Trenton Irrigation District records.

A composite acre approach was used to assess the impacts of a switch from irrigation to dry cropland farming. This approach has been applied in past studies quantifying irrigation benefits (Leitch and Anderson 1978, Leitch and Schaffner 1984, and Leitch et al. 1991). A composite acre approach minimizes the number of assumptions compared to a whole-farm approach, thereby making results less sensitive to assumptions.

Composite Acres

A composite acre represents the mix of crops grown across the area being analyzed. A composite acre is not necessarily what any one producer does, but instead represents what all producers do in the aggregate. Two composite acres were developed for the Buford-Trenton Irrigation District: (1) baseline irrigation and (2) dry cropland (Table 1). The irrigated composite acre represents actual crop

*Authors are research associate, research assistant, associate professor, and professor, respectively, Department of Agricultural Economics, North Dakota State University, Fargo.

TABLE 1. DISTRIBUTION OF CROPS FOR DRY AND IRRIGATED CROPLAND
COMPOSITE ACRES, BUFORD-TRENTON IRRIGATION DISTRICT, 1990

Crop	Dry Cropland ^a		Irrigated Cropland ^b	
	Acres	Percent	Acres	Percent
Barley	315	3.5	na	na
Beans-dry edible	na	na	250	2.8
Corn-silage	na	na	300	3.3
Hay-all ^c	873	9.7	1,450	16.1
Oats	342	3.8	na	na
Summerfallow	3,573	39.7	na	na
Sugarbeets	na	na	4,200	46.7
Wheat ^d	<u>3,897</u>	<u>43.3</u>	<u>2,800</u>	<u>31.1</u>
Total	9,000	100.0	9,000	100.0

^aCrops grown and percentage of crops based on an average of 1990 dry cropland acreage for McKenzie and Williams counties (North Dakota Agricultural Statistics Service 1991).

^bCrops grown and percentage of crops based on actual planted cropland acres in the Buford-Trenton Irrigation District in 1990.

^cRepresents alfalfa and other hay.

^dRepresents spring and durum wheat.

acres and percentages in 1990 in the Buford-Trenton Irrigation District. The dry cropland composite acre is based on an average of actual crop planted acreages in 1990 on dryland in McKenzie and Williams counties (North Dakota Agricultural Statistics Service 1991).

Crop Budgets

Budgets for irrigated crops in 1990 for the Buford-Trenton area are presented in Table 2. Irrigation yields and prices are actual values reported by irrigators in the Buford-Trenton Irrigation District in 1990. Production expenses for wheat, hay, corn silage, and dry edible beans are those reported in *Estimated 1991 Irrigated Crop Budgets Southwest North Dakota* (Haugen and Aakre 1991) and verified by irrigators in the Buford-Trenton Irrigation District. Sugarbeet expenses are based on *Sugarbeet Production Costs in the Red River Valley for 1990* (Johnson and Coon 1991) and modified to include irrigation costs in the Buford-Trenton Irrigation District. Hay yield and price are a weighted average of alfalfa and other hay. Hay expenses are a weighted average of the establishment year (one year) and the established stand (three years). Irrigators in the Buford-Trenton Irrigation District provided estimates of 1990 irrigation maintenance and water charges.

TABLE 2. CROP BUDGETS FOR AN ACRE OF IRRIGATED CROPLAND, BUFORD-TRENTON IRRIGATION DISTRICT, 1990

	Sugar- beets ^a	Wheat ^b	All Hay ^b	Corn Silage ^b	Dry Edible Beans ^b
Yield per acre	18.79 tons	51 bushels	3.4 tons	18.53 tons	21.8 cwt
Price	\$44.00/ton	\$2.25/bushel	\$54.94/ton	\$22.00/ton	\$20.00/cwt
GROSS INCOME	\$826.76	\$114.75	\$186.80	\$407.66	\$436.00
	----- dollars -----				
EXPENSES					
Seed	32.98	6.38	10.31	19.50	27.00
Fertilizer and chemicals	92.67	22.05	28.51	64.44	41.66
Miscellaneous	17.83	7.00	5.91	1.05	5.60
Insurance and interest	20.39	6.21	4.16	15.37	16.26
Fuel and lubrication	27.61	5.76	8.90	15.87	9.72
Repairs	25.73	7.15	12.37	9.32	7.39
Hired labor ^c	72.37 ^d	2.22	3.33	4.71	3.03
Machinery ownership	104.06	27.32	9.94	18.66	23.36
Land ownership	21.49	21.49	21.49	21.49	21.49
Irrigation maintenance ^e	25.00	25.00	25.00	25.00	25.00
Irrigation water ^e	<u>30.00</u>	<u>30.00</u>	<u>30.00</u>	<u>30.00</u>	<u>30.00</u>
Total	470.13	160.58	159.92	225.41	210.51
RETURNS TO UNPAID LABOR AND MANAGEMENT	356.63	(45.83)	26.88	182.25	225.49

^aYield and price are those reported by irrigators in the Buford-Trenton Irrigation District in 1990. Expenses are those reported in *Sugarbeet Production Costs in the Red River Valley for 1990* (Johnson and Coon 1991).

^bYields and prices are those reported by irrigators in the Buford-Trenton Irrigation District in 1990. Expenses are those reported in *Estimated 1991 Irrigated Crop Budgets Southwest North Dakota* (Haugen and Aakre 1991). Hay yield and price are a weighted average of alfalfa and other hay. Hay expenses are a weighted average of establishment year (one year) and established stand (three years).

^cAdditional labor requirement for irrigated cropland over and above dryland.

^dIncludes hired machine and migrant labor.

^eEstimates provided by irrigators in the Buford-Trenton Irrigation District for 1990.

Budgets for dryland crops in 1990 for the Buford-Trenton area are presented in Table 3. Yields are based on a weighted average of 1990 yields in McKenzie and Williams counties (North Dakota Agricultural Statistics Service 1991) and verified by extension personnel at the Williston Experiment Station. Prices for wheat, barley, and hay are based on actual prices irrigators received in the Buford-Trenton district. Hay price is a weighted average of alfalfa and other hay. Price per bushel of oats is the average 1990 price farmers received in the northwest agricultural statistics district (North Dakota Agricultural Statistics Service 1991). Expenses are those reported in *Estimated 1990 Crop Budgets Northwest North Dakota* (Aakre et al. 1990). Machinery ownership expenses for alfalfa and summerfallow are those reported in *A Reevaluation of Garrison Diversion Unit Irrigation* (Leitch et al. 1991).

Composite Acre Budgets

Composite acre budgets are estimated by multiplying individual crop budgets (i.e., gross income and production expenses presented in Tables 2 and 3) by the percentage of the crop in the composite acre (Table 1). This procedure condenses individual crop budget information into a composite acre, representing a typical or average farm in 1990 in the Buford-Trenton Irrigation District. Differences in returns to unpaid labor and management between composite irrigated and dry cropland acres represent the net on-farm impacts.

Gross income and production expenses for irrigated and dry cropland composite acres are multiplied by the number of acres switched from irrigation to dry cropland agriculture. **It is assumed that 9,000 acres will change from irrigated to dry cropland.** Irrigation and dry cropland expense and income categories are aggregated into economic sectors and applied to the North Dakota Input-Output Model.

The North Dakota Input-Output Model is used to estimate retail trade sales, personal income, total business activity, and secondary employment, resulting from economic activity on irrigated and dry cropland for the 9,000 acres in the Buford-Trenton Irrigation District. The difference between these economic measures represents the net effect of a hypothetical switch from irrigated to dry cropland agriculture in 1990.

TABLE 3. CROP BUDGETS FOR AN ACRE OF DRY CROPLAND, BUFORD-TRENTON IRRIGATION DISTRICT, 1990

	Wheat	All Hay	Oats	Barley	Summer-fallow
Yield per acre ^a	24.4 bushels	1.24 tons	38.41 bushels	28.67 bushels	---
Price ^b	\$2.25/bushel	\$54.94/ton	\$0.90/bushel	\$1.75/bushel	---
GROSS INCOME ^c	\$54.90	\$68.13	\$34.57	\$50.17	---
	----- dollars -----				
EXPENSES ^d					
Seed	5.50	10.06	8.75	5.31	1.20
Fertilizer and chemicals	9.51	6.15	5.65	6.39	0.00
Miscellaneous	3.10	3.00	5.20	4.20	0.20
Insurance and interest	4.92	1.06	5.98	5.76	0.58
Fuel and lubrication	4.94	5.29	4.12	4.12	5.69
Repairs	6.01	3.65	5.31	5.31	2.57
Machinery ownership	23.36	6.88	23.36	23.36	8.26
Land ownership	<u>21.49</u>	<u>21.49</u>	<u>21.49</u>	<u>21.49</u>	<u>21.49</u>
Total	78.83	57.58	79.86	75.94	39.99
RETURNS TO UNPAID LABOR AND MANAGEMENT	(23.93)	10.55	(45.29)	(25.77)	(39.99)

^aYields are based on a weighted average of 1990 yields from McKenzie and Williams counties (North Dakota Agricultural Statistics Service 1991).

^bPrices for wheat, barley, and alfalfa are based on actual prices farm operators received in the Buford-Trenton district. Price per bushel of oats is the average 1990 price farmers received in the northwest agricultural statistics district (North Dakota Agricultural Statistics Service 1991).

^cIrrigators have not participated in government farm programs. Their historic base acreages for program crops are zero. Therefore, no government payments are included.

^dExpenses are those reported in *Estimated 1990 Crop Budgets Northwest North Dakota* (Aakre et al. 1990), except machinery ownership expenses for alfalfa and summerfallow are those reported in *A Reevaluation of Garrison Diversion Unit Irrigation* (Leitch et al. 1991).

Regional Impacts

Conversion from irrigated to dryland crop production implies changes at the farm level and at the regional economy level. Farm level effects are captured by changes in per acre net returns, while changes in regional activity are captured using the North Dakota Input-Output Model (Coon et al. 1989). The curtailment in economic activity that comes with conversion from irrigation to dry cropland agriculture includes decreased purchases of inputs and sales of outputs, and presents fewer opportunities for value-added activities in the state. These changes in business activity result in lower profits to the agribusiness sector and to other sectors serving agriculture, and imply a loss of jobs across the regional and statewide economy.

Results

Converting from irrigation to dry cropland agriculture affects per acre on-farm net returns and regional economic activity. Changes in on-farm net returns directly affect the financial well-being of farm families. Changes in on-farm activities and finances have secondary impacts on off-farm business activity and employment.

On-farm Net Returns

A composite acre of irrigated cropland in the Buford-Trenton Irrigation District had returns to unpaid labor and management of \$169 per acre in 1990 (Table 4). The dry cropland composite acre had a -\$28 per acre return to unpaid labor and management in 1990 (Table 5). The on-farm net effect of a switch from irrigated to dry cropland agriculture in 1990 would have been a decrease in returns to unpaid labor and management of \$197 per acre.

Regional Economic Impacts

Over \$11.1 million in total business activity occurred in North Dakota in 1990 from irrigating 9,000 acres in the Buford-Trenton Irrigation District (Table 6). Irrigation contributed \$3.8 million in retail trade sales, \$4.1 million in personal income, and 140 jobs to the North Dakota economy. The potential net impact on the North Dakota economy of a hypothetical switch to dry cropland agriculture in 1990 was a \$10.4 million decrease in total business activity and a decrease of more than 130 jobs.

TABLE 4. BUDGET FOR A COMPOSITE ACRE OF IRRIGATED CROPLAND, BUFORD-TRENTON IRRIGATION DISTRICT, 1990

	Sugar- beets	Wheat	All Hay	Corn Silage	Dry Edible Beans	Total (per acre)	Total Dollars (9,000 acres)	Input-Output Sector
Percent of acre	46.7	31.1	16.1	3.3	2.8	100		
	----- dollars -----							
GROSS INCOME	386.10	35.69	30.07	13.45	12.21	477.52	4,297,672	
EXPENSES								
Seed	15.40	1.98	1.66	0.64	0.76	20.45	184,007	Retail
Fertilizer and chemicals	43.28	6.86	4.59	2.13	1.17	58.02	522,158	Retail
Miscellaneous	8.33	2.18	0.95	0.03	0.16	11.65	104,819	B&P Service
Insurance and interest	9.52	1.93	0.67	0.51	0.46	13.09	117,771	FIRE
Fuel and lubrication	12.89	1.79	1.43	0.52	0.27	16.91	152,226	Retail
Repairs	12.02	2.22	1.99	0.31	0.21	16.75	150,710	B&P Service
Hired labor	33.80	0.69	0.54	0.16	0.08	35.26	317,372	Households
Machinery ownership	48.60	8.50	1.60	0.62	0.65	59.96	539,665	Retail
Land ownership	10.04	6.68	3.46	0.71	0.60	21.49	193,410	FIRE
Irrigation maintenance	11.68	7.78	4.03	0.83	0.70	25.00	225,000	Retail
Irrigation water	<u>14.01</u>	<u>9.33</u>	<u>4.83</u>	<u>0.99</u>	<u>0.84</u>	<u>30.00</u>	<u>270,000</u>	Government
Total	219.55	49.94	25.75	7.44	5.89	308.57	2,777,139	
RETURNS TO UNPAID LABOR AND MANAGEMENT	166.55	(14.25)	4.33	6.01	6.31	168.95	1,520,533	Households

TABLE 5. BUDGET FOR A COMPOSITE ACRE OF DRY CROPLAND, BUFORD-TRENTON IRRIGATION DISTRICT, 1990

	Wheat	Summer-fallow	Alfalfa	Oats	Barley	Total (per acre)	Total Dollars (9,000 acres)	Input-Output Sector
Percent of Acre	43.3	39.7	9.7	3.8	3.5	100		
	----- dollars -----							
GROSS INCOME	23.77	0.00	6.61	1.31	1.76	33.45	301,046	
EXPENSES								
Seed	2.38	0.48	0.98	0.33	0.19	4.35	39,169	Retail
Fertilizer and chemicals	4.12	0.00	0.60	0.21	0.22	5.15	46,375	Retail
Miscellaneous	1.34	0.08	0.29	0.20	0.15	2.06	18,516	B&P Service
Insurance and interest	2.13	0.23	0.10	0.23	0.20	2.89	26,031	FIRE
Fuel and lubrication	2.14	2.26	0.51	0.16	0.14	5.21	46,907	Retail
Repairs	2.60	1.02	0.35	0.20	0.19	4.36	39,279	B&P Service
Machinery ownership	10.11	3.28	0.67	0.89	0.82	15.77	141,901	Retail
Land ownership	<u>9.31</u>	<u>8.53</u>	<u>2.08</u>	<u>0.82</u>	<u>0.75</u>	<u>21.49</u>	<u>193,410</u>	FIRE
Total	34.13	15.88	5.59	3.03	2.66	61.29	551,585	
RETURNS TO UNPAID LABOR AND MANAGEMENT	(10.36)	(15.88)	1.02	(1.72)	(0.90)	(27.84)	(250,539)	Households

TABLE 6. RETAIL TRADE, PERSONAL INCOME, TOTAL BUSINESS ACTIVITY, AND EMPLOYMENT, IRRIGATED AND DRY CROPLAND, 9,000 ACRES, BUFORD-TRENTON IRRIGATION DISTRICT, 1990

Cropping Options	Retail Trade	Personal Income	Total Business Activity	Secondary Employment
----- thousand dollars -----				
Irrigation	3,762	4,065	11,154	140
Dryland	<u>337</u>	<u>27</u>	<u>765</u>	<u>8</u>
Net Impact	-3,425	-4,038	-10,389	-132

Summary

The economic on-farm impact of a switch from irrigated to dry cropland agriculture in 1990 in the Buford-Trenton Irrigation District would have been a decline of \$197 per acre in returns to unpaid labor and management. Irrigation in the Buford-Trenton area contributed over \$11.1 million in total business activity and 140 jobs to the state in 1990. A switch to dry cropland agriculture would have resulted in a decline of over \$10.4 million in total business activity and 130 fewer jobs in 1990 in North Dakota.

References

- Aakre, Dwight, Frayne Olson, Harlen Hughes, and George Flaskerud. 1990. *Farm Management Planning Guide: Estimated 1990 Crop Budgets Northwest North Dakota*. Section VI, Region 1, North Dakota State University Extension Service, Fargo.
- Coon, Randal C., F. Larry Leistritz, and Thor A. Hertsgaard. 1989. *North Dakota Input-Output Economic Projection Model: Documentation and User's Guide*. Agricultural Economics Software Series No. 4, Department of Agricultural Economics, North Dakota State University, Fargo.
- Haugen, Ron and Dwight Aakre. 1991. *Farm Management Planning Guide: Estimated 1991 Irrigated Crop Budgets Southwest North Dakota*. Section VI, Region 4, North Dakota State University Extension Service, Fargo.
- Johnson, Roger G. and Randal C. Coon. 1991. "Sugarbeet Production Costs in the Red River Valley for 1990." *1990 Sugarbeet Research and Extension Reports*, North Dakota State University, Cooperative Extension Service, Fargo.
- Leitch, Jay A. and Donald E. Anderson. 1978. *Impact of Inundation and Changes in Garrison Diversion Project Plans on the North Dakota Economy*. Agricultural Economics Report No. 127, Department of Agricultural Economics, North Dakota Agricultural Experiment Station, North Dakota State University, Fargo.
- Leitch, Jay A. and LeRoy W. Schaffner. 1984. *Economic Activity Associated With the Garrison Diversion Unit in 1984*. Agricultural Economics Report No. 190, Department of Agricultural Economics, North Dakota Agricultural Experiment Station, North Dakota State University, Fargo.
- Leitch, Jay A, James F. Baltezare, Roger G. Johnson, and Randal C. Coon. 1991. *A Reevaluation of Garrison Diversion Unit Irrigation*. Staff Paper Series AE91006, Department of Agricultural Economics, North Dakota Agricultural Experiment Station, North Dakota State University, Fargo.
- North Dakota Agricultural Statistics Service. 1991. *North Dakota Agricultural Statistics*. Ag Statistics No. 60, North Dakota State University and the United States Department of Agriculture, Fargo.