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Economic Contribution of the Wheat Industry to North Dakota

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North Dakota, like other Great Plains states, relies heavily upon agriculture for much of its economic activity. The importance of agriculture can be measured by examining the amount of money that the activity brings into the state, sometimes called the economic base or basic income. From 1998 through 2002, agriculture accounted for 26 percent of North Dakota's economic base (Coon and Leistritz 2004). Agriculture's importance in the North Dakota economy also can be demonstrated by examining the state's gross state product. Gross state product is the value of all goods and services attributable to labor and property located within the state. In 2000, agriculture accounted for 8 percent of the state's gross state product, making North Dakota the second most agriculturally dependent state in the nation (Leistritz et al. 2002).

Agriculture does play a major role in North Dakota's economy and most people familiar with the state realize the importance of agriculture to the state's economy. However, the economic significance of the various activities within the agriculture industry are less understood. North Dakota has been dependent upon cash crop receipts (excluding government program payments) for nearly 76 percent of the state's total farm receipts since 2000. If cash crop receipts and government program payments are included over the same period, crop activities account for nearly 81 percent of all farm receipts (North Dakota Agricultural Statistics Service). Wheat production (excluding government payments) has accounted for 34 percent of all crop receipts from 2001 through 2003 (North Dakota Agricultural Statistics Service). Since farm receipts are an important measure of agricultural impacts on local economies, wheat arguably is the single most important enterprise for farmers and agriculturally-based rural economies in North Dakota.

OBJECTIVE

The purpose of this study was to estimate the economic contribution (direct and secondary effects) of the wheat industry to the North Dakota economy. Specifically, economic impacts from the wheat industry were estimated for crop production, grain handling, transportation, and processing activities.

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DISCUSSION

A general discussion of the procedures and methods used in the study is divided into (1) wheat production, (2) grain handling, (3) transportation, (4) processing, and (5) input-output analysis.

Wheat Production

North Dakota has a well-earned reputation as being a major producer of wheat in the United States. Over the last 15 years, North Dakota has led the nation in total wheat production 4 times and been second to Kansas 11 times. Wheat production in Kansas is dominated by winter wheat, whereas, in North Dakota, durum and spring wheat dominate production. Historically, North Dakota has been the nation's top producer of durum and spring wheat, averaging 73 and 43 percent of all U.S. production the last 15 years, respectively. From 2001 through 2003, North Dakota produced 62 percent of U.S. durum production and 45 percent of the country's spring wheat production. North Dakota has accounted for 14 percent of all wheat produced in the U.S. since 1989.

Wheat is produced in all areas of the state; however, production is concentrated in the Red River Valley and in the northern third of the state (Figure 1). Spring wheat and durum have historically dominated North Dakota wheat production, accounting for about 78 and 21 percent of all wheat production, respectively.

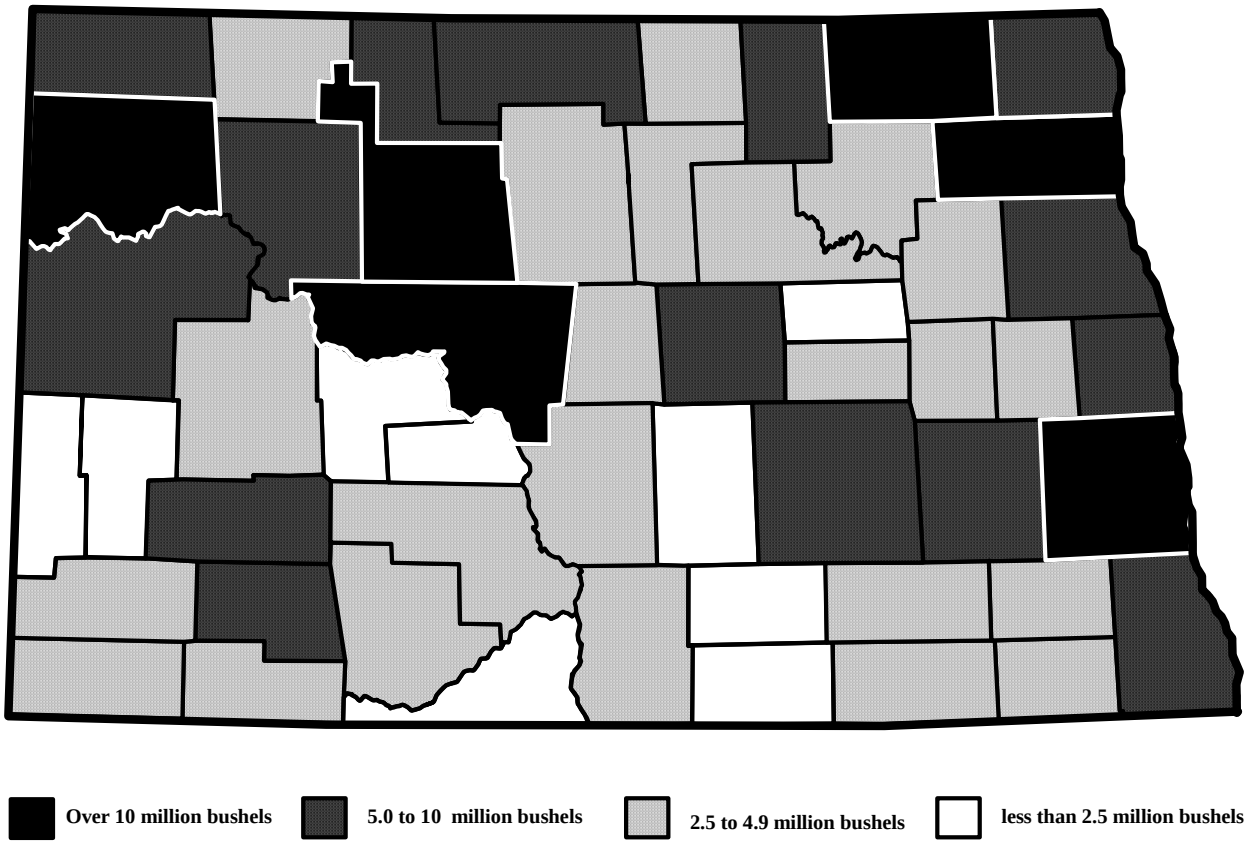

Figure 1. Average Wheat Production in North Dakota, by County, 2001 to 2003

Wheat production in North Dakota averaged about 9.1 million planted acres and 275 million bushels from 2001 through 2003 (North Dakota Agricultural Statistics Service). County wheat yields from 2001 through 2003 varied from 16 to 46 bushels per planted acre, with an overall state average of 30.4 bushels. Wheat yields are generally highest in the eastern third of the state.

Enterprise budgets were developed for spring wheat, durum, and winter wheat production in North Dakota. Estimates of wheat production costs were obtained from the North Dakota Farm and Ranch Business Management Education Program. Wheat revenues were a combination of yields and prices, government payments, disaster payments, and insurance indemnities, all averaged from 2001 through 2003.

Grain Handling

The economic activity from grain handling (i.e., cleaning, mixing, storing, loading, and unloading) was estimated for local (country) elevators. A grain handling budget, combined with a gross handling margin, was used to estimate returns and expenses from wheat handling activities. Country elevators handled approximately 264 million bushels of North Dakota wheat annually from 2001 through 2003.

Transportation

Grain flow is usually complex, involving several modes of transportation (e.g., truck, railroad, barge, vessel) and several possible destinations and handlers. For this study, grain movements were limited to shipments from (1) farms to country elevators and in-state processors, (2) country elevators to out-of-state destinations (i.e., river port, terminal elevator, subterminal elevator, another country elevator, processor) and (3) country elevators to in-state processors or final destinations.

Estimates of grain flow from various regions in North Dakota to in-state and out-of-state destinations were obtained from Vachal and VanWechel (2003a, 2003b) and Vachal (2002). Grain flow, including the amount shipped by truck and railroad, was estimated for various production regions to six general destinations. Destinations in Minnesota received about half of all North Dakota wheat shipments, followed by destinations in the pacific northwest (14 percent) and southwest/midland destinations (11 percent). About 84 percent of all North Dakota wheat shipped from local elevators to market destinations was moved by rail.

Transportation costs of shipping wheat from local elevators to market destinations were estimated from 1) the amount of wheat transported from counties to market destinations by mode of transport, 2) per unit expenses for truck and rail transportation, and (3) hauling distances from county locations to market destinations.

Trucking rates were obtained from the Upper Great Plains Transportation Institute (2004). A truck operating budget was developed to estimate hauling expenses. Railroad companies' expenses incurred in rail transport were estimated using a model developed by the Interstate Commerce Commission. A railroad budget was developed to allocate the costs obtained from the model to various economic sectors.

Shipping rates (tariffs) charged elevators for rail shipments were obtained from Burlington Northern-Santa Fe Corporation (2004) and used to estimate returns from rail shipments.

Processing

Economic impacts associated with the processing of North Dakota wheat were limited to in-state milling activities. Economic activity from wheat milling was estimated from industry contacts and a survey of in-state processors, and based on the amount of wheat milled from North Dakota sources. Only expenditures made to North Dakota entities by in-state processors were obtained from the survey.

Input-Output Analysis

Economic activity from a project, program, policy, or activity can be categorized into direct and secondary impacts. Direct impacts are those changes in output, employment, or income that represent the initial or first-round effects of the project, program, or activity. Secondary impacts (sometimes further categorized into indirect and induced effects) result from subsequent rounds of spending and respending within the economy. Input-output (I-O) analysis traces linkages (i.e., the amount of spending and respending) among sectors of an economy and calculates the total business activity resulting from a direct impact in a basic sector (Coon et al. 1985).

This process of spending and respending can be explained by using an example. A single dollar from a North Dakota wheat producer (*Households* sector) may be spent for a loaf of bread at the local store (*Retail Trade* sector); the store uses part of that dollar to pay for the next shipment of bread (*Transportation* and *Agricultural Processing* sectors) and part to pay the store employee (*Households* sector) who shelved or sold the bread; the bread supplier uses part of that dollar to pay for the grain used to make the bread (*Agriculture-Crops* sector) ... and so on.

RESULTS

The economic contribution from the wheat industry was estimated from production, grain handling, transportation, and processing activities. Expenditures and returns from these activities represent the direct economic impacts from the wheat industry. Subsequently, the direct impacts were used with an input-output model to estimate the secondary impacts.

Direct Economic Impacts

The direct impacts from the wheat industry on the economy of North Dakota include (1) expenditures and returns from the production of wheat, (2) expenditures and returns from handling wheat at local elevators, (3) expenses and returns from entities transporting wheat from local collection points to in-state and out-of-state destinations, and (4) expenses and returns from wheat milling activities.

The 9.1 million acres of wheat generated about $1 billion in production expenditures and $134 million in returns to unpaid labor, management, and equity annually from 2001 through 2003. Direct impacts (expenditures and returns) from wheat production averaged about $126.50 per acre or $1.145 billion annually (Table 1).

Local elevators in North Dakota handled approximately 264 million bushels (96 percent of production) of wheat annually from 2001 through 2003. With a gross margin of about $0.12 per bushel (Wilson 2004), grain handling at local elevators generated about $32 million in annual direct impacts (Table 1).

Direct economic impacts from shipping activities were estimated for truck and rail transportation by developing budgets for each mode and estimating quantities and distances of wheat shipped by each mode. Total direct economic impacts from truck transportation were $17.2 million annually. Country elevators spent about $199 million on rail transportation to ship North Dakota wheat to market destinations. About 28 percent or $55.4 million of the total amount spent on rail transportation remained as direct economic impacts.

Expenditures and returns from wheat processing were obtained from a survey of in-state milling firms. Milling firms in the state processed about 46 million bushels of wheat in 2003. About 40.5 million bushels were obtained from North Dakota sources. In-state expenditures and returns from processing North Dakota wheat were estimated at $100 million annually (Table 1).

Table 1. Direct Impacts From the Wheat Industry to the North Dakota Economy, by Economic Sector and Industry Activity, 2001 Through 2003

	Total Direct Impacts by Industry Activity				
Economic Sector	Wheat Production	Transpor-tation	Grain Handling	Proc-essing	Total Direct
	---------- 000s $ ----------				
Agriculture-Livestock	0	0	0	0	0
Agriculture-Crops	0	0	0	0	0
Nonmetal Mining	0	0	0	0	0
Construction	0	0	0	2,564	2,564
Transportation	0	11,896	0	27,324	39,220
Comm and Pub Util	11,813	49	1,777	5,485	19,124
Ag Proc and Misc Mfg	0	0	2,639	30,945	33,583
Retail Trade	503,597	34,466	8,589	5,397	552,050
Fin, Ins, and R Estate	123,586	1,069	5,628	3,226	133,509
Bus and Pers Service	133,566	0	1,185	2,623	137,373
Prof and Social Service	0	0	0	512	512
Households	322,625	23,599	10,367	21,405	377,995
Government	49,810	1,499	1,481	545	53,336
Total Direct Impacts	1,144,998	72,579	31,665	100,025	1,349,267

Total annual direct impacts from wheat production expenditures and returns in North Dakota were estimated at $1.14 billion. Grain handling, transportation, and processing activities generated an additional $204 million in annual direct impacts. All wheat industry activities generated about $1.35 billion annually in direct impacts from 2001 through 2003. Business activity was greatest in the *Retail Trade* ($552 million), *Households* ($378 million in economy-wide personal income), *Business and Personal Services* ($137 million), and *Finance, Insurance, and Real Estate* ($134 million) sectors (Table 1).

Secondary Economic Impacts

Secondary economic impacts were estimated separately for wheat production, grain handling, transportation, and processing. The direct impacts from each industry activity were allocated to various economic sectors of the North Dakota Input-Output Model. Total direct impacts of $1.14 billion from wheat production in North Dakota generated about $1.8 billion in secondary impacts. Total direct impacts of $32 million from grain handling generated about $60 million in secondary impacts. Total direct impacts of $73 million from wheat transportation generated about $114 million in secondary impacts. Total direct impacts of $100 million from wheat processing activities generated about $241 million in secondary impacts. Total secondary impacts from all activities were estimated at $2.2 billion annually.

Secondary impacts were highest in the *Households* ($765 million in economy-wide personal income), *Retail Trade* ($637 million), *Finance, Insurance, and Real Estate* ($141 million), *Communication and Public Utilities* ($110 million), and *Government* ($102 million) sectors. Overall, each dollar of direct impacts from the wheat industry generated about $1.64 in secondary impacts.

Total Economic Impacts

Total (direct and secondary effects) impacts from wheat production in North Dakota were estimated at $2.9 billion annually. Grain handling, transportation, and processing activities generated an additional $620 million annually in total impacts. The wheat industry generated a gross business volume of $3.6 billion annually from 2001 through 2003 (Table 2).

The economic sectors with the greatest *total* (direct and secondary) impacts included *Retail Trade* ($1.19 billion), *Households* ($1.14 billion in economy-wide personal income), *Finance, Insurance, and Real Estate* ($274 million), *Business and Personal Services* ($192 million), *Government* ($156 million), and *Communication and Public Utilities* ($129 million).

Employment

Approximately 12,900 farms raised wheat in North Dakota in 2002 (U.S. Department of Agriculture 2004); however, direct employment (full-time equivalent jobs) in wheat production is difficult to quantify. Direct employment in the grain handling and transportation industries is also extremely difficult to quantify. Direct employment in wheat processing activities was estimated at 471 full-time equivalent jobs. Many of the positions (employment) affiliated with wheat activities (i.e., those outside of production) generally exist in other industries. Employment at local

elevators is part of the grain handling business and jobs in shipping and hauling wheat are part of the transportation industry. Most of the jobs outside of wheat production are within industries that are supported only in part by the wheat industry, making employment estimates difficult to generate. The wheat industry does directly affect jobs in grain handling and transportation; however, actual quantification of those jobs was not estimated.

Secondary employment was estimated for wheat production, grain handling, transportation, and processing activities. Secondary employment estimates represent the number of full-time jobs generated based on the volume of business activity created by the industry. Wheat production indirectly supported about 27,519 full-time equivalent jobs. Transportation activities indirectly supported 2,171 full-time equivalent jobs. Wheat handling and processing activities combined indirectly supported another 5,351 full-time equivalent jobs. The wheat industry indirectly supported about 35,041 full-time equivalent jobs annually in North Dakota.

Table 2. Gross Business Volume (Direct and Secondary Impacts) from the Wheat Industry to the North Dakota Economy, by Economic Sector and Industry Activity, 2001 Through 2003

Economic Sector	Total Economic Impacts by Industry Activity				Total Impacts
	Wheat Production	Transpor-tation	Grain Handling	Proc-essing	
	000s $				
Agriculture-Livestock	79,717	5,264	2,427	9,704	97,112
Agriculture-Crops	31,302	1,972	2,512	21,591	57,377
Nonmetal Mining	4,278	332	137	712	5,459
Construction	63,785	3,997	1,993	8,859	78,634
Transportation	11,456	12,581	325	28,367	52,729
Comm and Pub Util	104,750	5,506	4,580	14,175	129,011
Ag Proc and Misc Mfg	48,364	2,948	5,879	56,233	113,424
Retail Trade	1,030,671	68,720	25,381	63,819	1,188,591
Fin, Ins, and R Estate	240,287	8,615	9,345	16,165	274,412
Bus and Pers Service	179,530	2,728	2,668	7,541	192,467
Prof and Social Service	62,925	3,976	2,007	6,659	75,567
Households	957,546	61,232	30,658	93,458	1,142,894
Government	129,249	8,598	4,021	13,865	155,733
Total Economic Impacts	2,943,860	186,469	91,933	341,148	3,563,410
Secondary Employment	27,519	2,171	824	4,527	35,041

Tax Collections

Direct economic impacts from production, handling, transportation, and processing were used with I-O analysis to estimate personal income, retail trade, and other business activity, which was then used to estimate tax revenues. Annual tax revenues generated by the wheat industry in North Dakota included $55 million in sales and use taxes, $14.8 million in personal income taxes, and $6.5 million in corporate income taxes. Total annual collections from sales and use, personal income, and corporate income taxes were about $76.4 million. Wheat production also was estimated to be directly responsible for about $49.8 million in property taxes.

Previous Industry Estimates

The economic size of the wheat industry was compared to a previous study completed in 1995 (Bangsund and Leistritz 1995). Wheat acreage from 2001 through 2003 decreased by over 2 million acres or 18 percent when compared to production levels from 1991 through 1993. Average production between the two periods decreased by 93 million bushels or by 25 percent. The gross business volume associated with wheat production from 1991 through 1993 was $4.7 billion (2003 dollars) versus $2.9 billion from 2001 through 2003. The economic impact from wheat production decreased by about $1.76 billion in real terms (i.e., effects of inflation removed) between the two periods. Since wheat prices in North Dakota over the two periods were similar and since per-acre government payments were also similar in magnitude, most of the change in the value of wheat production between the periods was attributable to changes in production levels.

Total annual impacts from wheat transportation were estimated at $333 million (2003 dollars) from 1991 through 1993, compared to $186 million from 2001 through 2003. The economic impact from wheat transportation decreased by $147 million in real terms between the two periods. Total annual impacts from grain handling were estimated at $171 million (2003 dollars) from 1991 through 1993, compared to $92 million from 2001 through 2003. The economic impact from grain handling decreased by nearly $80 million in real terms between the two periods. Since transportation and grain handling impacts are predominantly influenced by grain volume, most of the change in economic activity between the two periods also was due to a reduction in wheat production.

Economic impacts from wheat processing are not directly tied to production levels. In 1993, in-state processing of North Dakota wheat was estimated at 17.9 million bushels. By comparison, in-state processing of North Dakota wheat in 2003 was estimated at 40.5 million bushels. The total economic effect of wheat processing was estimated at $154.4 million (2003 dollars) in 1993, compared to $341.1 million in 2003. The processing sector of the wheat industry exhibited real growth of $186.7 million between the two periods.

The combined economic activity from wheat production, transportation, handling, and processing was estimated at $5.4 billion (2003 dollars) annually from 1991 through 1993. The gross business volume from the

wheat industry was estimated at $3.6 billion annually from 2001 through 2003. Overall, the wheat industry, in real terms, decreased by nearly $1.8 billion or by 33 percent between the two periods.

SUMMARY AND CONCLUSIONS

North Dakota has traditionally been a national leader in the production of several crops; however, the most important, in terms of acreage and farm sales, is wheat. Wheat is arguably the single most important agricultural activity in the state, accounting for over 20 percent of all farm receipts (crop and livestock sales) and generating over $1 billion in farm revenues annually. The importance of wheat to the state's economy becomes clear when the magnitude of wheat sales is combined with the state's dependence upon agricultural activities.

Economic impacts from the wheat industry were limited to wheat produced in North Dakota and included in-state expenditures and returns from wheat transportation, handling, and processing. Wheat acreage and yields, combined with crop prices, government payments, production expenses, and net returns were used to estimate the economic activity from wheat production. Grain flow statistics were used to determine the amount of wheat shipped to various market destinations. The volume of wheat moved was combined with truck and rail transportation costs and returns to estimate the economic impacts from wheat shipments. Grain handling costs and returns were estimated to determine the economic activity from wheat handling. Economic impacts from wheat processing were limited to in-state flour milling and were based on a survey of wheat processors in the state.

Total annual direct impacts from wheat production in North Dakota were estimated at $1.14 billion. Grain handling, transportation, and processing activities generated an additional $204 million in annual direct impacts. Collectively, wheat activities generated about $1.35 billion in annual direct impacts from 2001 through 2003. The $1.35 billion in direct impacts were estimated to generate about $2.2 billion in annual secondary impacts. Gross business volume (direct and secondary impacts) of the wheat industry was estimated at $3.6 billion annually from 2001 through 2003. The economic sectors with the greatest total (direct and secondary) impacts included *Retail Trade* ($1.19 billion), *Households* ($1.14 billion in economy-wide personal income), *Finance, Insurance, and Real Estate* ($274 million), *Business and Personal Services* ($192 million), *Government* ($156 million), and *Communication and Public Utilities* ($129 million).

Each acre of wheat planted in North Dakota (2001 through 2003) averaged about $394 in gross business volume (direct and secondary economic impacts) or, expressed alternatively, each bushel of wheat produced resulted in $12.95 in total business activity. For every 258 acres of wheat planted or 7,854 bushels of wheat harvested, one secondary FTE job in North Dakota was supported. On average, each acre of wheat planted in North Dakota generated about $13.94 in tax revenue ($5.50 in property tax and $8.44 in combined sales and use,

personal income, and corporate income taxes).

The economic size of the wheat industry was compared to a previous study completed in 1995. The combined economic activity from wheat production, transportation, handling, and processing was estimated at $5.4 billion (2003 dollars) annually from 1991 through 1993. The gross business volume from the wheat industry was estimated at $3.6 billion annually from 2001 through 2003. Overall, the wheat industry, in real terms, decreased by nearly $1.8 billion or by 33 percent between the two periods. Since wheat prices over the two periods were similar and since per-acre government payments also were similar in magnitude, most of the change in the value of wheat production between the periods was attributable to changes in production levels. Since transportation and grain handling impacts are predominantly influenced by grain volume, most of the change in economic activity in those activities also was due to a reduction in wheat production. The processing sector of the wheat industry exhibited real (i.e., effects of inflation removed) growth over the two periods primarily due to the addition of new processing plants in the state and expansion of processing capacities at existing plants.

Wheat production is undoubtedly the most important agricultural activity in North Dakota. The importance of wheat to the North Dakota economy is not a recent phenomenon; historical acreage and production suggest this crop has been the single most important agricultural activity in the state for many decades. The importance of wheat not only comes from the magnitude of the crop's impacts, but from the distribution of those impacts as well. Wheat is produced abundantly throughout North Dakota, which correspondingly implies the impacts are geographically distributed throughout the state. Also, much of the impacts from wheat production are generated in local and rural economies through the purchase of production inputs, which are not concentrated in any particular region or city.

The enormous influence of wheat production on North Dakota's economy also makes the economy sensitive to factors affecting overall crop value. Because of the magnitude of wheat production, small changes in wheat acreage, yields, or prices can have dramatic effects on the state's economy. Examples of the effects of these changes have been recently felt with yield reductions from adverse growing conditions and the effects of wheat diseases on crop values. For example, a $0.10 to $0.15 per bushel drop in the average yearly market value for wheat, based on production figures from 2001 through 2003, would cost the state $28 to $41 million in lost revenues, not including secondary economic effects. Alternatively, if crop prices remain unchanged but yield drops by 10 percent statewide, the state could experience a reduction in farm revenues of nearly $92 million. Decreases in crop quantities also affect transportation and grain handling impacts, further adding to the economic losses associated with reduced crop quantities.

North Dakota has experienced a decrease in wheat acreage over the last

decade due to a host of factors. Decreases in wheat acreage have reduced the economic importance of wheat to the state economy. However, substantial gains in wheat processing are an encouraging trend within the industry. Despite a reduction in wheat production, which has translated into reduced levels of economic activity associated with wheat handling and transportation, wheat is still a multi-billion dollar industry in the state. When measured in terms of secondary employment, economy-wide personal income, retail sales, tax revenues, and overall economic activity, the wheat industry in North Dakota remains one of the most important economic activities in the state, agricultural or otherwise.

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This document is a summary of a more comprehensive report, which contains supplemental information and additional documentation of study results. Copies of this report and a single copy of the main report, *Economic Contribution of the Wheat Industry to North Dakota*, are available free of charge. Please address your inquiry to Carol Jensen, Department of Agribusiness and Applied Economics, North Dakota State University, P.O. Box 5636, Fargo, ND 58105-5636, phone 701-231-7441, fax 701-231-7400, e-mail: cjensen@ndsuext.nodak.edu or these publications can be found on the internet at: http://agecon.lib.umn.edu/.

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