

The Red River Valley Potato Industry's Contribution to the Economies of North Dakota and Minnesota

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The potato industry of the Red River Valley of North Dakota and Minnesota is an integrated industry including both production and processing. Potato plantings in 1984 were 136,000 and 77,100 acres for North Dakota and Minnesota, respectively, with the resulting production being 20.6 and 13.8 million cwt for these states (Table 1). The Red River Valley potato production area was defined as including five counties in North Dakota and five in Minnesota. Minnesota counties include Clay, Kittson, Marshall, Norman, and Polk. Grand Forks, Pembina, Towner, Traill, and Walsh counties constitute the major potato producing areas of North Dakota. (Although Towner County is not located in the Red River Valley, it was considered to be part of that area's potato industry because of its proximity and the large amount of seed produced in that county for planting in the Red River Valley.) Potato production in the Red River Valley accounts for a large portion of the total for North Dakota and Minnesota. Since 1975, only a very small share of North Dakota potato plantings have occurred outside the Red River Valley (Figure 1). About two-thirds of the potatoes planted in Minnesota have been in the Red River Valley during the same period. Total and Red River Valley potato plantings for North Dakota and Minnesota have followed similar trends since 1975.

The potato industry of the Red River Valley consists of not only the farm production and storage but also the wash plants and processing factories located in that area. Processing facilities are concentrated in the northern end of the Red River Valley; for example, several wash plants are located in Walsh and Pembina counties, and two processing factories are operating in Grand Forks, North Dakota. Wash plants and processing factories included in this study consisted of those located in the Red River Valley or directly associated with the potato industry in that area. Other processing facilities are located elsewhere in the two-state area; however, these facilities were excluded from this analysis because, as previously mentioned, the study included only the Red River Valley potato industry.

Because the Red River Valley potato industry tends to be concentrated in a small area when compared to the major crops of North Dakota and Minnesota, the industry's contribution to the economies of the respective states is often overlooked. The purpose of this study was to estimate the economic contribution the Red River Valley potato industry made to North Dakota and Minnesota in 1985. These addi-

tions to the local economies were measured in terms of such key economic variables as business activity, retail sales, and personal income.

Local Industry Expenditures

Economic contribution analysis is based upon an industry's expenditures or monetary additions to the local economy. Contribution analysis includes all local expenditures by farmers for production and storage of potatoes, wash plant expenditures, and outlays by potato processing factories. Contribution analysis differs from economic impact analysis in that it shows the effects of all expenditures associated with the industry, whereas impact analysis shows the effects of the industry relative to its absence. In other words, the impact assessment of the potato industry would include the net amount of local expenditures over a situation in which the industry did not exist. This analysis will focus on the economic contribution the Red River Valley potato industry makes to North Dakota and Minnesota.

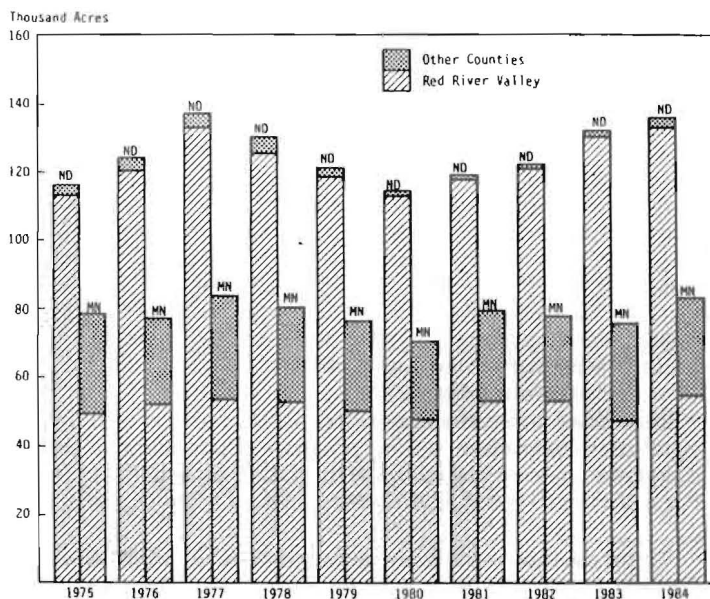


Figure 1. Total and Red River Valley Planted Acres of Potatoes, North Dakota and Minnesota, 1975-1984. Source: North Dakota Crop and Livestock Reporting Service 1976-1985; Minnesota Agricultural Statistics Service 1976-1985.

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Table 1. Acres Planted, Yield Per Acre Planted, and Production of Fall Potatoes in North Dakota and Minnesota, Selected Years 1965-1984.

Year	North Dakota			Minnesota		
	Acres Planted	Yield Per Acre Planted	Production	Acres Planted	Yield Per Acre Planted	Production
	-000 acres-	-----cwt-----	----000 cwt----	-000 acres-	-----cwt-----	----000 cwt----
1965	112.0	137.2	15,370	103.0	125.3	12,905
1970	121.0	145.0	17,550	95.0	120.4	11,440
1975	116.0	151.7	17,600	70.0	138.4	9,690
1980	114.0	137.5	15,680	65.0	152.6	9,920
1984	136.0	151.6	20,615	77.1	178.7	13,775

SOURCE: Statistical Reporting Service 1972-1985.

Detailed 1985 crop budgets (Reff 1985) were used to estimate per-acre local expenditures for production of potatoes. Local expenditures were estimated at \$322.12 per acre for 1985 (Table 2). These expenditures were less than the total cost of production as presented in the crop budget, but it should be pointed out that many of those costs (i.e., land charge, opportunity costs for the operator's labor and management, and overhead) are not normally cash expenditures in the local economy. Local expenditures for the land charge were virtually impossible to estimate because of the numerous rental and purchasing alternatives that existed. Therefore, including a land charge in the local expenditures would invariably overstate the economic contribution in this analysis.

Another budget cost that was excluded from the local expenditures was the machinery ownership cost which, in essence, was the charge for machinery necessary to farm the land. Local expenditures by farmers for machinery were not included in this analysis because data were not available to accurately estimate these purchases in 1985, a time characterized by declining capital purchases (Coon, Ali, and Johnson 1986).¹ Essentially, the estimated local expenditures consisted of the production costs or variable costs associated with raising potatoes.

Estimated local expenditures for potato production were determined by applying per-acre expenditures to the total acres planted to potatoes for North Dakota and Minnesota. Potato acreage by county was not available for 1985, so 1984 data were used. Potato acres planted in 1984 were above the five-year average and were consistent with preliminary state-level estimates for 1985 (Economic Research Service 1986); thus, 1984 acreages were assumed to accurately reflect 1985 plantings. Red River Valley potato plantings were 133,400 acres for North Dakota and 54,300 acres for Minnesota (Table 3).

In addition to production costs, potato farmers also incur significant costs when storing potatoes. Budgets have been developed to estimate the costs for potato storage in the Red River Valley (Benson and Preston 1985). Storage expenses

¹Capital purchases available in crop budgets did not accurately represent the local expenditures by farmers, the value required for contribution analysis. Budgeted machinery costs ignore trade-in values (i.e., local expenditures would be the cash difference between purchase price and trade-in). Also, estimating local machinery expenditures was extremely difficult during this period because of an abundance of lower-priced used machinery due to farm financial problems, and purchase prices varied considerably as implement dealers engaged in aggressive price discounting (Coon and Mittleider 1985).

Table 2. Estimated Local Per-Acre Expenditures for Production of Potatoes, Red River Valley of North Dakota and Minnesota, 1985.

Item	Local Expenditures Per Acre
	-----dollars-----
Seed	99.00
Fertilizer	29.70
Chemicals	69.92
Fuel and lubrication	31.32
Repairs	28.75
Crop insurance	14.44
Miscellaneous	16.44
Interest on operating capital	26.03
Labor ¹	6.52
Total	322.12

¹Labor category includes only the local expenditures for hired help. Data were not available from crop budgets to estimate hired labor; therefore, a 16 percent ratio of hired farm labor to total (Tsigas 1981) was applied to the crop budget labor costs to obtain the estimate.

Table 3. Potato Acreage and Production for the Red River Valley of North Dakota and Minnesota, by County, 1984.

State	County	Acres	Production
			-----cwt-----
North Dakota	Grand Forks	26,800	3,875,000
North Dakota	Pembina	36,400	5,989,500
North Dakota	Towner	2,400	300,000
North Dakota	Traill	5,000	630,000
North Dakota	Walsh	62,800	9,345,500
Total		133,400	20,140,000
Minnesota	Clay	8,600	1,120,000
Minnesota	Kittson	5,300	700,000
Minnesota	Marshall	11,300	1,512,000
Minnesota	Norman	1,500	162,500
Minnesota	Polk	27,600	4,240,000
Total		54,300	7,734,500

SOURCE: North Dakota Crop and Livestock Reporting Service 1985; Minnesota Agricultural Statistics Service 1985.

were calculated on a per-cwt basis from the budget estimates for a potato storage house with a 48,000 cwt storage capacity. Assumptions previously stated also applied to storage expenditures. Building costs were excluded because it was assumed very few or no storage buildings were constructed in 1985. Equipment and machinery expenses also were eliminated using the assumption that these purchases were at a minimum during 1985.

Estimated local monthly expenditures for potato storage on a cwt basis are presented in Table 4. These local expenditures totaled 8.57 cents per cwt per month of storage. The methodology used to compute this cost was similar to that used for production costs except for one item - interest on potato inventory was not included whereas interest on operating capital for production expenses was. The reason for this difference was that the interest on the potato inventory was essentially an opportunity cost and not a cash outlay into the local community.

Table 4. Estimated Local Monthly Expenditures by Economic Sector for Storage of Potatoes, Red River Valley of North Dakota and Minnesota, 1985.

Item	Local Expenditures Per Cwt
	-----dollars-----
Electricity	.0193
Telephone	.0083
Insurance	.0113
Labor	.0307
Office supplies	.0035
Disinfectant	.0026
Sprout inhibitor	.0100
Total	.0857

Data were not available on potato storage by month, but a methodology was derived to estimate the volume of potatoes in storage by month. State-level production and disposition of potatoes were available for 1980 to 1984 (Statistical Reporting Service 1981-1985), and the percent of production sold was determined for 1980 to 1984. The five-year average for North Dakota was used to estimate

total Red River Valley potato production sold. Monthly marketings of potatoes were available at the state level (Statistical Reporting Service 1981-1985), and five-year averages were calculated. Again, North Dakota averages were used because they were believed to more accurately reflect the Red River Valley potato marketings. Potato sales (i.e., production times percent sold) for each state were multiplied by monthly marketings to obtain potato sales on a monthly basis. Application of the estimated local storage expenditures per cwt to the potatoes in storage on a monthly basis yields monthly storage expenditures. Summation of the monthly storage costs yielded total estimated local potato storage expenditures for the Red River Valley.

Estimated local expenditures by Red River Valley potato growers for production and storage are presented in Table 5. Potato production expenditures amounted to almost \$43 million in North Dakota and about \$17 million in Minnesota in 1985 (Table 5). These expenditures were distributed through five sectors of the local economies. The largest share of the local expenditures was to the retail trade sector for production inputs (i.e., chemicals, fertilizer, fuel, etc.) followed by seed purchases and financing and insurance expenditures. Storage expenditures were estimated to be more than \$6 million and \$2 million for North Dakota and Minnesota, respectively. Summation of potato production and storage gives total local expenditures as a result of potato farmer outlays in the Red River Valley. Estimated economic contribution expenditures totaled around \$49 million in North Dakota and almost \$20 million in Minnesota in 1985.

Local expenditures were also made by potato wash plants and processing factories in the Red River Valley. Expenditures by these firms were obtained through a survey of the plants in the Red River Valley. Essentially, the questionnaire asked for expenditures within North Dakota and Minnesota excluding potato purchasing costs. These costs were excluded to prevent double counting; processor potato costs were actually accounted for by farmer production expenditures.

A sample of wash plants was surveyed through a combination of personal interviews and telephone contacts followed by a mail survey. Local expenditures from the surveys were aggregated and divided by the cwt of potatoes washed to give an average local expenditure per cwt. Average expenditures were applied to the estimated cwt of potatoes washed for plants not surveyed or not responding to the survey, yielding nonrespondent local expenditures. These values were added to the actual survey responses to

Table 5. Estimated Potato Production, Storage, and Total Local Contribution Expenditures by Economic Sector, by Farmers in the Red River Valley of North Dakota and Minnesota, 1985.

Sector	North Dakota Expenditures			Minnesota Expenditures		
	Production	Storage	Total	Production	Storage	Total
-----thousand dollars-----						
Agriculture, crops	12,006	—	12,006	4,887	—	4,887
Communications and utilities	—	1,967	1,967	—	756	756
Retail trade	21,303	1,148	22,451	8,671	441	9,112
Finance, insurance, real estate	5,399	806	6,205	2,198	309	2,507
Business and personal service	2,193	—	2,193	893	—	893
Households	2,070	2,188	4,258	843	840	1,683
Total	42,971	6,109	49,080	17,492	2,346	19,838

obtain estimated total local expenditures attributable to the potato wash plants.

All potato processing factories were surveyed (personal interviews and telephone-mail contacts) to obtain their local expenditures. Two of three factories responded to the survey; expenditures for the third were limited to an estimate of their payroll. This amount was estimated by applying the average annual earnings per worker for the two respondents to the workforce at the nonresponding facility. Because payrolls constituted a large share of the responding processing factories' nonpotato expenditures, limiting the nonresponding plant's estimated expenditures to payroll resulted in only a slight underestimation of the economic contribution. It should be mentioned that potato processing factory expenditures were combined with those for the wash plants to avoid disclosure of confidential data; separate totals were calculated for each state to facilitate a more detailed analysis. Estimated potato processing expenditures were distributed through nine sectors of the economy and totaled almost \$8 million for North Dakota and more than \$6 million for Minnesota in 1985 (Table 6).

Table 6. Estimated Potato Processing Local Expenditures by Economic Sector in the Red River Valley of North Dakota and Minnesota, 1985.

Sector	North Dakota	Minnesota
	-----thousand dollars -----	
Construction	225	600
Transportation	423	996
Communications and utilities	163	688
Wholesale trade	—	4
Retail trade	74	19
Finance, insurance, real estate	101	44
Business and personal services	23	17
Professional and social services	32	12
Households	6,918	3,906
Total	7,959	6,286

Input-Output Model

Economic contribution analysis requires choosing a technique for estimating the indirect and induced effects of an industry or a new project on economic activity, employment, and income. Input-output (I-O) analysis was selected as the economic assessment framework for the Red River Valley potato industry because it provides considerably more detailed assessment estimates (i.e., business volume and employment by sector) and allows the analyst to take explicit account of differences in wage rates and local input purchasing patterns to evaluate the impacts of various development proposals (Lewis 1968; Richardson 1972).

Input-output analysis is a technique for tabulating and describing the linkages or interdependencies between various industrial groups within an economy. The economy considered may be the national economy or an economy as

small as that of a multicounty area served by one of the state's major retail trade centers. Input-output models have previously been developed for the state and substate areas of North Dakota (Leistriz et al. 1982) and Minnesota (Coon, Vocke, and Leistriz 1984). [For a complete discussion of I-O theory and methodology, as well as a review of the North Dakota I-O model, see Coon et al. (1985).]

Input-output interdependence coefficients have previously been developed for North Dakota and Minnesota. These coefficients are commonly called multipliers because they measure the number of times a dollar of income "turns over" in the state. The multiplier effect results when each producing sector buys some fraction of its inputs from other sectors of the state's economy and these sectors, in turn, use some fraction of that income to buy some of their inputs from still other sectors, and so on. The multiplier effect is due to the spending and respending within the state's economy of part of each dollar that enters the state. Application of the local expenditures to the respective multipliers will yield levels of business activity necessary to measure the economic contribution of the potato industry. All local expenditures were in terms of 1985 current year prices, so applying these values to the multiplier also yields economic assessments in similar terms.

The ratio of gross business volume to employment, sometimes called the productivity ratio, indicates the amount of business activity in a sector per worker in that sector. When in-state expenditures for a particular industry are applied to the multipliers, the resultant business activity can be divided by the productivity ratios to estimate secondary (or indirect and induced) employment. This employment is in addition to the workers directly employed by the industry, and essentially comes into existence to serve and supply the industry. Productivity ratios were used to estimate indirect and induced workers resulting from the potato industry expenditures in the Red River Valley.

Several tax revenues can be estimated for each state using the I-O model. These include state personal income tax, corporate income tax, and sales and use tax collections. Tax revenue estimates are based on historic relationships between tax collections and I-O model estimates of gross business volume for selected sectors. Tax rates calculated were based on rates in existence in 1983 for North Dakota (Coon et al. 1984) and 1982 for Minnesota (Coon, Vocke, and Leistriz 1984). Estimating equations were used to calculate North Dakota personal income (2.1 percent times the I-O model's personal income estimate), corporate income tax (.31 percent times the model's estimate of total business activity of all business sectors), and sales and use tax (4.06 percent times the model's retail trade activity) collections attributable to the potato industry. Corresponding tax collections were also determined for Minnesota using similar equations (i.e., 3.43 percent for personal income, .32 percent for corporate income tax, and 2.44 percent for sales and use tax). Applying these tax estimating equations to the business activity generated from the local expenditures provides tax revenue estimations for the three major taxes for North Dakota and Minnesota.

Economic Contribution

The economic contributions of the potato industry to economies of North Dakota and Minnesota were analyzed by using the I-O model. Estimates of the industry's local expenditures provide the basis for estimates of business activity, personal income, retail sales, secondary employment, and selected tax revenue collections. Results will be

reported separately for each state and then summed to indicate the total effects of the industry on the Red River Valley.

Summing the farmers' expenditures for potato production and storage (Table 5) with wash plant and processing factories (Table 6) yielded industry total local expenditures for 1985. Total estimated economic contribution expenditures from the potato industry were more than \$57 million in North Dakota and about \$26 million for Minnesota in 1985 (Table 7). These payments were to 10 sectors of the economies in the two states with the retail trade sector receiving the greatest amount.

Personal income, retail trade sales, total business activity for all business sectors, and total business activity attributable to potato industry expenditures were determined for 1985. The estimated economic contribution to the North Dakota economy included personal income of about \$49 million, retail sales totaling more than \$53 million, and total level of business activity of almost \$163 million for 1985 (Table 8). Minnesota's estimated potato industry economic contributions included personal income of about \$23 million, retail

sales more than \$23 million, and a total level of business activity of almost \$75 million for 1985. The total economic contribution of the potato industry was obtained by adding the North Dakota and Minnesota values. Thus, total personal income in the Red River Valley attributable to the potato industry was more than \$72 million and retail sales were about \$77 million. The total economic activity, or the total volume of dollars generated in the economy as a result of the industry's presence in the Red River Valley, was \$237,491,000 for 1985.

Data in Table 8 provided the necessary measures of business activity to estimate tax revenue generated by the potato industry. Categories of tax revenues consisted of sales and use, personal income, and corporate income. Estimated tax revenues associated with the economic contribution of the potato industry were \$2,570,000 in North Dakota and \$1,273,000 in Minnesota for a total of \$3,843,000 (Table 9). The greatest source of tax revenue in North Dakota was the sales and use tax collections, whereas state personal income tax was the largest category in Minnesota.

Direct employment in potato production totaled 850 workers for the Red River Valley. These workers were the total number of farmers involved in the growing of potatoes and should not be confused with full-time equivalents. Converting farmers who grew potatoes into full-time equivalent potato growers is virtually impossible and meaningless. Direct processing workers were estimated at 651 in North Dakota and 310 in Minnesota (Table 10).

Potato industry expenditures also were responsible for creating secondary (indirect and induced) employment. Secondary employment for the economic contribution of the industry was 2,378 workers in North Dakota and 1,163 workers in Minnesota for a total secondary employment of 3,541 employees in the Red River Valley. This indirect and induced employment is the result of potato industry expenditures in the local economy.

Conclusions

Because the potato industry is concentrated in a rather small portion of the two-state area, its economic contribution may be underestimated or even overlooked by many people. The potato industry does, however, contribute significantly to the Red River Valley economy. Estimated local contribution expenditures amounted to \$57,039,000 in North Dakota and \$26,124,000 in Minnesota during 1985. These expenditures generated personal income of \$72,483,000, retail sales of \$76,627,000, and a total level of business activity amounting to \$237,491,000. The business activity generated by the potato industry resulted in tax collections estimated at \$2,570,000 for North Dakota and \$1,273,000 for Minnesota for 1985. In addition to the workers directly involved in the production and processing of potatoes, another 3,541 indirect and induced jobs resulted from contribution expenditures. Potato industry contribution expenditures generate another \$1.86 in business activity for each dollar spent, for a total of \$2.86. The potato industry is thus a very important factor in the Red River Valley economy.

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Table 7. Estimated Potato Industry's Total Local Contribution Expenditures by Economic Sector, for the Red River Valley of North Dakota and Minnesota, 1985.

Sector	North Dakota	Minnesota
	-----thousand dollars-----	
Agriculture, crops	12,006	4,887
Construction	225	600
Transportation	423	996
Communications and utilities	2,130	1,444
Wholesale trade	—	4
Retail trade	22,525	9,131
Finance, insurance, real estate	6,306	2,551
Business and personal services	2,216	910
Professional and social services	32	12
Households	11,176	5,589
Total	57,039	26,124

Table 8. Estimated Personal Income, Retail Sales, Business Activity of all Business (Nonagricultural) Sectors, and Total Business Activity for the Potato Industry of the Red River Valley of North Dakota and Minnesota, 1985.

Item	North Dakota	Minnesota	Total
	-----thousand dollars-----		
Personal income	49,376	23,107	72,483
Retail sales	53,300	23,327	76,627
Business activity of all business sectors ¹	90,253	41,600	131,853
Total business activity	162,757	74,734	237,491

¹Includes all sectors except agriculture (livestock and crops), households, and government.

Table 9. Estimated Tax Revenues Associated with the Potato Industry of the Red River Valley of North Dakota and Minnesota, 1985.

Area	Sales and Use Tax ¹	State Personal Income Tax	State Corporate Income Tax	Total
-----,thousand dollars -----				
North Dakota	1,253	1,037	280	2,570
Minnesota	347	793	133	1,273
Total	1,600	1,830	413	3,843

¹Most of the direct retail purchases made by farmers are for items exempt from sales tax (i.e., seed, fertilizer, chemicals, etc.) in both North Dakota and Minnesota. In order to not overestimate the sales and use tax collections, those purchases were deducted from the retail trade business activity before it was applied to the sales and use tax estimating equations for the respective states.

Table 10. Estimated Production, Processing, and Secondary Employment Attributable to the Potato Industry of the Red River Valley of North Dakota and Minnesota, 1985.

Area	Employment		
	Production	Processing	Secondary
Economic contribution:			
North Dakota	500	651	2,378
Minnesota	350	310	1,163
Total	850	961	3,541

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