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Contribution of the Pulse Crop Industry To the Economies of North Dakota and Eastern Montana

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Executive Summary

The Pulse Industry of North Dakota and eastern Montana is comprised of the production and processing of chick peas (garbanzo beans), lentils, and green and yellow field peas. Pulse crops prefer a cooler and dryer environment, which makes their production well suited for the western and northern areas of North Dakota and for eastern Montana. Demand for pulse crop products has been increasing in recent years, and producers in North Dakota and Montana have increased acreages to meet the industry's needs.

The regional pulse industry is more integrated than most other crop enterprises in North Dakota and Montana. Many different levels of processing exist, with a large share of the production processed at varying levels before being shipped to out-of-state markets. Products made from pulse crops include humus (garbanzo beans), gluten-free flour (green and yellow peas), and soup components. Currently, most of the regional processing facilities are located in North Dakota.

Crop acreages in North Dakota have been dominated by soybeans, corn, and wheat in recent years. In response to declining prices for these commodities, producers are looking for alternative crops that are profitable. Budgets for 2015 indicated that pulse crops could potentially provide greater profits than traditional crops. With the potential for increased pulse crop acreages, it is important to measure the economic contribution the industry makes to the state's economy. The pulse industry contributes to the economy not only from farm-level production, but also in the areas of transportation and processing.

The economic contribution of the pulse industry was evaluated for each of the three components (production, transportation, and processing) for western North Dakota, eastern Montana, and the two areas combined, or regionally. The industry is complex because of integration, so algorithms were developed to simulate production and product movements. Direct economic impacts (or direct expenditures) for North Dakota were estimated to be $115.7 million in 2015. The majority of these expenditures were for pulse crop production ($92.4 million), followed by processing ($16.6 million), and transportation ($6.7 million). Applying the direct impacts to the North Dakota Input-Output Model resulted in a total economic contribution (direct and secondary) of $297.9 million for 2015.

Impacts for the eastern Montana study area were very similar to those for North Dakota with production slightly larger ($100.3 million) due to more acres, but processing was smaller ($4.8 million) because the majority of the processing facilities were located in North Dakota. Total economic contribution (direct and secondary) in the local economy was estimated to be $282.2 million for 2015. Combining the western North Dakota and eastern Montana production areas resulted in a regional direct economic impact of $226.8 million and a total economic contribution of $580.1 million for 2015. The annual economic contribution the pulse industry makes in the 2-state area is significant.

Contribution of the Pulse Crop Industry To the Economies of North Dakota and Eastern Montana

Randal C. Coon, Frayne Olson, Dean Bangsund, and Nancy Hodur[1]

Introduction

The Pulse Industry of North Dakota and eastern Montana is comprised of chick peas (garbanzo beans), lentils, and green and yellow peas. Pulse crops are well adapted to the climate of western North Dakota with a cooler and dryer environment. Pulse crop production has shifted in recent years from the northern areas of the state to western North Dakota. Although pulse crops have been considered a specialty crop, the North Dakota State University Extension Service crop planning budgets for 2015 project pulse crops to be some of the more profitable crops in the state. Almost all counties in North Dakota had pulse crop acreages in 2014 as did all of the eastern Montana counties.

Demand for pulse crop products has grown in recent years. Products made from pulse crops include humus (garbanzo beans) and gluten-free flour (green and yellow peas). The regional pulse industry is more integrated than most other crop enterprises in the state. Many different levels of processing exist in North Dakota, with a large share of the production processed at varying levels, before being shipped to out-of-state markets. Growth in demand for pulse crops products has resulted in considerable interest in expanding acreages to meet future needs. Also, increased acreage could lead to substantial growth in pulse crop processing facilities. Because of the integration in the pulse industry, future growth in production could result in significant economic benefits for North Dakota and eastern Montana.

Need for Study

North Dakota's crop production is dominated by soybeans, corn, and wheat. In recent years high prices made production of soybeans, corn and wheat profitable. However, recent price declines in these crops have resulted in farmers looking for more profitable crops, which often takes the form of specialty crops such as pulse crops. Nearly all North Dakota counties had some acreages in 2014. Pulse crops are a good agronomic fit especially in the Northern corridor and acreage grew to over 429,000 acres in 2013, but declined to nearly 341,000 in 2014. Eastern Montana counties have increased acreage steadily reaching over 497,000 acres in 2014. Many multi-level processing facilities exist in North Dakota and much of the pulse production is processed at some level before it is shipped to the next-level markets.

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Beyond acreage data little is known about the size and scope of the pulse industry. Many of the commodity groups in the state have commissioned economic contribution studies to tell the story of their industry in economic terms, including such variables as personal income, retail trade activity, total business activity, tax revenues, and secondary employment. With the recent growth in the pulse acreage and processing activity, future growth in the industry could provide significant economic benefits to the state. The pulse industry of eastern Montana and North Dakota are inter-related and economic benefits can cross state lines. Relative and absolute growth in the pulse industry suggests that the industry would benefit from an economic contribution analysis. This analysis is timely considering the recent growth of the crops and associated processing activities in the state. Some view the economic growth in western and northwestern North Dakota strictly as a result of non-agricultural sectors, but the growth of an integrated pulse industry also contributes to economic growth. This economic contribution study will quantify the benefits of the pulse industry. Information provided in this analysis will help pulse producers, industry officials, and policy makers describe the economic contribution of the state as the industry moves forward to meet the demand for its products.

Study Area

The Northern Pulse Growers Association includes seven districts covering the entire states of Montana and North Dakota. This economic contribution analysis was primarily for North Dakota, but because of the close ties to the North Dakota industry, 16 eastern Montana counties were included in the study. Pulse crops have been defined for this study as chick peas (garbanzo beans), lentils, and peas (green and yellow). Pulse crop production has been concentrated in the northern and western counties of North Dakota, but in recent years production has shifted more to the western part of the state. During the 2012-2014 period, all but two counties (Sargent and Steele) in North Dakota grew some acreage of pulse crops. Many of the counties had small acreage of pulse crops, but because acreages were reported for the 2012-2014 period, they were included in the analysis (Figure 1).

Sixteen eastern Montana counties were included in the analysis because of their proximity and similarity to the North Dakota industry. Much of the production of pulse crops in the Montana study area flows to the east with some processed in North Dakota, and typically reaching markets similar to those of North Dakota production. Pulse crops produced in the non-study Montana counties typically would flow to the west or northwest for processing and final markets. Figure 2 presents the 16-county eastern Montana area included in the economic contribution analysis.

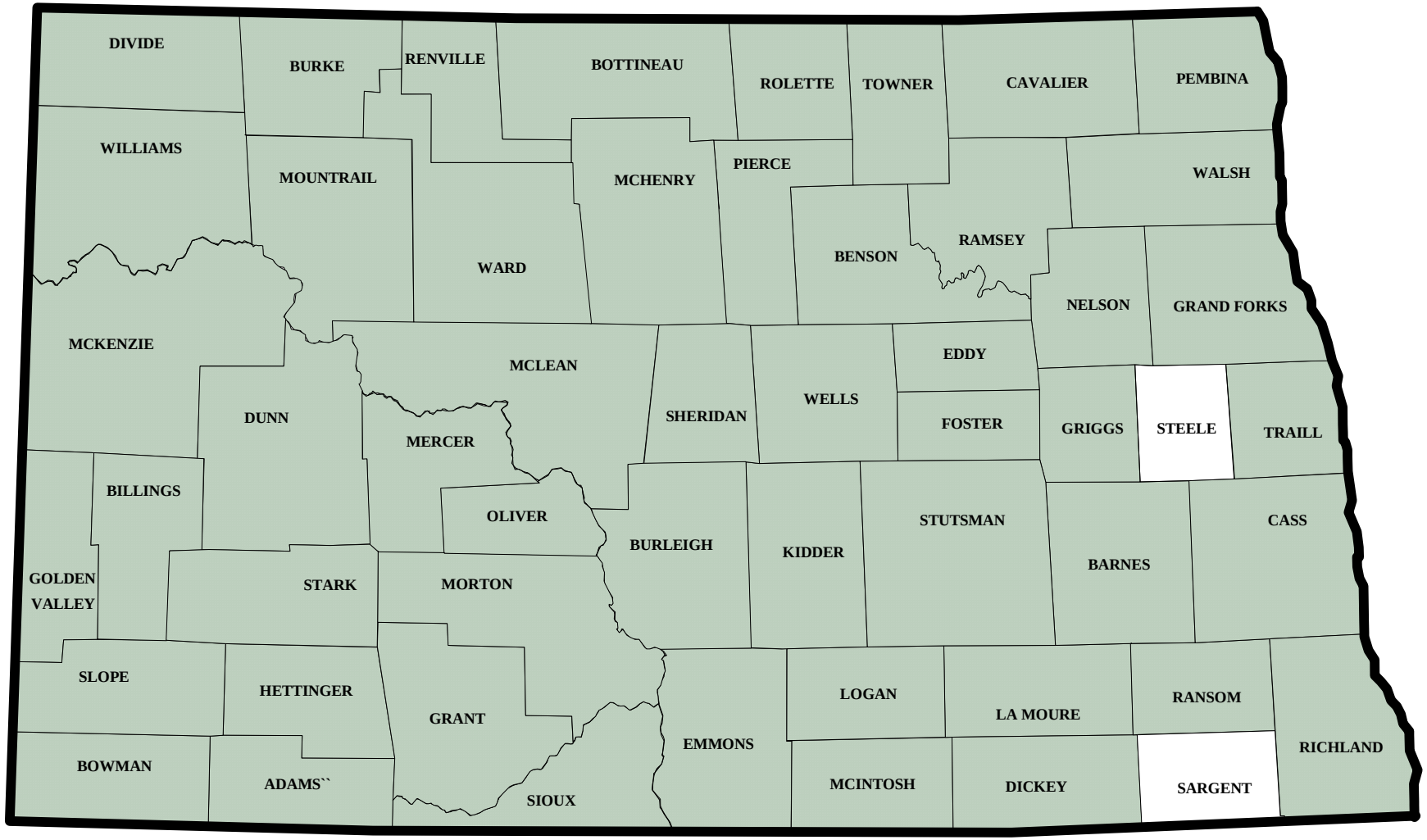


Figure 1. North Dakota counties included in the Economic Contribution of Pulse Crops Industry

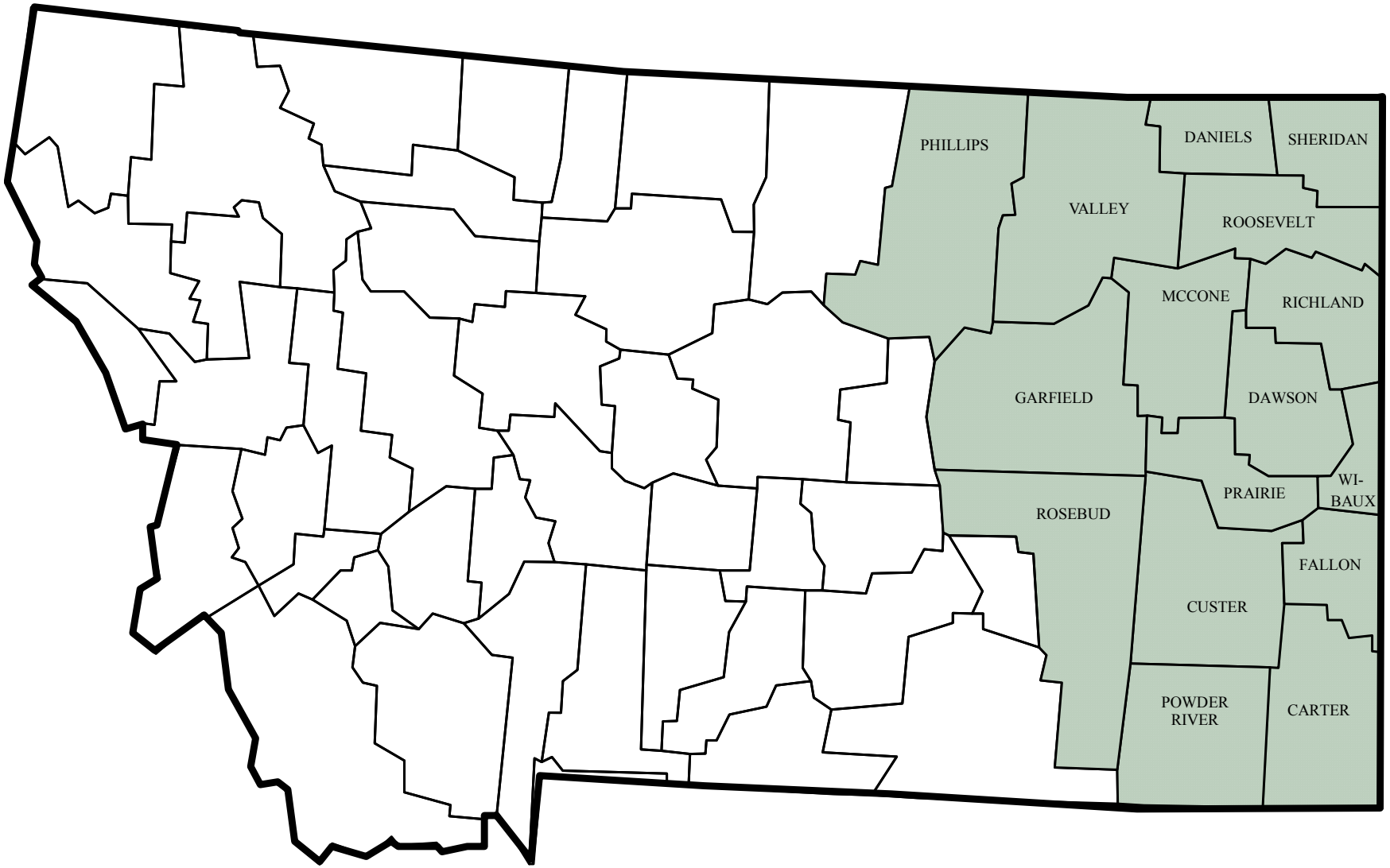


Figure 2. Montana counties included in the Economic Contribution of Pulse Crop Industry

Methods

Economic contribution of the pulse industry has three components: farm-level production, transportation, and processing. Unlike many other agricultural industries in the state, the pulse industry is more integrated with much of the production processed (at several different levels) in North Dakota before it reaches its final market. Because of this integration the 3 components will be analyzed separately and in total for this study. Local expenditures for farm-level production were estimated using secondary data sources, local transportation expenditures were based on a previously developed model, and processing outlays were obtained from a survey of pulse product processors in North Dakota. Industry product flows were originally going to be determined from check-off data, but these data were not available so knowledgeable persons working in the industry were contacted to provide insight into the product movement for pulse crops and products.

Farmer expenditures to grow pulse crops (chickpeas, field peas, and lentils were based on North Dakota State University Extension Service crop budgets (Swenson and Haugen 2014). Production expenditures were allocated to sectors corresponding with the North Dakota Input-Output Model to facilitate the analysis. Returns to labor and management (profits) were included in the *Households* Sector (personal income). If the budgets indicated returns to labor and management were negative, a zero value was used for the per acre profits to the farmer. Total per acre expenditures for chick peas were $349.98, lentils at $303.60, and field peas at $211.55 (Table 1). Local expenditures in Table 1 are presented by North Dakota Input-Output Model Sector rather than by line item budget category. Because the proximity and similarity of the North Dakota and eastern Montana pulse industries, the North Dakota crop production budgets were used for both states.

Table 1. Pulse Crop Expenditures Allocated to North Dakota Input-Output Model Economic Sectors, 2015

Sector	Field Peas	Lentils	Chick Peas
	----------$ per Acre----------		
(8) Retail Trade	137.77	127.60	215.75
(9) FIRE	10.42	18.17	19.52
(10) B&P Services	27.36	27.95	30.14
(12) Households	36.00	129.88	84.57
TOTAL	211.55	303.60	349.98

Acreages for each of the three respective pulse crops were available for 2012, 2013, and 2014 for North Dakota (Farm Service Agency 2015a; Farm Service Agency 2015b; Farm Service Agency 2015c) and Montana (Farm Service Agency 2015d; Farm Service Agency 2015e; Farm Service Agency 2015f). Examination of the acreage data for years prior to 2012 indicated that using a 3-year average provided a better indicator of the current acreage situation. Changing crop patterns, movement around the state of pulse acreages, and continued acceptance of pulse crop have resulted in long-term acreage average not reflecting the current situation. The 2012, 2013, and 2014 average acreages were relatively stable and the three year average production was used to estimate the current economic contribution of the pulse industry. In North Dakota, green and yellow pea acreages dominated the pulse acres with nearly 259,000 acres, followed by lentils (nearly 114,000 acres), and chick peas (nearly 9,000 acres) (Table 2). In percentage terms, green and yellow peas make up 67.8 percent of all pulse acres, followed by lentils (29.8 percent) and chick peas (2.4 percent). Acreage situation is very similar in the eastern Montana study area, where green and yellow peas have the largest acreages (65.4 percent of the pulse crop) followed by lentils (31.7 percent), and chick peas (2.9 percent) (Table 3). Total pulse average acreage for the two study areas was very close with the eastern Montana acreage being slightly over 409,000 acres and the North Dakota total at slightly more than 381,000 acres. Multiplying the acreage and the per acre expenditures for each respective crop gives the direct economic contribution for the county and individual crop. County outlays for each crop were summed, and the total for the 3 pulse crops was applied to the North Dakota Input-Output Model to estimate total economic contribution (direct and secondary) resulting from farm-level production of pulse crops.

Total production of chick peas, lentils, and green and yellow peas was not available from secondary data sources. National Agricultural Statistics Services production data were incomplete due to disclosure problems and check off data were not available. Total production data were needed for the transportation and processing components of the analysis. Therefore, total pulse production was estimated by applying the 3-year average acreages to yields for the respective crops. Yields for 2012 and 2013 were averaged for North Dakota and eastern Montana. North Dakota yields for lentils and peas were from the North Dakota Land Valuation Model used for agricultural real estate assessments (Aakre and Haugen 2014, Aakre and Haugen 2015). Data used in the model were provided by Risk Management Agency (2013; 2014) and are based on actual production history used for crop insurance purposes. With the limited acreages of chick peas, no yield estimates were available but farm management budgets (Swenson and Haugen 2014) provided a yield estimate for planning purposes that was developed with the help of industry sources. Montana chick peas, lentils and peas yields were published in the 2014 Montana Agricultural Statistics (National Agricultural Statistics Service 2014) for each of the respective crops at the county level for 2013 and 2014. Total production of chick peas, lentils, and peas for North Dakota and eastern Montana was obtained by multiplying the 3-year (2012, 2013, and 2014) acreages by the 2-year (2012 and 2013) average yields. These were the latest data available at the time of this analysis, and using multi-year averages provided better values for the economic contribution analysis than a snapshot in time approach.

Table 2. Three-Year Average Acres for Chick Peas, Lentils, and Peas by County, North Dakota Study Area, 2012-2014

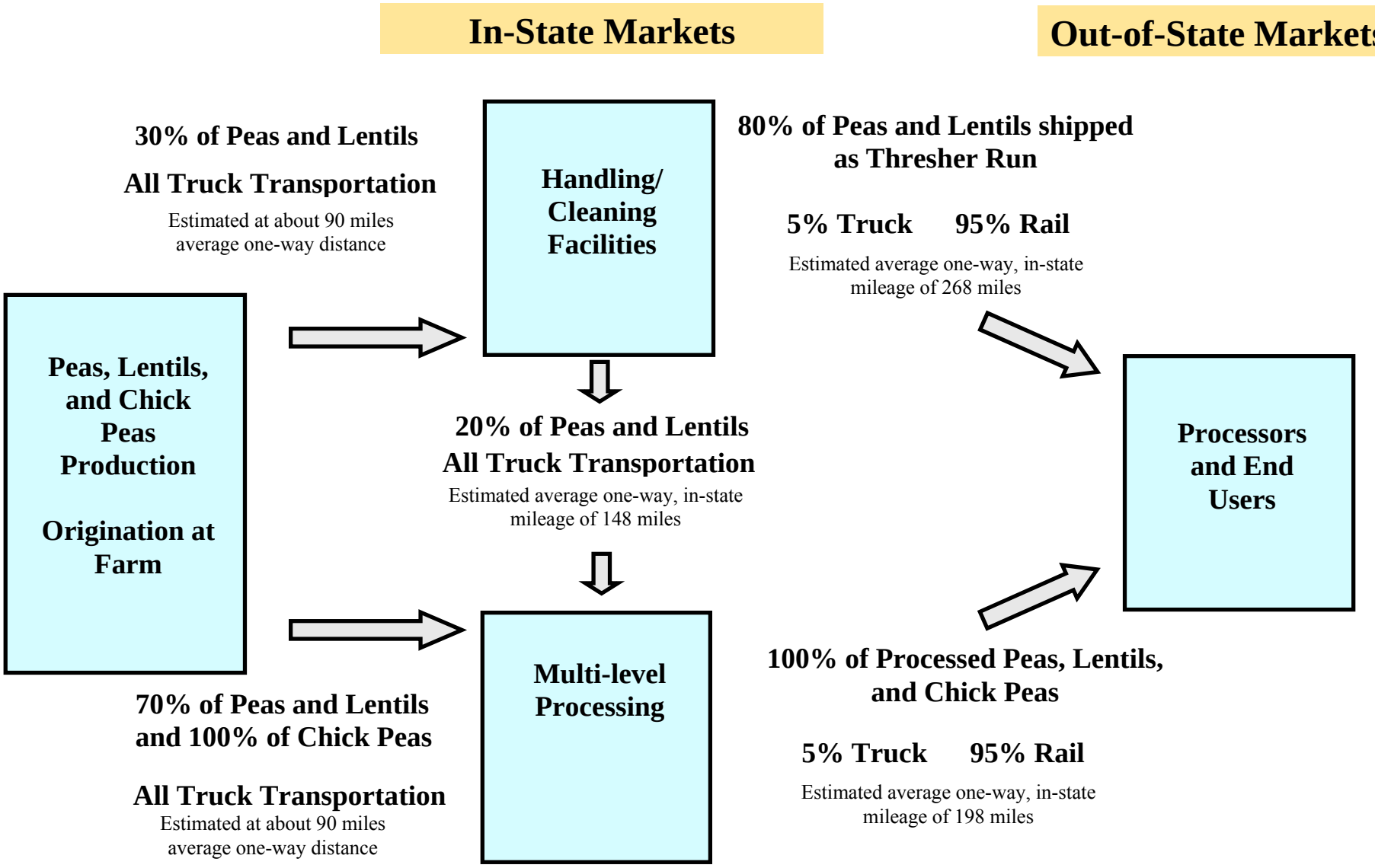
	----------3-year Average Acres----------		
County	Chick Peas	Lentils	Peas
Divide	138.5	31,836.9	35,301.2
McKenzie	0.0	4,812.7	10,905.1
Williams	3,599.6	62,870.9	45,883.2
Bottineau	0.0	10.0	4,527.2
Burke	0.0	839.0	8,541.3
McHenry	102.4	39.9	1,313.4
Mountrail	813.2	718.1	34,535.3
Pierce	0.0	0.0	2,076.0
Renville	0.0	0.0	6,792.3
Ward	173.7	977.1	16,901.1
Benson	0.0	63.3	115.5
Cavalier	0.0	0.0	393.5
Eddy	0.0	0.0	971.4
Ramsey	0.0	0.0	60.0
Rolette	0.0	0.0	2,043.0
Towner	0.0	0.0	1,075.1
Grand Forks	0.0	0.0	387.2
Nelson	0.0	0.0	1,131.3
Pembina	0.0	0.0	17.4
Walsh	0.0	0.0	306.8
Cass	0.0	0.0	87.2
Ransom	0.0	0.0	715.0
Richland	0.0	0.0	59.9
Traill	0.0	0.0	6.7
Barnes	0.0	0.0	146.0
Dickey	0.0	0.0	31.9
Foster	0.0	0.0	259.7
Griggs	0.0	0.0	137.0
LaMoure	0.0	0.0	190.9
Logan	194.6	0.0	397.4
McIntosh	0.0	0.0	446.3
Stutsman	303.9	0.0	1,684.1
Wells	0.0	0.0	985.5
Burleigh	0.0	36.7	3,933.6
Emmons	0.0	101.1	1,791.1
Grant	555.4	43.8	1,944.1
Kidder	0.0	833.7	1,597.4
McLean	227.9	3,891.4	27,742.1
Mercer	0.0	6.7	3,199.7
Morton	81.0	0.0	1,569.3
Oliver	27.9	324.1	2,997.7
Sheridan	0.0	12.9	111.0
Sioux	0.0	0.0	420.2
Adams	855.5	183.1	5,025.8
Billings	0.0	0.0	674.6
Bowman	42.5	978.4	10,155.7
Dunn	225.7	80.6	305.6
Golden Valley	574.3	3,427.6	8,866.1
Hettinger	520.0	51.9	2,284.9
Slope	275.0	1,162.5	6,714.7
Stark	241.6	476.6	1,045.6
TOTAL	8,952.7	113,778.9	258,804.1

Table 3. Three-Year Average Acres for Chick Peas, Lentils, and Peas by County, Eastern Montana Study Area, 2012-2014

	----------3-Year Average Acres----------		
County	Chick Peas	Lentils	Peas
Carter	0.0	724.4	2,844.5
Custer	0.0	0.0	1,266.9
Daniels	1,111.9	30,242.4	38,808.8
Dawson	1,131.3	4,113.	18,477.0
Fallon	39.6	1,222.7	2,944.0
Garfield	0.0	1,097.7	4,615.1
McCone	3,994.8	3,089.6	28,133.6
Phillips	0.0	1,214.3	14,660.5
Powder River	0.0	674.5	617.8
Prairie	113.7	562.4	3,344.6
Richland	213.4	1,128.4	5,116.6
Roosevelt	1,216.6	12,077.7	32,189.4
Rosebud	0.0	644.2	1,328.5
Sheridan	1,275.8	53,328.3	56,808.0
Valley	1,908.0	17,733.1	51,821.4
Wibaux	746.2	2,180.6	4,905.3
TOTAL	11,761.2	130,034.2	267,881.9

A second component of the analysis was the economic contribution of transporting pulse crops. Transportation included both truck and rail and involved the following: ① moving farm production to grain handling/cleaning elevators and directly to processors; ② from grain handling/cleaning elevators to local processors, out-of-state processors, and final markets; and, ③ local processors to out-of-state processors and final markets. The pulse industry in North Dakota and eastern Montana is more integrated than most other crop enterprises, with much of the production being processed locally. Check-off data were not available to describe the pulse industry's product flows, so a simplified product flow pattern diagram was created with input from industry experts. The pulse industry product flow diagram (Figure 3) illustrates product flows associated with the transportation and processing of the pulse crops in North Dakota and eastern Montana. Farm-level pulse crop distribution assumptions included 30 percent of commodity delivered to handling/cleaning elevators and 70 percent of commodity delivered to multi-level processors. Handling/cleaning elevators were assumed to ship 20 percent of their products (raw) to multi-level processors and 80 percent (thresher-run) to out-of-state markets. Multi-level processors were assumed to ship 100 percent of their products out-of-state.

Figure 3. North Dakota Pulse Industry Product Flow Diagram



Both truck and rail transportation were utilized for the movement of pulse products. Several assumptions regarding type of transportation used for moving pulse products were made in conjunction with industry product flows. Farm level production was transported to handling/cleaning elevators and to multi-level processors entirely by truck. Shipments from handling/cleaning elevators to multi-level processors were assumed to be made solely by truck. However, these facilities were assumed to ship their thresher-run products out-of-state primarily by rail (95 percent) with the remaining 5 percent by truck. Multi-level processors were assumed to ship their products out-of-state with 95 percent by rail and 5 percent by truck.

Transportation distances and truck and rail rates also were important in determining the economic contribution associated with the transportation of pulse crops and products. The transportation model developed for this analysis estimates local expenditures using methodology similar to that used for other commodities (Bangsund et al. 2011; Bangsund and Leistritz 2005; Bangsund and Leistritz 1995)).

Distances from the farm to handling/cleaning elevators and processors were not available from industry personnel. Other distances needed for the model, such as handling/cleaning elevator to multi-level processor and to end market, and multi-level processor to end market were also not available from secondary data or industry sources. A methodology was developed to estimate the distance for transporting the pulse crop and products to their markets. For farm-level production, a city in a county would be selected and the one-way distance to one or more handling/cleaning elevators and processing facilities was determined. Because a larger percentage of the pulse crops were hauled to processing facilities, more of those combinations were estimated. Not all counties and all markets were selected, but a representative sample was used emphasizing counties with larger pulse crop acreages and transportation to multi-level processing facilities. The average one-way distances for farm to market shipments were estimated to be 90.2 miles. Similar methodology was used for shipments from the handling/cleaning elevators to multi-level processors. The average one-way distance was estimated at 148.0 miles. Estimating the distance for shipments from handling/cleaning elevators and multi-level processors to out-of-state markets had a slightly different methodology. Out-of-state mileage is assumed to not contribute to the North Dakota economy; therefore, distances were determined from a facility to the eastern border of North Dakota. It was assumed that partially or fully processed pulse products would be marketed to Eastern U.S. for further processing or packaging. An average distance of 267.5 in-state miles was estimated for shipments from handling/cleaning elevators to out-of-state markets. Multi-level processors incurred an average of 198.0 miles in-state for shipments to out-of-state markets.

Transportation rates were combined with transportation distances to determine in-state shipping expenditures. Published truck market rates for grain shipments for the North Central region of the United States (United States Department of Agriculture 2015) were $2.92 per mile per truckload for a 100 mile trip. The rate for a 100 mile trip for multi-level processors to final markets were $2.61 per mile (United States Department of Agriculture 2015). Shipping distance from handler/cleaner elevators was 148.0 miles, so the 100-mile and 200mile rates were averaged ($2.77) to produce a 150-mile rate for those shipments. Local economies were estimated to capture 60 percent of truck transportation expenditures which were allocated to 7 Economic Sectors: *Transportation* (13.3 percent); *Communications & Public Utilities* (2.3 percent); *Retail Trade* (51.2 percent); *Finance, Insurance, and Real Estate* (8.2 percent); *Business and Personal Services* (7.0 percent); *Households* (15.4 percent); and *Government* (2.5

Percent) (Bangsund et al. 2011). Processed pulse crop products are typically shipped by rail in single cars. Tariff rates for a single care were assumed to be $3,200.00, based on general information on rail tariffs. About 37.5 percent of the tariff rate was assumed to represent variable expenses and 14.5 percent would represent fixed costs (Bangsund et al. 2011). Variable costs were allocated to the *Transportation* (11.47 percent), *Retail Trade* (44.80 percent), and *Households* (43.73 percent) sectors of the economy. Fixed rail costs were allocated to six sectors of the local economy: *Transportation* (45.44 percent); *Communications and Public Utilities* (0.41 percent); *Retail Trade* (45.44 percent); *Finance, Insurance, and Real Estate* (1.20 percent); *Households* (1.62 percent); and *Government* (5.89 percent). Rail expenditures locally for a one car tariff would amount to $1,200.00 in variable costs and $464.00 in fixed costs, for a total of $1,664.00. Local capture of rail expenditures was estimated to be 50 percent (Bangsund et al. 2011), therefore, each rail car shipped would result in $832.00 of in-state expenditures.

A questionnaire was distributed to all pulse processing firms in North Dakota to determine local expenditures for their activities. From the data collected, an expenditure by category per hundred weight processed was calculated for thresher-run peas, high value, and all other processing. The amount of each respective pulse crop processed was estimated from the production and industry flow diagram previously discussed. Expenditures were aggregated into economic sectors and comprised the direct economic contribution of the pulse crop industry processing component.

The complexity and number of assumptions that were made to estimate the economic contribution of the pulse industry necessitated development of an econometric model to simulate the industry. This model was developed to calculate the local expenditures for farm production, transportation outlays, and processing costs. These local expenditures (direct economic contribution) were determined for North Dakota, and eastern Montana, and a total for the region. This model can easily be modified if assumptions change or better data becomes available. Thus, the model is easily updated if costs, prices, etc., change. Results from the model are direct impacts by state for farm production, transportation, and processing. Values were applied to the North Dakota Input-output Model to estimate the total economic contribution (direct and secondary) for the pulse industry.

An economic contribution analysis represents an estimate of all relevant in-state expenditures and returns associated with an industry, activity, or project. The economic contribution approach to estimating economic activity has been used for numerous assessments of industries, activities, and projects in North Dakota (Bangsund and Hodur 2013; Bangsund and Leistritz 1995, 2005, 2010; Coon et al. 2012a, 2012b, 2012c; Hodur et al. 2006; Hodur and Leistritz 2007)

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, policy, or activity. Secondary impacts (sometimes further categorized into indirect and induced effects) result from subsequent rounds of spending and re-spending of the original dollars within the economy. This process of spending and re-spending is sometimes termed the multiplier process, and the resultant secondary effects are sometimes referred to as multiplier effects (Leistritz and Murdock 1981).

Input-Output analysis is an economic tool that traces linkages among sectors of an economy and calculates the total business activity resulting from a direct impact in a basic sector (Coon et al. 1985). The North Dakota Input Output Model has 17 economic sectors, is closed with respect to data from firms and households (households are included as a producing and consuming sector in the model), and was developed from primary (survey) data from firms and households in North Dakota. The North Dakota Input Output Model consists of interdependence coefficients, or multipliers, that measure the level of business activity generated in each economic sector from an additional dollar of expenditures in a given sector. A sector is a group of similar economic units, (e.g., firms engaged in retail trade make up the *Retail Trade* Sector). For a complete description of the input-output model, see Coon et al. (1985).

Empirical testing has shown the North Dakota Input-Output Model is sufficiently accurate in estimating gross business volume, personal income, retail activity, and gross receipts in major economic sectors in North Dakota. Over the period 1958-2013, estimates of statewide personal income derived from the model averaged within 10 percent of comparable values reported by the U.S. Department of Commerce (Coon et al. 2015, Bureau of Economic Analysis 2015). Coon et al. (2015) measured the statistical differences between the estimates of personal income from the two sources and found the absolute average difference was 7.0 percent, mean difference was -4.71 percent, and Theil's U_1 coefficient was 0.0395 for the 1958 to 2013 period.

The North Dakota Input Output Model was used to estimate the secondary economic impacts based on the pulse industry's expenditure data. The model estimates the changes in total business activity (gross receipts) for all sectors of the area economy resulting from the direct expenditures associated with the region's pulse industry. Increased business volumes were used to estimate secondary employment and tax revenues based on historic relationships.

The North Dakota Input-Output Model will be used for estimating the economic contribution of the pulse industry for both North Dakota and eastern Montana. Similarity and proximity of eastern Montana and western North Dakota would indicate the multipliers for these two areas are not significantly different. Previous research has used the North Dakota multipliers to estimate economic activity in Montana (see Hertsgaard et al. 1977). Also, the North Dakota multipliers were incorporated into a comprehensive economic-demographic-fiscal model based on a North Dakota version (Chase et al. 1982). However, fiscal relationships necessary to estimate tax revenues for Montana were not available, and were not able to be calculated within the scope of this study. Tax revenue estimates in this analysis were only available for business activity resulting from expenditures in North Dakota.

Economic Contribution

The economic contribution of the pulse industry was estimated in terms of economic measures including personal income, retail trade activity, total business activity, secondary employment, and for North Dakota tax revenues were also estimated. Direct economic contribution consisted of the in-state expenditures for farm-level production, transportation, and processing. Total economic contribution included the direct plus the secondary effects. Secondary economic benefits are those that result from the spending and re-spending of the original expenditures, commonly called the multiplier process. The North Dakota Input-Output Model estimates the total economic contribution associated with the direct expenditures.

Because the econometric model of the industry estimated expenditures for each component of the industry, and for North Dakota and eastern Montana, the North Dakota Input-Output Model also provided the analysis at that level of detail. North Dakota and eastern Montana results were also combined to give a regional economic contribution analysis for the pulse industry. Results will be presented for each of the three industry components for each state and a regional total. Results are dated 2015 because projected farm expenditures were for that year, whereas, acreages were for the last 3 years data were available and yields for the last 2 years available. Transportation expenditures were based on most recent available data and processing outlays were estimated from a survey conducted in 2014.

North Dakota

Direct expenditures in North Dakota totaled nearly $116 million in 2015 (Table 4). The largest share was from farm production expenditures which amounted to over $92 million, or 79.9 percent of the total. The largest percentage amount of farmer expenditures ($52.1 million) went to the *Retail Trade Sector* as they purchased, seed, fertilizer, fuel, etc., to plant and harvest the crop. Processing has the second largest local expenditures ($16.6 million or 14.3 percent) followed by transportation ($6.7 million) with 5.8 percent of the total. The processing component's largest expenditures were to the *Households* Sector $5.6 million, primarily for wages and salaries. Expenditures for the purchase of raw product were not included to avoid double counting, with those expenses already counted in farm production outlays. Transportation expenditures were largest in the *Retail Trade* Sector for items like fuel, tires, etc., followed by the *Households* Sector which were primarily for wages.

Table 4. Direct Economic Impacts Associated with the Production, Transportation, and Processing of Pulse Crops, North Dakota, 2015

Sector	Production	Transportation	Processing	Total
	----------$000----------			
Construction	- -	- -	726.2	726.2
Transportation	- -	1,111.8	13.2	1,125.0
Comm & Pub Utilities	- -	89.0	958.6	1,047.6
Ag Proc & Misc Mfg	- -	- -	11.5	11.5
Retail Trade	52,105.3	3,229.8	3,599.1	58,934.2
Fin, Ins, Real Estate	4,938.9	315.0	4,063.6	9,317.5
Bus & Pers Services	10,530.8	264.1	1,325.7	12,120.6
Prof & Soc Services	- -	- -	325.9	325.9
Households	24,851.7	1,515.3	5,565.4	31,932.4
Government	- -	141.1	- -	141.4
TOTAL	92,426.7	6,666.4	16,589.2	115,682.3

Applying the direct expenditures to the North Dakota Input-Output Model produced the total economic contribution for the pulse industry in North Dakota (Table 5). The pulse industry would generate nearly $298 million in additional business activity highlighted by $112 million in retail sales and $96 million in personal income. Farm-level production would generate $232 million in total business activity, with $93 million in retail sales and $73 million in personal income. Expenditures associated with the processing component would result in $49 million in total business activity with $17 million in personal income and $13 million in retail sales. The transportation component would produce $17 million of total business activity with $6 million in retail sales and $5 million in personal income. With nearly $300 million in total business activity resulting from the pulse industry's operations in North Dakota, the industry clearly has contributed significantly to the state's economy.

Business activity associated with the pulse industry's activities also supports secondary (indirect and induced) employment. Secondary jobs totaled 338 FTE, with 226 from farm-level production. Because of the difficulty allocating farm and transportation workers to a single enterprise and lack of information from the processor survey, a direct employment number associated with the pulse industry was not available. Tax revenues resulting from the pulse industry business activity were $5.1 million in sales and use taxes, $1.4 million in personal income taxes, and $0.6 million in corporate income tax revenues. The majority of the tax revenues were associated with farm-level production $5.8 million (81 percent). The pulse industry has contributed significantly to North Dakota's economy in terms of business activity, tax revenues, and secondary employment.

Table 5. Total Economic Contribution of the Pulse Industry's Production, Transportation and Processing, North Dakota, 2015

Item	Production	Transportation	Processing	Total
Total Impact: ($000)				
Construction	4,990	347	1,852	7,189
Comm & Pub Utilities	7,193	593	2,601	10,387
Retail Trade	92,964	6,221	13,020	112,205
Fin, Ins, Real Estate	13,968	973	6,147	21,088
Bus & Pers Services	13,960	510	2,181	16,651
Prof & Soc Services	4,805	339	1,484	6,628
Households	73,075	5,169	17,489	95,733
Other[1]	21,034	2,912	4,064	28,012
TOTAL	231,989	17,064	48,840	297,893
Tax Revenues: ($000)				
Sales & Use	4,304	288	603	5,195
Personal Income	1,096	78	262	1,436
Corporate Income	444	32	88	564
TOTAL	5,844	398	953	7,195
Employment: (FTE)				
Secondary Jobs	266	17	55	338

[1] Other includes agriculture, mining, transportation, agricultural processing and miscellaneous manufacturing, and government.

Eastern Montana

Eastern Montana's direct economic contribution was very similar to North Dakota. The study area in eastern Montana had a slightly larger average acreage of pulse crops, but had less multi-level processing activity. Most of the multi-level processing facilities are located in North Dakota, however, several handling/cleaning elevators are located in the Montana study area. Total eastern Montana pulse industry direct expenditures were $111.1 million, slightly less than the North Dakota total (Table 6). Larger pulse crop acreage in eastern Montana resulted in more farm-level expenditures, but processing outlay ($4.8 million) were less than those in North Dakota. Transportation expenditures for the two states were similar. Of the total expenditures in eastern Montana, Retail Trade ($59.6 million) was the largest category, followed by Households ($30.9 million). Farm-level production expenditures followed a similar pattern with Retail Trade being $56.0 million, followed by Households at ($27.5 million.) Like North Dakota, the *Retail Trade* Sector ($3.0 million) received the largest amount of transportation expenditures, and the *Households* Sector ($2.0 million) was the largest for processing. Because farm-level production expenditures are the largest component of the pulse industry, similar acreages in eastern Montana and North Dakota produced total direct expenditures nearly equal for the two areas.

Table 6. Direct Economic Impacts Associated with the Production, Transportation, and Processing of Pulse Crops, Eastern Montana, 2015

Sector	Production	Transportation	Processing	Total
	----------$000----------			
Construction	- -	- -	16.6	16.6
Transportation	- -	1,016.5	16.6	1,.033.1
Comm & Pub Utilities	- -	81.8	304.6	386.4
Ag Proc & Misc Mfg	- -	- -	13.3	13.3
Retail Trade	56,036.1	2,957.6	590.5	59,584.2
Fin, Ins, Real Estate	5,383.6	289.5	797.9	6,471.0
Bus & Pers Services	11,318.2	242.9	667.3	12,228.4
Prof & Soc Services	- -	- -	387.7	387.7
Households	27,527.2	1,384.5	1,982.4	30,894.1
Government	- -	129.5	- -	129.5
TOTAL	100,265.1	6,102.3	4,776.9	111,144.3

Total economic contribution of the pulse industry in eastern Montana is nearly the same as the industry's economic contribution for North Dakota. Total economic contribution (direct and secondary) in eastern Montana was $282.2 million (Table 7). Of the total pulse industry business activity generated 89.4 percent was from farm-level production activities. Transportation accounted for $15.6 million (5.5 percent) of business activity and processing was $14.4 million (5.1 percent) of the total. Business activity from the processing component of the eastern Montana pulse industry was significantly less than North Dakota, reflective of the large number of multi-level processors in North Dakota.

Pulse industry business activity was greatest in the *Retail Trade* Sector ($109.8 million) followed by the *Households* Sector ($90.1 million). Farmer expenditures for the inputs to produce the crop resulted in retail trade activity of $100.6 million and personal income of $79.9 million. Business activity from transportation activities of the industry was largest in the *Retail Trade* Sector ($5.7 million) and the processing component had $5.4 million in personal income.

With the pulse crop acres increasing in eastern Montana, further growth in the industry could potentially provide opportunities for additional processing enterprises. A large share of North Dakota's pulse industry is concentrated in the western portion of the state. This area combined with the pulse production in eastern Montana provides a region where the pulse industry has a very strong presence. As the demand for pulse products continues to increase, the economic contribution of the industry in this area should continue to grow.

It was not possible within the scope of this study to estimate tax revenues to Montana resulting from increased business levels. The tax structure for Montana was different than that of North Dakota, so using relationship developed for the North Dakota Input-Output Model would not be appropriate. Secondary employment resulting from the pulse industry's business activity accounted for 321 FTE jobs. Most were farm-level production (229 jobs), followed by 15 from processing, and 14 from transportation. Both eastern Montana and North Dakota have benefited from the pulse industry through increased business activity, retail sales, personal income, and secondary employment.

Table 7. Total Economic Contribution of the Pulse Industry's Production, Transportation, and Processing, Eastern Montana, 2015

Item	Production	Transportation	Processing	Total
Total Impact: ($000)				
Construction	5,444	318	365	6,127
Comm & Pub	7,829	543	805	9,177
Utilities	100,619	5,696	3,485	109,800
Retail Trade	15,238	893	1,445	17,576
Fin, Ins, Real Estate	15,059	468	924	16,451
Bus & Pers Services	5,252	310	755	6,317
Prof & Soc Services	79,912	4,732	5,433	90,077
Households	22,847	2,667	1,194	26,708
Other[1]				
TOTAL	252,200	15,627	14,406	282,233
Tax Revenues[2]: ($000)				
Sales & Use	n/a	n/a	n/a	n/a
Personal Income	n/a	n/a	n/a	n/a
Corporate Income	n/a	n/a	n/a	n/a
TOTAL	n/a	n/a	n/a	n/a
Employment: (FTE)				
Secondary Jobs	292	14	15	321

[1] Other includes agriculture, mining, transportation, agricultural processing and miscellaneous manufacturing, and government.

[2] The tax structures of North Dakota and Montana are not the same, therefore, the revenues for the Montana economy could not be estimated using relationships developed for the North Dakota Input-Output Model.

Regional Economic Contribution

Combining the direct impacts from North Dakota and eastern Montana provided a regional total. Table 8 presents the regional direct economic contribution. Total regional expenditures were $226.8 million, with farm production expenditures totaling $192.7 million, processing expenditures at $21.4 million, and transportation outlays at $12.8 million. Applying the regional expenditures to the North Dakota Input-Output Model produces an estimate of the total economic contribution (direct and secondary) of the pulse industry for the 2-state region.

Table 8. Direct Economic Impacts Associated with the Production, Transportation, and Processing of Pulse Crops, North Dakota and Eastern Montana, 2015

Sector	Production	Transportation	Processing	Total
	----------$000----------			
Construction	- -	- -	742.8	742.8
Transportation	- -	2,128.3	29.8	2,158.1
Comm & Pub Utilities	- -	170.8	1,263.2	1,434.0
Ag Proc & Misc Mfg	- -	- -	24.8	24.8
Retail Trade	108,141.4	6,187.4	4,189.6	118,518.4
Fin, Ins, Real Estate	10,322.5	604.5	4,861.5	15,778.5
Bus & Pers Services	21,849.0	507.0	1,993.0	24,349.0
Prof & Soc Services	- -	- -	713.6	713.6
Households	52,378.9	2,899.8	7,547.8	62,826.5
Government	- -	270.9	- -	270.9
TOTAL	192,691.8	12,768.7	21,366.1	226,826.6

The three components of the pulse industry resulted in $580.1 million in total business activity, with retail sales of $222.0 million, and personal income of $185.8 million total (direct and secondary). Regional business activity associated with transportation was $32.7 million and processing totaled $63.2 million. Pulse crop production resulted in $108.1 million in retail sales and $52.4 million in personal income. Farm-level production generated 83.5 percent of total (direct and secondary) economic activity for the region. Processing was responsible for $22.9 million in personal income and transportation resulted in $11.9 million in retail sales.

Tax revenues in Table 9 only reflect those for North Dakota levels of business activity. Montana tax structure differs from North Dakota and an assessment of Montana tax revenue was not within the scope of this study. The regional pulse industry which consists of production, transportation, and processing in eastern Montana and North Dakota would generate enough business activity to support 659 FTE secondary jobs. Although the pulse industry is considered a specialty crop enterprise, it makes a significant contribution to the economies of the respective states and the region. The level of business activity the industry generates in the region is substantial, over a half a billion dollars annually. This increased business activity has resulted in higher levels of retail sales ($222 million) and personal income ($186 million) in the regional economy).

Table 9. Total Economic Contribution of the Pulse Industry's Production, Transportation, and Processing, North Dakota and Eastern Montana, 2015

Item	Production	Transportation	Processing	Total
Total Impact: ($000)				
Construction	10,434	665	2,217	13,316
Comm & Pub Utilities	15,022	1,136	3,406	19,564
Retail Trade	193,583	11,917	16,505	222,005
Fin, Ins, Real Estate	29,206	1,866	7,592	38,664
Bus & Pers Services	29,019	978	3,105	33,102
Prof & Soc Services	10,057	649	2,239	12,945
Households	152,987	9,901	22,922	185,810
Other[1]	43,881	5,579	5,260	54,720
TOTAL	484,189	32,691	63,246	580,126
Tax Revenues[2]: ($000)				
Sales & Use	4,304	288	603	5,195
Personal Income	1,096	78	262	1,436
Corporate Income	444	32	88	564
TOTAL	5,844	398	953	7,195
Employment: (FTE)				
Secondary Jobs	558	31	70	659

[1] Other includes agriculture, mining, transportation, agricultural processing and miscellaneous manufacturing, and government.

[2] Tax revenue estimates represent only those for the North Dakota economy.

Summary

The pulse industry in North Dakota and eastern Montana consists of producing, transportation and processing of chick peas (garbanzo beans), lentils, and green and yellow peas. Pulse crops are considered specialty crops but have grown in popularity in western North Dakota and eastern Montana because of their agronomic traits and profitability. The industry is vertically integrated with farm production, transportation, and processing all contributing to the local economy. Although all of the multi-level processing currently exists in North Dakota, increased demand for pulse products could result in further expansion of processing and provide opportunities in Montana.

The purpose of this analysis was to estimate the economic contribution the pulse industry makes to the economies of North Dakota and eastern Montana. This industry is complex and determining product movements was critical to the analysis. Several algorithms were developed to replicate the industry production and product movements. Many of the basic assumptions were arrived at in conjunction with industry experts. A review of the methods section of this report reveals the large number of parameters needed to simulate the industry. To facilitate the ability to change/update the parameters of this analysis, an econometric model was developed which integrated all phases of the industry. This model has many potential uses including updating variables, changes in industry product flows, sensitivity analysis, etc. Although the economic contributions of the pulse industry was the primary purpose for this analysis, a valuable by-product is the econometric model that simulates the pulse industry.

The regional economic contribution of the pulse industry is significant. Economic activity associated with the industry's activities include business activity of $580 million annually which includes $222 million in retail sales and $186 million in personal income. Farm-level production expenditures generate the majority of the business activity ($484 million), 83.5 percent of the total. It is an integrated industry and processing activities generate $63 million in business activity. Increased acreages may be needed to meet the demand for pulse products, which could provide more processing opportunities. Profitability of pulse crops could lead to additional acres being planted in the future because commodity prices for the states 3 main crops (soybeans, corn, and wheat) have been slipping in recent years. Determining the contribution that pulse crops have made to the regional economy in terms of key economic variables can highlight this growing industry in North Dakota and eastern Montana.

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