Center for Agricultural Policy and Trade Studies
North Dakota State University

# Agricultural Policy Brief

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## Economic Analysis of the Recent Surge in Oil Prices

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### *Introduction*

Fuel prices have been in the daily news since early June, 2004. Crude oil prices have risen from around $35 per barrel in June 2004 to over $50 per barrel in September 2004. Natural gas prices, a large component in nitrogen fertilizer, have risen from $5.25 per mmbtu in March of 2004 to over $7.50 per mmbtu. These increases in energy costs are transferred directly to consumers, first in the form of higher gasoline and diesel prices, then in higher prices for products manufactured from energy products. Agriculture is a large consumer of energy products both directly, in the form of gasoline and diesel, and indirectly, in manufactured inputs. North Dakota is a major agricultural producing state; the state produced 317 million bushels of wheat, 131 million bushels of corn, and 88 million bushels of soybeans in 2003. Since wheat and corn production use nitrogen and oil intensively, the recent increase in fuel prices will have a significant impact on farm income and the state's economy.

The objective of this study is to estimate the cost of the higher energy prices to North Dakota agricultural producers for the 2005 crop year. This study uses the North Dakota Representative Farm Model, in which the state is divided into four regions based on the characteristics of crop production. An average farm in each region is used for this analysis.

### *Methodology*

The North Dakota Representative Farm Model was used to estimate the reduction in net farm income of North Dakota producers due to additional energy costs. North Dakota is divided into four regions in the model based on characteristics of crop production: Red River Valley (RRV), North Central (NC), South Central (SC), and West. Figure 1 shows region delineations in this study. An average farm is chosen for each region, and their characteristics are presented in Table 1.

The NDSU Extension Service conducts a survey each December to estimate input costs for the upcoming crop year. Table 2 shows the results of the past few years. Gasoline cost was $1.45 per gallon and diesel cost was $1.25 per gallon for the 2004 crop year. The futures prices for August 2003 to May 2004 averaged $0.95 per gallon for gasoline and $0.90 per gallon for diesel. Future prices for August 2004 to May 2005 contracts average $1.30 per gallon for gasoline and $1.28 per gallon for diesel. Comparing current futures price with last year's futures price, we estimated the cost of gasoline for the 2005 crop year would be $1.86 per gallon, while diesel would cost $1.63 per gallon. The same method was utilized for fertilizer prices. Nitrogen fertilizer, ammonia, was priced at $350 per ton for the 2004 crop year. Future prices of natural gas average $5.00 per mmbtu. Future prices for natural gas for the upcoming months average $7.50 per mmbtu. Industry

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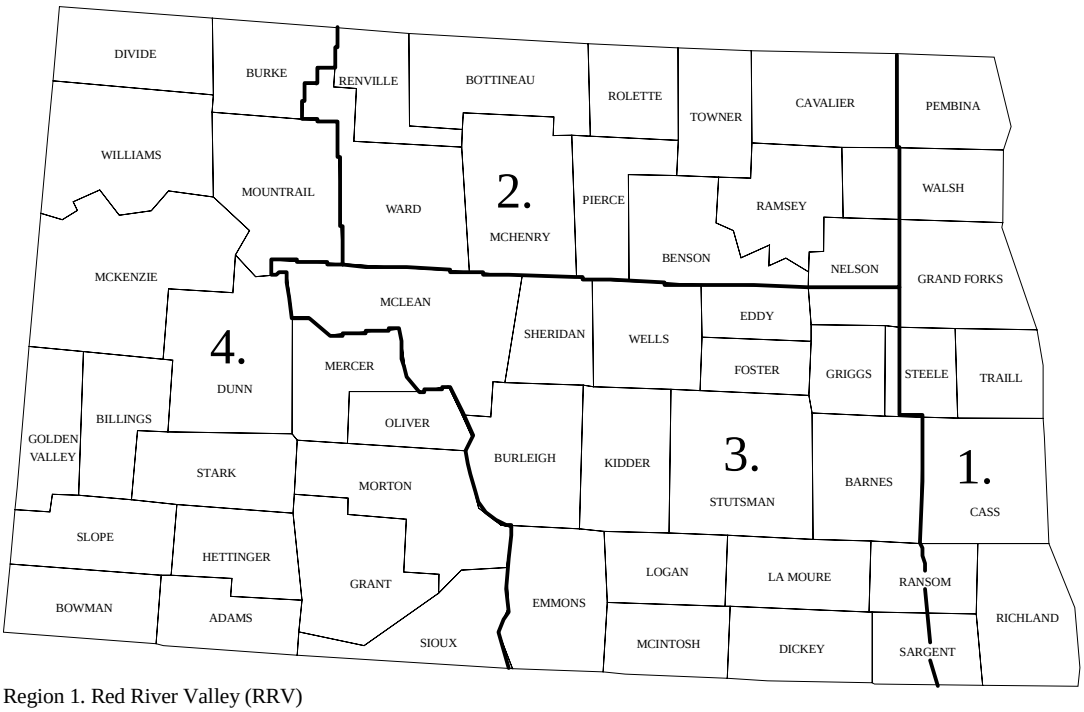


Region 1. Red River Valley (RRV)
Region 2. North Central (NC)
Region 3. South Central (SC)
Region 4. Western (West)

Figure 1. North Dakota Farm and Ranch Business Management Regions

uses 34 mmbtu of natural gas per ton of nitrogen produced. The factory energy cost of nitrogen in 2004 was $170 per ton, while the same expense for 2005 is estimated to be $255 per ton. We assumed that the entire additional cost will be transferred to users. The United States imports about 26% of the nitrogen fertilizer it needs (FATUS). We assumed that the percentage of imports and the price of imports will not change. The estimated nitrogen cost in North Dakota for the 2005 crop year will be $409 per ton. Even though ammonia is not 100% nitrogen, transportation and other cost increases will absorb the differences. Phosphorus fertilizer is not as sensitive to energy price; however, there will be some increase in cost due to transportation and manufacturing cost increases.

Table 3 shows the estimated percentage increase in fuel and fertilizer expense for North Dakota producers in 2005, compared with those in 2004. Gasoline costs will increase 28%, while diesel costs will increase 55%. Farmers typically use 80% diesel and 20% gasoline in their operation. Therefore, the fuel cost for the 2005 crop year is estimated to increase by 50%. It was assumed that producers use 60% nitrogen and 40% phosphorus fertilizer (North Dakota Department of Agriculture). Although the percentage will vary among different regions in the state with different crop mixes, no adjustment was made to the state average. The average fertilizer cost increases for 2005 will be 13%.

Operating expense is included in the North Dakota Representative Farm Model as a single number, and so the total increase in expense had to be estimated outside of the model. Table 4 shows internalized expenses of an average North Dakota farm in each region. For an average farm in the Red River Valley (RRV), the total expense for 2005, before energy price increases, was $433,152. Fuel expense was $19,511, and fertilizer expense was $42,250. The total expense less fuel and

Table 1. Average Size and Crop Mix of Farms in North Dakota Representative Farm Model

| | Wheat | Corn | Soybean | Total |
|---|---|---|---|---|
| | ——————————Acres—————————— | | | |
| RRV | 294 | 310 | 332 | 1,701 |
| NC | 585 | | | 1,858 |
| SC | 640 | 214 | 311 | 1,678 |
| West | 1,067 | | | 1,684 |

Source: North Dakota Farm and Ranch Business Management

Table 2. Estimated Energy Costs for the 2005 Crop Year

| | | 2001 | 2002 | 2003 | 2004 | 2005 estimated |
|---|---|---|---|---|---|---|
| Survey | | | | | | |
| Gas | $/gal | 1.50 | 1.24 | 1.44 | 1.45 | 1.86 |
| Diesel | $/gal | 1.10 | 0.86 | 1.03 | 1.25 | 1.63 |
| Futures | | | | | | |
| Gasoline | $/gal | | | | 0.95 | 1.30 |
| Heating oil | $/gal | | | | 0.90 | 1.28 |
| Natural gas | $/mmbtu | | | | 5.00 | 7.50 |
| Fertilizer cost survey | | | | | | |
| Nitrogen | $/ton | 280 | 210 | 260 | 350 | 409 |
| Phosphorus | $/ton | 205 | 210 | 220 | 235 | 250 |
| Fertilizer production cost | | | | | | |
| | mmbtu/ton | 34 | | | 170 | 255 |

Source: NDSU Extension Service, Wall Street Select ,WTRG Economics

Table 3. Estimated Increase in Energy Cost for North Dakota Producers

| | Percentage increase | Farm usage | Total increase |
|---|---|---|---|
| Gasoline | 28 | 20 | 6 |
| Diesel | 55 | 80 | 44 |
| *Average* | | | 50 |
| Nitrogen | 17 | 60 | 10 |
| Phosphorus | 6 | 40 | 3 |
| *Average* | | | 13 |

Table 4. Estimated Increase in Total Expense Due to Higher Energy Prices

| | | RRV | NC | SC | West |
|---|---|---|---|---|---|
| Total expense | (A) | 433,152 | 206,946 | 241,392 | 216,754 |
| Fuel expense | (B) | 19,511 | 20,782 | 13,647 | 11,298 |
| Fertilizer expense | (C) | 42,250 | 27,835 | 24,151 | 20,092 |
| Total less fuel and fertilizer | (A-B-C)=I | 371,391 | 158,329 | 203,594 | 185,364 |
| Unaffected expense | | | | | |
| Land | (D) | 89,947 | 28,166 | 34,590 | 29,437 |
| Interest | (E) | 26,443 | 16,408 | 17,027 | 20,001 |
| Labor | (F) | 24,135 | 6,419 | 6,125 | 9,037 |
| RE tax | (G) | 3,672 | 2,742 | 3,325 | 2,344 |
| Insurance | (H) | 8,029 | 3,463 | 4,562 | 3,726 |
| Total unaffected | (D+E+F+G+H)=J | 152,226 | 57,198 | 65,629 | 64,545 |
| Other affected expense | (I-J) | 219,165 | 101,131 | 137,965 | 120,819 |
| General Increase of 6% | ((I-J)*1.06)=K | 232,315 | 107,199 | 146,243 | 128,068 |
| New expense | (J+K) | 384,541 | 164,397 | 211,872 | 192,613 |
| New fuel expense | (B*%increase)=L | 29,236 | 31,140 | 20,449 | 16,929 |
| New fertilizer expense | (C*%increase)=M | 47,594 | 31,356 | 27,206 | 22,633 |
| New total expense | (J+K+L+M)=N | 461,372 | 226,894 | 259,527 | 232,176 |
| Percentage increase | (N–A)/A | 0.07 | 0.10 | 0.08 | 0.07 |

fertilizer was $371,391. The level of many expense categories will not change in the short run. They are land cost, interest, labor, real estate taxes, and insurance. Those were subtracted from the total expenses excluding fuel and fertilizer, leaving $219,165. It was assumed that a general price increase of 6% will affect all other expenses, such as chemicals, seed, repairs, supplies, and utilities. The new total expense is the sum of new fuel ($29,236) and new fertilizer expense ($47,594), the unaffected expenses ($152,266), and the expenses which are affected by energy price increases ($232,315). For an average farm in the RRV, it is estimated that total expense will increase 7% for the 2005 crop year. The same calculation was performed for the other regions in the state.

### *Alternative Scenarios*

A base and three alternative scenarios are developed for this study. The base scenario assumes no increase in fuel or fertilizer prices. The previous section describes alternative scenario 1, which assumes that recent increases in energy prices will continue through the 2005 crop year. Two additional scenarios are developed to estimate the effects on income if energy prices increase more or less than expected. Alternative scenario 2 assumes that energy prices will rise 20% higher than currently indicated, and alternative 3 assumes that energy will be 20% less than currently indicated. Scenarios 2 and 3 were developed mainly because of the uncertainty of increases in energy prices in the future.

### *Results*

Table 5 presents the results of the study. In the base scenario, net farm income for an average farm in the RRV was forecasted to be $89,903 for 2005. With the additional costs for fuel under alternative scenario 1, net farm income will drop by $32,378 to a new net income of $57,525. The producers' costs will increase $19.03 per acre. Net farm income for an average farm in the NC region was forecasted to be $57,109 for 2005 in the base scenario. After the fuel prices increase (alternative scenario 1), net farm income will be $29,233, representing a drop of $15.01 per acre. Similarly, the per acre cost increases for the SC and the West will be $15.06 and $15.34 per acre, respectively, under alternative scenario 1. Two additional scenarios were analyzed, assuming that fuel costs were 20% higher or 20% lower than estimated. The increase in per acre cost for the RRV under these two scenarios were $20.67 and $17.21, respectively. The other regions followed similar patterns.

Table 6 shows the total reduction in net farm income for average farms in the different regions in the state. The RRV harvested 3.4 million acres of crops in 2002, according to the Census of Agriculture for that year. Assuming that all crops in the region use fuel and fertilizer at the same level as wheat, corn, and soybeans, the total reduction in net farm income is $64.7 million. The NC, SC, and West regions will have a drop in net farm income of $64.0 million, $92.5 million and $84.9 million, respectively. The total loss of net farm income for the state will be $306.1 million under alternative scenario 1. Losses under alternative scenarios 2 and 3 will be $353.2 million and $274.3 million, respectively.

Table 5. Summary Results for the North Dakota Representative Farm Model, Various Scenarios

| | | Net Farm Income | Difference | Per Acre | Percentage change |
|---|---|---|---|---|---|
| RRV | | | | | |
| | Base | 89,903 | | | |
| | Scenario 1 | 57,525 | 32,378 | 19.03 | 0.36 |
| | Scenario 2 | 54,749 | 35,155 | 20.67 | 0.39 |
| | Scenario 3 | 61,450 | 28,453 | 17.21 | 0.32 |
| NC | | | | | |
| | Base | 57,109 | | | |
| | Scenario 1 | 29,233 | 27,876 | 15.01 | 0.49 |
| | Scenario 2 | 25,168 | 31,941 | 17.19 | 0.56 |
| | Scenario 3 | 33,008 | 24,101 | 12.97 | 0.42 |
| SC | | | | | |
| | Base | 55,977 | | | |
| | Scenario 1 | 30,696 | 25,281 | 15.06 | 0.45 |
| | Scenario 2 | 27,999 | 27,978 | 16.68 | 0.50 |
| | Scenario 3 | 33,393 | 22,584 | 13.46 | 0.40 |
| West | | | | | |
| | Base | 32,878 | | | |
| | Scenario 1 | 10,435 | 22,443 | 15.34 | 0.68 |
| | Scenario 2 | 7,906 | 24,972 | 17.07 | 0.76 |
| | Scenario 3 | 12,647 | 20,231 | 13.83 | 0.62 |

Table 6. Estimated Total Impact of Higher Energy Prices on North Dakota Agriculture, Alternative Various Scenarios

| | Total Harvested Acres | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|---|
| | | Reduction in Net Farm Income | | |
| | Million Acres | ----------Million $---------- | | |
| RRV | 3.4 | 64.7 | 70.2 | 57.7 |
| NC | 4.7 | 64.0 | 74.5 | 57.8 |
| SC | 6.5 | 92.5 | 105.6 | 86.7 |
| West | 6.2 | 84.9 | 102.9 | 72.1 |
| State | 20.8 | 306.1 | 353.2 | 274.3 |

## *Conclusions*

The typical producer in North Dakota will spend between $15 and $19 per acre more for energy products in 2005 under alternative scenario 1. The amount will vary depending on location, cropping and production patterns, and actual fuel price increases. It was assumed that cropping patterns and production methods will not change because of the higher energy costs. Tillage practices could be changed to lower fuel costs, fertilizer applications could be reduced, and a different crop mix could be selected to minimize the need for fertilizer. If the United States increases nitrogen fertilizer imports, the additional costs would decrease. In addition to higher farm expenses, other factors will affect the well-being of North Dakota agriculture. If higher energy costs result in inflation , the household cost of living will rise. Transportation cost will also increase, which will lower crop prices at the farm level and directly lower net farm income.

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