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2009 North Dakota Agricultural Outlook: Representative Farms, 2009-2018

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Abstract

Net farm income for all representative farms in 2018 is projected to be lower than in 2008. Low-profit farms, which comprise 20% of the farms in the study, may not have financial resiliency to survive without off-farm income. Commodity prices are expected to fall from current levels however the final level is unknown. Commodity yields are projected to increase at historical trend-line rates and production expenses are expected to return to normal growth rates after 2009. Debt-to-asset ratios for all farms except for the low profit farm will decrease slightly throughout the forecast period. Debt-to-asset ratios for the low-profit farms are expected to increase to about 0.50.

Keywords: net farm income, debt-to-asset ratios, cropland prices, land rental rates, farm operating expenses, capitalization rate, risk

Highlights

Net farm income is projected to be lower in 2009 than 2008 for most farms, but much higher than the 2005-2007 average. The high prices received in 2007 and 2008 are expected to be lower in the future, however 2009 prices may hold steady. Wheat prices, along with all commodity prices, were at all time highs but have dropped substantially in late 2008 and early 2009.

Net farm income for the large-size farm is predicted to decrease from $219 to $214 thousand over the 2009-2018 period. The net farm income is predicted to decrease from $97 to $72 thousand for the medium-size farm and from $25 to $4 thousand for the small-size farm. Net farm income is predicted to decrease from $251 to $141 thousand for the high-profit farm and from $101 to $55 thousand for the average-profit farm. Net farm income for the low-profit farm is predicted to decrease from $2 thousand in 2009 to $-25 thousand in 2018.

Risk analysis indicated the possibility of a wide variation in net farm income for the representative farms. A large variation in historical yields and prices results in a wide distribution of forecasted incomes. In 2009, the mean net farm income is expected to be $101 thousand with a standard deviation of $42 thousand and a 90% confidence interval of $34 thousand to $179 thousand. By 2018, the mean net farm income is expected to be $55 thousand with a standard deviation of $55 thousand. The 90% confidence interval will be $-13 thousand to $133 thousand.

Debt-to-asset ratios for most representative farms are predicted to decrease throughout the forecast period. Debt-to-asset ratios are projected to decrease 6% for the large-size representative farm, 13% for the medium-size representative farm, and 4% for the small-size representative farm by 2018. The ratios are also projected to decrease 7% and 12% for the high and average-profit representative farms by 2018, respectively. The debt-to asset ratio for the low profit farm is projected to increase 7%.

For the average-profit representative farm, state average cropland values will increase 4.4%, from $985 per acre in 2008 to $1,028 per acre in 2018. Cash rents will increase 4.4%, from $52.27 per acre in 2008 to $54.55 per acre in 2018. Cropland values and rent are estimated solely on returns to cropland and not the recent market run-up. The average price of cropland in North Dakota was $565 per acre in 2004. It increased 4.2% to $589 per acre in 2005. Land price was $592 per acre in 2006 and $842 per acre in 2007, a 42% increase in one year. Land cost is only one part of operating expense. Overall operating expense increased by 62% since 2004 because of higher fertilizer, fuel, chemicals, and land costs and those costs may continue into the future.

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INTRODUCTION

North Dakota represents a major agricultural area with a distinctive climate and crop mix. The state is uniquely situated in terms of marketing and logistics within the United States because it shares a border with Canada, which is the United States' largest trading partner. Changes in government policies through recent farm bills and the Uruguay Round Agreement (URA) have affected the region's economy. The recent changes in Federal policy towards renewable energy has increased corn ethanol production along with commodity prices. However, the current recession reduced commodity prices in late 2008 and 2009.

The main objective of this analysis is to evaluate changes in net farm income and debt-to-asset ratios for different size and profit categories of representative farms. The representative farms are developed from the North Dakota Farm and Ranch Business Management Education Program farm records and are projected over the 2009 to 2018 period under the Food, Conservation, and Energy Act of 2008, the URA, and the North American Free Trade Agreement (NAFTA). Secondary objectives are to evaluate the reaction of cropland prices and cash rental rates to the farm income estimates over the same time horizon. Additional objectives are to evaluate the model under risk, where mean values for yields and price are replaced with distributions with known standard deviations and means.

The North Dakota agricultural outlook for the 2009-2018 period is based on the baseline results produced by the Food and Agricultural Policy Research Institute (FAPRI) global model and the North Dakota Global Wheat Policy Simulation Model.

U.S. agriculture has been influenced by major changes in agricultural and trade policies. Trade agreements, such as CUSTA, the North American Free Trade Agreement (NAFTA), and the URA, have liberalized agricultural trade and will continue to do so for the next decade.

DEVELOPMENT OF AN EMPIRICAL MODEL

Major crops produced in North Dakota are hard red spring wheat, durum wheat, barley (malting and feed), corn, soybeans, and minor oilseeds, including sunflower and canola. In addition, the region produces dry edible beans, flax, field peas, sugarbeets, and potatoes. The agricultural sector provides between 5% and 10% of the state economy. The average farm size in North Dakota is 1,309 acres including pasture. About 43% of total farms in North Dakota have a farm size less than 1,000 crop acres. In addition, small farms (less than 200 acres) account for 26% of total farms in North Dakota but only 3% of total farmland.

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The North Dakota Representative Farm Model is a stochastic simulation model designed to analyze the impact of policy changes on farm income. The model projects average net farm incomes, debt-to-asset ratios, cash rents, and cropland prices for representative farms producing five major crops: wheat, barley, corn, soybeans, and sunflowers. The model is linked to the FAPRI and North Dakota econometric simulation models, and it uses the prices of the crops generated from these models (Figure 1). The base model assumes an average trend yield based on historical data and average predicted prices received by farmers based on the historical relationships between FAPRI prices and North Dakota prices. In addition, macro policies and assumptions, trade policies, and agricultural policies are incorporated into the model directly or indirectly by the assumptions made by FAPRI in its price series. For the outlook, policies are assumed to remain constant.

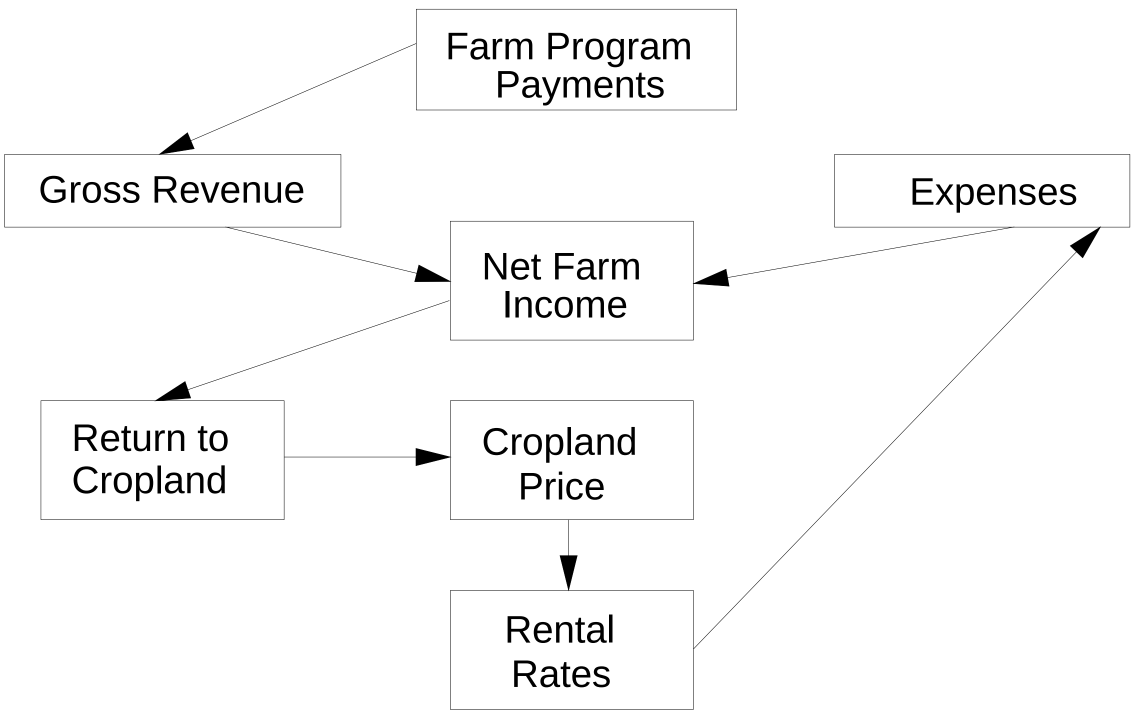
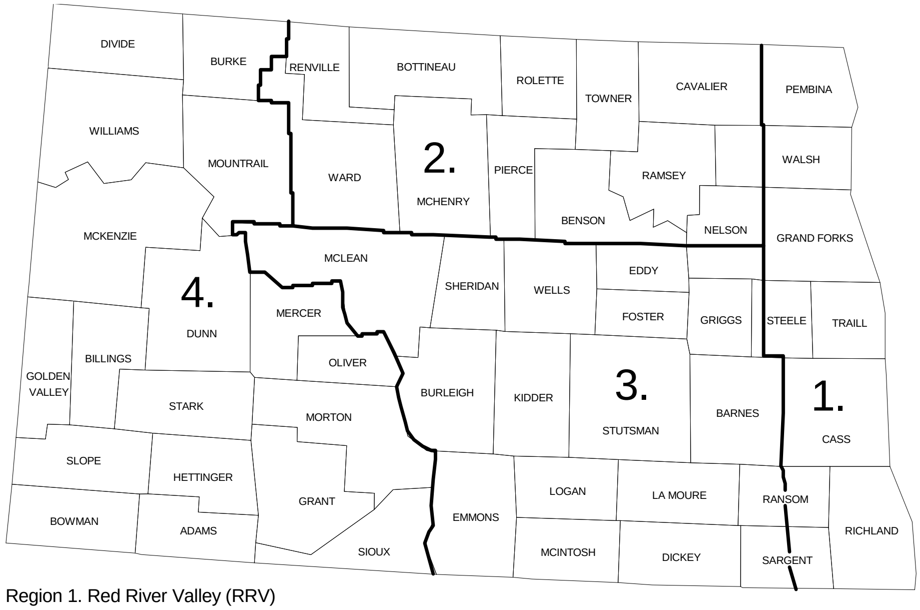


Figure 1. Structure of the North Dakota Representative Farm Model

Alternative farm policies affect net farm income for the representative farms. Changes in return to cropland, given the market-determined capitalization rate, result in changes in land prices. Changes in return to cropland affect cash rental rates that farmers are willing to pay on land used to produce crops. Changes in land price and cash rental rates, in turn, affect net farm income through adjustments in farm expenses. These changes affect the debt-to-asset ratios of the representative farms.

The North Dakota Representative Farm

The model has 24 representative farms: six farms in each of the four regions of North Dakota. These regions are the Red River Valley (RRV), North Central (NC), South Central (SC), and Western (West) (Figure 2). The farms in each region are representative of the average, high,



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

Figure 2. North Dakota Farm and Ranch Business Management Regions

and low-profit farms and small, medium, and large-size farms enrolled in the North Dakota Farm and Ranch Business Management Education Program.

The representative farms average 1,894 acres of cropland and 642 acres of pasture. The farms are about 84% larger than the state average reported by the North Dakota Agricultural Statistics Service. A reason for this difference is that the state average includes all farms with $1,000 or more in sales; therefore, hobby farms, farms operated as part of combined larger farms, semi-retired farms, and commercial farms are all included, while the farms used in this study mainly represent commercial farms.

The average representative farm is an average of all farms in the Farm and Ranch Business Management Records System for the state in each production region. The high-profit representative farm is an average of farms in the top 20% of farm profitability for each production region. The low-profit representative farm is an average of farms in the bottom 20% of farm profitability in each production region. Average farm sizes are 3,780 cropland acres for the high-profit farms, 1,894 cropland acres for the average-profit farms, and 984 cropland acres for the low-profit farms. In addition, the high, average, and low profit farms had 1,040, 715, and 366 acres of pasture, respectively. The profit farms include some RRV farms located in Minnesota.

The large representative farm is the average of the largest 25% of farms in cropland acres for each producing region. The small representative farm is an average of the smallest 25% of the farms for each producing region. Average farm sizes are 3,863 cropland acres for the large-size farms, 1,710 cropland acres for the medium-size farms, and 542 cropland acres for the small-size farms (Table 1). In addition, the large, medium, and small-size farms had 736, 634, and 722 acres of pasture, respectively. The size farms include only farms located North Dakota.

Table 1. Characteristics of Representative North Dakota Farms, 2008

	Size			Profit		
	Large	Medium	Small	High	Average	Low
Number of Farms	133	265	133	127	634	127
Total Cropland (ac)	3,863	1,710	542	3,780	1,894	984
Spring Wheat (ac)	729	301	69	818	449	232
Durum Wheat (ac)	105	104	4	77	37	6
Barley (ac)	232	118	15	157	88	47
Corn (ac)	292	92	35	270	119	44
Sunflower (ac)	123	64	16	126	60	7
Soybeans (ac)	449	200	80	613	288	133

Figure 3 shows the historical average farm expense and profit for the farms in the North Dakota Farm and Ranch Management Program located in the NC, SC, and West regions of the state during the past 10 years, excluding the RRV. In 1994, the farms averaged $171,713 gross income with a profit of $46,289. In 2008, the farms averaged $607,627 gross return with a profit of $131,380. In 1994, the farms generated $1.37 gross output for every $1 in inputs; by 2006, that had fallen to $1.22 gross output for every $1 in inputs. In 2008, that ratio was 1.28. Figure 4 shows the average size of the farms. In 1994, the average size was 1,262 acres. In 2008, the average size was 1,894 acres. This is an increase of 50% over the 13-year period. Net return per acre fell from $36.67 per acre in 1994 to $33.20 per acre in 2005 before increasing to $88.97 in 2007 and then falling to $69.37 per acre in 2008. Operating expenses has increased 153% since 1994 and 87% since 2004.

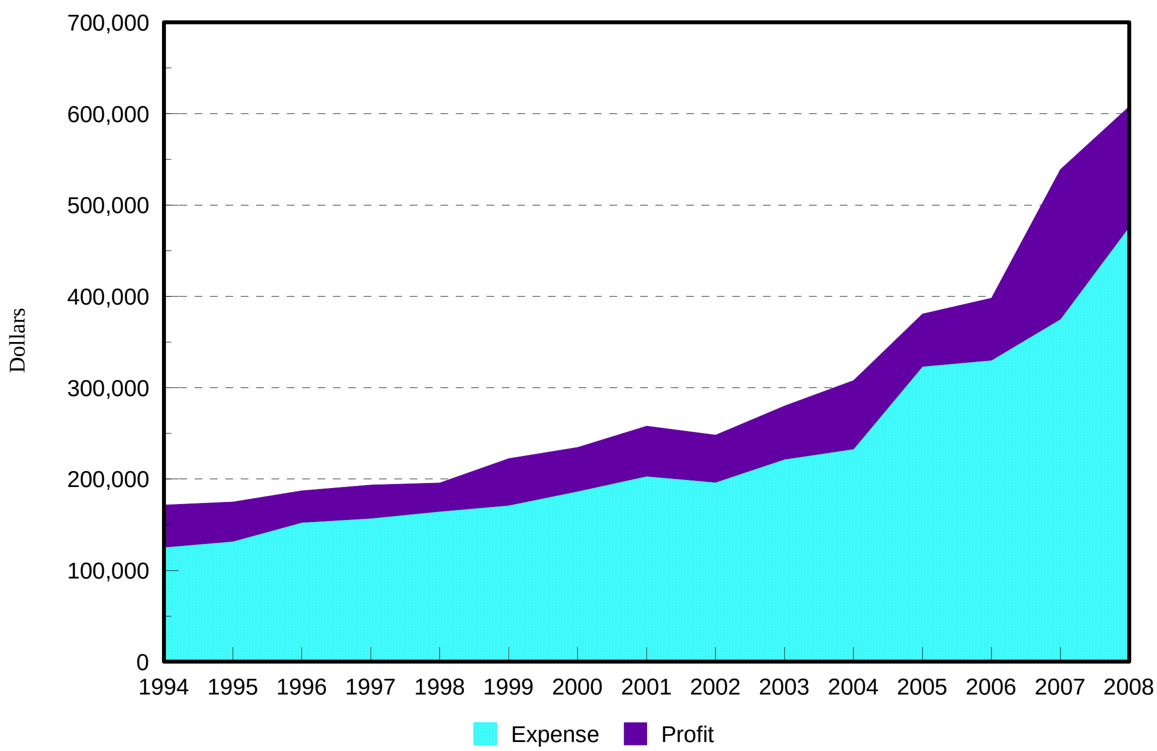


Figure 3. Average Expense and Profit for Farms Excluding the Red River Valley, in the North Dakota Farm and Ranch Business Management Program

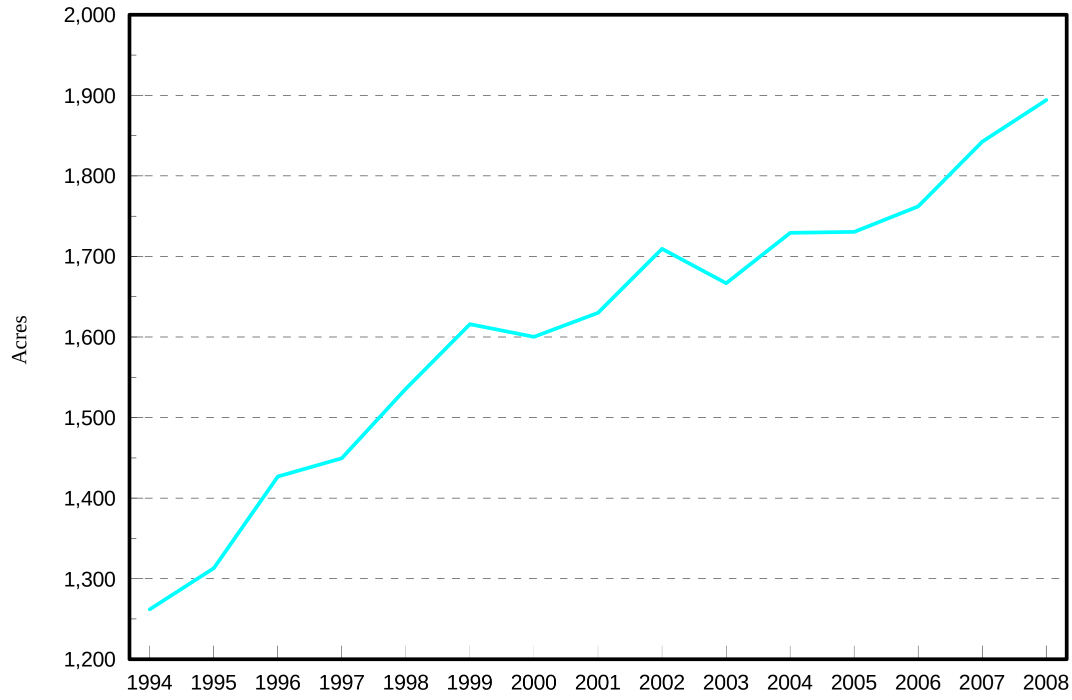


Figure 4. Average Cropland Acres for Farms in the North Dakota Farm and Ranch Business Management Program

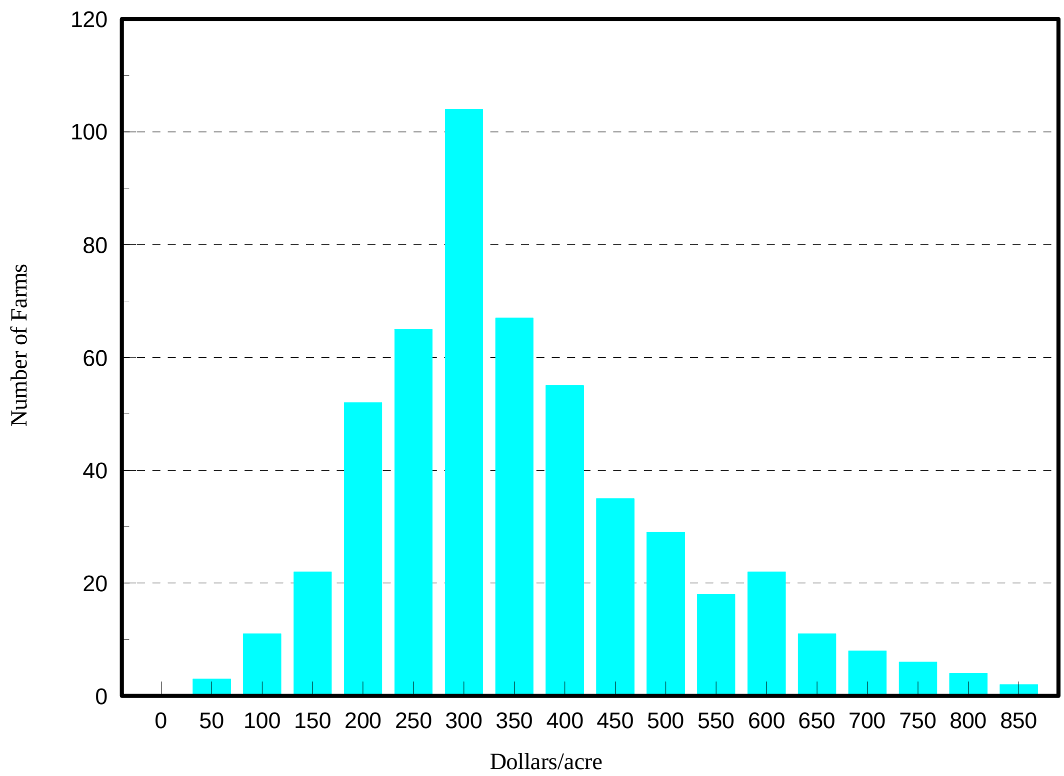


Figure 5. Distribution of Gross Returns Per Acre of Cropland for 2008

Figure 5 shows the distribution of per acre gross returns for all farms within the Farm and Ranch Business Management program for 2008. The majority of the returns are in the $200 to $400 per acre. Many of the farms in the lower distribution are farms in the West region where livestock is the major enterprise and farms in the upper distribution are RRV farms with sugarbeets. The average gross returns for 2008 is $321 per acre, which is higher than any of the previous years. In 2007, the majority of farms had net returns between $160,000 and $280,000. Table 2 shows the average per acre gross returns to cropland and net farm income for 2000 to 2008. Per acre gross returns has increased from $67 in 2000 to $138 in 2006 while net farm income has stayed in the $59,000-60,000 range for those two years. In 2008, net farm income increased to about $216,900 because of higher commodity prices. There are numerous factors involved in net farm income other than crop returns. Returns to livestock are a major factor in the western portion of the state along with government payments and proceeds from crop insurance. Expenses have also increased substantially during the past seven years which put downward pressure on net farm income.

Table 2. Average Per Acre Gross Returns and Net Farm Income For Farms in the North Dakota Farm and Ranch Business Management Program

	Per Acre Gross Returns	Net Farm Income
	Dollars per acre	Dollars
2000	67	68,800
2001	78	44,400
2002	101	59,100
2003	114	76,400
2004	119	66,800
2005	119	57,500
2006	138	68,200
2007	249	199,200
2008	321	196,900

Structure of the Representative Farm Model

The model consists of four components: net farm income, debt-to-asset ratio, land price, and cash rent. This section discusses the definition of each component and the formulas used to calculate them.

Net Farm Income. Net farm income is calculated by subtracting total crop and livestock expenses from total farm income. Crop and livestock expenses consist of direct costs that include seed, fertilizer, fuel, repairs, feed, supplies, feeder livestock purchases, and hired labor; and indirect costs that include machinery depreciation, overhead such as insurance and licenses, land taxes, and land rent or interest on real estate debt. Total farm income is the sum of cash receipts from crop and livestock enterprises, government payments, CRP payments, custom work, patronage dividends, insurance income, and miscellaneous income. Net farm income is calculated as

$$NFI = \sum Y_j P_j A_j + \sum P_h L_h + \sum S_j A_j + I^o - \sum EX_h^L - \sum EX_j^C \quad (1)$$

where

Y_j = yield per acre for crop j,
P_j = price of crop j,
A_j = planted acres of crop j,
P_h = price of livestock h,
L_h = number of livestock h sold,
S_j = government subsidies for crop j per acre,
I^o = other farm income including direct payments,
EX^C_j = total expenses in producing crop j,
EX^L_h = total expenses in producing livestock h.

Inventory changes, accounts receivable, accounts payable, and prepaid expenses and supplies are assumed to be constant from year to year. Cash receipts are based on predicted cash prices and yields in North Dakota. Cash prices received by farmers are based on national price projection by FAPRI, adjusted to North Dakota. The adjustments are estimated from North Dakota price equations which were calculated on the basis of the historical relationships between North Dakota prices and U.S. export prices of the commodities. Annual data from 1974 to 2007 were used to estimate price equations. The price equations were used to estimate cash prices received by North Dakota farmers for the 2009-2018 period. The FAPRI prices are used as exogenous variables in the price estimates.

Regional North Dakota yield trend equations were estimated from historical yield data reported by the North Dakota Agricultural Statistics Service from 1974 to 2006. The estimated equations were used to forecast crop yield trends for future years. A dummy variable was used to compensate for two drought years: 1980 and 1988.

Debt-to-asset Ratio. The debt-to-asset ratio is calculated by dividing total outstanding farm debt by total farm assets. Total debt includes debt on land, intermediate debt, and short-term debt. Total assets include price of farmland times acres of farmland owned and the depreciated value of farm equipment and supplies, livestock, and liquid assets. The value of farm equipment, supplies, and livestock is assumed to be constant over the forecast period.

Cropland Prices and Cash Rent. Land prices for representative farms are estimated on the basis of the implicit discount rate the farms have previously used and the expected return on land. Therefore, land prices are defined as the amount that farms can afford to pay for farmland. They are not prevailing market prices. Financial data from average representative farms for each region are used to calculate a dollar return to land. To do this, all production expenses for the crops, including depreciation, land taxes, a labor charge for unpaid family labor, net return from a livestock enterprise, and a management fee equivalent to that charged by bank trust departments for management of share-rented farms, are subtracted from gross farm income. To the remaining balance, interest on real estate debt is added back because the return to land is not affected by ownership of the land. This figure is used as the return allocated to cropland.

The average return allocated to each acre of cropland per year is divided by the average cropland price to determine the long-run capitalization rate used by farmers, as follows:

$$R_g = \frac{M_g}{PL_g} \tag{2}$$

where

R_g = long-run capitalization rate in region g,
M_g = average net return allocated to cropland in region g,
PL_g = average observed price of cropland in region g.

For the forecast years, this capitalization rate is applied to the estimated average income per acre allocated to cropland to determine cropland value for land utilized to produce wheat, corn, soybeans, barley, and sunflowers. The average net return is an n-year weighted moving average of annual per acre income. Calculation of cropland prices is summarized as

$$PL_{gT} = \frac{1}{R_g} \sum_{t=T-n}^{T} W_t M_{tg} + T_r \tag{3}$$

where

PL_{gT} = cropland price in region g in time t,
W_t = weighting factor for year t,
M_{tg} = net return allocated to cropland in region g and year t,
T_r = trend.

The price of cropland calculated in Equation 3 can be defined as the amount farmers are willing to pay for the cropland to produce wheat, barley, corn, soybeans, and sunflowers.

Cash Rent. Cash rent for cropland is calculated by multiplying a k-year moving average of estimated price of cropland by the long-run capitalization rate, plus taxes on land. Calculation of cash rent is summarized by

$$CR_{gT} = \sum PL_{gt} R_g + TX_T \tag{4}$$

CR_{gT} = cropland cash rent in region g in time T,
PL_{gt} = estimated price of cropland in region g and year t,
TX_T = taxes on land in time T.

The cash rent is defined as the amount farmers are willing to pay for the rented cropland to produce wheat, barley, corn, soybeans, and sunflowers.

DATA USED FOR THE REPRESENTATIVE FARM

The commodity prices for crops are obtained from the FAPRI and ND Global Wheat Policy simulation models. The national average farm prices are converted to the prices received by North Dakota representative farms by regressing average farm price of each crop produced in North Dakota against the national average farm price of the same crop. The price equation used for this study is specified in a dynamic framework on the basis of Nerlove's partial adjustment hypothesis, as follows:

$$P_{it} = a_0 + a_1 P_t + a_2 P_{it-1} + e_{it} \qquad (5)$$

where P_{it} = average farm price of a crop in region i in time t,
P_t = national average farm price of a crop in time t.

The price equation is estimated for each crop produced in North Dakota using the time series data from 1975 to 2007. The estimated equations are used to predict average prices received by farmers in each region from the national average prices found in the FAPRI and ND simulation models. Table 3 shows the projected North Dakota prices based on FAPRI's estimates. FAPRI assumes that wheat prices will fall to the lower $5.00 range for wheat and upper $3.00 range for corn.

Table 3. North Dakota Baseline Price Estimates

	Spring Wheat	Durum Wheat	Malting Barley	Sunflower	Soybeans	Corn	Canola
	------------$/bu-------------------			-$/cwt-	-------$/bu-------		-$/cwt-
2007	6.64	9.44	3.81	18.78	8.95	3.82	16.81
2008	6.74	9.30	5.66	27.06	9.55	3.72	24.06
2009	5.17	7.35	3.15	17.94	8.55	3.72	16.30
2010	5.13	7.29	3.04	18.21	8.68	3.62	16.12
2011	5.20	7.39	3.08	18.01	8.59	3.66	16.37
2012	5.25	7.46	3.10	18.29	8.72	3.70	16.52
2013	5.36	7.62	3.15	18.45	8.79	3.78	16.70
2014	5.41	7.69	3.14	18.65	8.89	3.77	16.70
2015	5.47	7.77	3.16	18.65	8.89	3.80	16.79
2016	5.50	7.81	3.12	18.76	8.94	3.75	16.65
2017	5.53	7.86	3.12	18.60	8.86	3.75	16.65
2018	5.56	7.90	3.12	18.60	8.86	3.75	16.65

Crop yields in each region also are predicted using the estimated yield equations for crops produced in each region. The yield equation for each crop in each region is specified in the same dynamic framework as that in the price equation, as follows:

$$y_{it} = b_0 + b_1 \text{trend} + b_2 y_{it-1} + D_t + e_{it} \qquad (6)$$

where y_{it} represents yield of a crop in region i in time t, and e_{it} is a random error term. A dummy variable (D) was used to compensate for two drought years: 1980 and 1988. The trend variable is included to capture changes in production technology.

This equation is estimated for each crop in each region using time series data from 1974 to 2007. The estimated equations are used to predict crop yields in each region. Figure 6 shows the estimated spring and durum wheat yields. The yields show a slight upward trend throughout the forecast period. Figure 7 shows the estimated yields for corn and soybeans. Corn and soybean yields are also expected to increase over the forecast period.

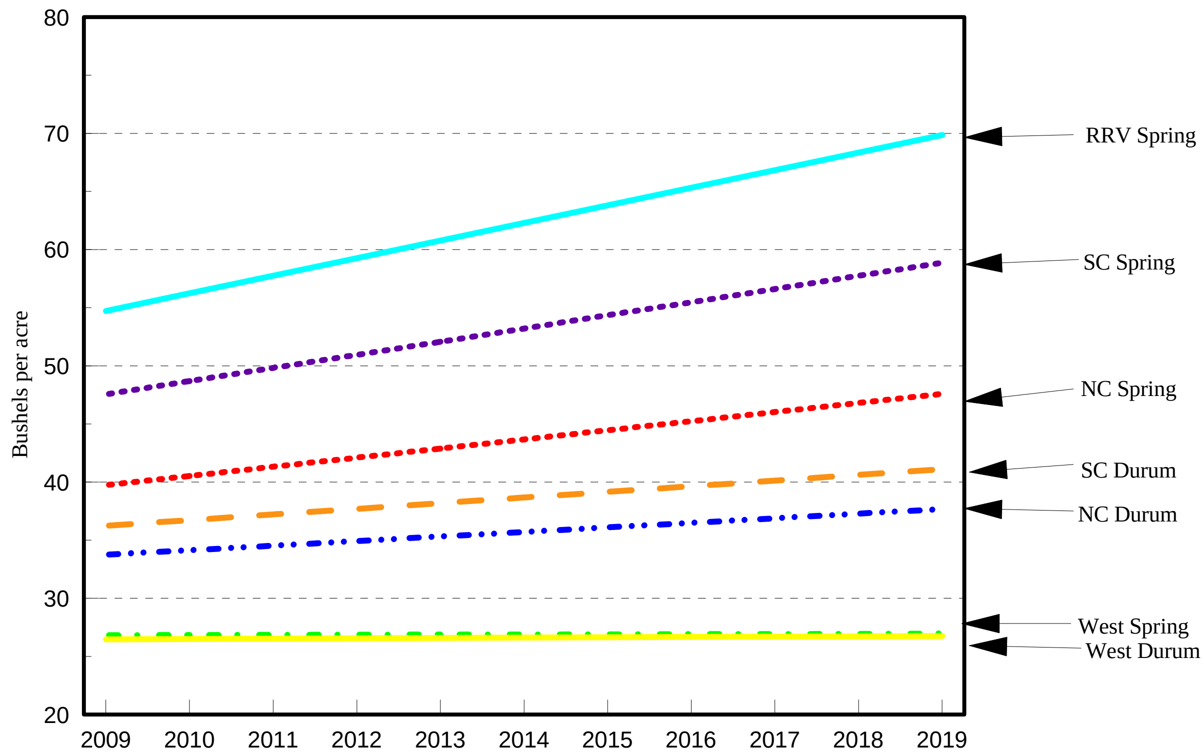


Figure 6. North Dakota Estimated Wheat Yields Used in the Representative Farm Model

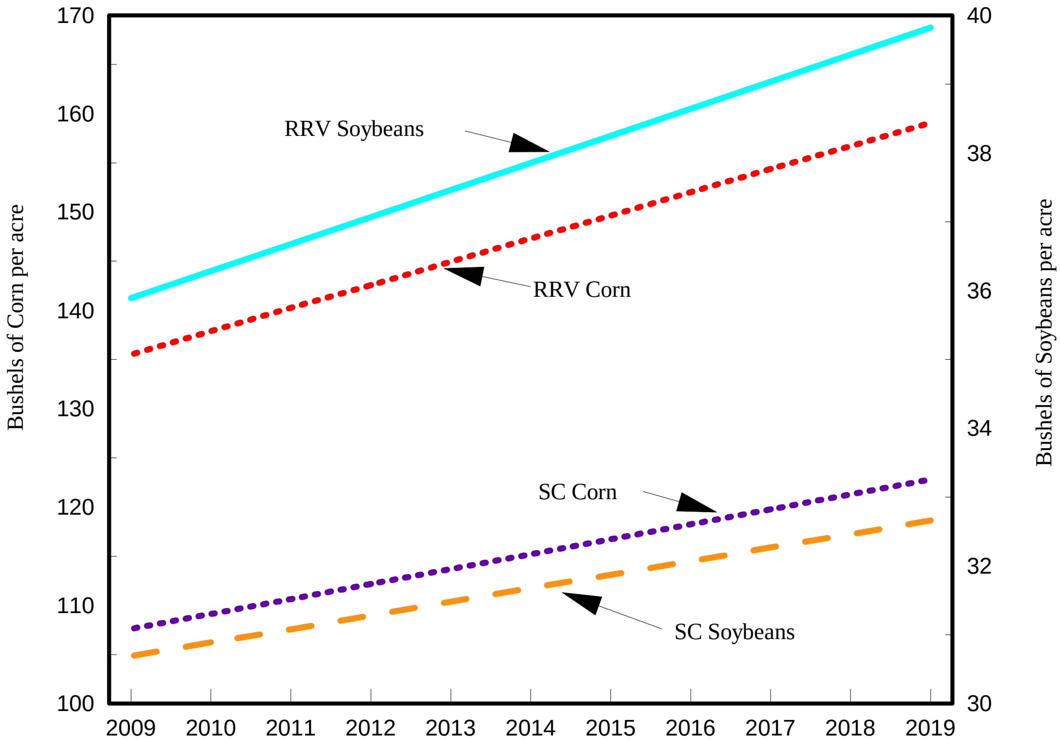


Figure 7. North Dakota Estimated Row-crop Yields Used in the Representative Farm Model

Crop mix changes over time as a function of prices of the crops produced in each region. A dynamic acreage equation for each crop is specified on the basis of Nerlove's partial adjustment hypothesis, as follows:

$$A_{jit} = c_o + \sum_{j=1}^{n} c_j P_{jit} + c_{n+1} A_{jit-1} + c_{n+2} G_{jt} + e_{jit} \qquad (7)$$

where A_{jit} = the total acres of the jth crop in region i in time t,
P_{jit} = the price of the jth crop in region i in time t,
G_{jt} = government policy variables applied to the jth crop in time t,
e_{jit} = a random error term
c = regression coefficient.

The equations are estimated using time series data from 1976 to 2006. The estimated equations are used to predict the total acres of each crop produced in each region. The predicted prices from Equation 5 are used in the acreage equations. The jth crop share in region i in time t is then calculated as follows:

$$S_{jit}=A_{jit}/\sum_{j=1}^{i} A_{jit} \qquad (8)$$

where S_{jit} is an acreage share of the jth crop in region i in time t.

The estimated share of a crop is applied to calculate the total acres of the crop produced in the region by multiplying the total acres in the region by the share.

Other data needed for the model are obtained from the North Dakota Farm and Ranch Business Management Association.

Farm size has been increasing about 2% per year. The size increase has been similar for all profit and size categories of farms. During the forecast period, the representative farms are allowed to increase 2% in size per year. With the increased size, expenses are allowed to increase about 2% above the expected rate of inflation to account for the additional acreage. Expenses have increased substantially in recent years. Since 2006, production expenses increased 61% and about 20% between 2007 and 2008. Expenses are assumed to return to 2% per year increase between 2009 and 2018.

In the previous reports, livestock income was assumed to remain constant throughout the forecast period. For the past three years, the model was adapted to allow returns from livestock to follow FAPRI's projections for cow-calf prices in the future. FAPRI projects the cattle cycle to bottom in 2009 before recovering during the entire forecast period.

AGRICULTURAL OUTLOOK FOR THE REPRESENTATIVE FARMS, 2009-2018

The North Dakota Representative Farm Model was used to estimate net farm income, debt-to-asset ratios, land prices, and rental rates for 2009-2018. Additional assumptions in this study are:

1. Net farm income from the production of other crops, including potatoes and dry beans, remains constant during the period.
2. The farm equipment stock remains constant, indicating that depreciation allowances are invested back into farm equipment.
3. Inventory changes, accounts receivable, accounts payable, and prepaid expenses and supplies are constant from year to year.
4. The U.S. farm program and macroeconomic policies remain the same during the forecasting period.
5. Weather conditions and other factors affecting production practices are normal.

Net Income for North Dakota Representative Farms

Table 4 presents net farm income for farms by size and profitability. Average net income for North Dakota representative farms varies, depending upon the size of farm and its profitability. The net income for the large-size farm will decrease from the 2006-2008 average of $370 thousand to $214 thousand in 2018, which is a 42% decrease (Figure 8). Net farm income for the medium-size farm, which averaged $149 thousand for 2006-2008, decreases to $72 thousand in 2018. Net farm income for the small-size farm averaged $36 thousand for 2006-2008 and will decrease to $4 thousand in 2018. State average net farm income over the 10-year period is $207 thousand for the large-size farm, $75 thousand for the medium-size farm, and $8 thousand for the small-size farm. The main reason for the decrease in net farm income is due to the very high income levels in 2007 and 2008. All incomes were at historical high levels in 2007 and 2008. A substantial portion of the income is due to changes in inventories and accounts receivable. The higher income levels imply that most farms in North Dakota will have enough income under the current farm bill and international market conditions, although the small-size farm may need off-farm income to supplement family living.

Table 4. State Average Net Farm Income for Different Size and Profit Representative Farms

	Size			Profit		
	Large	Medium	Small	High	Average	Low
	--dollars---					
2006-08 avg	370,134	148,810	35,504	454,397	163,271	-2
2008	499,792	182,820	34,009	595,578	216,971	7,072
2009	218,896	96,743	24,892	250,896	101,268	1,793
2010	204,853	84,510	13,143	213,176	82,377	-10,158
2011	200,795	73,368	9,613	189,389	69,909	-17,075
2012	201,965	72,622	8,012	179,392	66,142	-20,685
2013	202,091	71,266	6,594	171,542	64,223	-22,727
2014	203,241	69,217	5,344	164,427	60,507	-24,259
2015	204,753	68,433	5,064	153,583	58,297	-25,036
2016	206,247	96,890	4,287	148,788	55,953	-25,518
2017	210,879	70,090	3,985	144,057	55,068	-25,190
2018	213,807	71,703	3,542	141,445	55,033	-24,098

Future crop production in the United States and around the world is predicted to be consistent with annual trend line increases, while demand is predicted to increase slowly. Producers are protected from price declines below loan rates specified in the 2008 farm bill. Any drop in prices below loan rates will be offset by an increase in governmental subsidies. Further price protection is available through counter-cyclical payments which are triggered when the national average price is less than the target price minus the direct payment rate. The counter-cyclical payment is decoupled from actual production and based on historical yields and 85% of base acreage. However, at current and projected commodity prices, neither marketing loans or counter cyclical payments will be made.

Net farm income for the high-profit farm is projected at $251 thousand for 2009 and is expected to decrease to $141 thousand in 2018 (Figure 8). Net farm income for the average-profit farm is projected to be $101 thousand in 2009 and is projected to decrease to $55 thousand in 2018. The low-profit farm is expected to show net farm income in 2009 of $2 thousand and slowly fall to $-24 thousand by 2018. The low-profit farm may not have the financial resiliency to survive without outside income. State average net farm income over the 2009-2018 period is $176 thousand for the high-profit farm, $67 thousand for the average-profit farm, and $-19 thousand for the low-profit farm.

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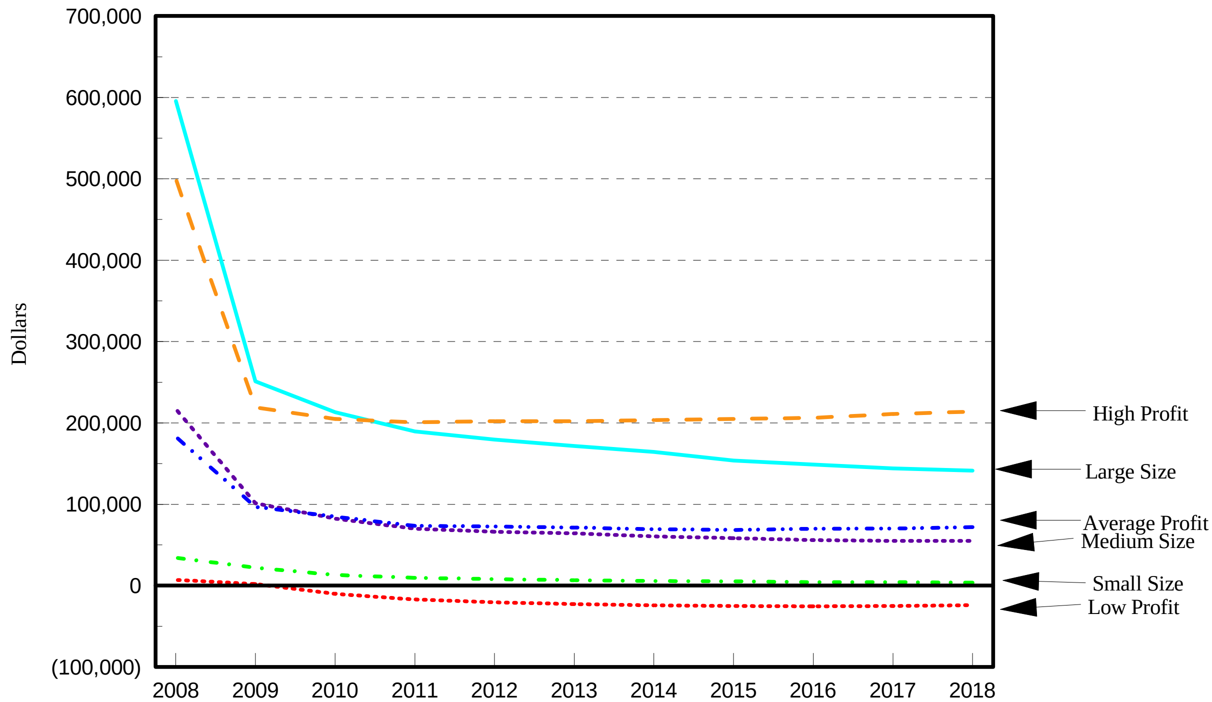

Figure 8. Net Farm Income for Size and Profit North Dakota Representative Farms

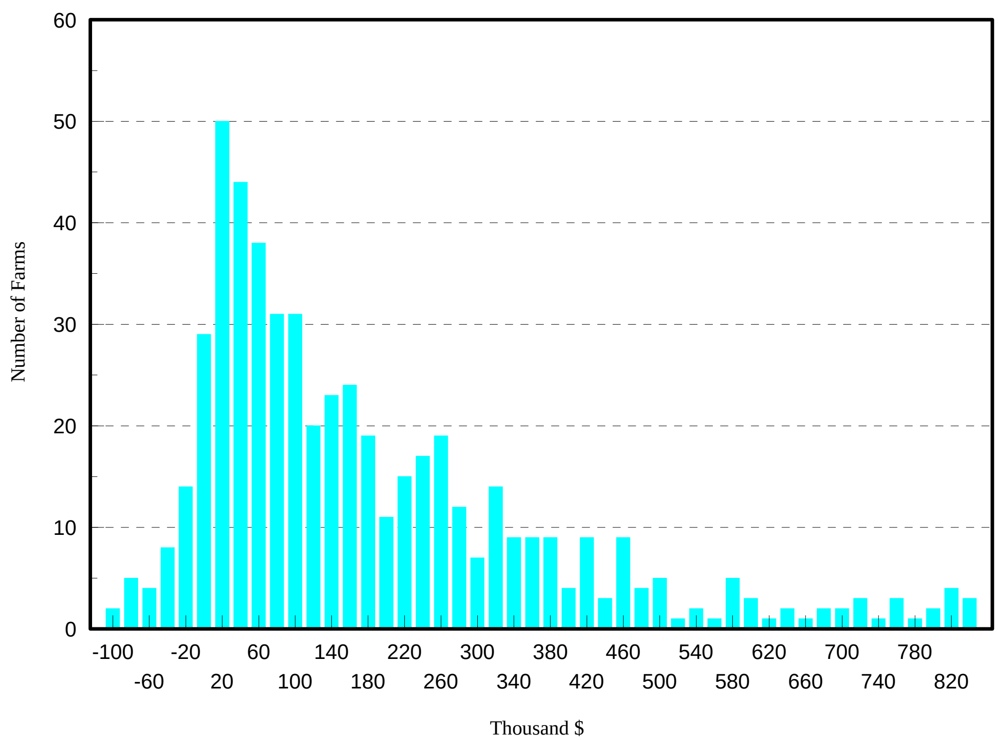

Figure 9. Number of Farms in Each Income Categoory, 2008

Figure 9 shows the distribution at each income level for the average profit representative farm. A majority of the producers in the Farm and Ranch Business Management program are in the $40 thousand to $140 thousand range for net farm income with a long tail extending out to over $800 thousand.

Risk Simulation

Table 5 shows the forecasted net farm income, standard deviation, maximum and minimum level, and the 90% confidence interval for the average profit representative farms, when mean values for price and yields are replaced by price and yield distributions with known standard deviations and means. The standard deviations, an indication of variation, are large for the state, averaging 56% of net farm income in 2009, by 2018 the standard deviation is almost 100% of mean incomes. The large standard deviation makes long range planning difficult as future incomes are likely to have large fluctuations.

The 90% confidence interval means that the mean or average net farm income will be between the lower and upper bounds 90% of the time. The extreme width of the confidence interval indicates that net farm income within the state is subject to wide variation and is very difficult to predict.

Table 5. Results of the Simulation for the Average Profit Representative Farm Model, Net Farm Income

	Mean	Std Deviation	Maximum	Minimum	90% Confidence Interval
	--		dollars		--
2008					
State	101,268	44,097	254,609	(33,214)	33,568 to 179,291
2011					
State	64,223	49,119	217,564	(70,259)	(3,477) to 142,043
2016					
State	55,033	54,722	208,373	(79,449)	(12,667) to 132,853

Debt-to-asset Ratios for North Dakota Representative Farms

Debt-to-asset ratios for all representative farms fall throughout the forecast period.(Table 6 and Figures 10-11). The debt-to asset ratio is total debts, both long and short term, divided by total assets owned by the producer. The debt-to-asset ratio is one of the financial measures used to estimate the financial health of a business. The debt-to-asset ratio for the large size in 2009 is projected to be 0.212 and slowly falls to 0.169 by 2018. This indicates that total debts are about 21% of total assets for the large size farm. The medium size farm debt-to-asset ratio is 0.278 in 2009 and falls slowly to 0.241 by 2018. The small farm’s debt-to-asset falls from 0.452 in 2009 to 0.434 in 2018. The debt-to-asset ratio for the high profit farm falls from 0.238 in 2009 to 0.221 in 2018 and 0.282 in 2009 to 0.249 in 2018 for the average profit farm. The debt-to-asset ratio for the low profit farm increases from 0.456 in 2009 to 0.504 in 2009. The low income levels for both the small size and the low profit farms require income from outside sources for the family to continue farming. In 2008, low profit farms averaged over $29,000 in off farm income and small size farms averaged $31,000.

Table 6. State Average Debt-to-asset Ratios for Different Size and Profit Representative Farms

	Size			Profit		
	Large	Medium	Small	High	Average	Low
2008	0.220	0.285	0.460	0.253	0.301	0.470
2009	0.212	0.278	0.452	0.238	0.282	0.456
2010	0.207	0.272	0.449	0.246	0.286	0.461
2011	0.203	0.270	0.450	0.254	0.285	0.465
2012	0.196	0.266	0.449	0.246	0.280	0.471
2013	0.188	0.260	0.448	0.243	0.276	0.478
2014	0.183	0.256	0.446	0.239	0.271	0.484
2015	0.178	0.251	0.443	0.232	0.263	0.487
2016	0.174	0.245	0.436	0.229	0.260	0.494
2017	0.172	0.243	0.434	0.226	0.256	0.501
2018	0.169	0.241	0.434	0.221	0.249	0.504
Average	0.191	0.261	0.446	0.251	0.286	0.480

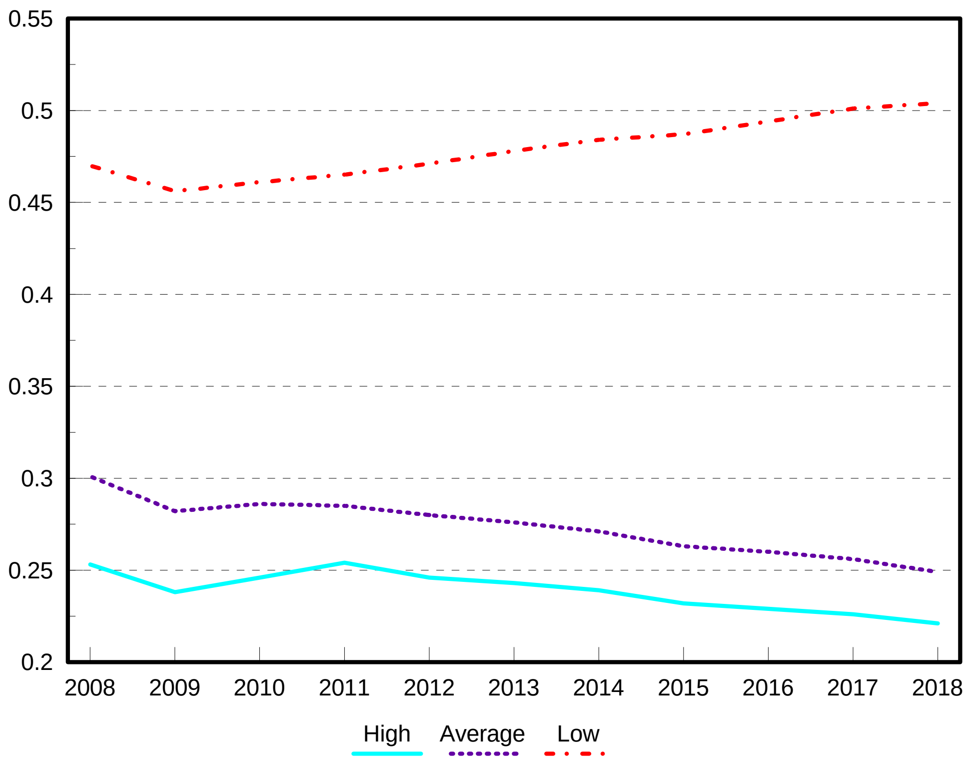

Figure 10. Debt-to-asset Ratio for North Dakota Representative Farms by Profit Category

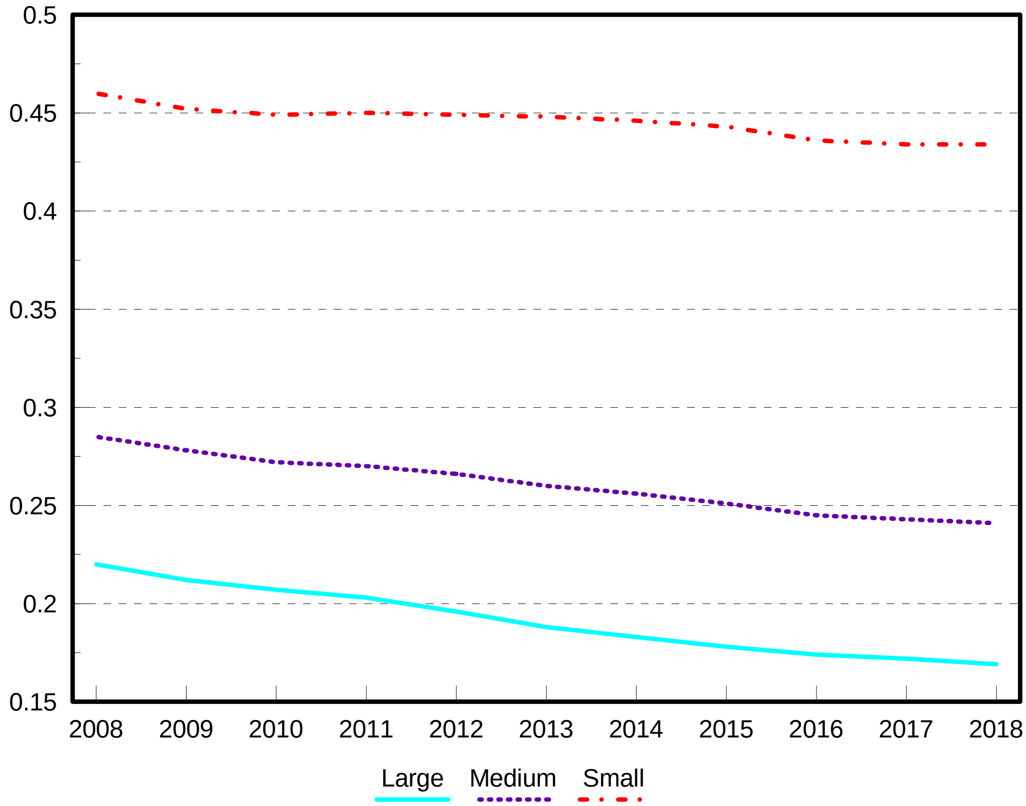

Figure 11. Debt-to-asset Ratio for North Dakota Representative Farms by Size Category

Farm Land Value and Cash Rents

Table 7 presents land values for representative farms in North Dakota. Land values have increased substantially in recent years. In 2004, average cropland values in North Dakota was $490 per acre, by 2007 that had increased to $842 per acre and by 2008 it had increased to $985 per acre. Cropland values depend on return-to-land. Land values in the RRV increase from $1,672 per acre in 2008 to $1,733 per acre in 2018. The model likely under estimates land prices as actual RRV land prices increased almost 40% between 2006 and 2007 and 17% between 2007 and 2008. Producers, under very favorable income situations, seem willing to invest their assets in land at higher rates than during normal income periods.

Cash rents follow land prices which increases operating expenses. Land values for the average-profit representative farms are shown in Figure 12. Land prices differ between the regions; the highest prices are in the RRV, and the lowest are in the West region. Land prices are expected to increase by 4.3% over the forecast period. Land values are based on return to crop acres. Other factors are not considered. Therefore, the land values and cash rents may not reflect current market values.

Table 7. North Dakota Land Prices for Average-Profit Representative Farms

	RRV	NC	SC	West	State
	----------------------------	--------	$/acre	--------	----------------------------
2008	1,671.93	736.35	957.39	575.64	985.33
2009	1,681.43	742.54	962.80	582.31	992.27
2010	1,688.94	747.41	966.94	587.77	997.76
2011	1,695.56	751.34	970.20	592.53	1002.40
2012	1,701.89	754.68	973.03	596.95	1006.64
2013	1,708.25	757.49	975.90	601.15	1010.70
2014	1,714.14	759.81	978.73	605.18	1014.46
2015	1,719.57	761.68	981.59	609.22	1018.01
2016	1,724.55	763.09	984.45	613.31	1021.35
2017	1,729.09	764.05	987.36	617.65	1024.54
2018	1,733.18	764.81	990.38	622.23	1027.65
2009-2018avg	1,703.53	753.84	973.84	598.17	1007.35

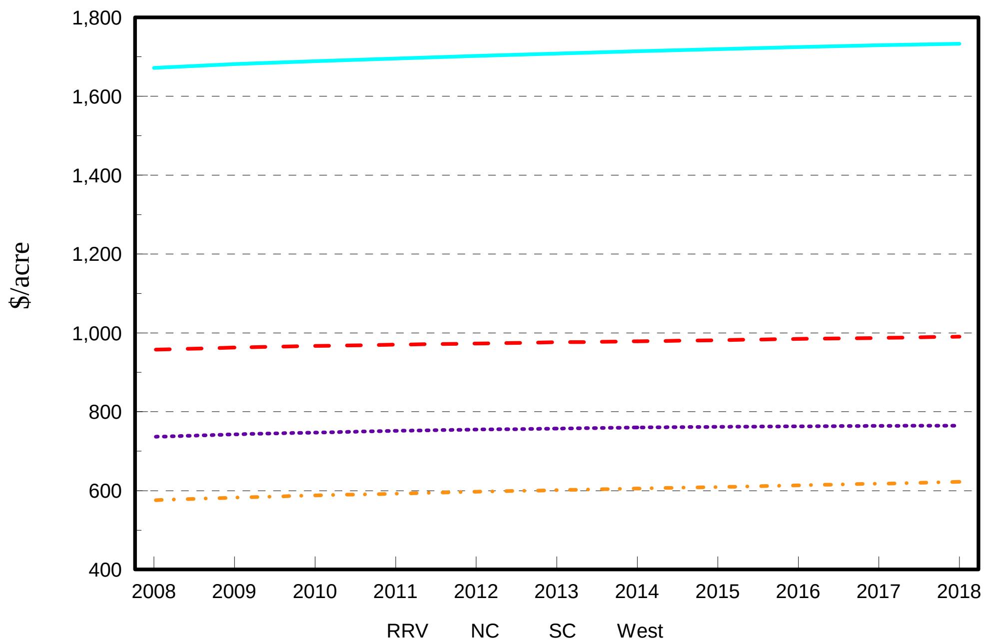

Figure 12. Average Value of Cropland for North Dakota Averge-Representative Farms

Cash rents for the average-profit farms slowly increase in all regions (Table 8). Cash rents also differ between regions; the highest are in the RRV, and the lowest are in the West (Figure 13).

According the North Dakota Farm and Ranch Business Management Education program, cash rent in the RRV averaged $68.64 in 2006, $71.55 in 2007 and $76.00 in 2008 even though land prices increased about 17% in the RRV.

Table 8. North Dakota Cash Rent for Average-Profit Representative Farms Under the FAPRI Scenario

	RRV	NC	SC	West	State
	--------------------------$/acre------------------------------				
2008	76.00	46.02	53.19	33.86	52.27
2009	76.43	46.41	53.49	34.25	52.64
2010	76.77	46.71	53.72	34.57	52.94
2011	77.07	46.96	53.90	34.85	53.20
2012	77.36	47.17	54.06	35.11	53.42
2013	77.65	47.34	54.22	35.36	53.64
2014	77.92	47.49	54.37	35.60	53.84
2015	78.16	47.60	54.53	35.84	54.03
2016	78.39	47.69	54.69	36.08	54.21
2017	78.60	47.75	54.85	36.33	54.38
2018	78.78	47.80	55.02	36.60	54.55
2009-2018 avg	77.43	47.12	54.10	35.19	53.46

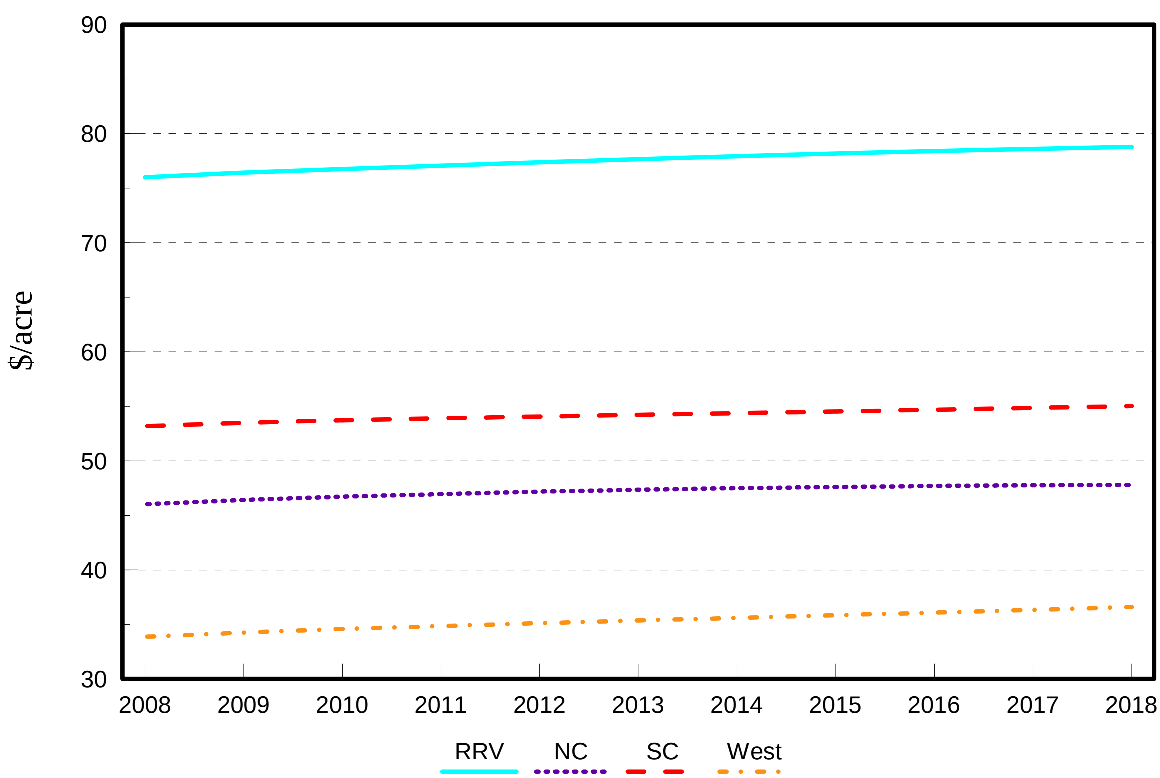

Figure 13. Average Cash Rent of Cropland for North Dakota Average- Profit Representative Farms

CONCLUDING REMARKS

Net farm income in 2018 is predicted to be lower than in 2008 for most farms. For example, net farm income for the average profit farm was $217 thousand in 2008 and is predicted to be $55 thousand in 2018. Production expenses increased 105% since 1994 and 51% since 2004. Continued increases in production expenses will erode incomes. It was assumed the expenses for 2009 will increase 2% above 2008 levels and continue increasing at the 2% level. Crop production in the United States and around the world is assumed to be normal with annual trend-line increases.

Debt-to-asset ratios are predicted to decrease slowly, except for the low profit farms, throughout the forecast period. Higher price levels will benefit most farms in the state.

Land values are predicted to increase during the forecast period because they are based on return to land as a result projected land values increase just over 5% for the projection period. However, recent North Dakota land prices have increased from $490 per acre in 2004 to $842 per acre in 2007. Cash rent levels follow patterns similar to land values. Current increases in market land values and cash rents are not reflected in the model as the model uses current returns to land and not future expected returns.

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