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2007 North Dakota Agricultural Outlook: Representative Farms, 2007-2016

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Abstract

Net farm income for nearly all representative farms in 2016 is projected to be higher than in 2006. 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 and yields are projected to increase slightly faster than costs, which will increase net farm income. Cropland prices and cash rental rates are projected to increase slightly in all regions. Debt-to-asset ratios for all farms will decrease slightly throughout the forecast period. Debt-to-asset ratios for the low-profit farms are expected to remain near the 0.50 level.

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 2007 than the 2004-2006 average for most farms, because higher row crop yields across the state in 2006 are expected to return to trend line levels in 2007. The higher prices received in 2006 were partially offset by lower government payments to producers. Currently, the most important component of net farm income seems to be production volume. The government provides adequate price support, but production support through crop insurance is substantially less adequate.

Net farm income for the large-size farm is predicted to increase from $132 to $161 thousand over the 2007-2016 period. The net farm income is predicted to increase from $49 to $59 thousand for the medium-size farm and from $17 to $24 thousand for the small-size farm.

During the 2007-2016 period, net farm income is predicted to increase from $117 to $126 thousand for the high-profit farm and from $49 to $60 thousand for the average-profit farm. The low-profit farm is expected to show a net loss early in the forecast period. but then become profitable by 2012. This strongly implies that efficient management is a key factor for a profitable farm operator, along with favorable weather.

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 2007, the mean net farm income is expected to be $48,927 with a standard deviation of $42,121 and a 90% confidence interval of $0 to $104,268. By 2016, the mean net farm income is expected to be $66,724 with a standard deviation of $53,790. The 90% confidence interval will be $1,116 to $133,379.

Debt-to-asset ratios for most representative farms are predicted to decrease slightly throughout the forecast period. Debt-to-asset ratios are projected to decrease 9% for the large-size representative farm, 11% for the medium-size representative farm, and 7% for the small-size representative farm by 2016. The ratios are also projected to decrease 1% and 11% for the high and average-profit representative farms by 2016, respectively. The debt-to asset ratio for the low profit farm is projected to decrease 14%.

For the average-profit representative farm, state average cropland values will increase 3.9%, from $596.13 per acre in 2007 to $619.13 per acre in 2016. Cash rents will increase 4.1%, from $39.80 per acre in 2007 to $41.42 per acre in 201. Cropland values and rent are estimated solely on returns to cropland and not the recent market run-up.

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INTRODUCTION

North Dakota represents a major agricultural area with 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, as has the increase in corn ethanol production.

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 forecasted over the 2007 to 2016 period under the Farm Security and Rural Investment Act (FSRIA) of 2002, the URA, and the Canada - United States Free Trade Agreement (CUSTA). 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 prices are replaced with distributions with known standard deviations and means.

The North Dakota agricultural outlook for the 2007-2016 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 1,313 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 their price series. For the outlook, policies are assumed to remain constant.

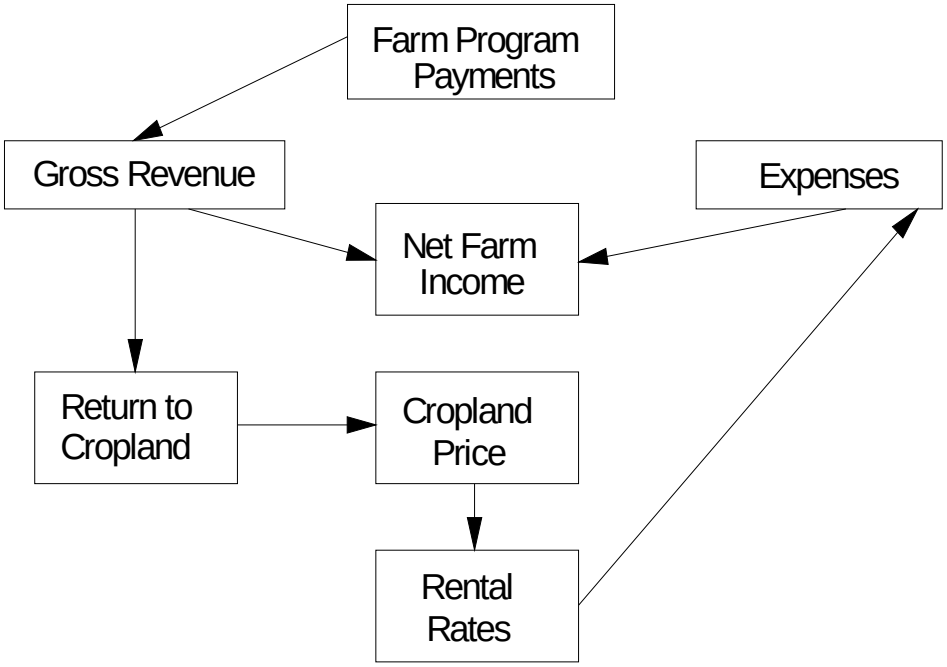
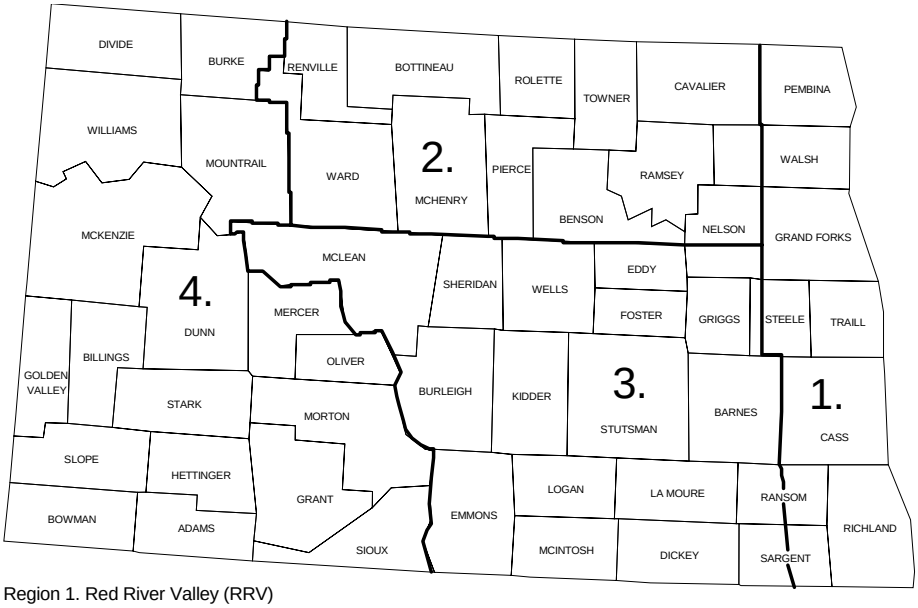


Figure 1. Structure of the North Dakota Representative Farm Model

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 1,762 acres of cropland and 635 acres of pasture. The farms in the study are about 83% 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 2,762 cropland acres for the high-profit farms, 1,762 cropland acres for the average-profit farms, and 1,611 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 3,394 cropland acres for the large-size farms, 1,406 cropland acres for the medium-size farms, and 416 cropland acres for the small-size farms (Table 1). In addition, the large, medium, and small-size farms had 729, 630, and 718 acres of pasture, respectively. The size farms include only farms located North Dakota.

Table 1. Characteristics of Representative North Dakota Farms, 2006

	Size			Profit		
	Large	Medium	Small	High	Average	Low
Number of Farms	127	255	127	91	456	91
Total Cropland (ac)	3,394	1,406	416	2,762	1,762	1,611
Spring Wheat (ac)	1,081	367	62	1,093	715	650
Durum Wheat (ac)	77	14	5	87	57	96
Barley (ac)	188	80	11	225	131	130
Corn (ac)	252	116	38	99	57	27
Sunflower (ac)	175	68	11	113	71	53
Soybeans (ac)	681	259	76	418	247	135

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 2006, the farms averaged $398,251 gross return with a profit of $68,173. In 1994, the farms generated $1.37 gross output for every $1 in inputs; by 2006, that had fallen to $1.21 gross output for every $1 in inputs. Figure 4 shows the average size of the farms. In 1994, the average size was 1,262 acres. In 2006, the average size was 1,762 acres. This is an increase of 40% over the 12-year period. Net return per acre fell from $36.67 per acre in 1994 to $33.20 per acre in 2005 before increasing to $38.69 in 2006.

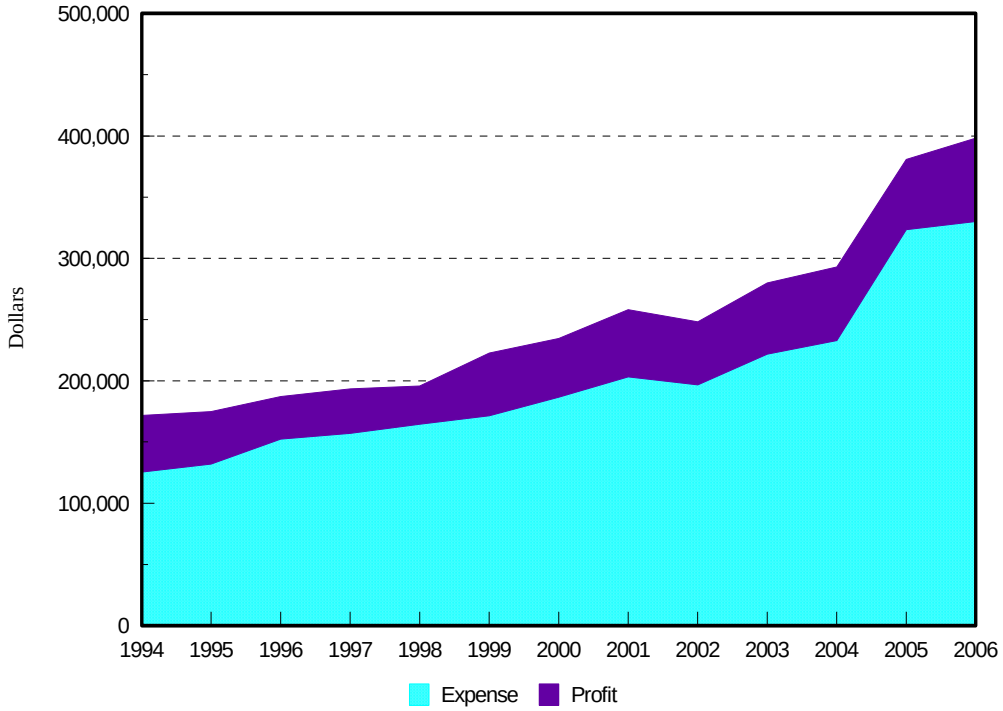


Figure 3. Average Expense and Profit for Farms in the North Dakota Farm and Ranch Business Management Program

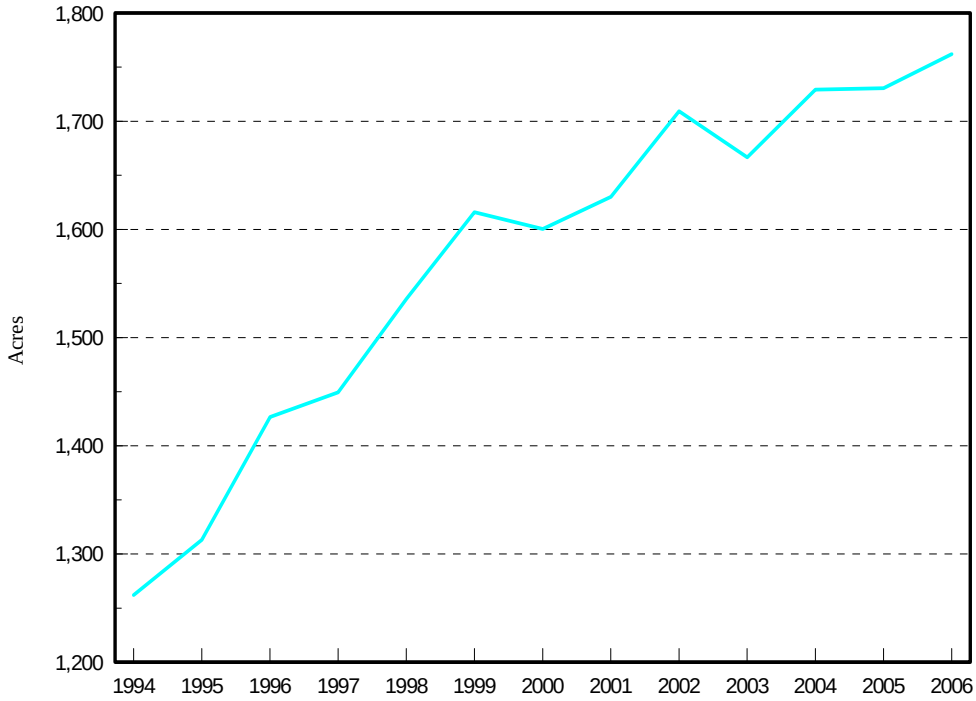


Figure 4. Average Cropland Acres of Farms in the North Dakota Farm and Ranch Business Management Program

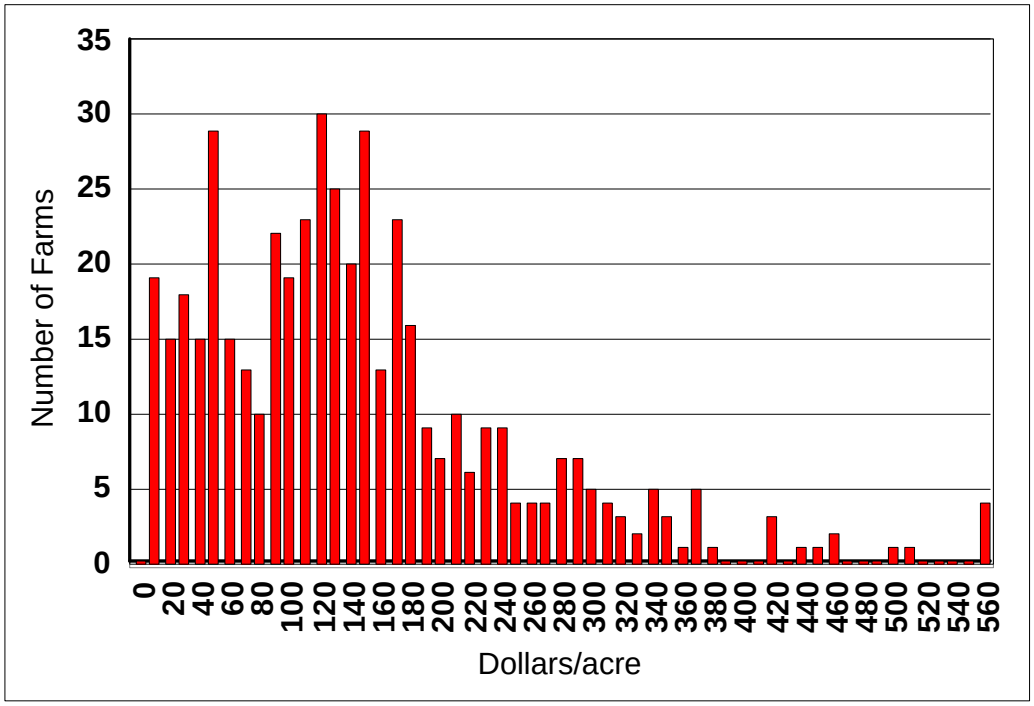


Figure 5. Distribution of Gross Return per Acre of Cropland for 2006

Figure 5 shows the distribution of per acre gross returns for farms within the Farm and Ranch Business Management program for 2006. The majority of the returns are in the $90 to $180 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 2006 is $138 per acre, which is higher than any of the previous years. Table 2 shows the average per acre gross returns to cropland and net farm income for 2000 to 2006. 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. 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	59600
2001	78	37600
2002	101	55200
2003	114	72800
2004	119	64000
2005	119	58500
2006	138	58200

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.

The Model was developed as a stochastic simulation model using the software program @Risk by Palisade. @Risk allows replacement of mean values with distributions and correlations between the variables to model the varying price levels and yields of the eight commodities. Standard deviations and the correlations between variables were taken from "Analysis of the 2002 Farm Bill and New Farm Bill Alternatives" by Taylor and Koo.

Standard deviations were estimated from individual farm records from the North Dakota Farm and Ranch Business Management Association. The year which was used for the simulation was 2006.

Future prices and yields are not known with certainty; therefore, a distribution of inputs are utilized to develop a distribution of outputs. The software program @Risk chooses a random

value of the independent variable, spring wheat yield. All yield variables are assumed to have a normal distribution with the mean value and standard deviation. Likewise, the price for the independent variable, spring wheat, is chosen with a log-normal distribution. Other prices with correlations are drawn by the program. The model is simulated 1,000 times, which allows the output to develop stable means and distribution.

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,
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 2006 were used to estimate price equations. The price equations were used to estimate cash prices received by North Dakota farmers for the 2007-2016 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.

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 income 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

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

CR_{gT} = cropland cash rent in region g in time T,
EM_{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:

$$P_{it} = a_0 + a_1 P_t + a_2 P_{it-1} + e_{it} \quad (6)$$

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 2006. 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. The predicted farm prices are shown in Table 3. These prices were estimated before the current weather markets occurred. Prices for 2007 are currently much higher than the estimated prices. Whether prices will remain at or near the current levels is unknown, so it was assumed that they will return to normal levels in the future.

Table 3. North Dakota Baseline Price Estimates from the Projected FAPRI Baseline

	Spring Wheat	Durum Wheat	Malting Barley	Sunflower	Soybeans	Corn	Canola
	----------$/bu----------			-$/cwt-	-------$/bu-------		-$/cwt-
2006	3.96	3.49	2.18	12.44	5.42	2.08	10.51
2007	4.02	4.36	2.56	11.69	5.87	2.37	10.86
2008	4	4.33	2.56	12.06	6.08	2.37	11.22
2009	4.02	4.36	2.56	12.03	6.06	2.37	11.19
2010	4.04	4.39	2.55	11.91	5.99	2.37	11.07
2011	4.05	4.4	2.55	11.84	5.96	2.36	11.01
2012	4.06	4.42	2.53	11.75	5.9	2.35	10.92
2013	4.06	4.41	2.51	11.66	5.85	2.33	10.83
2014	4.05	4.4	2.51	11.53	5.78	2.32	10.7
2015	4.06	4.41	2.49	11.44	5.72	2.31	10.61
2016	4.06	4.42	2.49	11.34	5.67	2.3	10.52

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:

$$y_{it} = b_0 + b_1 \text{ trend} + b_2 y_{it-1} + D_t + e_{it} \quad (7)$$

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 2006. The estimated equations are used to predict crop yields in each region. Figure 6 shows the estimated spring and durum wheat yields. Wheat yields are expected to return to trend line levels in 2007 after lower yields in 2006 in the North Central, South Central and West. Corn yields are expected to decrease for 2007 and return to the long-term trend line while soybean yields are expected to increase. 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 expected to increase slightly over the forecast period.

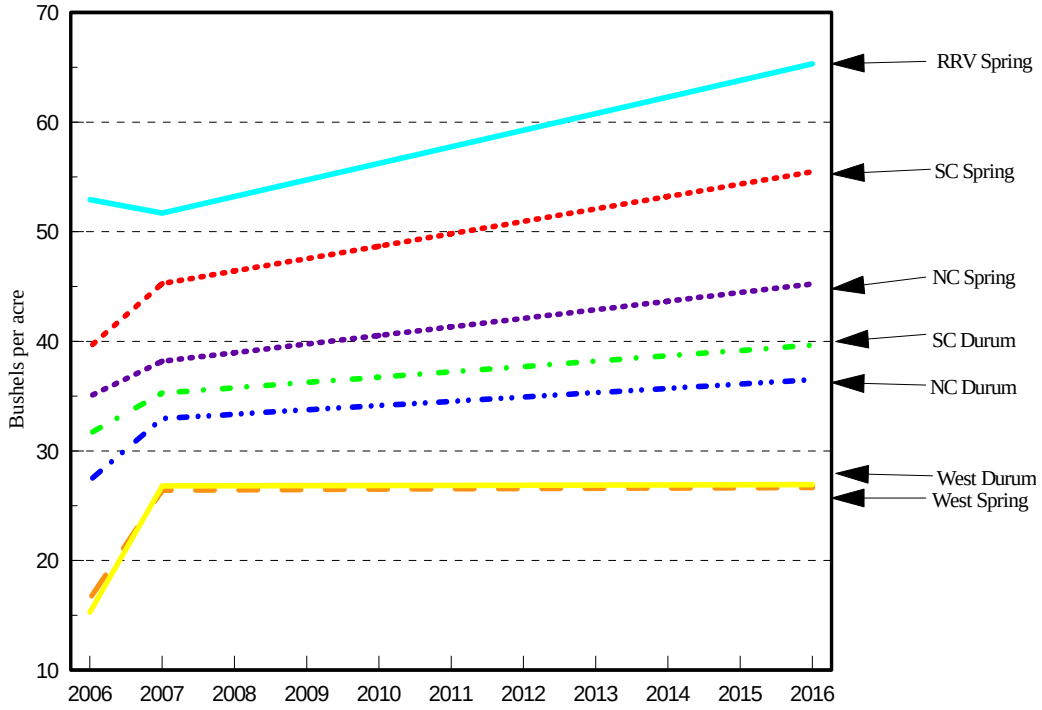


Figure 6. North Dakota Estimated Wheat Yields Used in the Representative Farm Model

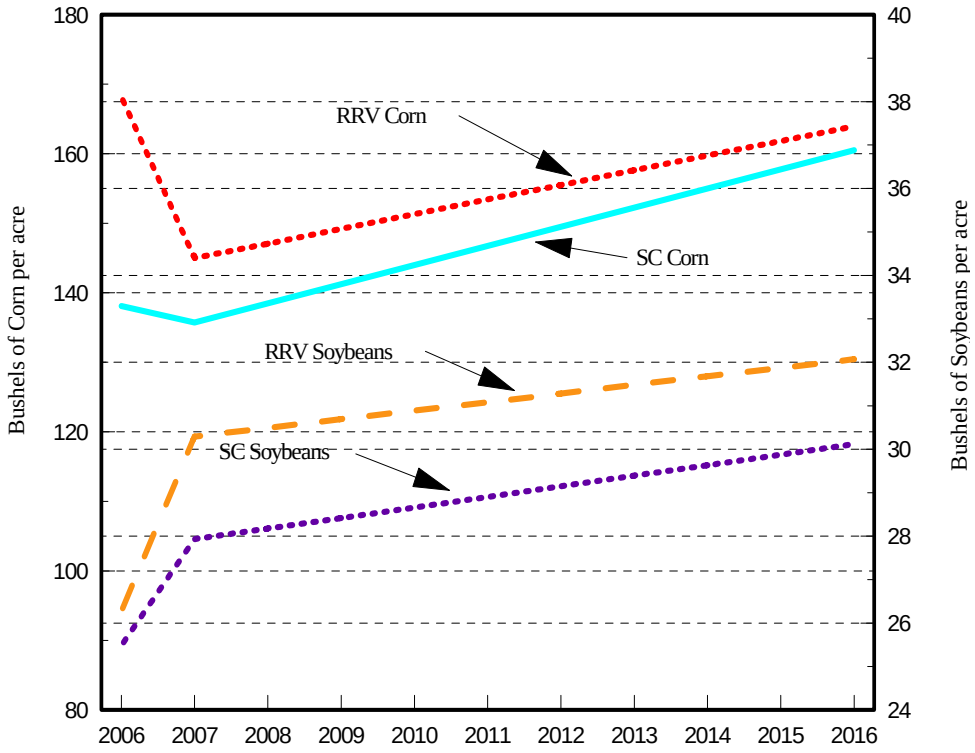


Figure 7. North Dakota Estimated Row-crop Yields Used in the Representative Farm Model

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:

$$A_{jit}=c_o+\sum_{j=1}^{n} c_j P_{jit}+c_{n+1}A_{jit-1}+c_{n+2}G_{jt}+e_{jit} \quad (8)$$

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.

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 6 are used in the acreage equations. The jth crop share in region i in time t is then calculated as follows:

$$S_{jit}=A_{jit}/\sum_{j=1}^{i} A_{jit} \quad (9)$$

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 record system data).

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.

In the previous reports, livestock income was assumed to remain constant throughout the forecast period. For the past two years, the model was adapted to allow returns from livestock to follow FAPRI's projections for cow-calf returns in the future.

AGRICULTURAL OUTLOOK FOR THE REPRESENTATIVE FARMS, 2007-2016

The North Dakota Representative Farm Model was used to estimate net farm income, debt-to-asset ratios, land prices, and rental rates for 2007-2016.

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 model is based on FAPRI prices which were estimated in January 2007, before the recent summer increases.

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 increase from the 2004-2006 average of $132 thousand to $162 thousand in 2016, which is a 23% increase (Figure 8). Net farm income for the medium-size farm, which averaged $57 thousand for 2004-2006, increases to $59 thousand in 2016. Net farm income for the small-size farm averaged $25 thousand for 2004-2006 and will decrease to $24 thousand in 2016. State average net farm income over the 10-year period is $147 thousand for the large-size farm, $54 thousand for the medium-size farm, and $21 thousand for the small-size farm. The reason for the large decrease in net farm income for the high-profit farm is most of the farms from Minnesota that are included in the profit representative farms were in the high profit class. Those farms impacted the entire state average. In 2007, it was assumed that income levels would return to a normal level. The higher income levels imply that most farms in North Dakota will have enough net income to survive 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					
2004-2006 avg	131685	57147	24526	192496	66526	-15725
2006	132201	52699	16695	205034	68095	-25909
2007	132622	49428	16946	117341	48927	-9319
2008	133794	49849	17605	110616	48128	-7876
2009	136689	50275	18772	106479	47896	-6956
2010	141120	53117	20089	111254	51066	-2240
2011	145077	52387	20617	113146	53152	-1043
2012	149773	54393	21511	116155	55336	3131
2013	152531	56370	22084	119862	56705	5649
2014	155296	57880	22829	121870	58006	7087
2015	158625	58906	23593	125413	60067	6523
2016	161681	58993	23935	126502	60224	6445

The increases in net farm income from 2007 to 2016 results from increases in yields and prices, which make up for any increases in expenses. 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, limiting upward pressure on prices. Producers are protected from price declines below loan rates specified in the 2002 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.

Yield protection is available though the Federal Crop Insurance program. Producers are able to obtain various levels of protection. The model assumes a yield protection level of 70%.

Net farm income for the high-profit farm is projected at $107 thousand in 2007 and is expected to increase to $116 thousand in 2016 (Figure 8). Net farm income for the average-profit farm is projected to be $44 thousand in 2007 and is projected to increase to $57 thousand in 2016. The low-profit farm is expected to show a net operating loss in 2007, but they are expected to return to profitability by 2012. The low-profit farm may not have the financial resiliency to survive without outside income. State average net farm income over the 2007-2016 period is $106 thousand for the high-profit farm, $50 thousand for the average-profit farm, and zero for the low-profit farm. This implies that efficient management is the key for profitable farm operation. The low-profit farm may not be able to survive, mainly because their operation is too expensive compared to the other farms.

The slow increase in farm size (2% per year) assists net farm income, but the increase in expenses each year eliminates much of the benefit. Increases in energy costs also weigh heavily on potential profits.

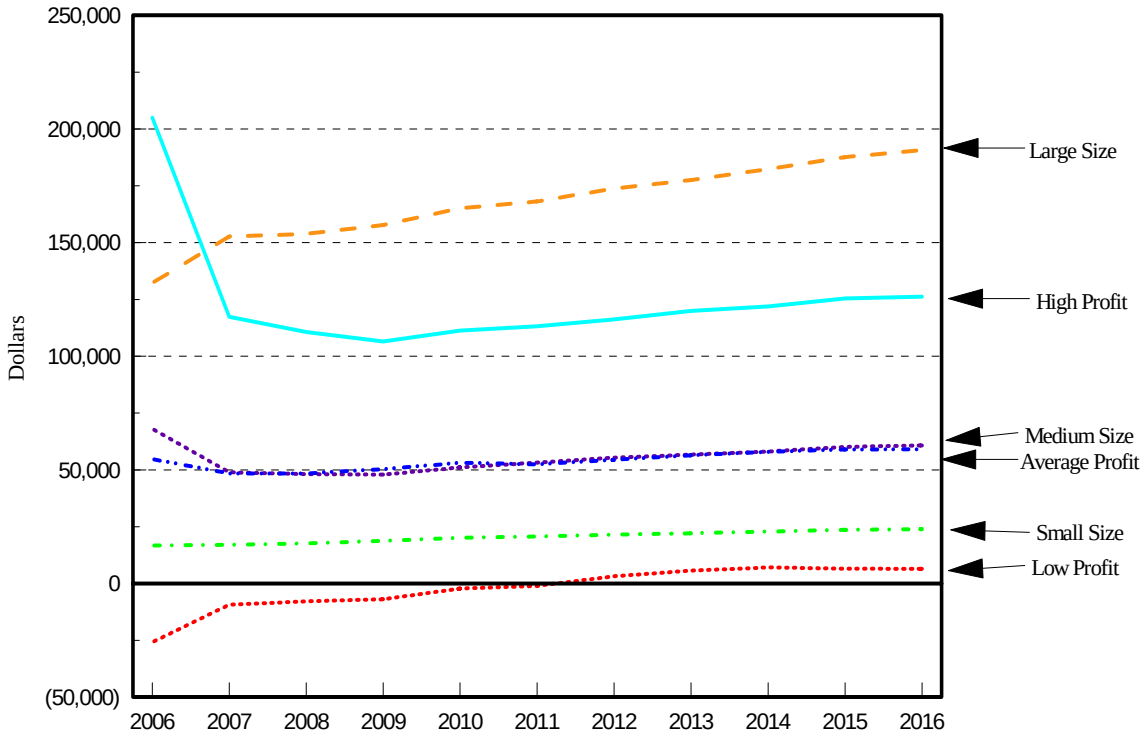


Figure 8. Net Farm Income for Size and Profit North Dakota Representative Farms

Net farm income for 2007 is expected to be slightly lower than in 2006 because many farmers in the RRV had extremely high incomes which impacted the entire state's average. Those returns are expected to return to normal levels in the future

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 distributions with known standard deviations and means. The standard deviations, an indication of variation, are large for the state, averaging 86% of net farm income. 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.

Figure 9 shows the state average net farm income and 80% confidence interval over time. The confidence interval widens over time as more variations accrue in the model. By 2016, the 80% confidence interval is $19 thousand to $107 thousand with mean at $60 thousand.

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----------				
2007					
State	48428	42121	2174612	-46068	(97) to 104,268
2011					
State	53152	49857	263820	-65466	(2,278) to 116,917
2016					
State	60724	53790	251090	-105088	1,166 to 133,379

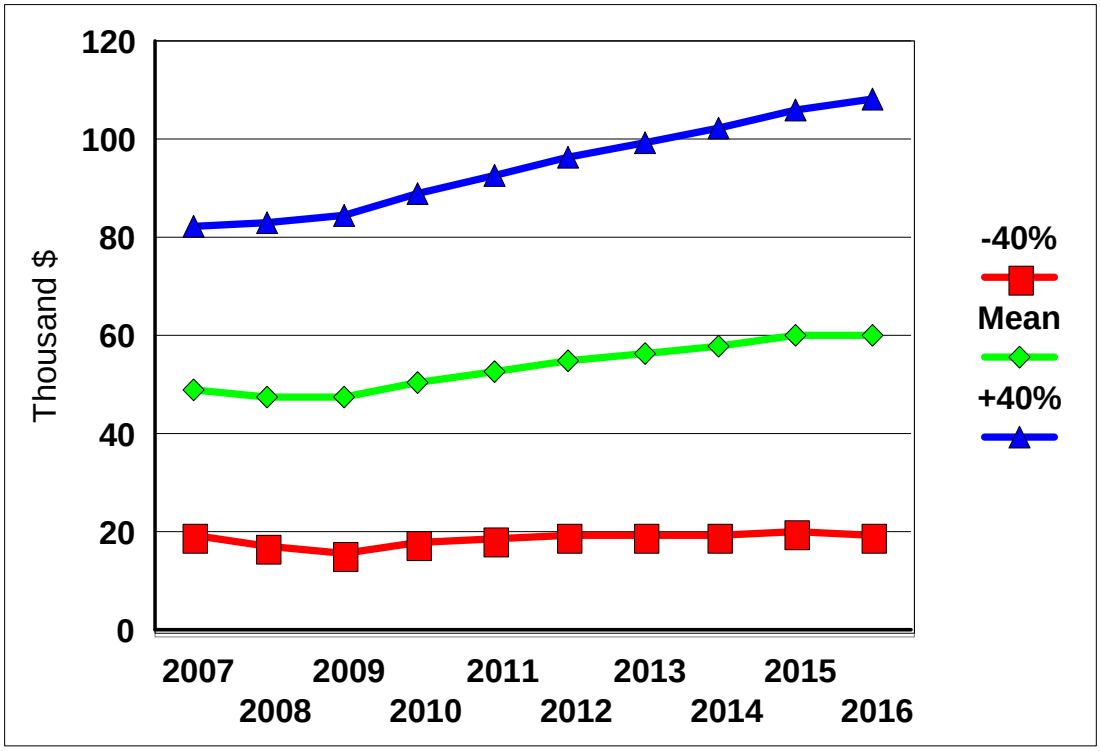


Figure 9. Average Net Farm Income and 80% Confidence Interval for Average Profit Representative Farms, 2007 to 2016

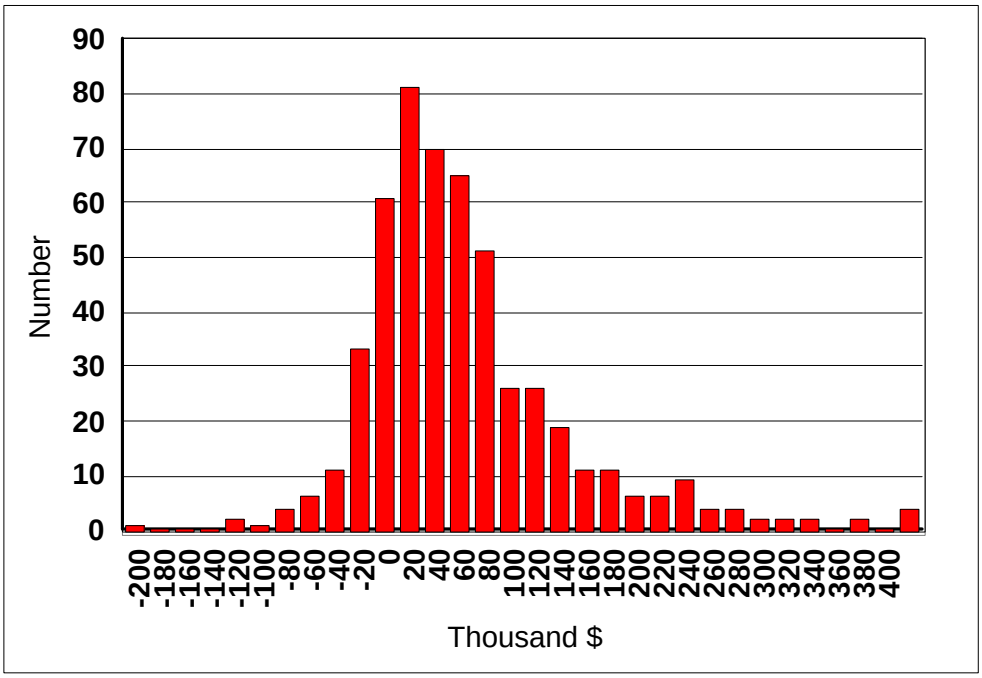


Figure 10. Percentage of Representative Farms in Each Income Category, 2006

Figure 10 shows the distribution at each income level for the average profit representative farm. The impact of the current farm bill and federal crop insurance is clearly seen. The left side of the

distribution is moved toward the center of the distribution due to farm payments and other programs. The distribution would be much wider without government support during period of low prices and yields.

Debt-to-asset Ratios for North Dakota Representative Farms

Debt-to-asset ratios for all representative farms fall throughout the forecast period. The debt-to-asset ratios for the low profit farm will remain around 0.50 and will fall slowly to 0.472 for the small size farm (Table 6 and Figures 11-12).

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

	Size			Profit		
	Large	Medium	Small	High	Average	Low
2006	0.348	0.355	0.508	0.341	0.395	0.509
2007	0.329	0.352	0.508	0.331	0.391	0.539
2008	0.324	0.344	0.501	0.353	0.402	0.528
2009	0.321	0.339	0.497	0.355	0.403	0.523
2010	0.317	0.334	0.492	0.351	0.399	0.518
2011	0.314	0.331	0.489	0.346	0.388	0.506
2012	0.311	0.326	0.485	0.343	0.385	0.505
2013	0.308	0.322	0.482	0.339	0.363	0.476
2014	0.305	0.318	0.478	0.336	0.359	0.471
2015	0.303	0.314	0.475	0.329	0.35	0.464
2016	0.301	0.311	0.472	0.327	0.0348	0.462
Average	0.313	0.329	0.488	0.341	0.379	0.499

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

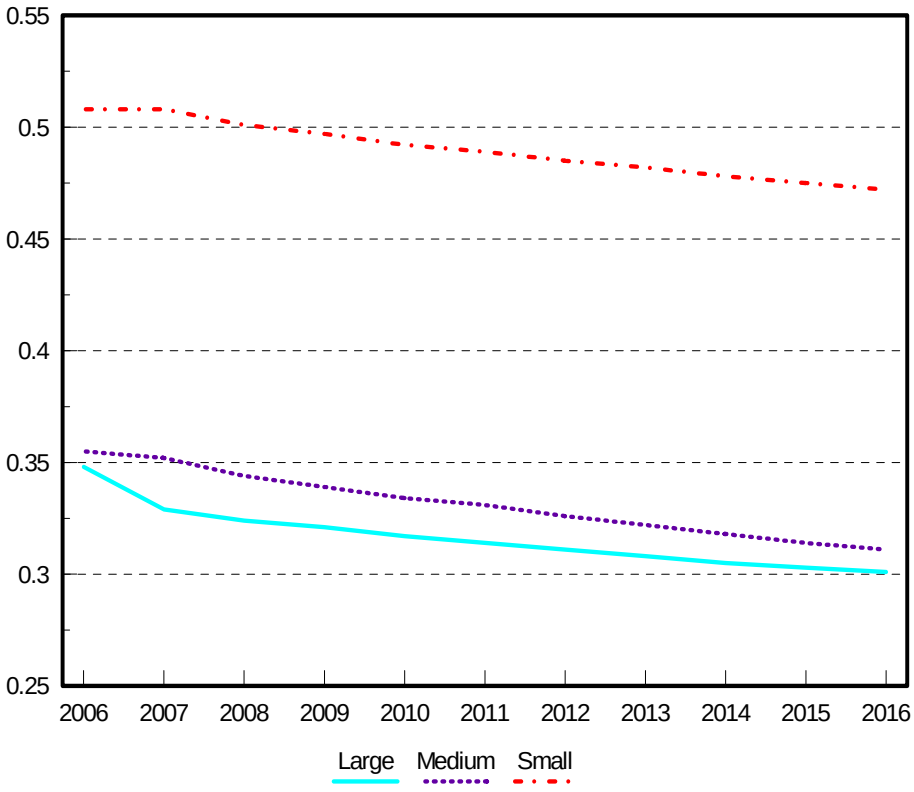


Figure 12. Debt-to-asset Ratio for North Dakota Representative Farms by Size Category

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 2006, low profit farms averaged almost $25,000 in off farm income and small size farms averaged $22,000.

Land Value and Cash Rents

Table 7 presents land prices for representative farms in North Dakota. Land values for the average-profit representative farms are shown in Figure 13. 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 4.8% over the forecast period. Land values are expected to increase 9.7% in the West region and 2.5% in the RRV. Land values are based on return to crop acres. Other factors are not considered. Therefore the land values and cash rents may not reflect market values.

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

	RRV	NC	SC	West	State
			$/acre		
2006	978.46	473.5	540.28	377.31	592.39
2007	981.21	475.74	545.98	381.6	596.13
2008	986.8	478.04	551.25	385.75	600.46
2009	989.64	480.03	555.85	389.58	603.77
2010	991.99	481.73	559.76	393.2	606.67
2011	994.2	483.25	563.03	396.58	609.26
2012	996.03	484.49	565.51	399.8	611.46
2013	997.65	485.53	567.48	403	613.41
2014	999.37	486.38	568.94	406.25	615.24
2015	1000.83	487.07	570.53	408.65	616.77
2016	1001.96	487.5	572.1	414.98	619.13
2007-2016 avg	993.97	482.98	562.04	397.94	606.23

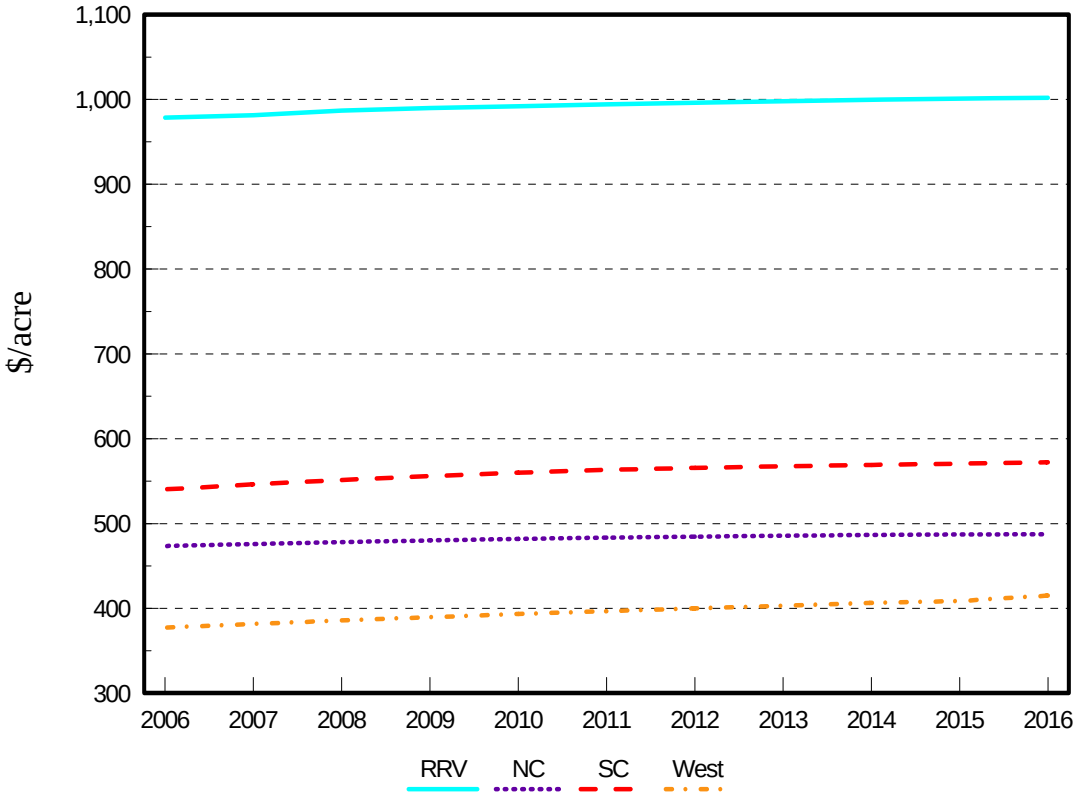


Figure 13. Average Value of Cropland for North Dakota Average-Profit Representative Farms

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 14).

Table 8. North Dakota Cash Rent for Average-Profit Representative Farms

	RRV	NC	SC	West	State
			$/acre		
2006	56.23	34.31	38.59	29.02	39.54
2007	56.39	34.47	39	29.35	39.8
2008	56.71	34.64	39.37	29.67	40.1
2009	56.88	34.79	39.7	29.97	40.33
2010	57.01	34.91	39.98	30.25	40.54
2011	57.14	35.02	40.22	30.51	40.72
2012	57.24	35.11	40.39	30.75	40.87
2013	57.34	35.18	40.53	31	41.01
2014	57.43	35.25	40.64	31.25	41.14
2015	57.52	35.29	40.75	31.43	41.25
2016	57.58	35.33	40.86	31.92	41.42
2006-2015 avg	57.12	35	40.14	30.61	40.72

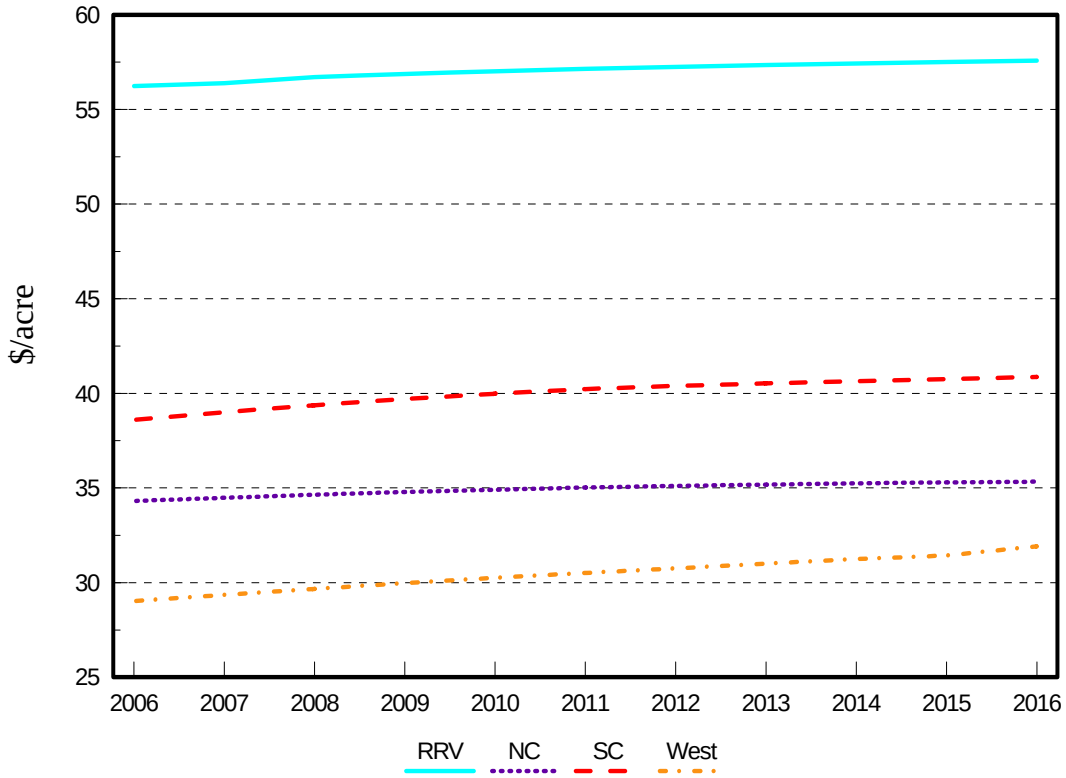


Figure 14 Average Cash Rent of Cropland for North Dakota Average-Profit Representative Farms

CONCLUDING REMARKS

Net farm income in 2016 may be higher than in 2006 for most farms. Conditions in the RRV were extremely favorable in 2006 which increased incomes for those farms well above normal. Those conditions are assumed to return to normal in the future. The higher prices received in 2006 were partially offset by lower government payments to producers. However, higher prices and yields late in the forecast period should increase returns. The most important component in net farm income seems to be production volume. The government provides adequate price support, but production support through crop insurance is substantially less adequate. Crop production in the United States and around the world is assumed to be normal with annual trend-line increases. The counter-cyclical payments protect producers from market price decreases if they produce the same crops and yields as their bases.

A risk analysis was conducted based on the historical variations of prices and yields for North Dakota farmers. The analysis indicated a wide distribution of possible net farm income for North Dakota farms. For most farms, average standard deviations were about 80% of net farm income. This means, for example, if the average net farm income was $60,000, the normal expected range of income would be between $12,000 and $108,000. The wide variations in possible net farm income makes long-term planning very difficult as potential income levels cannot be known with any certainty.

Debt-to-asset ratios are predicted to decrease slowly throughout the forecast period. Higher price levels will benefit all farms in the state.

Land values are predicted to increase slightly during the forecast period because they are based on return to land for the average profit farms. 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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