Agribusiness & Applied Economics Report No. 569 **July 2005**

2005 North Dakota Agricultural Outlook: Representative Farms, 2005-2014

Richard D. Taylor
Won W. Koo
Andrew L. Swenson

Center for Agricultural Policy and Trade Studies
Department of Agribusiness and Applied Economics
North Dakota State University
Fargo, North Dakota 58105-5636

Acknowledgments

The authors extend appreciation to Mr. Timothy Petry, Dr. Kranti Mulik, and Mr. Jeremy Mattson for their constructive comments and suggestions. Special thanks go to Ms. Beth Ambrosio and Ms. Carol Jensen, who helped to prepare the manuscript.

This research is funded under a grant by the General Service Administration.

We would be happy to provide a single copy of this publication free of charge. You can address your inquiry to: Beth Ambrosio, CAPTS, Department of Agribusiness and Applied Economics, North Dakota State University, P.O. Box 5636, Fargo, ND, 58105-5636, Ph. 701-231-7334, Fax 701-231-7400, e-mail beth.ambrosio@ndsu.nodak.edu . This publication is also available electronically at this web site: http://agecon.lib.umn.edu/.

NDSU is an equal opportunity institution.

Information on other titles in this series may be obtained from: Department of Agribusiness and Applied Economics, North Dakota State University, P.O. Box 5636, Fargo, ND 58105. Telephone: 701-231-7441, Fax: 701-231-7400, or e-mail: cjensen@ndsuext.nodak.edu.

TABLE OF CONTENTS

List of Tables

List of Figures

Abstract

Net farm income for all representative farms in 2014 is projected to be lower than in 2004. Low-profit farms, which comprise 25% of the farms in the study, may not have financial resiliency to survive without off-farm income. Costs are projected to increase faster than yields, which will pressure net farm income downward. Cropland prices and cash rental rates are projected to increase slightly in all regions. Debt-to-asset ratios for most farms will decrease slightly throughout the forecast period. Debt-to-asset ratios for the low-profit and small-size farms are higher than those for large and high-profit farms.

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

Highlights

Net farm income is projected to be higher in 2005 than the 2002-2004 average because lower yields across the state in 2002 are expected to return to trend line levels in 2005. The higher prices received in 2004 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 decrease from $116 to $110 thousand over the 2005-2014 period. The net farm income is predicted to decrease from $50 to $47 thousand for the medium-size farm and from $24 to $21 thousand for the small-size farm. The level of net farm income will not be maintained because production expenses are rising faster than yields.

Net farm income also decreases for farms in the different profit categories. During the 2005-2014 period, net farm income is predicted to decrease from $176 to $173 thousand for the high-profit farm and from $66 to $49 thousand for the average-profit farm. The low-profit farm is expected to show a net loss for the period.

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 3% for the large-size and small-size representative farms by 2014. The ratios are also projected to decrease 25% and 5% for the high and average-profit representative farms by 2014, respectively. The debt-to asset ratios for the medium size and low profit farm are projected to increase 4% and 45%, respectively.

For the average-profit representative farm, state average cropland prices will increase 6.4%, from $578.96 per acre in 2005 to $616.25 per acre in 2014. Cash rents will increase 6.5%, from $38.63 per acre in 2005 to $41.16 per acre in 2014.

2005 North Dakota Agricultural Outlook: Representative Farms, 2005-2014

Richard D. Taylor, Won W. Koo, and Andrew L. Swenson*

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.

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 2005 to 2014 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.

The North Dakota agricultural outlook for the 2005-2014 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.

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

*Research Scientist and Professor and Director in the Center for Agricultural Policy and Trade Studies, and Farm and Family Resource Management Specialist, in the Department of Agribusiness and Applied Economics, North Dakota State University, Fargo.

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 the FAPRI in their price series. For the outlook, policies are assumed to remain constant.

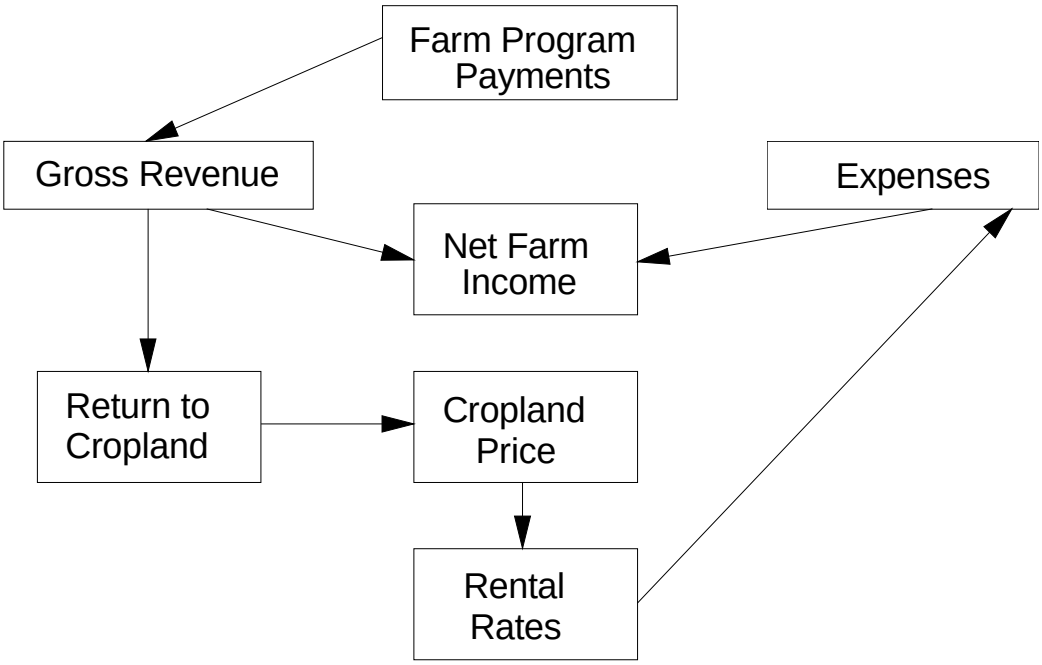
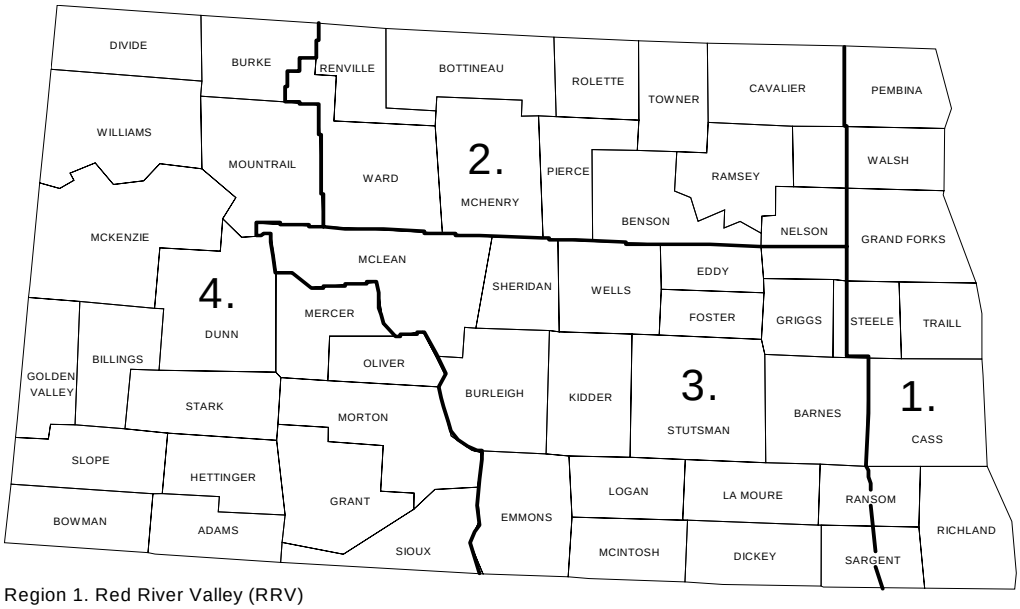


Figure 1. Structure of the North Dakota Representative Farm Model

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



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

The representative farms average 1,771 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 2,846 cropland acres for the high-profit farms, 1,728 cropland acres for the average-profit farms, and 1,242 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 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 3,389 cropland acres for the large-size farms, 1,453 cropland acres for the medium-size farms, and 527 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.

Table 1. Characteristics of Representative North Dakota Farms, 2004

	Size			Profit		
	Large	Medium	Small	High	Average	Low
Number of Farms	131	261	131	124	621	124
Total Cropland (ac)	3,389	1,453	527	2,846	1,728	1,242
Spring Wheat (ac)	1,020	370	96	678	442	316
Durum Wheat (ac)	163	114	88	237	135	86
Barley (ac)	255	104	22	254	201	126
Corn (ac)	216	96	54	219	106	95
Sunflower (ac)	160	53	9	361	238	176
Soybeans (ac)	610	235	88	355	192	169

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 2004, the farms averaged $290,753 gross return with a profit of $60,047. In 1994, the farms generated $1.37 gross output for every $1 inputs; by 2004, that had fallen to $1.26 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 2004, the average size was 1,771 acres. This is an increase of 32% over the 10-year period. Net return per acre fell from $36.67 per acre in 1994 to $34.74 per acre in 2004.

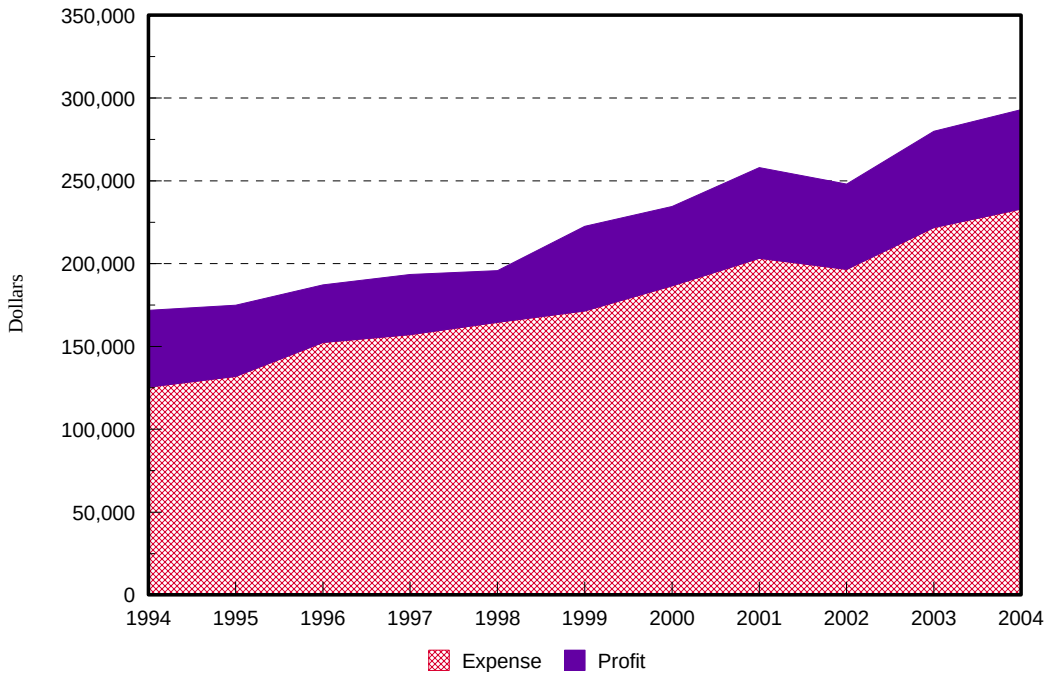


Figure 3. Average Expense and Profit for Farms in the North Dakota Farm and Ranch Business Management Program

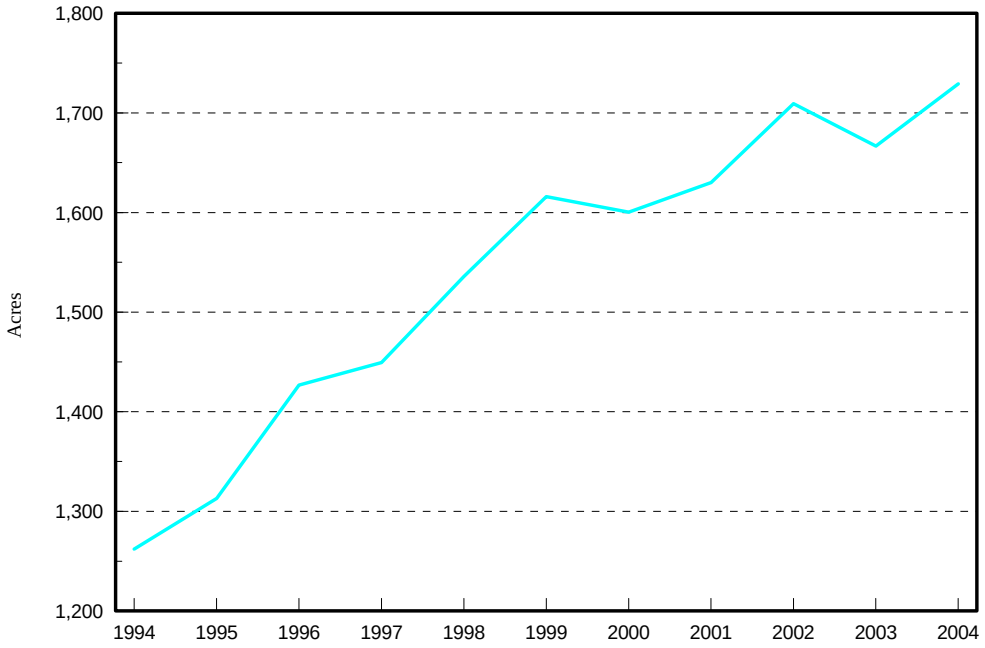


Figure 4. Average Cropland Acres of Farms in the North Dakota Farm and Ranch Business Management Program

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,
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 2002 were used to estimate price equations. The price equations were used to estimate cash prices received by North Dakota farmers for the 2005-2014 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 2002. 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

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

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

$$CR_{gT}=\sum EM_{gt}R_g+TX_T \quad (4)$$

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.

Probability of the Forecasted Income. Yields and commodity prices vary each year. The model is based on assumptions that yields will follow a trend line and prices will follow FAPRI's price forecast. Since actual future prices and yields are unknown, the model's forecast will not be accurate. The probabilities for the forecasted income are estimated under the assumption that future prices and yields vary similar to the past.

To calculate the probability that the projected income will be within 15% of the actual income, the historical mean and standard deviation were determined for each representative farm. The distribution of the forecasted net farm income was normalized to a standard normal distribution with a mean of 0 and a standard deviation of 1. Equation 5 shows the standard normal distribution of X, which has a mean of m and a standard error of S.

$$Z= (X-m)/s \quad (5)$$

where X is the forecasted net farm income, m is the sample mean and s is the standard deviation. Z is a standard normal distribution of X. In Figure 5, he area of X_1 to u is the probability for a 15% lower income, and the area of X_2 to u is the probability for a 15% higher income. The

difference between the two areas is the probability that the forecasted net farm income is within 15% of the actual net farm income.

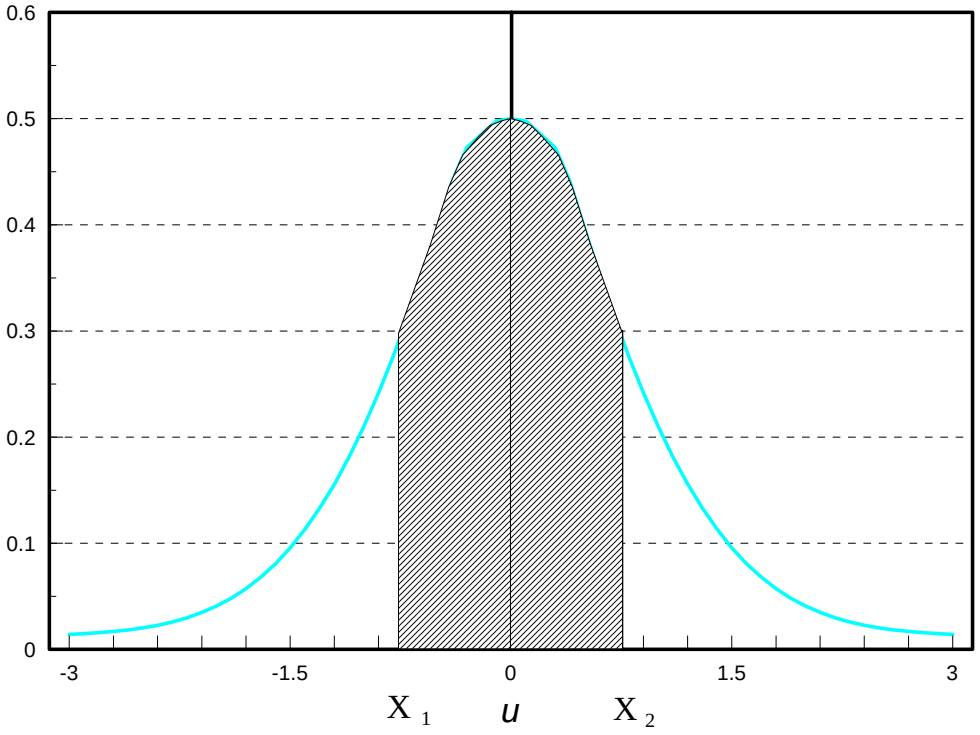


Figure 5. Probability of Actual Income Being within 15% of Forecasted Income

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:

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

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 2002. 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 2.

Table 2. North Dakota Baseline Price Estimates from the Projected FAPRI Baseline

	Spring Wheat	Durum Wheat	Malting Barley	Feed Barley	Sunflower	Soybeans	Corn	Canola
	----------$/bu----------				-$/cwt-	-------$/bu-------		-$/cwt-
2004	3.55	3.93	2.58	1.74	13.55	7.25	2.43	12.01
2005	3.28	3.56	2.33	1.87	11.75	4.49	1.81	9.39
2006	3.31	3.60	2.42	1.93	11.60	4.53	1.86	9.56
2007	3.37	3.70	2.44	1.94	11.86	4.68	1.89	9.73
2008	3.42	3.78	2.43	1.93	11.86	4.81	1.90	9.90
2009	3.48	3.86	2.44	1.94	11.94	4.82	1.93	9.93
2010	3.53	3.94	2.44	1.94	11.89	4.83	1.95	9.85
2011	3.57	3.99	2.45	1.95	11.85	4.84	1.96	9.86
2012	3.62	4.07	2.45	1.95	11.83	4.84	1.98	9.85
2013	3.66	4.13	2.47	1.96	11.82	4.84	1.98	8.85
2014	3.69	4.17	2.49	1.98	11.80	4.83	1.99	8.84

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 2002. The estimated equations are used to predict crop yields in each region. Figure 6 shows the estimated spring and durum wheat yields. Wheat yields, especially for spring wheat, are expected to return to trend line levels in 2005 after higher yields in 2004, and row crop yields are expected to increase in 2005 and return to the long term trend line. 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.

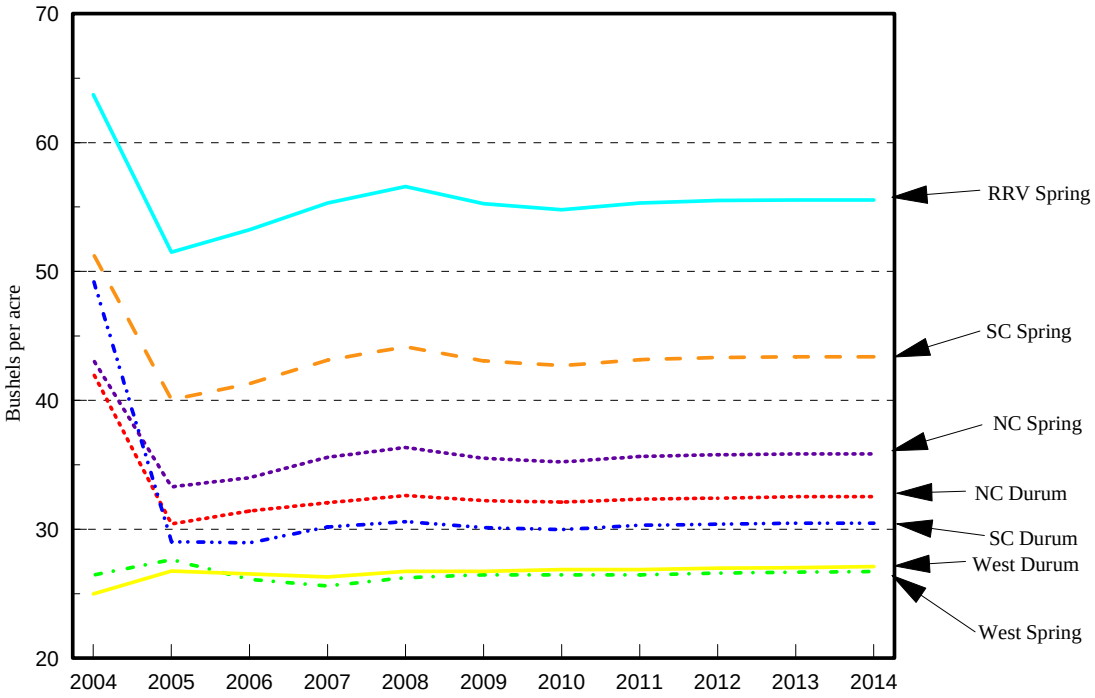


Figure 6. North Dakota Estimated Wheat Yields Used in the Representative Farm Model

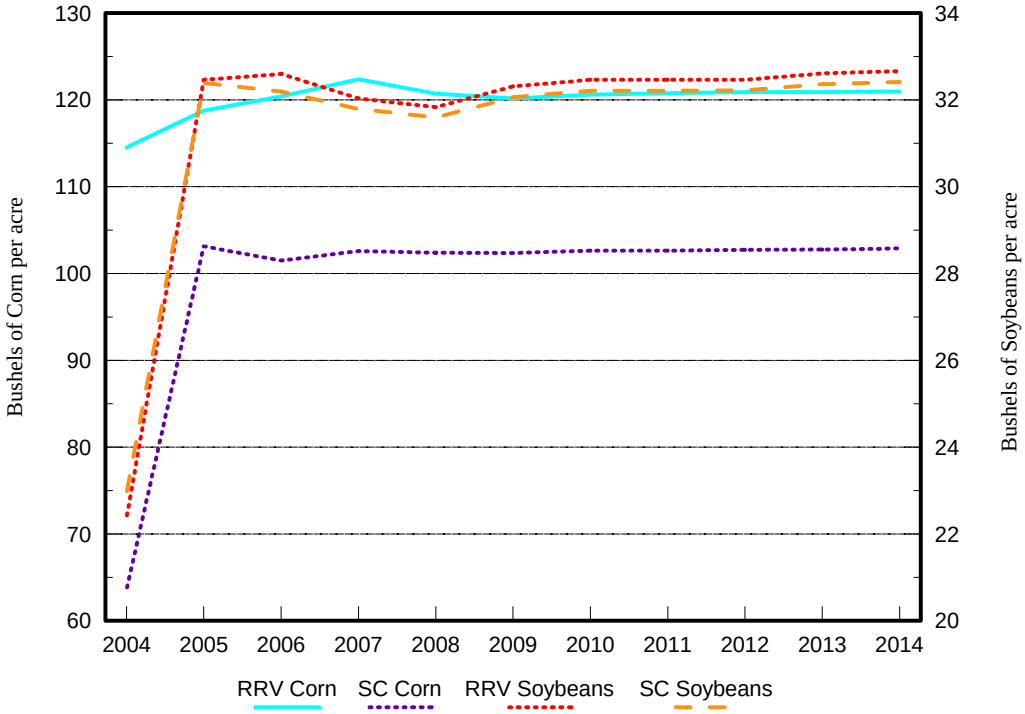


Figure 7. North Dakota Estimated Row-crop Yields Used in the Representative Farm Model

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 2001. 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. This year, 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, 2005-2014

The North Dakota Representative Farm Model was used to estimate net farm income, debt-to-asset ratios, land prices, and rental rates for 2005-2014.

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.

Net Income for North Dakota Representative Farms

Table 3 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 2002-2004 average of $131 thousand to $109 thousand in 2014, which is a 16% decline (Figure 8). Net farm income for the medium-size farm, which averaged $62 thousand for 2002-2004, decreases to $47 thousand in 2014. Net farm income for the small-size farm averaged $31 thousand for 2002-2004 and will decrease to $21 thousand in 2014. State average net farm income over the 10-year period is $113 thousand for the large-size farm, $47 thousand for the medium-size farm, and $22 thousand for the small-size farm. This result implies 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 will probably need off-farm income to supplement family living.

Table 3. State Average Net Farm Income for Different Size and Profit Representative Farms

	Size			Profit		
	Large	Medium	Small	High	Average	Low
				dollars		
2002-2004 avg	130,512	61,502	31,060	175,984	68,053	-785
2004	128,814	53,918	27,190	175,588	65,840	-12,756
2005	116,837	49,652	24,258	172,841	63,814	527
2006	115,232	48,339	23,550	174,107	64,079	766
2007	115,736	47,544	23,247	176,785	65,627	915
2008	113,776	46,308	22,210	179,467	64,916	-271
2009	111,149	45,722	21,494	176,642	61,045	-2,999
2010	111,111	45,719	21,428	175,441	58,124	-5,834
2011	111,666	45,943	21,213	175,152	55,599	-8,511
2012	111,137	45,883	21,917	173,603	52,307	-11,305
2013	110,531	46,218	20,681	173,892	50,323	-13,537
2014	109,863	46,516	20,971	173,497	48,609	-15,674

The decreases in net farm income from 2005 to 2014 are because increases in future yields do not make up for 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 rate will be offset by an increase in governmental subsidies. Further price protection is available through counter-cycle payments which are triggered when the national average price is less than the target prices minus the direct payment rate. However, the counter-cycle payment is decoupled from actual production and based on historical yields and 85% of base acreage.

Net farm income for the high-profit farm is projected at $172 thousand in 2005 and is expected to increase to $173 thousand in 2014 (Figure 8). Net farm income for the average-profit farm is $64 thousand in 2005 and is projected to decrease to $48 thousand in 2014. The low-profit farm is expected to show a slight net operating profit in 2005, but losses are projected for much of the forecast period. The low-profit farm may not have the financial resiliency to survive without outside income. State average net farm income over the 2005-2014 period is $175 thousand for the high-profit farm, $58 thousand for the average-profit farm, and -$6 thousand for the low-profit farm.

The slow increase in farm size (2% per year) does assist 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.

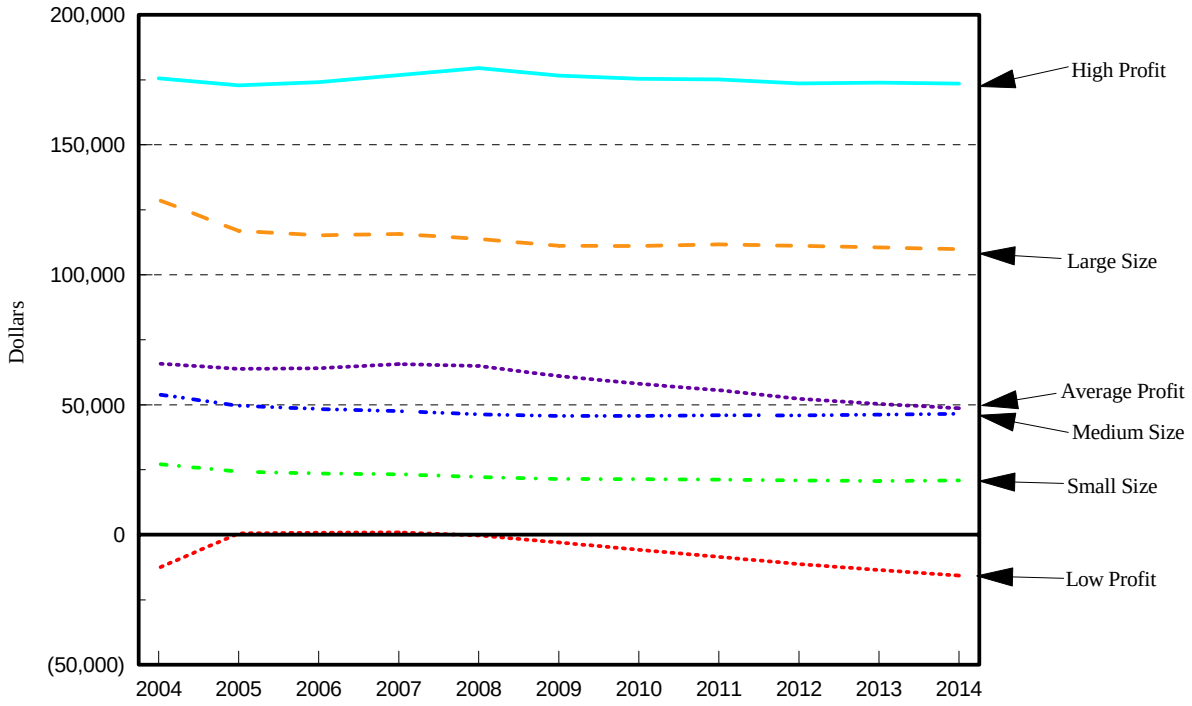


Figure 8. Net Farm Income for Size and Profit North Dakota Representative Farms

Net farm income for 2005 is expected to be lower than in 2004 because crop yields for spring and durum wheat, barley, and canola were substantially higher in 2004 than in most regions of the state. It is expected that crop yields return to normal in 2005. The higher prices received in 2004 were partially offset by lower government payments.

Table 4 shows the forecasted net farm income for the profit representative farms by region and the probabilities that these projections are within plus/minus 15% of the actual net farm income. The probability is higher than 50% for the high and average-profit farms in the RRV and in the 35% to 40% range for the remainder of the high-profit farms in the other regions. The probabilities for average and low-profit farms in the South Central and West regions are between 30% and 40%. The probabilities for the low-profit farms in the RRV and North Central regions are below 30% in most cases. The main reason for the low probabilities in the case of low-profit farms is that the standard deviations are large compared to the mean of the net farm income, indicating that net farm income for low-profit farms fluctuates greatly.

Table 4. Net Farm Income for North Dakota Profit Representative Farms by Region and Probability of Forecasted Income Being within 15% of Actual Income

	RRV			NC		
	High	Medium	Low	High	Medium	Low
2005	189,402	81,700	6,685	159,530	57,989	2,731
	(0.54)	(0.51)	(0.23)	(0.48)	(0.49)	(0.22)
2006	196,290	84,898	11,013	160,617	63,667	5,395
	(0.55)	(0.51)	(0.25)	(0.47)	(0.45)	(0.24)
2007	189,756	89,761	14,030	170,723	67,061	6,394
	(0.54)	(0.50)	(0.25)	(0.41)	(0.46)	(0.24)
2008	189,893	89,070	14,410	176,184	67,014	5,588
	(0.54)	(0.50)	(0.26)	(0.38)	(0.46)	(0.24)
2009	187,195	86,077	14,563	173,550	61,937	2,211
	(0.50)	(0.51)	(0.25)	(0.39)	(0.48)	(0.22)
2010	189,250	86,183	14,190	171,316	57,061	-1,165
	(0.50)	(0.51)	(0.25)	(0.41)	(0.48)	(0.19)
2011	190,713	85,851	14,007	172,231	53,779	-3,973
	(0.51)	(0.51)	(0.25)	(0.40)	(0.48)	(0.17)
2012	189,108	83,324	14,393	170,943	49,041	-7,692
	(0.50)	(0.51)	(0.26)	(0.40)	(0.46)	(0.15)
2013	188,642	81,436	14,197	170,914	45,484	-10,897
	(0.50)	(0.51)	(0.25)	(0.40)	(0.44)	(0.14)
2014	188,937	80,826	14,619	167,641	41,579	-14,419
	(0.50)	(0.51)	(0.26)	(0.43)	(0.41)	(0.13)

	SC			West		
	High	Medium	Low	High	Medium	Low
2005	198,313	60,739	-3,646	144,119	54,829	-3,661
	(0.39)	(0.35)	(0.31)	(0.34)	(0.31)	(0.30)
2006	204,273	60,636	-6,147	135,245	47,114	-7,197
	(0.38)	(0.35)	(0.31)	(0.37)	(0.34)	(0.31)
2007	215,110	63,086	-6,599	131,551	42,601	-10,167
	(0.36)	(0.34)	(0.31)	(0.38)	(0.37)	(0.34)
2008	217,411	61,830	-9,826	134,381	41,750	-11,257
	(0.36)	(0.35)	(0.33)	(0.36)	(0.38)	(0.33)
2009	212,463	57,389	-15,468	133,361	38,777	-13,303
	(0.37)	(0.36)	(0.36)	(0.37)	(0.40)	(0.31)
2010	207,816	52,995	-21,221	133,382	36,255	-15,140
	(0.37)	(0.37)	(0.39)	(0.37)	(0.41)	(0.34)
2011	204,445	49,088	-27,053	133,218	33,677	-17,026
	(0.38)	(0.38)	(0.41)	(0.37)	(0.42)	(0.36)
2012	199,288	44,441	-33,619	135,072	32,421	-18,302
	(0.39)	(0.39)	(0.39)	(0.37)	(0.43)	(0.37)
2013	196,796	415063	-38,588	139,218	32,865	-18,859
	(0.40)	(0.39)	(0.39)	(0.35)	(0.43)	(0.37)
2014	193,726	38,306	-43,749	143,684	33,724	-19,147
	(0.40)	(0.40)	(0.35)	(0.34)	(0.42)	(0.37)

Numbers in Parentheses represent the probability on actual income being within 15% of the forecasted income.

Debt-to-asset Ratios for North Dakota Representative Farms

Debt-to-asset ratios for the high and average representative farms fall throughout the forecast period (Table 5 and Figure 9). The debt-to-asset ratio for the low-profit farm increases from 0.58 in 2004 to 0.81 by 2014, which indicates that these farms will most likely not be able to obtain new credit.

Table 5. State Average Debt-to-asset ratios for Different Size and Profit Representative Farms

	Size			Profit		
	Large	Med	Small	High	Ave	Low
2004	0.41	0.46	0.52	0.36	0.45	0.58
2005	0.40	0.45	0.51	0.34	0.44	0.56
2006	0.39	0.45	0.50	0.31	0.41	0.55
2007	0.39	0.45	0.49	0.29	0.41	0.57
2008	0.38	0.45	0.49	0.28	0.40	0.58
2009	0.38	0.45	0.49	0.28	0.40	0.60
2010	0.38	0.45	0.49	0.27	0.40	0.63
2011	0.38	0.45	0.48	0.26	0.40	0.66
2012	0.38	0.46	0.49	0.26	0.40	0.70
2013	0.38	0.46	0.49	0.25	0.41	0.76
2014	0.38	0.47	0.49	0.25	0.41	0.81
Average	0.38	0.45	0.49	0.28	0.41	0.64

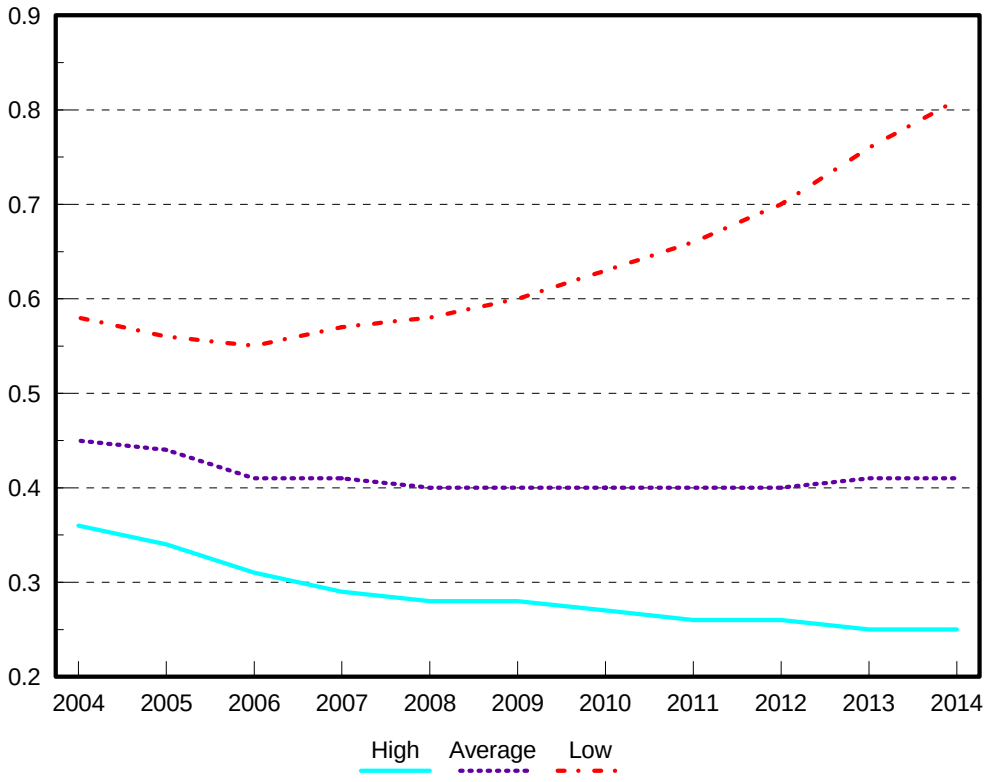


Figure 9. Debt-to-asset Ratio for North Dakota Representative Farms by Profit

Debt-to-asset ratios for large and small-size farms also fall slightly throughout the forecast period (Figure 10). The debt-to-asset ratio for the large-size farm is 0.41 in 2005 and slowly falls to 0.38 in 2014; while the ratio for the small-size farm decreases from 0.51 in 2005 to 0.49 in 2014. The debt-to-asset ratio for the medium-size farm increases from 0.45 in 2005 to 0.47 in 2014.

Higher debt-to-asset ratios for the low-profit farms, when coupled with low net farm income, suggest serious problems in sustaining the farm business unless substantial off-farm income is earned. Without additional off-farm income to provide family living requirements, it is unlikely that the low-profit farm can survive or be able to obtain operating credit. The farm operator may wish to investigate another investment opportunity with the possibility of higher returns or markedly restructure the farming operation to improve its profitability.

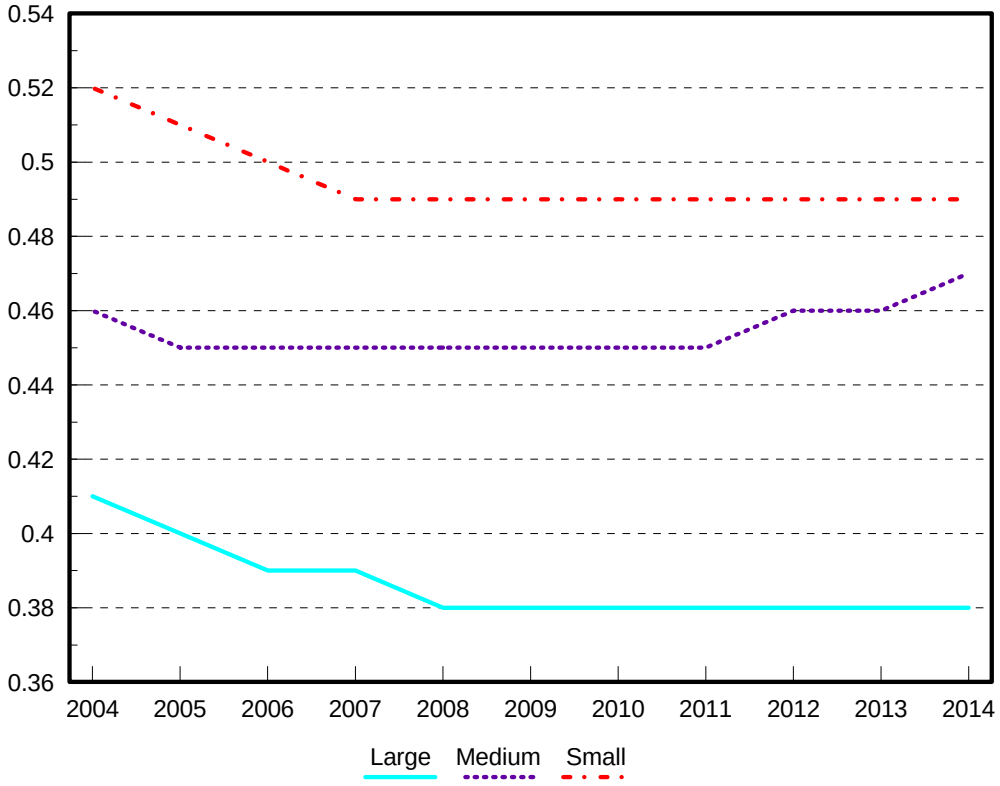


Figure 10. Debt-to-asset Ratio for North Dakota Representative Farms by Size

Land Value and Cash Rents

Table 6 presents land prices for various representative farms in North Dakota. Land values for the average-profit representative farms are shown in Figure 11. Land prices differ between the regions; the highest prices are in the RRV, and the lowest are in the West region. Land prices are also expected to change over the forecast period and are expected to increase by 6.4%. Land values are based on return to crop acres and other factors are not considered.

Table 6. North Dakota Land Prices for Average-Profit Representative Farms

	RRV	NC	SC	West	State
			$/acre		
2004	975.71	470.36	489.00	326.72	565.45
2005	978.56	472.32	512.36	352.58	578.96
2006	981.62	474.64	536.70	374.17	591.79
2007	985.01	477.18	544.36	376.70	595.81
2008	991.38	479.68	551.78	379.12	600.49
2009	994.37	481.79	558.40	381.23	603.95
2010	997.31	483.52	564.23	383.05	607.03
2011	1000.15	484.97	569.33	384.59	609.76
2012	1002.71	486.04	573.54	385.98	612.07
2013	1005.05	487.94	577.17	387.38	614.39
2014	1007.26	488.72	580.17	388.84	616.25
2005-2014 avg	994.34	481.68	556.80	379.36	603.05

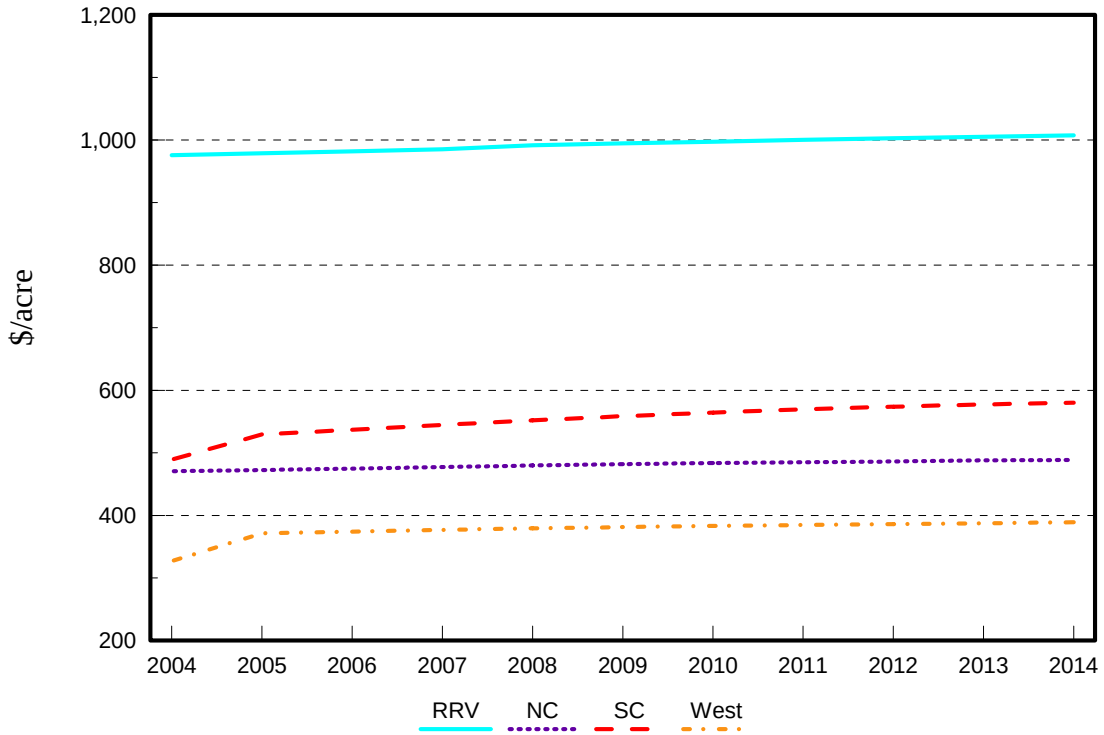


Figure 11. Average Value of Cropland for North Dakota Average-Profit Representative Farms

Cash rents for the average-profit farms slowly increase in all regions (Table 7). Cash rents also differ between regions; the highest are in the RRV, and the lowest are in the West (Figure 12).

Table 7. North Dakota Cash Rent for Average-Profit Representative Farms

	RRV	NC	SC	West	State
	----------$/acre----------				
2004	56.08	34.08	34.93	25.13	37.56
2005	56.24	34.23	36.82	27.25	38.63
2006	56.42	34.39	38.34	28.28	39.36
2007	56.61	34.58	38.88	28.98	39.76
2008	56.98	34.76	39.41	29.16	40.08
2009	57.15	34.91	39.89	29.33	40.32
2010	57.32	35.04	40.30	29.47	40.53
2011	57.48	35.14	40.67	29.58	40.72
2012	57.63	35.22	40.97	29.69	40.88
2013	57.76	35.36	41.23	29.80	41.04
2014	57.89	35.41	41.44	29.91	41.16
2005-2014 avg	57.15	34.90	39.79	29.14	40.25

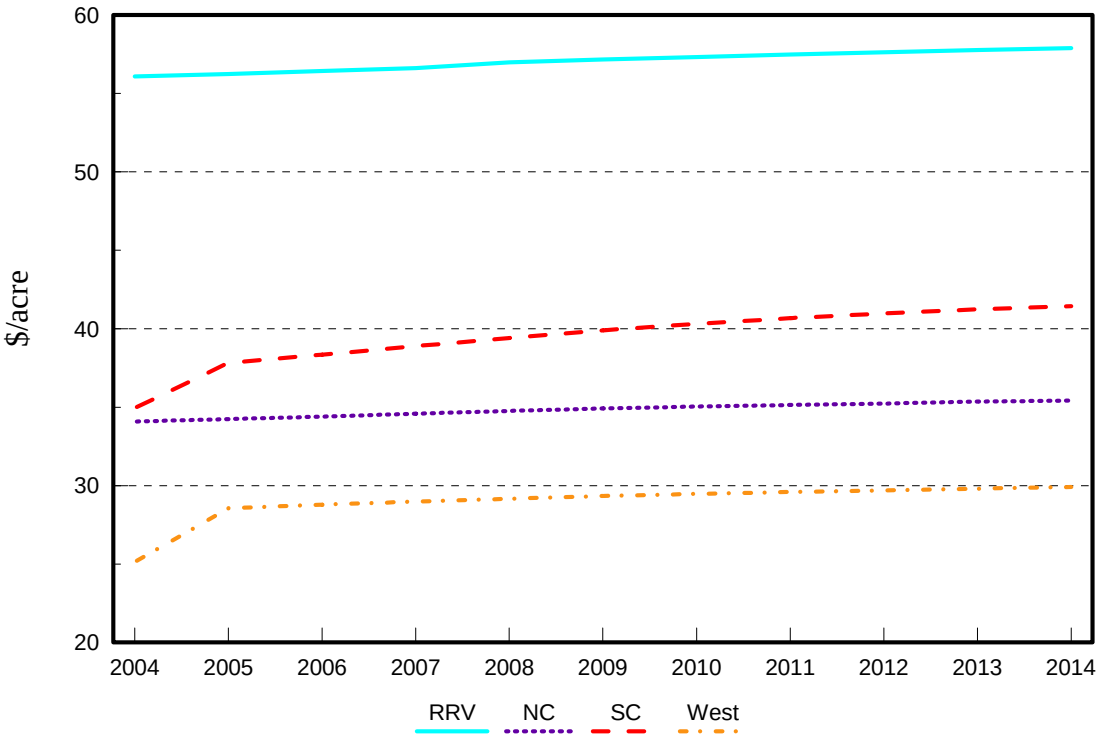


Figure 12. Average Cash Rent of Cropland for North Dakota Average-Profit Representative Farms

CONCLUDING REMARKS

Net farm income in 2014 may be lower than in 2004. The higher prices received in 2004 were partially offset by lower government payments to producers. 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. Net farm income for all representative farms is projected to fall slowly throughout the forecast period. 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.

Probabilities that actual net farm income will be within 15% of the projections were between 30% and 50% for most farms, with the exception of the low-profit farms. The probabilities were calculated based on historical means and standard deviations.

Debt-to-asset ratios are predicted to decrease slowly, for most farms, throughout the forecast period. The higher debt-to-asset ratios for the low-profit farms, when coupled with their low net farm income, suggest problems in sustaining the farm business unless substantial off-farm income is earned.

Land prices are predicted to increase slightly during the forecast period. Cash rent levels follow a pattern similar to land prices.

References

Benirschka, Martin, and Won W. Koo. 1995. *World Wheat Policy Simulation Model: Description and Computer Program Documentation*. Agricultural Economics Report No. 340, Department of Agricultural Economics, North Dakota State University, Fargo.

Benirschka, Martin, and Won W. Koo. 1996. *World Sugar Policy Simulation Model: Description and Computer Program Documentation*. Agricultural Economics Report No. 356, Department of Agricultural Economics, North Dakota State University, Fargo.

FAPRI Baseline Projections. January 2005. Food and Agricultural Policy Research Institute, Columbia, MO.

North Dakota Agricultural Statistics. Various issues. North Dakota Agricultural Statistics Service, Fargo.

North Dakota Farm and Ranch Business Management Annual Reports 2003 and 2004. North Dakota State Board for Vocational Education, Bismarck.

Wooldridge, Jeffrey M. 1999. *Introductory Econometrics: A Modern Approach*. South-Western College Publishing.