

**2006 North Dakota Agricultural Outlook:
Representative Farms, 2006-2015**

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 the U.S. agricultural policy and trade research program funded by the U.S. Department of Homeland Security/U.S. Customs and Border Protection Service (Grant No. TC-03-003G, ND1301).

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.

NOTICE:

The analyses and views reported in this paper are those of the author(s). They are not necessarily endorsed by the Department of Agribusiness and Applied Economics or by North Dakota State University.

North Dakota State University is committed to the policy that all persons shall have equal access to its programs, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

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@ndsuent.nodak.edu.

Copyright © 2006 by Richard D. Taylor, Won W. Koo, and Andrew L. Swenson. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

TABLE OF CONTENTS

	Page
List of Tables	ii
List of Figures	iii
Abstract	iv
Highlights	v
Introduction	1
Development of an Empirical Model	1
The North Dakota Representative Farm	2
Structure of the Representative Farm Model	5
Net Farm Income	6
Cropland Prices and Cash Rent	6
Cash Rent	7
Data Used for the Representative Farm	8
Agricultural Outlook for the Representative Farms, 2005-2014	11
Net Income for North Dakota Representative Farms	11
Risk Simulation	13
Debt-to-asset Ratios for North Dakota Representative Farms	15
Land Value and Cash Rents	17
Concluding Remarks	20
References	21

List of Tables

<u>No.</u>		<u>Page</u>
1	Characteristics of Representative North Dakota Farms, 2005	4
2	North Dakota Baseline Price Estimates from the Projected FAPRI Baseline	8
3	State Average Net Farm Income for Different Size and Profit Representative Farms	12
4	Results of the Risk Simulation for the Profit Representative Farm Model, Net Farm Income	14
5	State Average Debt-to-asset Ratios for Different Size and Profit Representative Farms	16
6	North Dakota Land Prices for Average-Profit Representative Farms	18
7	North Dakota Cash Rent for Average-Profit Representative Farms	19

List of Figures

<u>No.</u>		<u>Page</u>
1	Structure of the North Dakota Representative Farm Model	2
2	North Dakota Farm and Ranch Business Management Regions	3
3	Average Expense and Profit for Farms in the North Dakota Farm and Ranch Business Management Program	4
4	Average Cropland Acres of Farms in the North Dakota Farm and Ranch Business Management Program	5
5	North Dakota Estimated Wheat Yields Used in the Representative Farm Model	9
6	North Dakota Estimated Row-crop Yields Used in the Representative Farm Model	10
7	Net Farm Income for Size and Profit North Dakota Representative Farms	13
8	Average Net Farm Income and 80% Confidence Interval for Profit Representative Farms, 2005-2015	14
9	Percentage of Representative Farms in Each Income Category, 2006	15
10	Debt-to-asset Ratio for North Dakota Representative Farms by Profit	16
11	Debt-to-asset Ratio for North Dakota Representative Farms by Size	17
12	Average Value of Cropland for North Dakota Average-Profit Representative Farms	18
13	Average Cash Rent of Cropland for North Dakota Average-Profit Representative Farms	19

Abstract

Net farm income for nearly all representative farms in 2015 is projected to be higher than in 2005. 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 most farms will decrease slightly throughout the forecast period. Debt-to-asset ratios for the low-profit farms are expected to increase throughout the forecast period.

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 2006 than the 2003-2005 average for most farms, because higher row crop yields across the state in 2005 are expected to return to trend line levels in 2006. 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 increase from \$120 to \$138 thousand over the 2006-2015 period. The net farm income is predicted to increase from \$64 to \$68 thousand for the medium-size farm and from \$37 to \$43 thousand for the small-size farm.

Net farm income is expected to increase for the high-profit farms. During the 2006-2015 period, net farm income is predicted to increase from \$159 to \$163 thousand for the high-profit farm and to decrease from \$64 to \$59 thousand for the average-profit farm. The low-profit farm is expected to show a net loss for the period. 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 2006, the mean net farm income is expected to be \$77,818 with a standard deviation of \$43,678 and a 90% confidence interval of \$25,687 to \$134,570. By 2015, the mean net farm income is expected to be \$80,043 with a standard deviation of \$66,109. The 90% confidence interval will be \$1,504 to \$169,476. A significant increase in uncertainty in farm income is expected for the next decade.

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 11% for the large-size representative farm, 10% for the medium-size representative farm, and 8% for the small-size representative farm by 2015. The ratios are also projected to decrease 8% and 12% for the high and average-profit representative farms by 2015, respectively. The debt-to asset ratio for the low profit farm is projected to increase 5%.

For the average-profit representative farm, state average cropland values will increase 4.1%, from \$592.39 per acre in 2006 to \$616.77 per acre in 2015. Cash rents will increase 4.3%, from \$39.54 per acre in 2006 to \$41.25 per acre in 2015. Cropland values and rent are estimated solely on returns to cropland.

2006 North Dakota Agricultural Outlook: Representative Farms, 2006-2015

**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 2006 to 2015 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 2006-2015 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.

*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.

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.

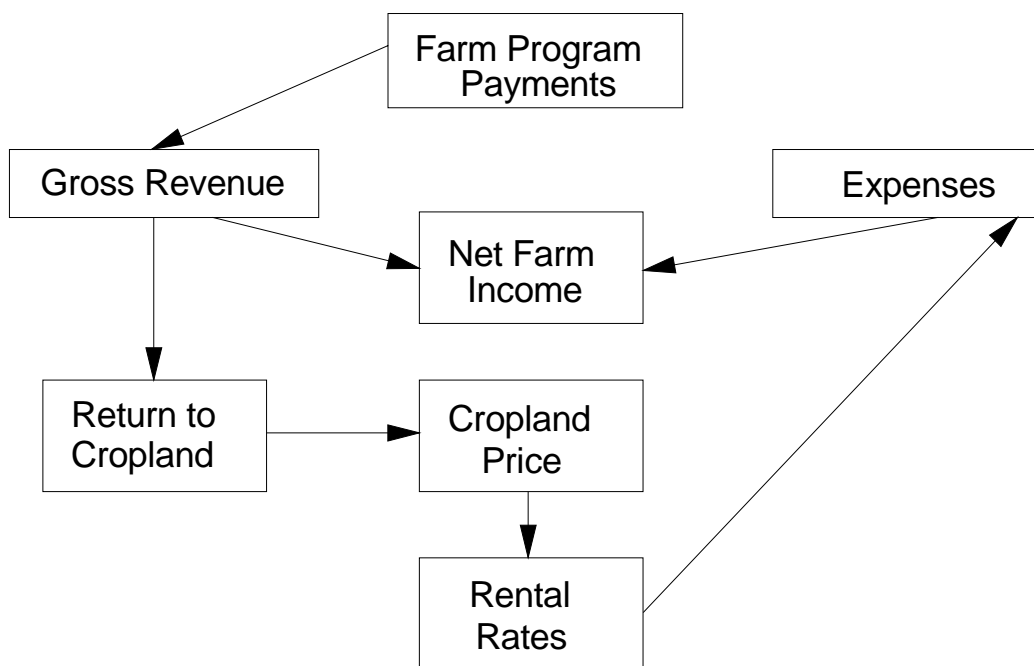
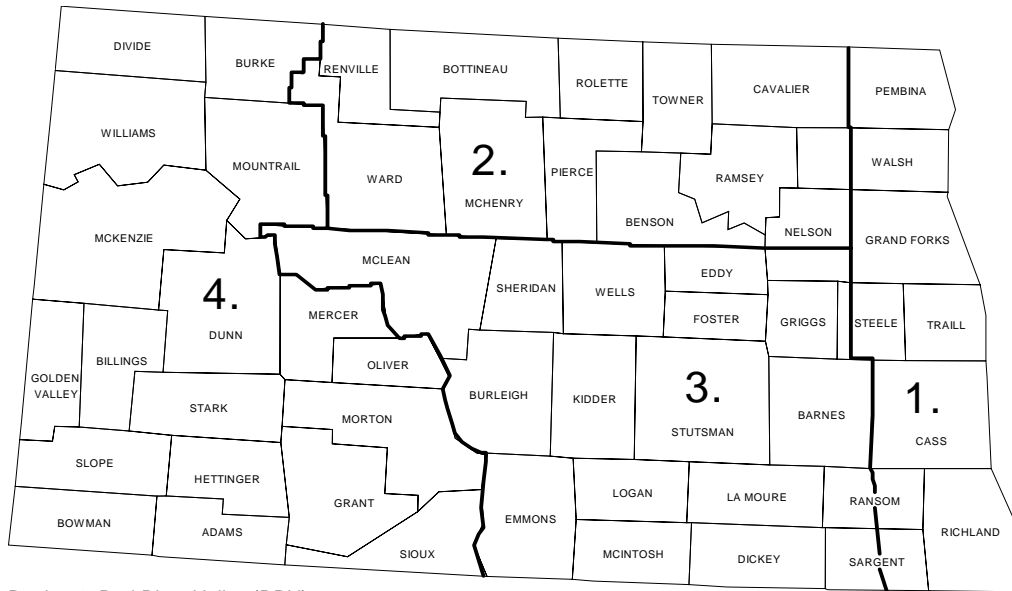


Figure 1. Structure of the North Dakota Representative Farm Model

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 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 1,731 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 2,845 cropland acres for the high-profit farms, 1,731 cropland acres for the average-profit farms, and 1,406 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 3,434 cropland acres for the large-size farms, 1,426 cropland acres for the medium-size farms, and 498 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, 2005

	Size				Profit	
	Large	Medium	Small	High	Average	Low
Number of Farms	130	260	130	124	622	124
Total Cropland (ac)	3,434	1,426	498	2,845	1,731	1,406
Spring Wheat (ac)	1,049	394	115	1,132	699	589
Durum Wheat (ac)	312	138	17	90	55	40
Barley (ac)	294	116	38	233	128	103
Corn (ac)	168	79	37	94	57	37
Sunflower (ac)	221	129	29	118	70	53
Soybeans (ac)	586	227	85	418	249	211

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 2005, the farms averaged \$380,804 gross return with a profit of \$57,456. In 1994, the farms generated \$1.37 gross output for every \$1 in inputs; by 2005, that had fallen to \$1.17 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 2005, the average size was 1,731 acres. This is an increase of 32% over the 11-year period. Net return per acre fell from \$36.67 per acre in 1994 to \$33.20 per acre in 2005.

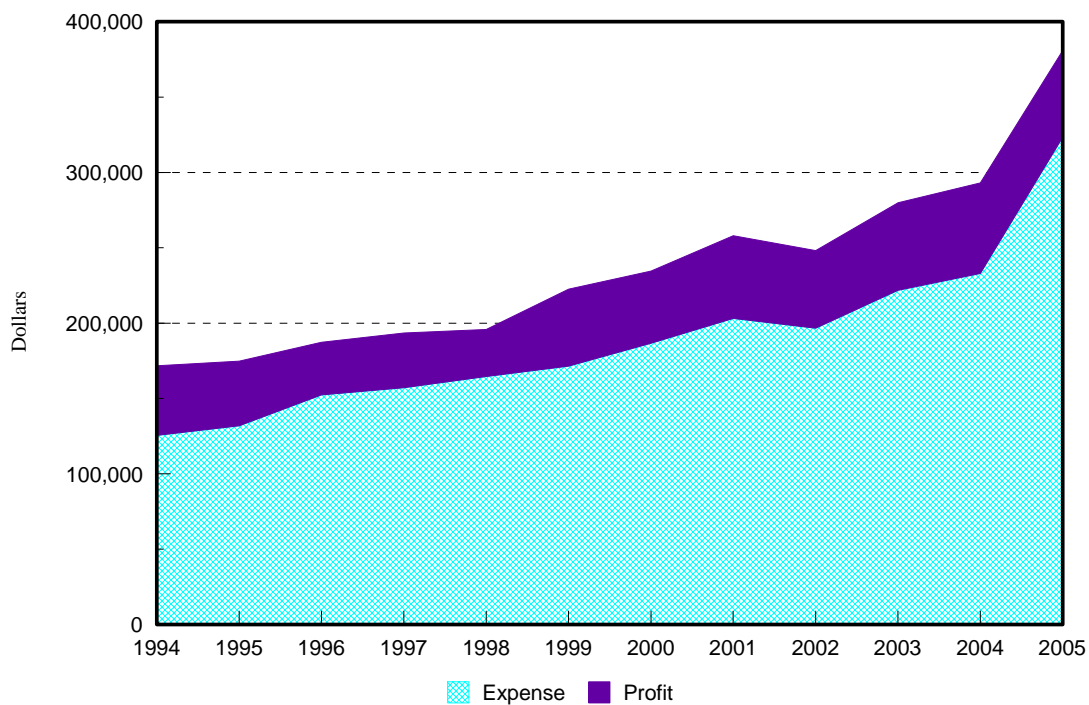


Figure 3. Average Expense and Profit for Farms in the North Dakota Farm and Ranch business Management Program

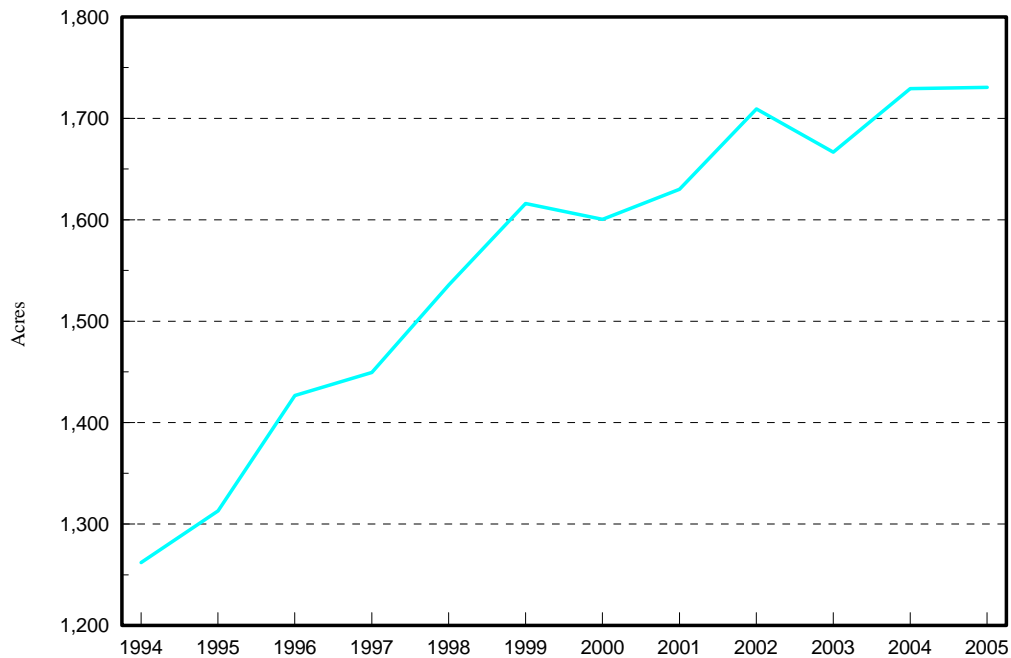


Figure 4. Average Cropland Acres of Farms in the North Dakota Farm and Ranch Business Management Program

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.

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 2005.

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_j^C	=	total expenses in producing crop j,
EX_h^L	=	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 2006-2015 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 2004. 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:

$$R_g = \frac{M_g}{PL_g} \quad (2)$$

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

$$PL_{gT} = \frac{1}{R_{g,t=T-n}} \sum_{t=T-n}^T W_t M_{ig} + T_r \quad (3)$$

where

- PL_{gT} = cropland price in region g in time T,
- W_t = weighting factor for year t,
- M_{ig} = 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.

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 2004. 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. These prices were estimated before the current weather markets occurred. Prices for 2006 are currently much higher than the estimated prices.

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

	Spring Wheat	Durum Wheat	Malting Barley	Sunflower	Soybeans	Corn	Canola
	-----\$/bu-----			-\$/cwt-	-----\$/bu-----		-\$/cwt-
2005	3.60	3.45	1.80	11.40	5.30	1.80	9.40
2006	3.56	3.69	2.50	11.60	4.65	1.83	9.56
2007	3.55	3.82	2.58	11.86	4.67	1.87	9.73
2008	3.51	3.91	2.67	11.86	4.85	1.96	9.90
2009	3.61	4.05	2.69	11.94	4.87	2.04	9.93
2010	3.67	4.14	2.72	11.89	4.91	2.09	9.85
2011	3.72	4.21	2.70	11.85	4.96	2.11	9.86
2012	3.75	4.26	2.69	11.83	4.97	2.12	9.85
2013	3.78	4.30	2.70	11.82	4.97	2.13	9.85
2014	3.81	4.34	2.72	11.80	4.95	2.13	9.84
2015	3.83	4.37	2.74	11.80	4.93	2.14	9.84

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 2004. The estimated equations are used to predict crop yields in each region. Figure 5 shows the estimated spring and durum wheat yields. Wheat yields, especially for spring wheat, are expected to return to trend line levels in 2006 after lower yields in 2005 in the RRV. Row crop yields are expected to decrease in 2006 and return to the long-term trend line. The yields show a slight upward trend throughout the forecast period. Figure 6 shows the estimated yields for corn and soybeans. Corn and soybean yields are expected to increase slightly over the forecast period.

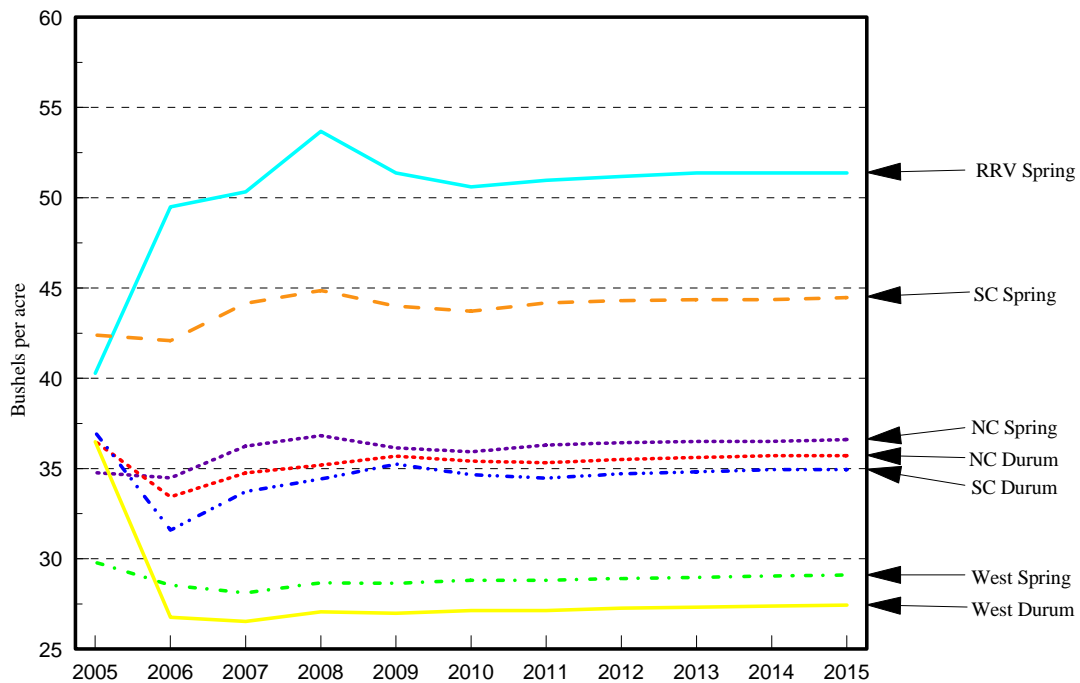


Figure 5. North Dakota Estimated Wheat Yields Used in the Representative Farm Model

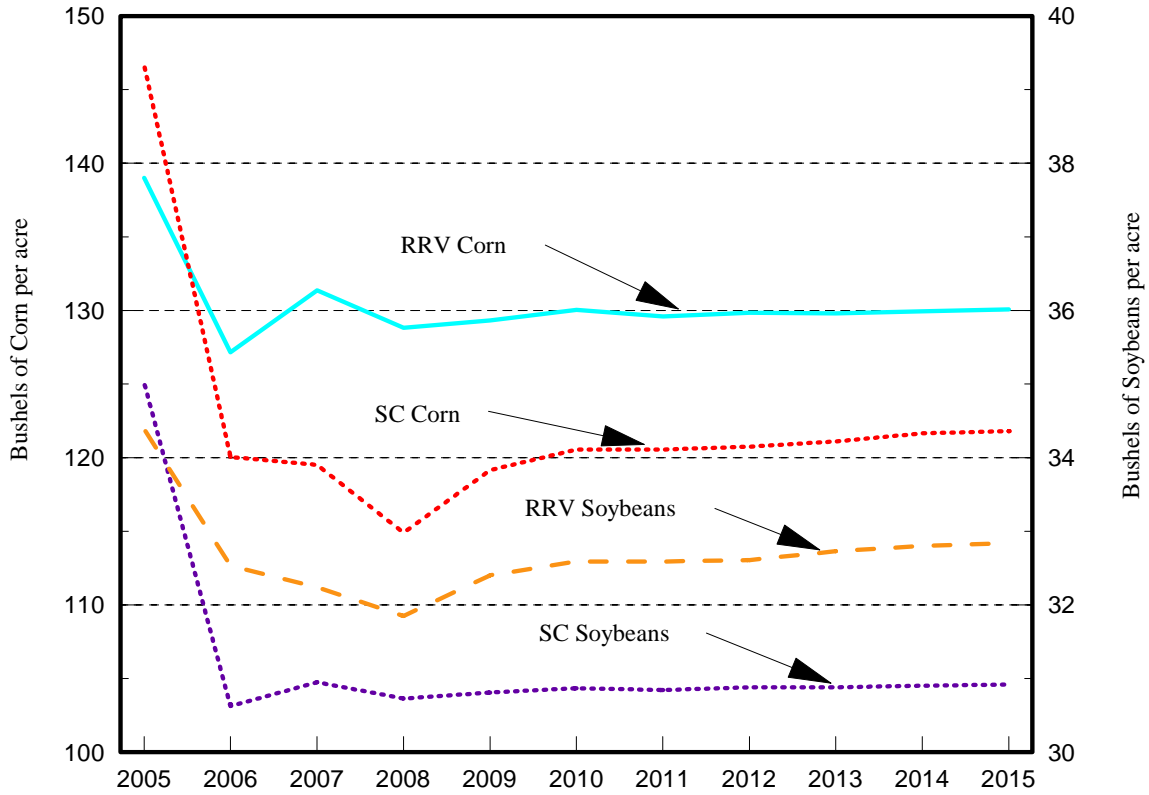


Figure 6. North Dakota Estimated Row-crop Yields Used in the Representative Farm Model

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:

$$A_{jit} = c_0 + \sum_{j=1}^n c_j P_{jit} + c_{n+1} A_{jit-1} + c_{n+2} G_{jt} + e_{jit} \tag{8}$$

- 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 2003. 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:

$$S_{jit} = A_{jit} / \sum_{j=1}^i A_{jit}$$

where S_{jit} is an acreage share of the j th 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, 2006-2015

The North Dakota Representative Farm Model was used to estimate net farm income, debt-to-asset ratios, land prices, and rental rates for 2006-2015.

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 increase from the 2003-2005 average of \$132 thousand to \$138 thousand in 2015, which is a 5% increase (Figure 7). Net farm income for the medium-size farm, which averaged \$58 thousand for 2003-2005, increases to \$68 thousand in

2015. Net farm income for the small-size farm averaged \$29 thousand for 2003-2005 and will increase to \$43 thousand in 2015. State average net farm income over the 10-year period is \$131 thousand for the large-size farm, \$66 thousand for the medium-size farm, and \$39 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 may 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-----					
2003-2005 avg	131,537	57,620	28,807	183,790	66,526	-12,652
2005	112,521	60,222	32,837	169,815	57,456	-20,551
2006	120,144	64,305	36,917	159,139	64,001	-14,867
2007	124,552	65,223	37,943	164,059	67,165	-15,123
2008	126,285	65,022	38,137	169,608	69,074	-14,010
2009	127,419	65,423	38,718	167,661	66,672	-15,560
2010	128,906	65,515	39,447	164,454	64,473	-16,656
2011	135,112	67,021	40,432	164,202	63,400	-17,240
2012	136,075	66,860	40,970	161,545	61,226	-18,104
2013	136,863	67,661	41,411	161,512	60,117	-18,862
2014	138,408	68,247	42,130	162,711	59,838	-19,025
2015	138,311	68,110	42,767	163,101	59,304	-19,399

The increases in net farm income from 2006 to 2015 result from increases in future 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 through 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 \$170 thousand in 2006 and is expected to decrease to \$163 thousand in 2015 (Figure 7). Net farm income for the average-profit farm is \$57 thousand in 2006 and is projected to increase to \$59 thousand in 2015. The low-profit farm is expected to show a net operating loss in 2006, and those losses are projected to continue throughout 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 2006-2015 period is \$164 thousand for the high-profit farm, \$64 thousand for the average-profit farm, and -\$17 thousand 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.

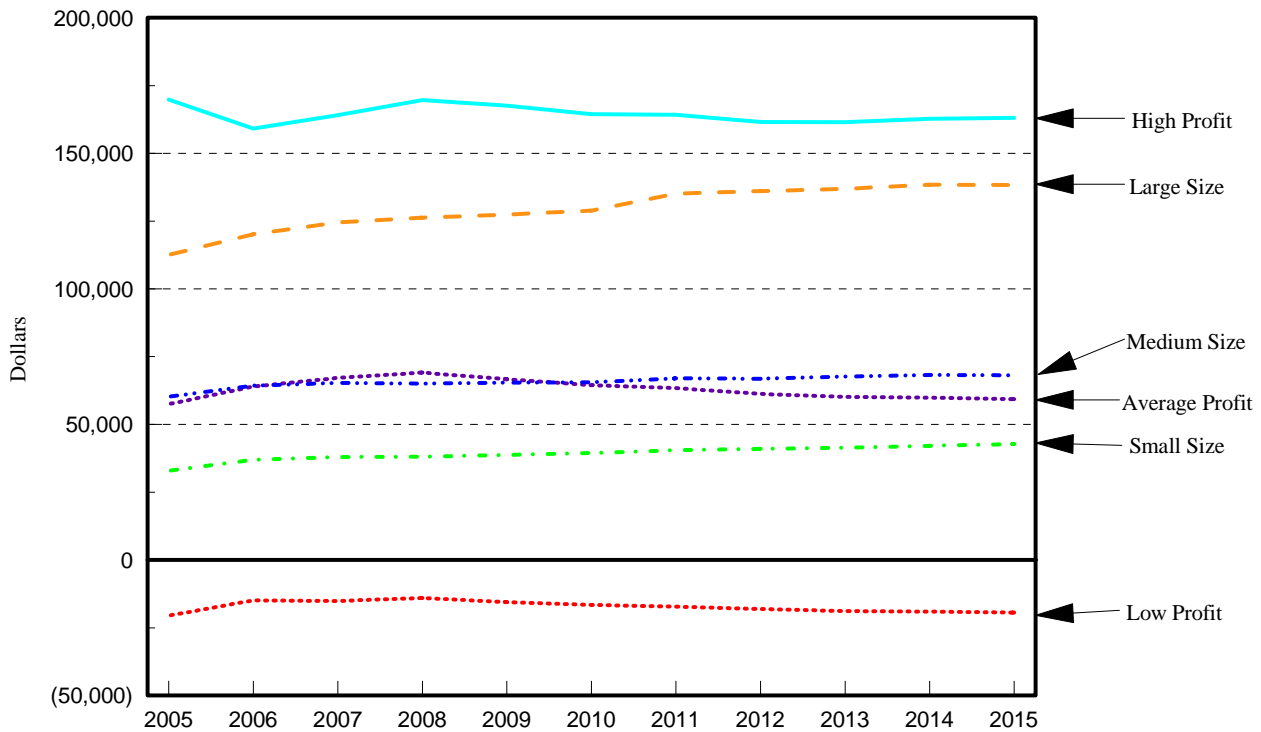


Figure 7. Net Farm Income for Size and Profit North Dakota Representative Farms

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.

Net farm income for 2006 is expected to be slightly higher than in 2005 because poor small grain yields in the RRV are expected to return to normal in 2006. It is also expected that row crop yields return to normal in 2006.

Risk Simulation

Table 4 shows the forecasted net farm income, standard deviation, maximum and minimum level, and the 90% confidence interval for the profit representative farms by region, 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 RRV, NC, and SC regions, averaging 63% of net farm income, compared to the West region. The West region has a large livestock sector which helps stabilize net farm income.

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 8 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 2015, the 80% confidence interval is \$20,000 to \$133,000 with mean at \$73,000.

Table 4. Results of the Simulation for the Average Profit Representative Farm Model, Net Farm Income

	Mean	Std Deviation	Maximum	Minimum	90% Confidence Interval
<u>2006</u>					
RRV	81,121	49,437	278,232	(59,196)	21,032-145,669
NC	66,732	52,274	278,177	(7,766)	5,193-135,064
SC	89,553	45,355	300,377	4,645	34,105-145,631
West	73,864	27,646	212,498	35,692	42,418-111,915
<u>2010</u>					
RRV	91,433	60,959	346,321	(61,449)	20,480-167,363
NC	74,095	66,413	361,666	(24,342)	(3,746)-165,139
SC	93,822	57,709	418,639	(17,860)	26,598-167,054
West	71,739	36,585	226,317	24,716	31,216-122,368
<u>2015</u>					
RRV	90,151	70,964	346,480	(87,434)	3,439-182,256
NC	69,393	79,614	397,642	(54,379)	(24,866)-179,492
SC	89,301	71,248	384,542	(46,017)	4,264-182,947
West	71,326	42,608	226,122	14,987	23,177-133,209

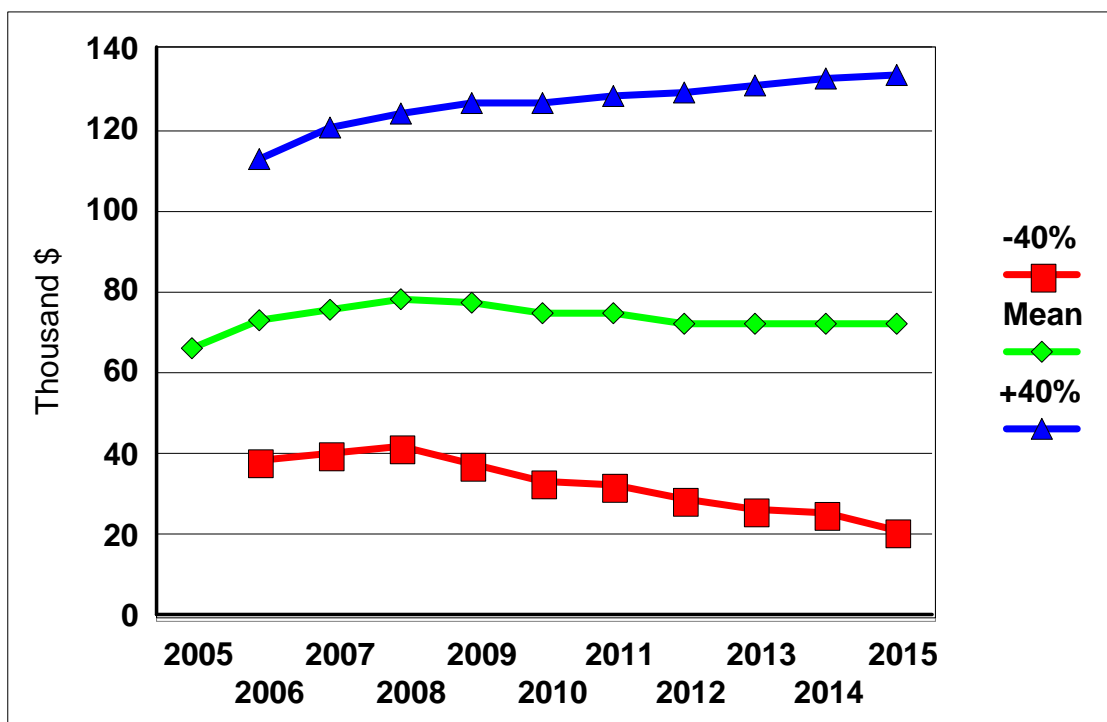


Figure 8. Average Net Farm Income and 80% Confidence Interval for Profit Representative Farms, 2005 to 2015

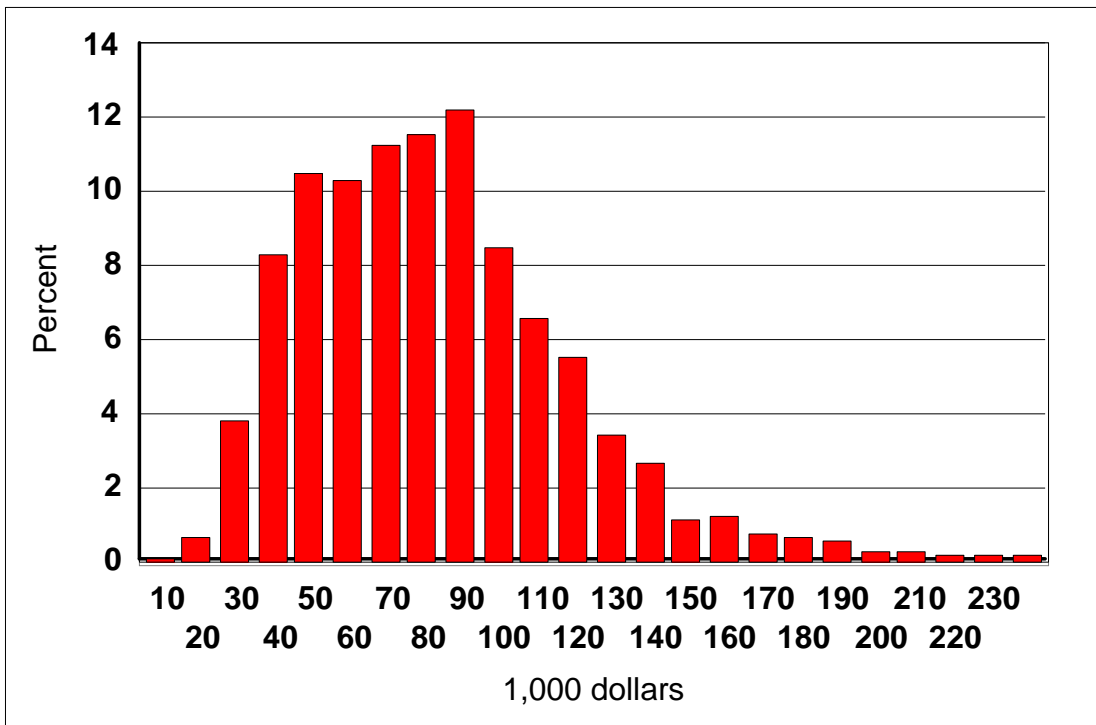


Figure 9. Percentage of Representative Farms in Each Income Category, 2006

Figure 9 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 to the distribution due to farm payments. Without government policies, the lower end would extend out to -\$60,000.

Debt-to-asset Ratios for North Dakota Representative Farms

Debt-to-asset ratios for all representative farms fall throughout the forecast period, except for the low-profit farms (Table 5 and Figures 10-11). The debt-to-asset ratio for the low-profit farm increases from 0.56 in 2005 to 0.60 by 2015, 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	Medium	Small	High	Average	Low
2005	0.304	0.342	0.449	0.349	0.407	0.558
2006	0.298	0.337	0.442	0.350	0.409	0.567
2007	0.294	0.333	0.438	0.351	0.409	0.570
2008	0.287	0.326	0.432	0.348	0.406	0.573
2009	0.284	0.322	0.429	0.344	0.405	0.577
2010	0.281	0.319	0.425	0.342	0.402	0.579
2011	0.277	0.315	0.421	0.338	0.393	0.583
2012	0.274	0.312	0.418	0.335	0.392	0.587
2013	0.271	0.308	0.414	0.333	0.372	0.590
2014	0.268	0.305	0.411	0.329	0.368	0.594
2015	0.265	0.302	0.407	0.322	0.359	0.598
Average	0.282	0.320	0.426	0.340	0.393	0.582

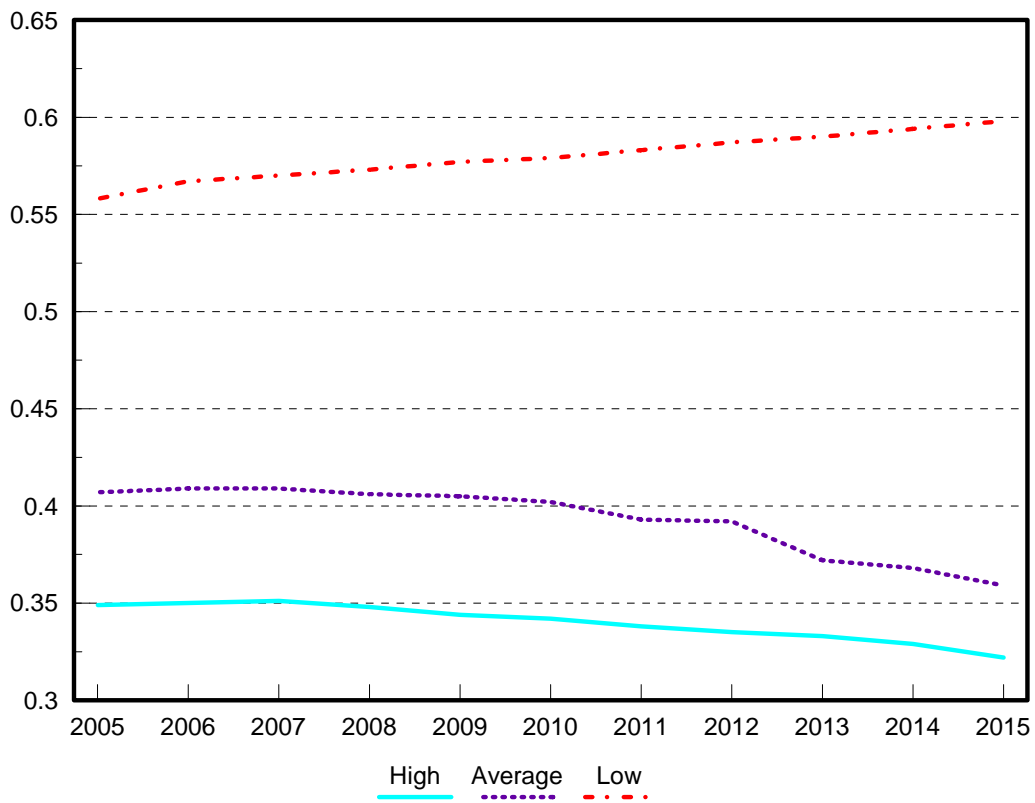


Figure 10. Debt-to-asset Ratio for North Dakota Representative Farms by Profit

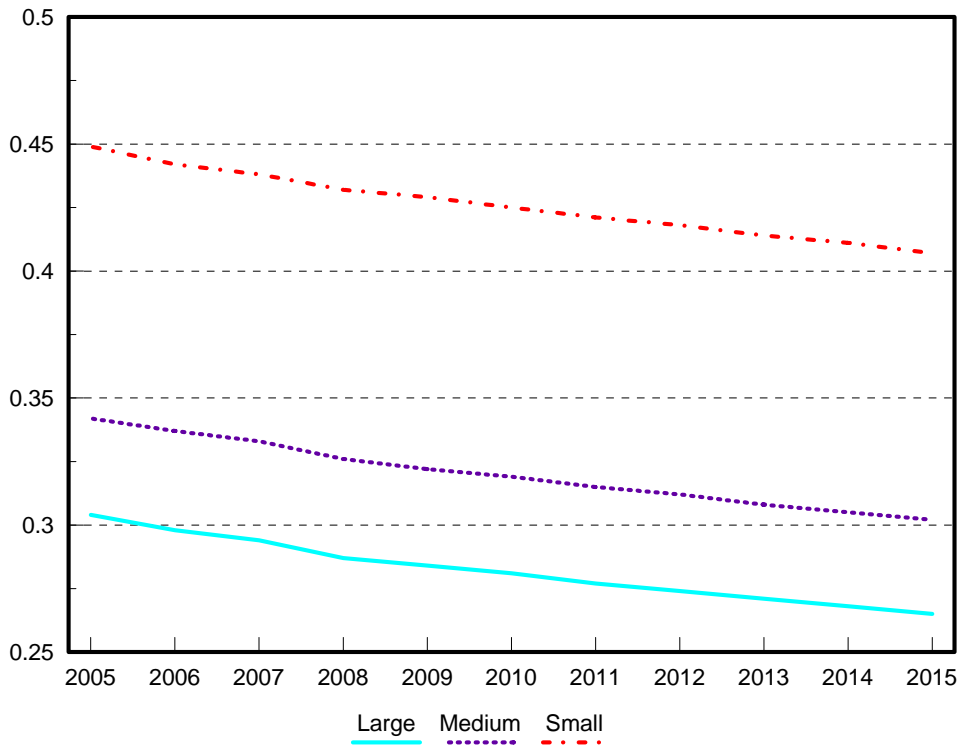


Figure 11. Debt-to-asset Ratio for North Dakota Representative Farms by Size

Higher debt-to-asset ratios for the low-profit farms, when coupled with negative 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.

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 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 also expected to change over the forecast period and are expected to increase by 4.8%. 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.

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

	RRV	NC	SC	West	State
	-----\$/acre-----				
2005	976.08	471.53	534.91	372.58	588.78
2006	978.46	473.50	540.28	377.31	592.39
2007	981.21	475.74	545.98	381.60	596.13
2008	986.80	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	393.20	606.67
2011	994.20	483.25	563.03	396.58	609.26
2012	996.03	484.49	565.51	399.80	611.46
2013	997.65	485.53	567.48	403.00	613.41
2014	999.37	486.38	568.94	406.25	615.24
2015	1000.83	487.07	570.53	408.65	616.77
2006-2015 avg	991.62	481.58	558.86	394.17	606.56

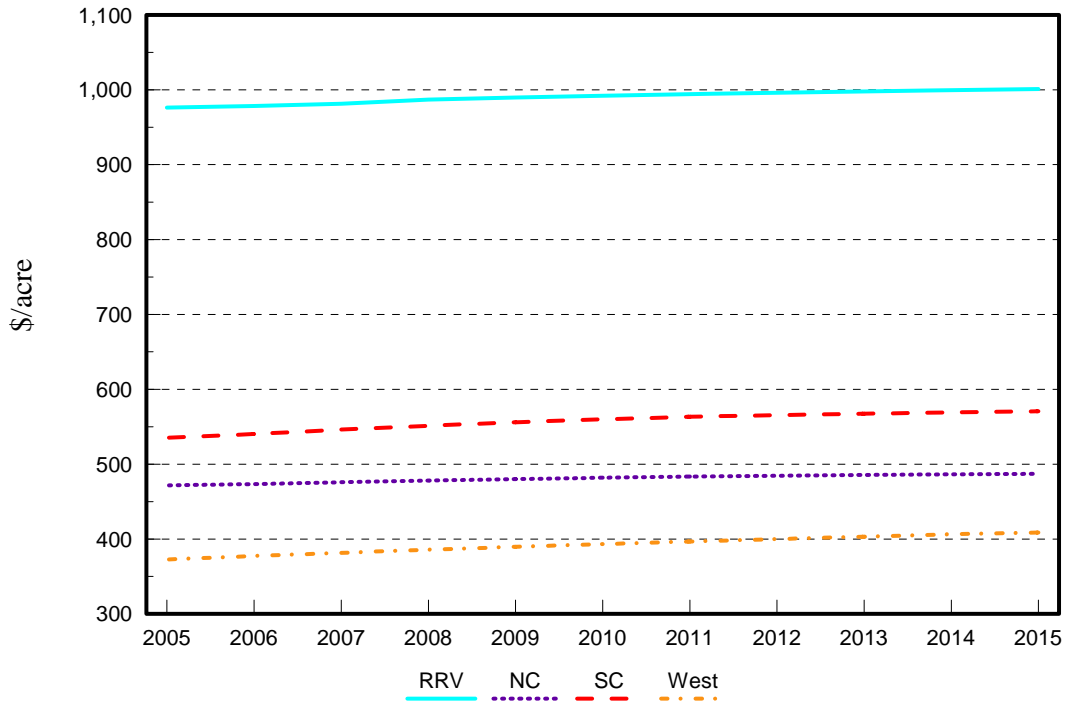


Figure 12. Average Value of Cropland for North Dakota Average-Profit Representative Farms

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 13).

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

	RRV	NC	SC	West	State
	-----\$/acre-----				
2005	56.10	34.17	38.21	28.66	39.28
2006	56.23	34.31	38.59	29.02	39.54
2007	56.39	34.47	39.00	29.35	39.80
2008	56.71	34.64	39.37	29.67	40.10
2009	56.88	34.79	39.70	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	31.00	41.01
2014	57.43	35.25	40.64	31.25	41.14
2015	57.52	35.29	40.75	31.43	41.25
2006-2015 avg	56.99	34.90	39.92	30.32	40.53

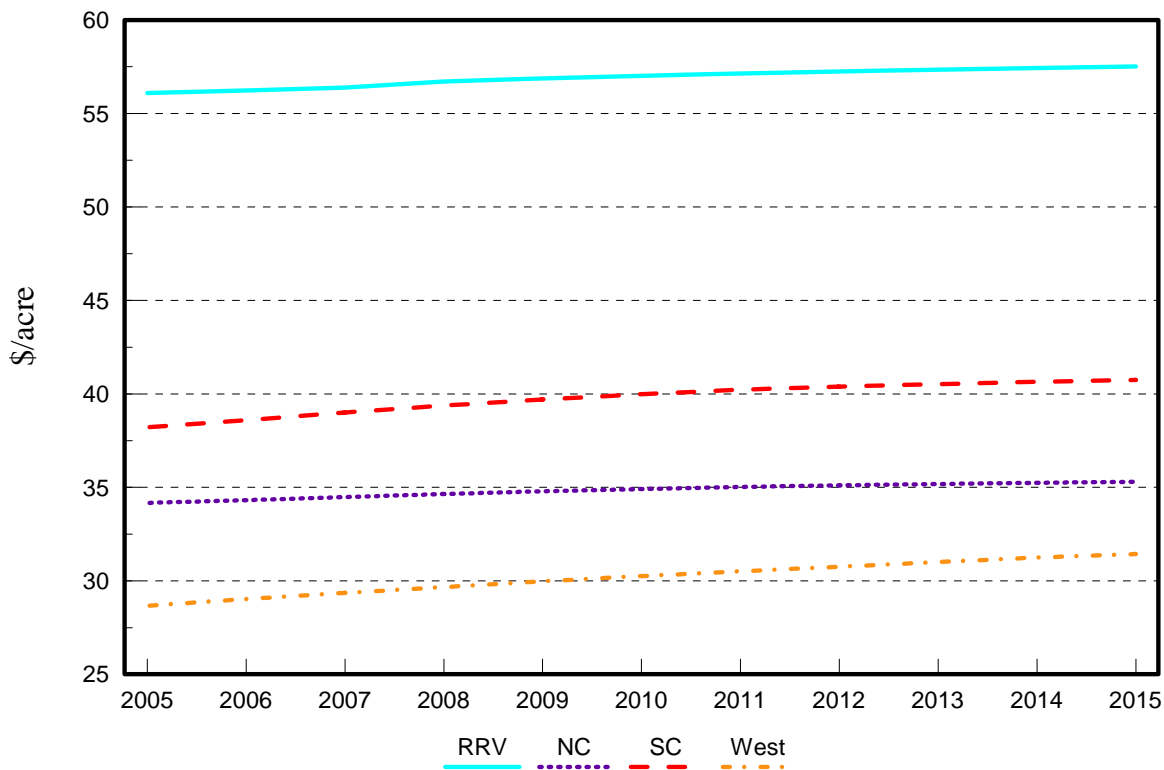


Figure 13. Average Cash Rent of Cropland for North Dakota Average-Profit Representative Farms

CONCLUDING REMARKS

Net farm income in 2015 may be higher than in 2005 for most farms. The higher prices received in 2004 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 55% 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 \$27,000 and \$93,000. The wide variations in possible net farm income makes long-term planing very difficult as potential income levels cannot be known with any certainty.

Debt-to-asset ratios are predicted to decrease slowly, except for the low-profit 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 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.

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 2006. Food and Agricultural Policy Research Institute, Columbia, MO.
- Palisade. @Risk computer software and Manuel. *Advanced Risk Analysis for Spreadsheets*. Newfield NY. July 1997
- North Dakota Agricultural Statistics*. Various issues. North Dakota Agricultural Statistics Service, Fargo.
- North Dakota Farm and Ranch Business Management Annual Reports 2004 and 2005*. North Dakota State Board for Vocational Education, Bismarck.
- Taylor, Richard D. And Won W. Koo. 2006. *Analysis of the 2002 Farm Bill and New Farm Bill Alternatives*. Agribusiness & Applied Economics Report No. 578. Center for Agricultural Policy and Trade Studies. North Dakota State University, Fargo.