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Center for Agricultural Policy and Trade Studies
North Dakota State University

AGRICULTURAL POLICY BRIEF

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**The Changing Impact of Corn Production on
North Dakota Agriculture**

Richard Taylor and Won W. Koo

Introduction

North Dakota's agricultural landscape has changed dramatically during the past 15 year. In 1996, about 600,000 acres of corn was harvested in North Dakota producing about 65.5 million bushels of corn. In 2011, 2.06 million acres were used to produce 216 million bushels of corn. Harvested acres increased by 243% while production increased 304% during that time period.

The impact of corn production in the southeastern portion of the state has been more dramatic. Figure 1 presents the distribution of planted corn acres in 1996. Each mark represents 10,000 acres. In 1996 corn production represented 22.5% of the acres in Richland County. Other major crops were soybeans (36%) and spring wheat (26%). By 2011 corn acres were planted on 25% of Richland county acres with soybeans at 34% and wheat at 7.5%. Cass County planted 100 thousand acres of corn in 1996. That had grown 138% to 238 thousand acres by 2011. The increase has been more dramatic in non-traditional counties. Barnes County, in 1996 planted 14.4 thousand acres of corn (1.7% of available farm land). However, Barnes County planted 129 thousand acres of corn (14.2% of available farm land) in 2011.

Four reasons can be identified as possible causes of this increase in corn production in North Dakota. First, in the 1996 Freedom to Farm Act, planting requirements were removed from the farm bill. This allowed farmers to replace wheat and barley acres with both corn and soybeans; second, in 1996 Monsanto released GMO varieties of corn which were resistant of Glyphosate herbicide. This changed the management requirements of corn production; thirdly, North Dakota has been experiencing favorable weather condition since 1993, high than average rainfall: and finally, increased energy prices in 2005 increased the demand for corn based ethanol beginning in 2006. That increase raised corn prices from \$2.00/ bushel in 2005 to \$3.04/ bushel in 2006 and \$4.20/bushel in 2007.

Traditionally corn production in North Dakota has been concentrated in the southeastern counties of the state. In 1996, Richland, Ransom, Sargent, Cass, La Moure, Dickey and Traill counties planted almost 83% of the corn in North Dakota. In 2011 those counties planted 49% of North Dakota corn. The production in those counties has increased by 118% but the state share decreased because of increases in corn production in other counties.

** Research Scientist, and Professor and Director, respectively, in the Center for Agricultural Policy and Trade Studies in Fargo, North Dakota.*

**This empirical analysis was prepared for Senator Conrad and the North Dakota Farmers Union.*

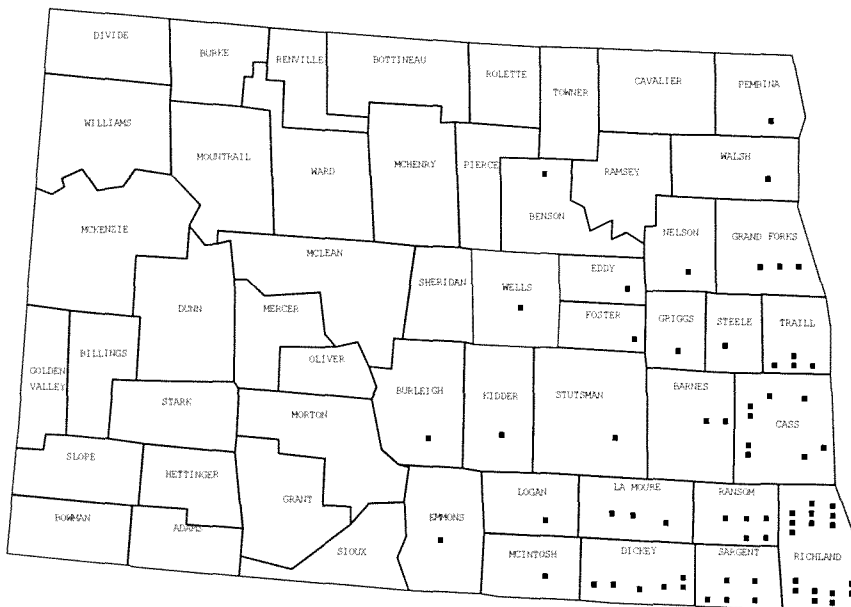
Corn is now produced as far north as Pembina and Walsh counties and as far west as Morton and Grant counties. In addition, state corn yields have increased by 40% during the same time period.

The objective of this study is to estimate the relationship between various commodity prices and planted corn acres in selected counties in North Dakota. Then projected prices from the North Dakota Corn and Soybean Model and the North Dakota Wheat Model will be used to estimate future North Dakota corn plantings through 2021.

Table 1 presents the relationship between North Dakota corn acres and the prices of corn, wheat and soybeans. The soybean price ratio averaged 2.78 during 1996-99. That ratio fell to 2.34 during 2008-11. This indicates that the price of corn increased faster than the soybean price. The same occurred for the wheat corn price ratio. It fell from 1.76 in 1996-99 to 1.51 in 2008-11.

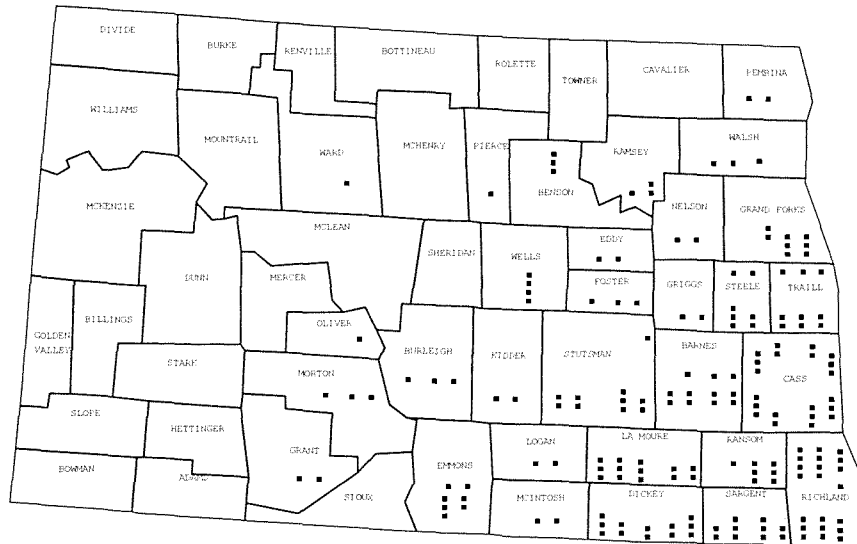
Crop yields have changed substantially during the past 16 years. Corn yields have increased an average of 1.23 bu/acre compared to 0.66 bu/acre for wheat and no yield increase for soybeans. Yield increases have been more dramatic in non-traditional counties. For example, corn yields in Stutsman have increased an average of 2.41 bu/acre compared to 0.86 bu/acre for wheat and 0.32 bu/acre for soybeans.

Table 2 shows planted corn acres in the 15 largest corn producing counties in the state. The fastest growth occurred in the non-traditional counties, Emmons (864%), Ramsey (702%), Stutsman (617%), and Wells (609%). Between 1996-99 and 2008-11, state planted corn acres increased 182%.



Each ■ represents 10,000 acres

Figure 1. North Dakota Planted Corn Acres, 1996



Each • Represents 10,000 Acres

Figure 2. North Dakota Planted Corn Acres, 2011

Table 1. Historical Commodity Prices and North Dakota Corn Acres, 1996-2011				
	Corn Acres	Corn	Soybeans	Wheat
	1,000 acres	-----\$/bu-----		
1996	600	2.43	7.05	4.19
1997	590	2.12	6.10	3.82
1998	825	1.71	4.64	3.03
1999	655	1.59	4.19	2.77
2000	930	1.65	4.23	2.71
2001	705	1.87	4.05	2.79
2002	995	2.16	5.32	3.80
2003	1,170	2.37	6.62	3.63
2004	1,150	1.88	5.75	3.40
2005	1,200	1.80	5.37	3.55
2006	1,400	2.77	5.98	4.50
2007	2,350	4.06	9.63	7.74
2008	2,300	3.74	9.71	7.31
2009	1,740	3.18	9.26	4.82
2010	1,880	5.36	11.10	7.73
2011	2,060	7.04	12.46	7.81

Method

The largest fifteen corn producing counties in North Dakota were identified along with the rest of the state region. Sixteen years data, from 1996 through 2011 were obtained from NASS and used to estimate the relationship between the prices and planted acres. An equation was developed from economic theory that planted corn acres are a function of corn prices and prices of other competing crops along with a trend variable to represent on going genetic improvements in corn. Equation 1 shows the relationship.

$$A_t^c = a_0 + a_1P_{t-1}^c + a_2P_{t-1}^s + a_3P_{t-1}^w + a_4Tr + e_t \quad (1)$$

Where:

A_t^c = planted acres of corn in time period t in county c

P_{t-1}^c = price of corn in time period t-1

P_{t-1}^s = price of soybeans in time period t-1

P_{t-1}^w = price of spring wheat in time period t-1

Tr = trend

E_t = error term

It is expected that the coefficient on corn price is positive while the coefficients on both soybean and wheat price are negative. The equation was estimated for each of the 15 counties along with the rest of the state.

	Richland	Cass	Barnes	Dickey	La Moure	Stutsman	Sargent	Traill	
	acres								
1996-99	168,600	82,867	16,667	57,567	27,533	14,467	54,267	36,233	
2009-11	236,333	211,167	113,733	124,800	125,833	103,767	97,333	91,767	
%Chg	42	155	582	117	357	617	79	153	
	Ransom	Steele	Emmons	G.Forks	Wells	Benson	Ramsey	Others	State
	Acres								
1996-99	54,700	13,667	7,333	25,900	5,967	5,633	4,033	96,233	671,667
2009-11	67,167	67,400	70,667	76,933	42,933	34,133	32,367	394,600	1,893,333
%Chg	23	393	864	197	609	506	702	310	182

Results

Equation 1 was estimated for each of the 15 counties and the rest of the state with 16 years data from 1996 to 2011. Then the estimated equations were used to estimate corn production in each on the counties with projected prices for corn, soybeans and wheat. The projected prices are

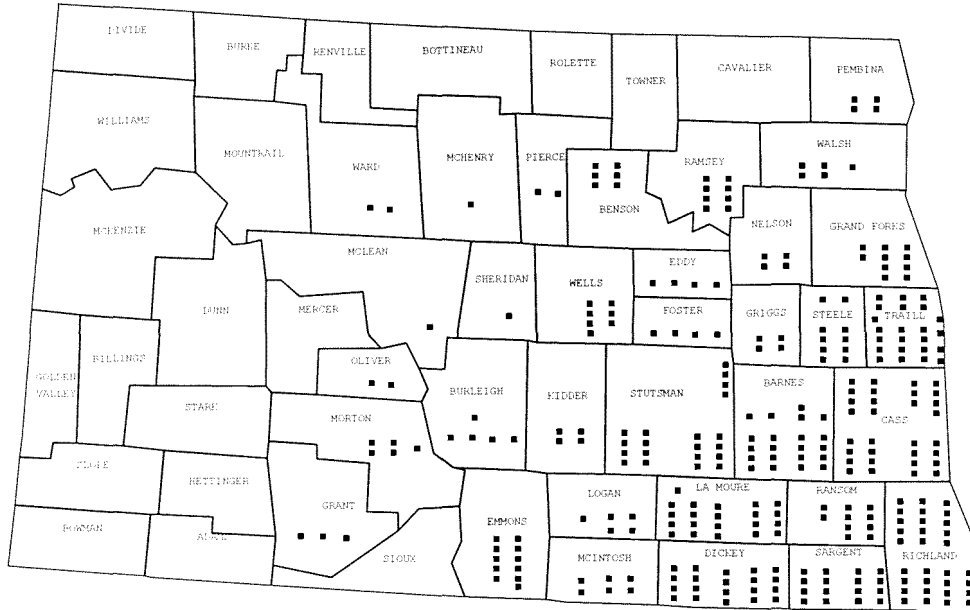
obtained from the Global Wheat, Corn and Soybean Simulation Models operational at the Center for Agricultural Policy and Trade Studies.

Table 3 shows the projected North Dakota planted corn acres along with the forecasted commodity prices from the various crop models. State corn acres are expected to continue to increase for the forecasting period. However, the rate of change is expected to decrease from 2017. The main reason for the decrease in the rate of change is that after 2014 corn price is expected to fall throughout the remaining forecast period. Soybean prices are expected to follow corn prices while wheat prices are expected to continue to increase slowly throughout the time period.

Table 3. Projected Commodity Prices and Estimated North Dakota Corn Acres, 2012-2021

	Corn Acres	Corn	Soybeans	Wheat
	1,000 acres	-----\$/bu-----		
2012	2,495	6.87	12.18	7.72
2013	2,669	7.13	12.16	7.54
2014	2,765	7.15	11.98	7.49
2015	2,823	6.99	11.91	7.53
2016	2,919	6.96	11.81	7.54
2017	2,990	6.91	11.78	7.59
2018	3,014	6.61	11.75	7.73
2019	3,044	6.33	11.62	7.96
2020	3,077	6.23	11.42	8.10
2021	3,099	6.09	11.27	8.17

Figure 3 presents a North Dakota corn production map similar to Figure 1 and 2. Each marker represents 10,000 acres. The map clearly shows that corn will become a major crop in the south east corner of the state. From Emmons County in the south central to Grand Forks in the north east corn will become a major crop in the region. Table 4 shows the projected corn acres for 15 major counties, the rest of the state and the state total. The largest growth in terms of percentage change is in the non-traditional areas of the state, Traill (151%), Ramsey (132%), Stutsman (91%), and Barnes (87%). Even in the traditional areas, Sargent (77%), La Moure (71%), Dickey (63%), Cass (45%), Ransom (45%), and Richland (31%) will continue to increase corn acres. The state is expected to plant 64% more corn acres in 2021 than was planted in 2009-11. Those acres will come at the expense of other crop, mainly wheat and soybeans.



Each ■ Represents 10,000 Acres

Figure 3. North Dakota Estimated Corn Acres, 2021

Table 4. Projected North Dakota Planted Corn Acres, by County, 2021									
	Richland	Cass	Barnes	Dickey	La Moure	Stutsman	Sargent	Traill	
	Acres								
2009-11	236,333	211,167	113,733	124,800	125,833	103,767	97,333	91,767	
2021	314,689	306,423	212,876	203,537	214,949	198,450	172,749	230,142	
%Chg	31	45	87	63	71	91	77	151	45
	Ransom	Steele	Emmons	G.Forks	Wells	Benson	Ramsey	Others	State
	Acres								
2009-11	67,167	67,400	70,667	76,933	42,933	34,133	32,367	394,600	1,893,333
2021	97,358	103,237	109,131	98,610	65,256	55,353	75,014	640,958	3,098,732
%Chg	45	53	54	28	54	62	132	62	64

Summary and Implications

Corn production has increased by 240% in North Dakota since 1996. It is expected that that increase will continue. In 2021 it is expected that North Dakota will plant 3.1 million acres of corn producing about 430 million bushels of corn or an increase of 81% from 2011. Acres are expected to increase 64% and yields are expected to follow the historical trend lines.

Total cropland area in North Dakota is about 22 million acres. Total acres in the “potential” corn producing regions are about 7 to 8 million acres. In 2011, the state planted 2.06 million acres or about 26% to 29% of the tillable land in the main corn producing regions. By 2021 that could be

39% to 44% of available tillable land. In addition to increased acres, the increase in commodity handling will be substantial. Each additional acre of corn will increase commodity handling by 100-130 bushel less 30-40 bushels for the loss of one acre of wheat or soybeans. The additional 1 million acre of corn will increase commodity handling by 70 to 90 million bushels. This will require additional storage and handling facilities in the region.

The financial requirements of corn production are higher than either soybeans or wheat. From the "Farm Management Planning Guide" from the NDSU Extension Service, total cost for corn production in the southeast region of the state is \$469/acre compared to \$309/acre for wheat and \$258 for soybeans. When corn replaces an acre of wheat or soybeans, production costs would increase about \$185/acre. Without any adjustment for inflation the expected increased corn production will increase operating costs in the state by almost \$200 million. That increase has a direct impact on local economies and businesses.

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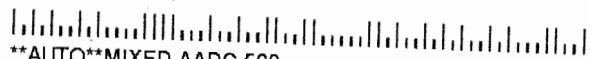
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Center for Agricultural Policy
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