Implications of Increased Ethanol Production on Nebraska Hay Production: An Initial Investigation

Deborah Bridges
University of Nebraska at Kearney

Frank Tenkorang
University of Nebraska at Kearney

Abstract: Nebraska, with its ample corn production capacity, is an attractive location for ethanol production, as evidenced by the 24 ethanol plants currently operating in the state. As ethanol production increases, the demand for corn also increases – which in turn will require additional acreage devoted to corn production. As more acres are used to produce corn, there are fewer acres available to produce other crops such as soybeans, sorghum, and forage. While many studies have examined the impact of ethanol production on commodity prices, few researchers have examined the impact on forage production. The objective of this study is to investigate what impact ethanol production has had on forage production in Nebraska by examining production trends in counties where ethanol plants are operating. It should be noted that both the acres in and value of hay production is low relative to that of corn and soybeans. Hence, strong demand for ethanol could have a significant impact on hay acreage. A preliminary analysis of corn and hay harvested acres in the five Nebraska counties with the longest operating ethanol plants and the eight counties with ethanol plants opening in 2007 shows mixed impact. Although corn production increased in four of the counties, only two counties had a significant decline in hay production after the opening of an ethanol plant in each county.

Introduction

Hay is an important crop to both the U.S. and Nebraska agricultural sector. In 2001, US hay production was 156.4 million tons valued at $12.6 billion; in 2012, US hay production was 119.8 million tons valued at $18.5 billion. In 2001, Nebraska was ranked 6th in hay production with 7.4 million tons produced valued at $507 million; in 2012, Nebraska ranked 10th in all hay production with 4.1 million tons produced valued at $750 million (National Agricultural Statistics).

Although hay is an important crop, it has received scant attention in the literature. Previous studies have either focused on the factors determining hay prices at the state-level (Diersen, 2008; Acheampong et al., 2010; Bazen et al., 2008; and Blake and Clevenger, 1984) or have focused on the characteristics and operation of hay markets (Miller, 1986). While not the primary focus, other studies have shown that hay acreage is negatively impacted by increased value of corn production due in part to the increased ethanol production to meet mandates in energy policy (Dicks et al., 2009; Wilson et al., 2008; and Tokgoz et al., 2008). Since hay competes with other crops for acreage, the value of other commodities that can be produced on the same ground impact the acres allocated to hay (Diersen, 2008; Acheampong et al., 2010; Bazen et al., 2008; Blake and Clevenger, 1984) but as a perennial crop, whose value is low relative to those other crops, the establishment costs associated with hay makes the decision to switch ground out of hay to corn easier than switching corn ground to hay (Diersen, 2008; Acheampong et al., 2010). In addition, since hay is bulky and costly to transport much of the hay produced is used locally, primarily on the farms on which it was produced (Miller, 1986; Diersen, 2008; Dismukes and Zepp, 1996). As a result, hay prices are determined by local supply and demand forces (Diersen, 2008). Thus, local events, such as the opening of a new ethanol plant, that put upward pressure on prices of other commodities, such as corn, would be expected to have impacts on acreage allocation decisions including the decision to reduce land allocated to hay and forage production.

Ethanol plants locate in areas of ample corn production and areas where livestock feeding facilities are available to make use of the co-products from the ethanol production process (Baker and Zahniser, 2007). While the recent rise in corn prices is attributed to increased demand for corn, there is also evidence that local and/or regional corn prices are positively impacted, at least in the short-run, by the opening of new ethanol plants. McNew and Griffith (2005) estimated the short-run local price impact of twelve new ethanol plants that opened from 2001 and 2002 to be between 4.6 and 19.3 cents per bushel, or, on-average, local producers received 12.5 cents more per-bushel after the plants opened. Behnke and Fortenbery (2011), using a longer time-frame than McNew and Griffith, examined the impact of ethanol production on local basis across several Midwestern states and found that ethanol production within a 50-mile region of a county centroid had a positive, yet small, impact on corn prices and estimated that the impact of a 50 million gallon per year (mgy) plant is a 0.425 cent per bushel increase. Olson et al. (2007), focusing only on South Dakota, found the impact on corn prices from ethanol production differed across districts and by plant size in 2005; their results suggest that an additional 40 mgy ethanol plant would increase corn price by $0.06 to $0.16 per bushel and by $0.04 to $0.27 per bushel for a 100 mgy plant. However, after accounting for both spatial and temporal effects Katchova (2009) found that producers located

close to ethanol plants have not received significantly higher prices. The above findings suggest that the opening of an ethanol plant does positively impact local corn prices but these impacts may dissipate over time. Although the evidence regarding localized impact of ethanol plants on corn prices is mixed, there is no doubt that increased ethanol production has contributed to the recent strong upward trend in corn prices and as corn prices rise there will be an impact on farmer's land-use decisions. Thus, the opening of an ethanol plant is expected to have some impact on acreage allocation decisions at the local level (Wilson et al., 2008; Wallander et al., 2011).

Examining how hay production has been impacted by ethanol production is an important endeavor as both corn and hay are important crops in Nebraska. Nebraska was the third largest corn producer in the nation in both 2001 and 2012. Nebraska ranked third in alfalfa production and sixth in all hay production in 2001; however, the state's ranking had declined to 8th in alfalfa and 10th in all hay production in 2012. During this same period, acres devoted to corn, due in part to expanded ethanol production, increased from 7.75 million acres to 9.1 million acres while hay acreage declined from 3.2 million acres in 2001 to 2.57 million acres in 2012. Figure 1 illustrates the trend in hay and corn acres for the 1980 – 2012 period.

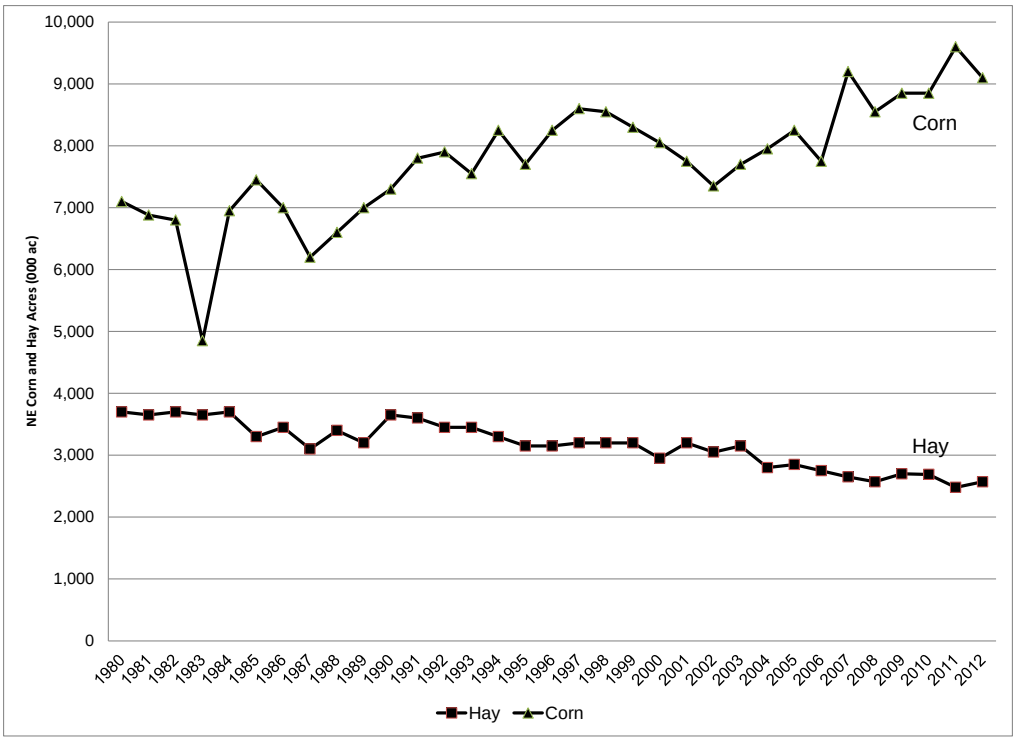

Figure 1. Nebraska Corn and hay Acres for period 1980 – 2012 (000 acres).

One of the factors contributing to the rapid increase in corn acreage is the growth in ethanol production both nationally and within Nebraska. At the national level, U.S. ethanol production increased from 1.63 billion gallons in 2000 to over 13 billion gallons in 2012 (Renewable Fuels Association); during this same time period, Nebraska's ethanol production

expanded from 351 million gallons in 2000 to over 2 million gallons in 2012. The expansion in ethanol production was spurred in part by changes in national energy policy. The Energy Policy Act of 2005 established the Renewable Fuels Standards (RFS) at 7.5 billion gallons by calendar year 2012 and the Energy Independence and Security Act of 2007 revised the RFS to require 36 billion gallons of renewable fuels, with specific amounts for different biofuels (e.g., cellulosic biofuel, biomass-based diesel, and advanced biofuel) beyond the 15 billion gallons coming from conventional biofuels such as ethanol, by 2022 (Westcott, 2009). Since corn is currently the primary feedstock for U.S. ethanol production, and likely to remain so in the near future, meeting these RFS targets will increase the demand for corn maintaining upward pressure on corn prices as more corn is utilized by the ethanol industry and impact land-use decisions as higher returns provide economic incentives to increase corn acreage by diverting land from other uses including hay (Westcott, 2007; Acheampong et al., 2010; Baker and Zahniser, 2007; Wallander et al., 2011; Hoffman et al., 2007; Wilson et al., 2008; Dicks et al., 2009).

As ethanol production in Nebraska has increased, so has the acreage devoted to corn; as illustrated in Figure 1, acres devoted to corn have expanded significantly since 1980 while hay acreage has trended downward. This implies that ethanol may have had an impact on acreage allocations to corn and hay, especially in the counties where ethanol plants are located, and examining production trends for both hay and corn can provide insight into the impact that increased ethanol production has had on Nebraska hay production. The first step in this process is to evaluate the history of ethanol production in Nebraska – or the timeline of production. This timeline of production is summarized in Table 1.

Table 1. Timeline of Ethanol Production Capacity in Nebraska.

Year	Cumulative Number of Plants	Cumulative production capacity (mgy[/1])	Cumulative annual grind (mby[/2])	Counties with Ethanol Plants
1985	1	68	68	Adams
1992	2	468	168	Platte
1994	3	523	188	York
1995	6	826	299	Adams, Hamilton, Washington
1999	7	851	309	Sutherland
2003	9	986	358	Kearney, Pierce
2004	11	1,131	411	Merrick, Hitchcock
2006	12	1,181	430	Dawson
2007	20	1,749	645	Gage, Boone, Fillmore, Dakota, Perkins, Madison, Valley, Buffalo
2008	24	2,006	741	Holt, Morrill, Furnas, Hall

[/1]million gallons per year
[/2]million bushels per year

Ethanol production in Nebraska has expanded over time The first ethanol plant opened in Adams County in 1985 and by 1995 the number of ethanol plants operating in Nebraska had increased from 1 plant to 6 plants (in five different counties) and production capacity increased from 68 mgy to 826 mgy - an increase of over 1,000 percent. Between 1995 and 2006 Nebraska's ethanol production capacity increased moderately from 826 mgy from 6 plants in five counties to 1,181 mgy from 12 plants in 11 counties. However, in 2007 Nebraska's ethanol production experienced a rapid expansion with 8 new plants in 8 different counties opening and capacity increasing by 48.1% - from 1,181 mgy to 1,749 mgy. The expansion phase continued through 2008 with 4 new plants, all in different counties, opening and capacity increasing to 2,006 mgy (up 14.7% from 2007). Nebraska is now the second largest ethanol producing state.

As shown in Table 1, Nebraska's ethanol production is geographically dispersed with 24 ethanol plants operating in 23 different counties (only Adams County has two ethanol plants in operation). As discussed earlier, the expansion of ethanol production tends to put upward pressure on corn prices which in turn influences producers' land use decisions. Given that corn and hay can be produced on the same land, it is reasonable to expect that hay acreage would be reallocated to corn as increased ethanol production increased the profitability of corn production. In addition, the development of Nebraska's ethanol production capacity exhibits identifiable periods of expansion. This provides a unique opportunity to examine the potential impacts of increased ethanol production on hay production by examining production trends before and after the opening of ethanol plants.

Purpose and Objectives

The purpose of this study is to examine the impact that increased ethanol production has had on Nebraska's hay production. To accomplish this objective, county level production trends for hay and corn will be examined using two expansion periods. The first period of expansion occurred prior to 1995 with ethanol plants opening and operating in five counties: Adams (1985, 1995); Platte (1992); York (1994); Hamilton (1995) and Washington (1995). The second, more recent period of expansion took place in 2007 with ethanol plants opening and operating in eight counties: Buffalo, Valley, Boone, Dakota, Madison, Fillmore, Gage, and Perkins. Comparing production trends in the counties with the oldest operating ethanol plants (pre-1995) to those opening more recently (2007) provides a means of examining hay production from the perspective of the long-term adjustment to the increased demand for corn due to ethanol production to the impact from more recent increase in ethanol production within the state. Thus, by examining production trends before- and after ethanol production began in selected areas one can infer the impact of ethanol production on production of other crops, including hay production.

Production trends for a 5 year period before- and after-plant openings will be used to examine the impact of the ethanol production on hay acreage. A five-year period is chosen for two primary reasons. One, hay is a perennial crop that takes time and costs to establish but once established will produce for 7 to 10 years (Dismukes and Zepp, 1996). Second, it is easier for producers to switch land from other annual crops (e.g., soybeans, wheat, etc.) to corn than it is to convert land from hay and pasture to annual crops (Dicks et al., 2009; ERS, 2011; Lee and

Kennedy, 2008). Assuming that producers make land-use decision based on expected returns in the next growing season, this implies that prices for competing crops would have to be high enough for a time period longer than one-year to entice producers to pull land out of hay production and switch over to another crop such as corn.

For purposes of this study, acreage is used as a proxy for production since production is heavily dependent on yields and yields vary with many factors including weather. Thus, acreage as a prime determinant for production is a better measure of production trends. In addition, comparing the changes in corn and hay acres at the state level to those observed at the county level assist in isolating the impact of ethanol production on those acreage allocation decisions.

Results

The purpose of this study is to examine the impact that increased ethanol production has had on Nebraska's hay production by examining county level production trends for hay and corn during two expansion periods (pre-1995 and 2007) of Nebraska's ethanol industry. Prior to examining the county level impacts, the state level impact was examined using the Granger causality test.

The Granger causality test requires ordinary least squares estimation of the following (1) unrestricted and (2) restricted equations:

$$(1)\ H_t = \alpha + \sum_{i=1}^{P} \beta_i H_{t-i} + \sum_{i=1}^{P} \gamma_i E_{t-i} + e_t$$

$$(2)\ H_t = \alpha + \sum_{i=1}^{P} \beta_i H_{t-i} + u_t$$

where H_t is millions of hay acres in year t, H_{t-i} is millions of hay acres lagged i periods, E_{t-i} is millions of gallons of ethanol produced in year t-i, and e_t and u_t are residual terms. Rejecting the null hypothesis $H_0 : \gamma_1 = \gamma_2 = ... = \gamma_p = 0$ implies ethanol production Granger-causes hay production. The above equations were estimated using data for the 1985 to 2007 period; ethanol production data was obtained from the Nebraska Energy Office website (www.neo.gov) while the hay acreage data was obtained from the National Agricultural Statistics Service (USDA). Given the inclusion of the lagged dependent variable as an independent variable, the estimation is done using the AUTOREG procedure in SAS and the length of the autoregressive lag (p) was set at 2 in order to avoid compromising degrees of freedom due to limited number of observations (23) and, in the opinion of the authors, two years is considered sufficient for any acreage adjustment due to ethanol production to occur. The results of the Granger test are presented in Table 2. Both F test and Chi square test (asymptotic) are statistically significant hence it can be concluded that ethanol production Granger-causes hay acreage to decline in Nebraska. Due to insufficient data, the test could not be done for individual counties. Instead, trend analyses were done at the county level.

Figure 2 reports the hay harvested acres for the counties with the oldest operating ethanol plants for the period 1980 – 1999, the first expansion period for Nebraska's ethanol sector. For ease of comparison, a vertical line is used to designate the year the ethanol plant

Table 2. Hay-Ethanol Granger Causality Test Results

	Equations:	
	Unrestricted	Restricted
Intercept	2.8139	-0.0899
Hay_{t-1}	-0.0772	0.4204*
Hay_{t-2}	0.2537	0.5909*
$Ethanol_{t-1}$	-0.0017	
$Ethanol_{t-2}$	0.0007	
R square	0.7391	0.6308
DW statistic	1.5414	1.6061

H_0: Ethanol production does not Granger Cause Hay acreage

Test 1: F-value = 3.7359*

Test 2: χ^2 = 9.5473**

*Statistically significant at 5% level

**Statistically significant at 1% level

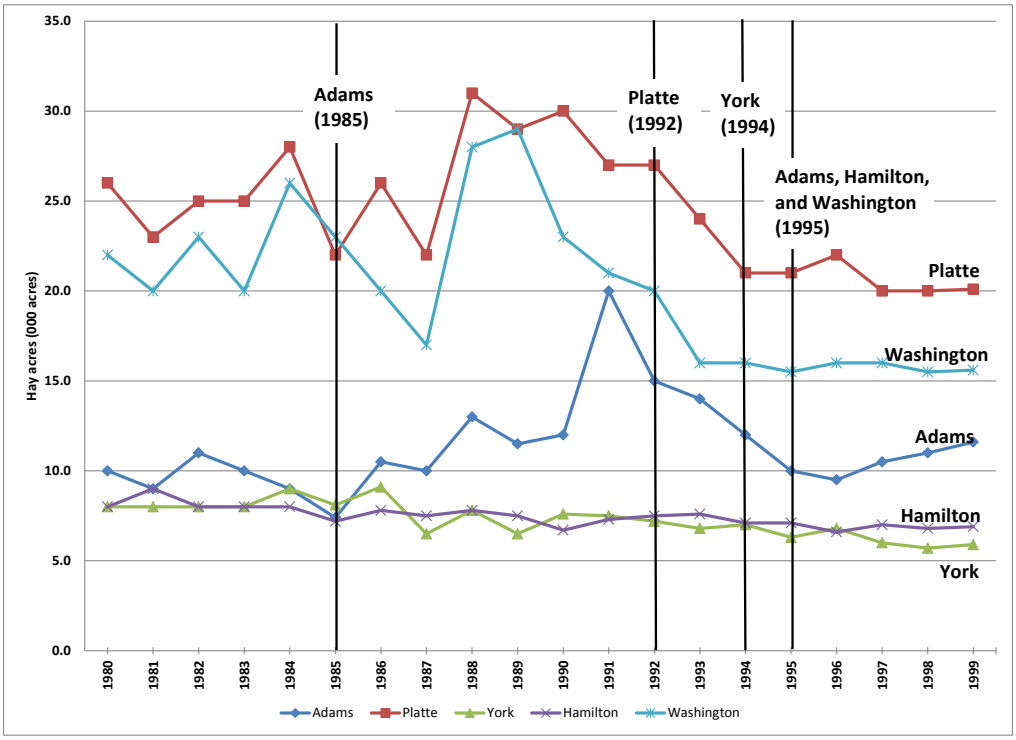

Figure 2. Hay Acres for Counties with Ethanol Plants Opening Before 1995 (000 acres).

opened and the counties are identified. Generally speaking, the trends observed in hay acreage in the counties with the oldest operating ethanol plants follow the same trends as those observed at the state level (see Figure 1). With the exception of Adams County and Washington County, all of the counties exhibited a decrease in hay acres in the 5 years after the ethanol plant opening. Adams County is the only county whose hay acres increased after ethanol plant began operating, both for the plant opening in 1985 and 1995; an increase that could be, at least in part, due to the placement of ethanol plants near livestock production facilities to take advantage of markets for co-products (dried distiller's grains solubles). Hay acres in Washington County, while lower in the post ethanol plant opening period, remained fairly stable during the entire 5-year period.

Figure 3 reports corn acres harvested for the counties with the oldest operating ethanol plants. With the exception of Platte and Washington Counties, corn acres have increased in the 5-year period after the opening of the ethanol plant and trends in corn acres are consistent with the trends observed at the state level (see Figure 1). In Platte County, corn acres increased in the 5-year period before the plant opened in 1992 and then gradually declined during the 5-year post ethanol plant opening. A similar pattern in corn acres is also shown in Hamilton and Washington Counties. Some of these changes may be attributed to factors outside of ethanol production, such as changes in government programs affecting crop choices and weather conditions.

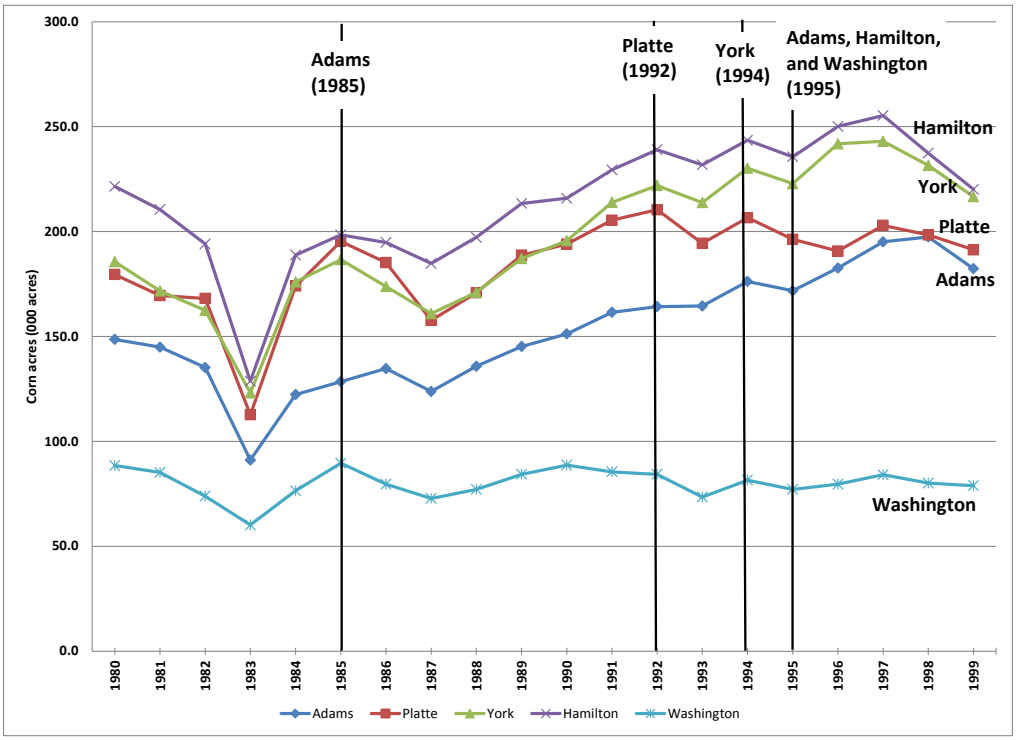

Figure 3. Corn Acres for Counties with Ethanol Plants Opening Before 1995 (000 acres).

Comparing corn and hay acres at the state (Figure 1) and county (Figures 2 and 3) level it is apparent that although the overall trend is similar, the acreage changes in individual counties from year to year tend to be larger in magnitude than those observed at the state level. Examining the entire 1980 – 1999 period it is clear that hay acreage has been declining and corn acreage has been increasing – although there are fluctuations from year to year. It is interesting to note that the decline in hay acreage in each of the counties with ethanol plants has exceeded that of the rate observed at the state level. Based on this, it might be concluded that the opening of ethanol plants within the counties of Adams, Platte, York, Hamilton, and Washington counties had little impact on either hay or corn acres; however, this could be due primarily to the space of time between plant openings and the modest size of the ethanol plants.

The second expansion period for Nebraska's ethanol sector examined include the eight plants opening in 2007. The hay and corn harvested acres for the eight counties with ethanol plants opening in 2007 are reported in Figure 4 and Figure 5, respectively For ease of comparison, a vertical line is used to designate the year the ethanol plants opened.

As shown in Figure 4, between 2002 and 2011 hay acres declined in seven of the eight counties and followed the same general trend observed at the state level (see Figure 1) but at a larger magnitude. Only Fillmore County had hay acres increase between 2002 and 2011, from 7,600 acres in 2002 to 7,900 acres in 2011 – a very modest 3.95%. All other counties had hay acres decrease by a larger magnitude than that observed at the state level (see Figure 1). Examining the amount of change during the period immediately before the opening of the ethanol plant shows that the counties of Buffalo, Boone, and Perkins hay acreage declined faster than the state and the counties Valley, Dakota, and Gage had smaller percentage changes. During the period after opening of the ethanol plant in 2007, all of the counties - except Fillmore and Gage - had hay acreage decline at a larger magnitude than at the state level. This suggests that the opening of the ethanol plants have had some impact on acreage and the rate of change within the individual counties. It is also interesting to look at the changes that occurred between the year-before and year-of opening of the ethanol plants. When examined in this light, all counties with the exception of Dakota experienced a decrease in hay acres that were comparable or exceeded the decline in hay acres at the state level. State level hay acres declined from 2.75 million acres in 2006 to 2.65 million acres in 2007 – a 3.6% decrease. By comparison, hay acres declined fairly modestly in Buffalo (3.3%) and Boone (5.3%) counties, with much larger decreases observed in Valley (10.7%), Gage (13.4%) and Madison (15.6%) counties. However, the largest reductions in hay acres between 2006 and 2007 were in Perkins (28.57%) and Fillmore (21%) counties. Unlike the other seven counties, hay acres in Dakota County increased from 5,400 acres in 2006 to 6,000 acres in 2007 – an 11.1% increase. Dakota County (see Figure 4) shows that between 2002 and 2007 hay acres slowly trended upward (from 5,800 acres in 2002 to 6,000 acres in 2007) before beginning to trend downward (to 3,700 acres in 2011). Comparing the overall trend in hay acres at the state level (Figure 1) with those observed at the individual county level (Figure 4) shows the same general downward trend in hay acres during the 2002 – 2011 period.

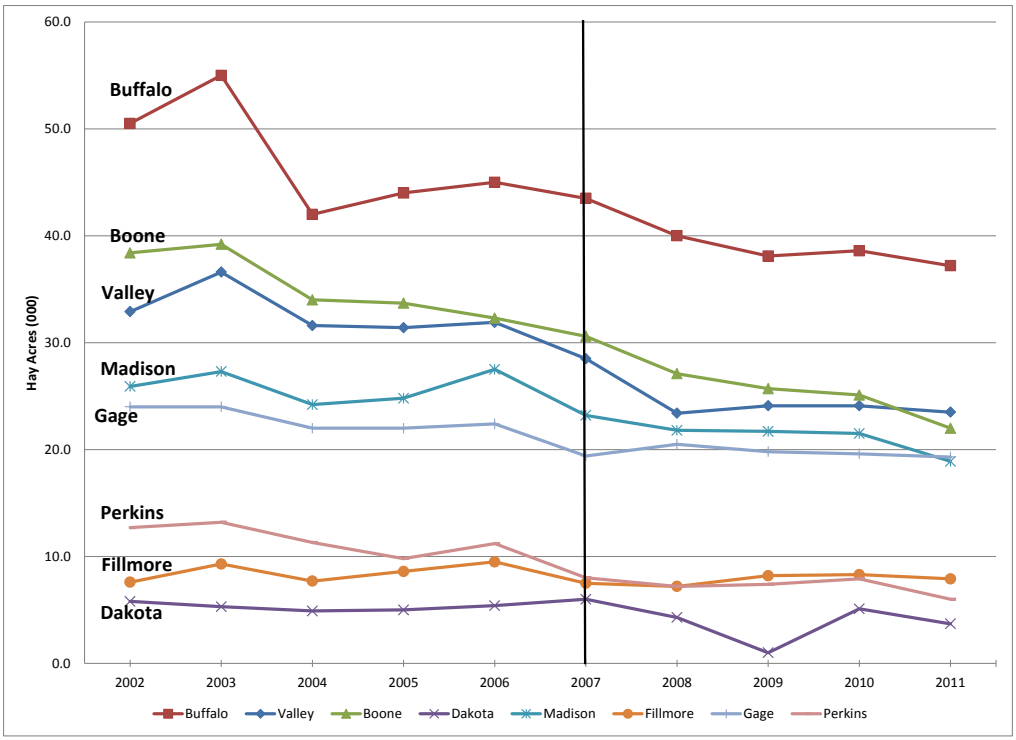

Figure 4. Hay Acres for Counties with Ethanol Plants Opening in 2007 (000 acres).

Figure 5 reports the corn acres harvested in the counties with ethanol plants opening in 2007. Between 2002 and 2011 corn acres increased in all eight counties and followed the same general trend observed at the state level (see Figure 1) but at a smaller magnitude. At the state level, corn acres increased from 7.35 to 9.6 million acres or by 30.6%, of the eight counties with ethanol plants opening in 2007 only Buffalo (from 154,300 acres in 2002 to 205,800 acres in 2011 – a 33.4% increase) and Perkins (from 158,700 acres in 2002 to 224,200 acres in 2011 – an increase of 41.3%) counties had acreage increase by more than 30% during the 2002 – 2011 period. Closer examination of Figure 6 suggests that during the 5-year period (2002 – 2006) immediately before the opening of the ethanol plant shows that corn acres increased the fastest in Buffalo county (from 154,300 to 178,800 or 15.9%) and that Fillmore, Gage, and Perkins actually had fewer corn acres in 2006 than in 2002. During the 5-year period (2007 – 2011) immediately following the ethanol plant opening, five of the counties (Buffalo, Valley, Boone, Madison, and Fillmore) had fewer acres in corn in 2011 than in 2002, while the remaining three counties (Dakota, Gage, and Perkins) had higher corn acres. This seems to suggest that corn acres began declining after the opening of the ethanol plants. However, upon closer examination the comparison of corn acres in 2006 to 2007 (the year prior to opening and first year of plant operations) suggest that all counties had a large increase in corn acreage upon opening of the ethanol plant. For example, between 2006 and 2007 corn acres increased by 46,300 acres (or 30%) and 16,800 acres (or 27%) in Fillmore and Valley County, respectively; during that same time period the other counties experienced an increase in corn acres greater

than 10%. This suggests that the initial increase in corn acres in response to the ethanol plant opening may have occurred immediately prior to the plant's opening and then trailed off as the plant remained in operation for some time. Given that area producers have advance knowledge of when an ethanol plant will begin operation this result is not unexpected.

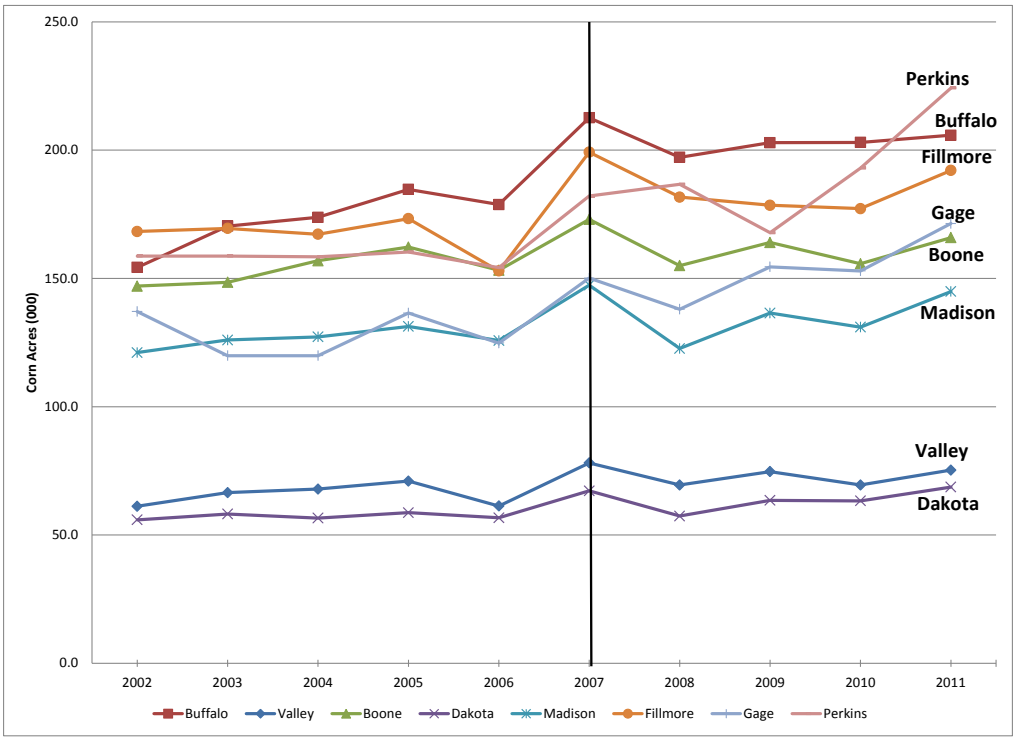

Figure 5. Corn Acres for Counties with Ethanol Plants Opening in 2007 (000 acres).

Another way to examine if ethanol production has impacted hay production is to compare mean acreage levels before and after the opening of ethanol plant openings. The results are presented in Table 3.

As shown in Table 3, the initial impact of the first few ethanol plants in Nebraska had little impact on both hay and corn acres. While mean corn acres increased in the 5-year period after ethanol plants opened in Adams, Platte, York, Hamilton and Washington counties, the difference in mean acres is statistically significant only for York and Adams (plant opened 1995). With the exception of the first ethanol plant (1985) in Adams county, hay acres declined in the 5-year period after ethanol plants opened in Adams, Platte, York, Hamilton, and Washington counties. The difference in mean hay acres is statistically significant for both Platte and York counties. One item of interest is the decline in mean corn acres observed in Washington County during the 5-year period after the opening of the ethanol plant. Given the time frame the decline in corn acres could be attributed, in part, to the changes in the 1996 farm legislation which allowed producers to switch acres from corn to soybeans without penalty of lost corn

base acres. Hay acres in each of these counties is relatively small, especially when compared to corn, and thus the level of hay acres may be less influenced by the increased ethanol production as land in other crops were reallocated to corn production. Another possible explanation is the modest size of the ethanol plants that opened. Of the six plants that opened between 1985 and 1995, only two plants had an annual grind greater than 30 million bushels per year. The plant in Platte County – at 143 million bushels per year – is the largest plant in the state and Platte County also had a statistically significant decline in hay acres in the 5-year period after the plant opened in 1992.

Table 3. Average Acreage Levels: Before and After Plant Opening.

County	Ethanol Plant Opened	Annual Grind (mil bu)	Average Corn acres (000 ac)		Average Hay acres (000 ac)	
			5-years before	5-years after	5-years before	5-years after
Adams	1984	25	128.42	133.60	9.80	10.48
Platte	1992	143	183.32	199.68	27.80/1	23.00/1
York	1994	20	206.46/1	233.86/1	7.12/1	6.36/1
Adams	1995	20	163.52/1	185.84/1	14.60	10.52
Hamilton	1995	18	231.92	239.70	7.24	6.88
Washington	1995	73	82.70	79.96	19.20	15.72
Buffalo	2007	30	172.4/1	204.3/1	47.30/1	39.48/1
Valley	2007	19	65.58/1	73.42/1	32.88/1	24.72/1
Boone	2007	41	153.56	162.72	35.52/1	26.10/1
Dakota	2007	22	57.22/1	64.02/1	5.28	4.02
Madison	2007	20	126.28	136.50	25.94/1	21.42/1
Fillmore	2007	43	166.24/1	185.74/1	8.54	7.82
Gage	2007	20	127.64/1	153.38/1	22.88/1	19.72/1
Perkins	2007	20	158.06/1	190.76/1	11.64/1	7.30/1

/1difference in means statistically significant at $\alpha = 0.05$

Table 3 also reports the mean hay and corn acres for the eight counties with ethanol plants opening in 2007. All eight counties experienced increased corn acres and decreased hay acres in the 5-year period after ethanol plants opened. With the exception of Boone and Madison counties, all of the changes in corn acres are statistically significant (at $\alpha = 0.05$). In terms of hay acres, the decline in mean hay acres between the two time periods is statistically significant (at $\alpha = 0.05$) for six (Buffalo, Valley, Boone, Madison, Gage, and Perkins) of the eight counties; only changes in mean hay acres between the two time periods for Dakota and Fillmore counties was not statistically significant. The decline in hay acres observed for these eight counties may be more representative of the impacts of ethanol production for two reasons. First, these eight counties have higher levels of hay acreage than the counties with ethanol plants opening before 1995. Second, due in large part to the implementation of renewable fuel standards in the Energy Act of 2005 and EISA of 2007, increased ethanol

production has had a larger impact on corn prices recently than in the past. For example, Nebraska corn prices averaged $2.29 in 1990, $3.57 in 1995, $1.94 in 2005, $4.37 in 2007, and $6.89 in 2012. The rapid increases in and sustained higher corn prices seen since 2006 have enticed producers to grow more corn and has put increased pressure to reduce acreage devoted to other crops such as hay.

Summary and Conclusions

Nebraska's ethanol industry has a long history which has exhibited distinct periods of expansion. The purpose of this study was to examine the impact of increased ethanol production on hay production. Granger causality test indicates ethanol production causes hay production to decrease at the state level. At the county level, a comparison of two distinct expansionary periods: 1985-1995 and 2007 was used. Counties with the oldest operating ethanol plants or the plants that opened earlier seems to have less impact on hay production – which could be due lower prices during that time period - than those counties with ethanol plants opening during the most recent expansionary phase.

Counties with ethanol plants did exhibit increased corn acreage and those increases often exceeded the rate of increase at the state level. In addition, the decreased hay acreage in many of the counties with ethanol plants provides some evidence of acreage reallocation taking place; however, some of that acreage reallocation may be coming from other row crops (e.g., sorghum and wheat) rather than hay acreage. A possible reason for the limited reallocation could be due to the modest size of ethanol plants, only six of the plants in Nebraska have the capacity to produce more than 100 mgy. The importance of cattle feeding/production in the counties examined may also have a dampening effect on dramatic acreage shifts toward corn.

Additional investigation is needed to determine the impact of increased corn acreage on hay production in Nebraska – additional variables to examine would include the economic value of corn relative to hay, past production, and cattle numbers in the counties where ethanol plants are located.

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