

## Ethanol Impact Studies – Part 1: Weather and Corn Yields

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There have been a number of studies presented over the past few months about the impact of ethanol on the demand for corn and the impact on corn prices. One of the most recent receiving media attention was the Kraft paper authored by former USDA Chief Economist Dr. Keith Collins. These papers are all relatively well documented economic studies that have concluded the increased demand for ethanol has resulted in corn prices anywhere from 10% to 60% higher than would have been the case if there was no federal program to encourage ethanol production (see Appendix 1).

With regard to the current price of corn, there has been one important element of this issue that has been ignored by these studies – the yield experience of corn over the past few years. Start with the year of 2004 in which the reported average national yield was 160.4 bushels per acre. This new record yield was nearly 21 bushels per acre over the projected trend line yield for 2004. (Trend line yield is defined as the actual national average corn yield for the previous 10 years regressed against time and projected forward one year.) The record yield of 2004 resulted from nearly ideal weather conditions throughout the growing season, a fact that might not have been fully appreciated at the time.

It should also be noted that about once a decade corn yields jump some 10-15% to a new record level as happened in 2004. That would also include the years 1992 and 1978. However, the decade of the 1980s did not experience any really large yield jumps but instead a couple of major declines approaching 30% in 1983 and 1988. However, over the past ten years there has not been this type of yield decline. The two times yields did drop in the past ten years it was in the 6-8% range. Perhaps this is due in some part to the genetic enhancements. So it could be argued that the bottom end of corn yield fluctuations has been reduced or that corn yields are now more stable.

In 2004 biotech corn seed had been utilized for about six years and it was argued that as a result of these genetic enhancements the trend line yield of corn would advance at an increasingly rapid pace. Moreover, this argument was widely utilized as one of the rationale for farmers being able to produce increasing amounts of corn in order to satisfy the demand for corn that might result from legislative changes to promote the increased production of ethanol. In January 2007 Dr. Collins mentioned this in his remarks at a session on Biofuels at the American Farm Bureau Federation's Annual Meeting in Salt Lake City.

In reviewing the record of actual U.S. average corn yields since 2004 it is apparent that the expectation for increased yields has not shown up in the field. As can be seen in the following table, yields have been essentially flat, hovering around 150 bushels per acre. Moreover, based on current conditions, it appears 2008 will remain at this general level.

### Predicted Trend Line vs. Actual Corn Yields

Year	Predicted Corn Yield				Actual Yield	Difference
	1994-03	1995-04	1996-05	1997-06		
	bushels per acre					
2004	139.7				160.4	+ 20.7
2005		152.8			148.0	- 4.8
2006			153.7		149.1	- 4.6
2007				154.5	151.1	- 3.4
2008					148.4*	- 6.5

\* Projected Yield, July 2008 USDA WASDE Report

Before going any further it should be emphasized that this somewhat disappointing yield experience is almost entirely due to the weather. The exception to that is 2007 when corn acreage was expanded by 15 million acres or 19%. Large expansions in acreage meant that corn ground that previously in a crop rotation plan might have been planted back to corn a second consecutive year; that new ground of somewhat marginal production capacity was utilized and that new growers in non-traditional Corn Belt states were growing corn, perhaps some for the first time. All of these factors would tend to have a negative impact on yields, decreasing the yield slightly.

Genetically enhanced corn seed has the potential to deliver higher yields, a fact that has been repeatedly demonstrated in hundreds of test plots across the nation. However, the nation's corn crop does not come from test plots but a widely diverse geographic area with huge variations in soil types, management techniques and, most importantly, weather. A recent paper by Tannura, Irwin and Good, "Are Corn Yields Increasing at a Faster Rate?," looked at this issue in some depth.<sup>1</sup> This included an observation from another paper, "While higher yields might be due to a new trend, such claims should be treated with caution since weather can have a large effect on trend yields estimated over short periods of time."

The authors went on to note that, "The charts show that weather for the period from the mid-1990s forward (to mid-2000) was relatively favorable to corn production." As it turns out this was the period of time that the biotech corn varieties were being introduced and grown by corn farmers; it is understandable that many people would attribute the relatively good yield results to this advanced seed technology. While offering no firm conclusions on the issue, the Tannura, Irwin and Good paper examines numerous aspects of historical corn yields and weather and is well worth reading.

The next question that should be asked is what would have been the impact if, in fact, yields would have come in at the trend projections and what impact would that have had on corn prices? To determine that answer the yield differences from 2005 through 2008 (utilizing the most recent USDA projection for 2008) were multiplied by the harvested acreage for the respective year. As can be seen in the following table, the cumulative

<sup>1</sup> Tannura, Mike, Scott Irwin and Darrel Good. 2008. "Are Corn Trend Yields Increasing at a Faster Rate?" University of Illinois at Urbana-Champaign, Department of Agricultural and Consumer Economics Marketing & Outlook Briefs 08-02, February 20.

production impact of the adverse weather over the 2005 to 2008 period is 1.5 billion bushels of corn.

### **Impact of Yield Difference on Corn Production**

Year	Harvested Acres (million)	Yield Difference (bushels)	Production (million bushels)	Cumulative
2005	75.1	4.8	360	360
2006	70.6	4.6	325	685
2007	86.5	3.4	294	979
2008	78.9	6.9	544	1,523

One of the most important factors in determining corn prices are stocks levels at the conclusion of the crop year. (Crop years for corn run from September – when the corn harvest starts in the Midwest – until the end of August.) The lower the stocks at the conclusion of the crop year, the higher the price and vice versa. One of the main reasons corn prices are currently so high is that the July World Agriculture Supply and Demand Estimate (WASDE) projected ending stock of corn at the conclusion of the 2008/09 crop year will be only 833 million bushels.<sup>2</sup> However, if trend line yields would have occurred over the 2005-2008 period, an additional 1.5 billion bushels of corn would be added to the 2008/09 ending stock number for a total 2.3 billion bushels of corn. Now it must be acknowledged that if that amount of corn were available in the 2008/09 crop marketing year usage would probably be higher and the ending stocks number more likely would be around 1.5 billion bushels. Nevertheless, corn prices would be noticeably lower; at least \$1 per bushel and perhaps \$2 per bushel or more, if that were the current projected ending stocks number.

What are the lessons to be drawn from this experience? First, the assumptions that went into legislation concerning ethanol were based on the reasonable expectation that corn yields would continue to rise at a trend line rate. Second, despite the best innovations and planning of man, Mother Nature does not necessarily play by the rules when it comes to weather. Weather remains largely a random variable and, as pointed out in the Tannura, Irwin and Good paper, a number of adverse years can negatively influence corn yields just as easily as several good years can boost yields. Finally, while ethanol is one of the reasons for higher corn prices, it is only one of several other variables (to be addressed in a subsequent paper). However, with respect to corn production and current high corn prices, weather is probably the most important factor to date.

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<sup>2</sup> U.S. Department of Agriculture, World Agricultural Outlook Board. 2008. World Agricultural Supply and Demand Estimates, WASDE-460, July 11.

## Appendix 1

*The Effects of Ethanol on Texas Food and Feed*, Texas A&M, April 2008<sup>1</sup>

“Relaxing the RFS does not result in significantly lower corn prices.”

“—with a one-quarter RFS waiver price falling about \$0.30 per bushel below the full RFS price a few years hence, and the one-half RFS waiver price falling about \$0.50 to \$0.60 per bushel below the full RFS expected price.”

Food and Agriculture Policy Research Institute, FAPRI, January 2008<sup>2</sup>

“—implementation of EISA’s RFC (in the absence of the tax credit) will raise corn prices about 19%—the ethanol tax credit of \$0.51 per gallon (in the absence of the RFS) supports corn prices by a slightly smaller 11%. Because of the interactions between the two subsidies, it is estimated that joint implementation of both the RFS and tax credit supports corn prices by about 20%.”

Center for Agricultural Research and Development, CARD, March 2008<sup>3</sup>

“—jointly the RFS and tax credit supported the price of corn by a slightly smaller 16%.”

*The Effect of Ethanol Production on the U.S. National Corn Price*, University of Wisconsin, Madison, April 2008<sup>4</sup>

“—the model results above suggest that ethanol’s contribution to the price rise was about 41 cents per bushel, *ceteris paribus*.”

*The Role of Biofuels and Other Factors in Increasing Farm and Food Prices*, Keith Collins, June 2008.<sup>5</sup>

“This paper reviews various studies that have examined the relationship between corn used in ethanol production and corn prices. They suggest increased corn demand for ethanol could account for 25 to 50 percent of the corn price increase expected from 2006/07 to 2008/09. Another analysis presented in the paper suggests that ethanol could account for 60 percent of the expected increase in corn prices between 2006/07 and 2008/09—“

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<sup>1</sup> Anderson, D.P., Outlaw, J.L., Bryant, H.L., Richardson, J.W., Ernstes, D.P., Raulston, J.M., Welch, J.M., Knapek, G., Herbst, B.K., and Allison, M. 2008. “The Effects of Ethanol on Texas Food and Feed,” Agricultural and Food Policy Center, Texas A&M University, April 10.

<sup>2</sup> Food and Agricultural Policy Institute. 2008. “The Energy Independence and Security Act of 2007: Preliminary Evaluation of Selected Provisions,” University of Missouri-Columbia, FAPRI-MU #01-03, January.

<sup>3</sup> Du, Xiaodong, and Dermot J. Hayes. 2008. “The Impact of Ethanol Production on U.S. and Regional Gasoline Prices and on the Profitability of the U.S. Oil Refinery Industry,” Center for Agricultural and Rural Development, Iowa State University, Working Paper 08-WP467, April.

<sup>4</sup> Fortenbery, T. Randall, and Hwanil Park. 2008. “The Effect of Ethanol Production on the U.S. National Corn Price,” University of Wisconsin-Madison, Department of Agricultural Economics, Staff Paper No. 523, April.

<sup>5</sup> Collins, Keith J. “The Role of Biofuels and Other Factors in Increasing Farm and Food Prices: A Review of Recent Developments with a Focus on Feed Grain Market Prospects.” Prepared as supporting material for a review conducted by Kraft Foods Global, Inc., June 19.

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