FACTSHEET

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An Overview of the Impacts of Increased Corn Demand for Ethanol

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The Issue: Increased Corn Demand for Ethanol

The surge in corn demand for ethanol production will have widespread and diverse impacts on U.S. agriculture in the coming years. Corn used for ethanol increased by 21 percent from 2004 to 2005 and is projected to increase another 34 percent in the 2006/2007 crop year (USDA). This represents a total of 2.15 billion bushels of corn used for ethanol, an increase of over 800 million bushels in the last two years. Estimates for future demand vary widely but some estimates suggest ethanol production could increase from the current level of nearly 5 billion gallons to as much as 20 billion gallons with some proposals for as much as 35 billion gallons. More modest forecasts suggest that ethanol production could increase to a total of 10 – 12 billion gallons in the next three to five years. This would require roughly 17 million more acres of corn production (or imported corn!) if other uses of corn remain at current levels. Growth in ethanol production may not be as dramatic or occur as fast as currently envisioned given the multitude of related impacts that this growth implies.

This growing component of corn demand will have a variety of impacts on total corn supply and demand; other crop markets; and livestock production. National level impacts will vary regionally and short run impacts will be different than long run impacts. Each of these is discussed briefly in the following sections.

Impact: Corn Supply

Increased corn demand initially causes higher corn prices which is the market signal to increase corn production. In general, corn production can be increased either by increasing corn acreage and/or corn yield. Where will additional corn acreage come from? Table 1 shows crop land use for the major U.S. crops. Corn acreage has averaged 72 million acres for the past decade, roughly 23 percent of total crop acreage. Corn along with soybeans, hay and wheat represents 85 percent of harvested cropland and adding cotton and grain sorghum brings the total to 91 percent. All other crops account for the remaining 9 percent of harvested cropland. This suggests that most, if not all, of the increased corn acreage will have to come from acreage currently used for production of one of the major crops in Table 1.

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The most likely source of additional corn acres is from soybeans. Both crops are grown in the same areas and usually in a 1:1 corn to soybean crop rotation. The simplest way to increase corn acreage is to utilize a 2:1 corn to soybean crop rotation. This could allow up to 95 million acres to be used for corn while reducing soybean acreage to less than 50 million acres. There is a yield effect of changing the crop rotation that will be discussed below. Additionally, reduced soybean acreage would lead to increased soybean prices that would mute and perhaps eliminate the incentive to switch more acres into corn. Historically a soybean to corn price ratio of less than 2:1 was required to move acres from soybeans into corn. However, this relationship may change in the future. Some wheat acres could also shift to corn or soybeans but again, the relative price of wheat and the tendency for higher wheat prices with reduced acreage would limit such a switch. It is unlikely that significant hay/forage production would switch to corn production since much of the hay is perennial and higher feed prices will make forage crops even more valuable. However, some forage acres could switch to wheat or other crops as indirect effects.

Table 1. Current and Average Crop Acreage

Crop	2005/2006 Harvested Acres (Million)	1997-2006 Average Harvested Acres (Million)	% of Total Harvested Cropland*
Corn	75.1	71.7	22.5
Soybeans	71.3	72.2	23.8
Wheat	50.1	52.3	15.0
Cotton	13.8	12.8	4.1
Grain Sorghum	5.7	7.4	2.2
Subtotal (1)	216.0	216.4	67.2
Hay/Forage**			23.4
Subtotal (2)			91.0

* 2002 Census of Agriculture

** Includes all hay, greenchop, haylage and silage (including corn and sorghum silage)

The nearly 36 million acres of cropland currently in the Conservation Reserve Program (CRP) is sometimes mentioned as a source of additional land for crop production. Much of the CRP land is in the Great Plains rather than the Corn Belt and is not well suited for corn production. However some CRP land could be used to increase production of wheat, grain sorghum or other crops to offset the effects of increased corn production in the Midwest. A significant portion of currently enrolled CRP land is in trees, wetlands or other uses that limit or prevent crop production. The amount of CRP land actually available is probably 15 to 25 million acres, depending on policy considerations and the extent to which the most environmentally sensitive acres remain protected.

The second way to increase corn production is to increase yields. Higher corn prices encourage more intensive use of fertilizers, hybrid seed and other inputs and would result in some increase in yields on currently cropped acres. However, switching to a 2:1 corn to soybean crop rotation causes corn yield reductions of 6 to 12 percent. Thus, beginning the first time that acres are cropped with back to back corn, the average yield on those acres will drop roughly 15 bushels/acre. A 2:1 corn to soybean crop rotation does however result in a boost to

soybean yields of roughly 12 percent which would partially offset the impact of reduced soybean acreage on total soybean production.

Adding additional corn acres will necessarily be on land more marginal for corn production and thus tend to pull down average yields. This effect would be magnified if CRP acres are used for corn production. In general, it is difficult to increase corn acreage and yield at the same time. Corn yields have trended up for many years and new technology will continue that increase but no major break-through technology appears to be on the horizon at this time that would immediately overcome the initial decrease in yields due to changes in crop production patterns.

Increased input use will result in higher input prices, especially for fertilizer. The effects of higher crop input prices would be felt far beyond corn production regions and would impact producers of all crops. Crop land values across the country will likely increase due to the direct and indirect effects of increased corn demand.

Impact: Corn Demand for Other Uses

Increased corn demand for ethanol and the resulting higher prices will tend to ration corn for other uses and may lead to demand substitution between various uses of corn. If corn used for ethanol is bid away from other uses, less net increase in corn production will be required. The question is to what extent might this demand substitution take place? Corn use is broadly grouped into the three categories of feed; food, seed and industrial (including ethanol); and exports. The largest of these uses is animal feed which has averaged 5.8 billion bushels per year or 57.8 percent of total corn use in the past decade. The food, seed and industrial category includes corn used for seed, direct human consumption, and corn processed for corn sweetener and ethanol. This category has averaged nearly 2.4 billion bushels annually or 23.6 percent of total corn use the last ten years. The U.S. has exported 1.9 billion bushels of corn annually in the last decade, which represents 18.7 percent of total use.

Higher corn prices provide an incentive to substitute other feed resources, most likely grain sorghum, for animal feed. If corn price is high enough or wheat price is low enough, relative to each other, wheat can be substituted economically as an animal feed but only to a limited extent depending on the specie. In general when the wheat to corn price ratio drops below 1.1:1, wheat can be used economically for animal feed. However, the amount of corn used as a feed grain is much greater than can be replaced by either grain sorghum or wheat. Higher feed prices could lead to reduced animal production which reduces total feed demand and implies higher meat and dairy prices for consumers. Overall, corn demand for animal feed is unlikely to decrease significantly and the circumstances that would induce a bigger decrease in corn for animal feed imply dramatic impacts on meat production and consumer prices for meat.

Besides corn used for ethanol production, the largest component of the food, seed and industrial category is corn used for corn sweetener. Roughly 800 million bushels of corn are used annually for corn sweetener production as a supplement to sugar production. Corn is used for sweetener in the U.S. mostly because sugar prices are maintained artificially higher than world sugar prices by the sugar program. If the sugar program were modified or eliminated to reduce this effect, much of the corn currently used for sweetener would likely be used for ethanol production. The direct use of corn in food products, such as breakfast cereals, corn starch and beverage distilling would not likely change much but prices for these products could increase.

Perhaps the most obvious way to meet ethanol demand for corn is to divert some corn exports back into the domestic market. Higher corn prices are expected to decrease corn exports in the coming years. However, the U.S. is the largest exporter of corn in the world accounting for roughly 60 percent of world trade. Thus, it will take much higher prices to significantly diminish U.S. corn exports and there will be ripple effects in many exporting and importing countries around the world.

Impact: Livestock Production Issues

It was previously noted that higher corn prices and consequently generally higher feed costs could reduce total animal production and would certainly encourage livestock producers to seek alternative feed sources. Ethanol production results in distillers grains as a by-product. Distillers grains are used as wet distillers grains (35 percent dry matter, DM), modified wet distillers grains (50 percent DM) or dried distiller grains (90 percent DM). Each bushel of corn (56 pounds) used for ethanol production returns about 18 pounds of dried distillers grains. Ethanol by-product feeds can be used by all meat animal species but with limitations for various reasons for each specie. Poultry rations are generally limited to no more than 10 percent while hogs can use up to 25 percent of distillers grains due to concerns about lysine availability. Cattle finishing rations are limited to 40 percent and dairy rations to 25 percent due to concerns about fat content, sulfur toxicity and phosphorous levels. There are few problems with distillers grains as supplements for cow-calf or stocker cattle because of low levels of consumption. By-product feeds are variable in quality and require additional management to avoid negative impacts on animal performance.

Wet by-product feeds of ethanol production are significantly cheaper than dried products but must be used close to the source of production. The high water content limits hauling to no more than 100 miles from the ethanol plant. Wet feeds are difficult to handle and are unstable thereby spoiling quickly, especially in the summer. Wet feeds are particularly prone to bridging and poor flowability and may require specialized handling equipment. Dried by-product feeds are storable and more transportable but significantly more costly.

Although the availability of by-product feed offsets some of the corn used for ethanol production on a quantity basis, the more significant impact is on the relative supply and demand for various nutrients. Corn is used primarily as an energy feed for livestock and it is this same energy or starch that is removed by ethanol production. Distillers grains remaining after ethanol production retain the protein and fiber plus minerals. The result is a relatively high protein feed. In general, the impact of increased ethanol production is to increase the relative supply of protein feeds and reduce the relative supply of energy feeds for animals. Thus, by-product feeds will compete more with protein feeds, usually derived from oilseeds such as soybeans and cottonseed than with energy feeds.

Availability of distillers grains may help offset potential reductions in soymeal production if corn replaces soybeans in the total crop mix. Although the net impact on protein feed supplies and prices is uncertain, there is clearly a relative deficit of energy feeds which implies an increased demand for other energy feeds such as grain sorghum and possibly wheat, barley and oats. It is also true that generally higher feed grain prices will increase the value of forage and will favor production of cattle using more forage and less feed grains.

Impact: Regional Changes in Crop and Livestock Production

The impacts described above are national in scope but specific impacts will vary regionally across the country. The most dramatic direct impacts on crop production will likely occur in the Corn Belt with increased corn production and reductions in soybeans and perhaps wheat. Farther south, crop land could be diverted to more corn or more soybeans with possible reductions in cotton, wheat and rice acreage. In the Great Plains, marginal increases in corn and soybeans are possible but more likely is increased grain sorghum production with possible losses of wheat acreage. In all regions, it will be relative prices for viable crop alternatives that determine changes in crop production patterns.

Most of current ethanol production and much of the currently planned expansion directly coincides with corn production regions. However, there are numerous plans and proposals for plants outside the Corn Belt in the Southern Plains, the Southeast and the far eastern Corn Belt into the Northeast. The location of ethanol production will generally impact transportation of

inputs and outputs and may significantly affect local markets for grain and local availability of by-products. For example, with enough increase in ethanol production, Iowa could become a net importer of corn thereby reversing normal grain flows. If ethanol production grows and corn exports decrease significantly, spatial price and basis relationships between regions could change significantly and the corn market will be more of a "country market" and less of a "river market". Transportation and grain storage systems across the country could be impacted by changes in product flows, seasonal use and peak load problems.

The concentration of ethanol plants in the Corn Belt means that local supplies of distiller grains will increase significantly in those regions. Use of wet distillers grain, which is the cheapest, means animal production must be located close to the ethanol plants. The biggest potential users of distillers grains are cattle feedlots and dairies. Although there is much hog production and cattle feeding in the Corn Belt and dairy production in the upper Midwest, it is unlikely that a majority of the by-product feeds can be effectively used on a year-around basis in wet form. This implies that much of the by-product feed will have to be dried for storage and transportation. There is considerable potential for use of distiller grains in Southern Plains feedlots; dairies in the Southwest and West Coast; and also for cow-calf and stocker supplement (mostly in the winter) in a variety of regions.

Long term there may be questions of whether the geographical structure of livestock industries might change as a result of the location of ethanol production. For example, could this cause more cattle feeding to relocate back into the Midwest? It is too early to predict such an outcome but the potential for this and other long term impacts must be considered and monitored.

Impact: Timing and Investment Issues

The numbers change constantly but there appears to be upwards of 50 new ethanol plants currently under construction with proposals for as many as 300 more in the next few years. Taken at face value this level and rate of expansion is rather frightening. However, there are a multitude of market adjustments taking place that will likely result in many of the proposals being modified, delayed or scrapped entirely. Ethanol plant location and construction depends on a variety of considerations including availability and price of feedstocks, energy and water; markets for by-products; and adequacy of storage and transportation infrastructure.

Currently there are a limited number of firms qualified to design and construct ethanol plants and there are already indications of bottlenecks in getting plants built and operational. Moreover, construction costs are rising due to rising construction materials demand and bottlenecks in availability of construction inputs. Ethanol is very corrosive and is currently transported by truck and rail rather than pipeline thus increasing truck and rail transportation requirements. At large enough volumes, ethanol could be transported in pipelines but current crude oil pipeline infrastructure moves the wrong way and are not set up to move product from the Midwest to the coasts. Ethanol is normally blended at distribution facilities near consumption centers immediately before the gasoline is sold. There are currently limited rail handling facilities for ethanol and a severe shortage of ethanol rail cars. This complex set of agricultural and non-agricultural market adjustments is taking place simultaneously and may significantly alter current plans.

Other Bio-energy Issues

Although ethanol is receiving the most attention at this time, there are other bio-energy issues that could add complexity to the myriad of issues already discussed. Bio-diesel is another renewable energy alternative that can be made from a wide variety of plant and animal fats. Significant growth in bio-diesel production could imply increased soybean production but may also offer opportunities for peanuts, sunflowers, canola or other oilseed crops. Two major implications are readily obvious. First, it will be impossible to significantly increase both corn

and soybean production simultaneously. Second, increased bio-diesel demand could prompt more oilseed production driven by the oil value and simultaneously contribute to the relative surplus of protein feeds due to the resulting oil meal feeds.

Cellulosic energy production is another alternative of interest. Cellulosic energy production could potentially utilize many agricultural crop wastes and by-products or fiber crops as feedstock and thus be somewhat less competitive with traditional agricultural production than ethanol production. Cellulosic bio-energy has a theoretical net energy balance of 8 or 10 to 1 which is significantly higher than corn ethanol, which has a net energy balance of 1.3 to 1. However, cellulosic conversion technology is not currently commercially feasible and is very expensive. Although different compared to ethanol production, there are important tradeoffs with cellulosic energy production as well including the fact that many by-product feeds and roughage source used for livestock production might redirected into energy production. Although the potential is considerable, this technology is still a number of years away.

Policy and Environmental Issues

Amidst the market adjustments described above, there will be on-going and likely intensifying policy debate in a various arenas in addition to those mentioned previously. The impact of ethanol production subsidies are already under scrutiny with respect to intended as well as unintended impacts on agriculture. Ethanol and bio-fuels will continue to be a part of a broader discussion of U.S. energy policy. Ethanol impacts will also play a central role in discussions of farm policy with respect to overall support for agriculture; impacts on various sectors; trade policy and WTO obligations; and environmental concerns. While ethanol is supported in part for positive environmental impacts, these will need to be discussed carefully relative to tradeoffs in other respects. For example, ethanol is a cleaner burning fuel but increased corn production on marginal acres could lead to offsetting negative environmental impacts on soil erosion and water quality. Eventually, increased use of cellulosic crops for bio-energy may have less direct tradeoffs with agricultural production but could have long run environmental impacts if, for example, most crop aftermath is used for energy production rather than returned to the soil as it is today.

Summary

The growing demand for corn for ethanol represents a fundamentally new direction for U.S. agriculture. Use of agricultural resources for energy production is pitted against traditional food and fiber production resulting in a complex and sweeping set of changes and tradeoffs in agricultural input and output markets. Little can be said with certainty about the net impacts, both short and long run, except that markets will be dynamic and risky during the transition. Agricultural producers will see new opportunities (especially in the crop sector) and new threats (especially in the livestock sector). Producers will need to be increasingly nimble and vigilant in order to take advantage of opportunities or mitigate the threats in volatile markets. Many fundamental price and value relationships are likely to change and must be constantly evaluated to manage risk and increase the odds of financial success. Depending on your point of view, the next few years will be interesting, exciting or frightening, or perhaps all at the same time.