September 22, 2009 Final
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Analysis for Submission on RFS2 Notice of Proposed Rule Making

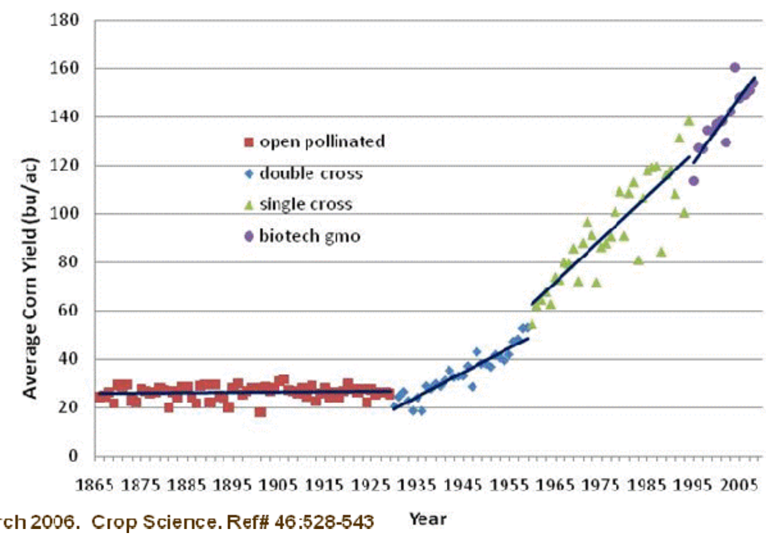
U.S. Corn Yields

EPA used very conservative projections on future corn yield assuming the trend for 1977 to 2007 for the average national yield would continue to 2022 and result in a yield of 183 bushels per acre in 2022. They note USDA uses similar projections.

NCGA's strategic plan adopted in February 2009 includes yield expectations of 175.9 bushels per acre for 2015 and 205 bushels per acre for 2020. These would allow NCGA to achieve its market objectives without increasing acres harvested beyond the recent high of 86.5 million acres in 2007.

Since the wide adoption of hybrid seed corn in the 1940s corn yields have been increasing. See Figure 1. That technological breakthrough was followed by increased use of commercial fertilizers in the 1950s and 1960s and herbicides and insecticides in the 1960s and 1970s. The last half of the 1990s and the current decade have seed corn enhanced through biotechnology. The trend line from 1990 to today is steeper that the previous trend from 1970 to 1990.

Figure 1



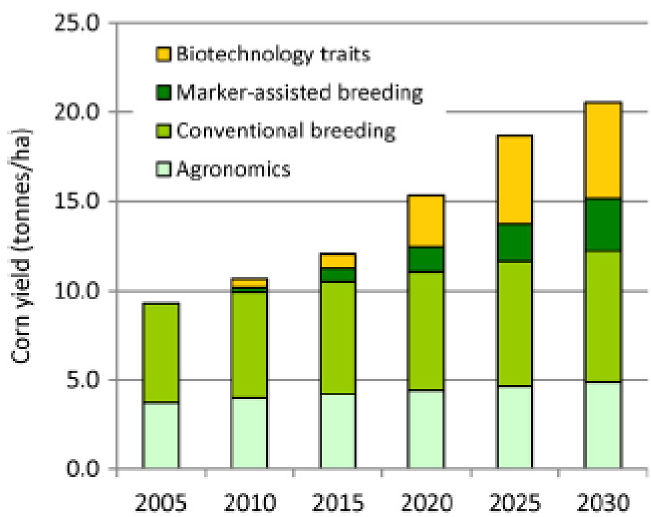
Source: March 2006. Crop Science. Ref# 46:528-543

Consecutive Periods Being Compared	Difference	SE	p-value
Double cross - Open pollinated	0.9901	0.1349	<0.0001
Single cross - Double cross	0.7991	0.1639	<0.0001
Biotech GMO - Single cross	0.8767	0.4163	0.0371

Rate of yield gain is increasing

Consensus estimates are that about 50-60 percent of the yield increases over the past 70 years are related to genetic improvements with the other 40-50 percent due to agronomic changes. Changes in agronomic practices are expected to play a much smaller role in total corn yield increases from the present to 2030 than from 1930 to now. See Figure 2 from Edgerton, Monsanto "Increasing Crop Productivity to Meet Global Needs for Feed, Food and Fuel," Plant Physiology, January 2009, Vol. 149, pp. 7–13. With yields increasing from 151 bushels per acre in 2005 to 325 bushels per acre by 2030, agronomic changes are expected to contribute about 15 bushels. Conventional breeding will add 25 bushels per acre and marker assisted breeding about 50 bushels per acre. Biotechnology is expected to add about 85 bushels per acre. This includes herbicide tolerance, insect resistance, drought tolerance and the introduction of three additional yield enhancing traits over the next decade.

Figure 2
Source of Future Corn Yield Increases



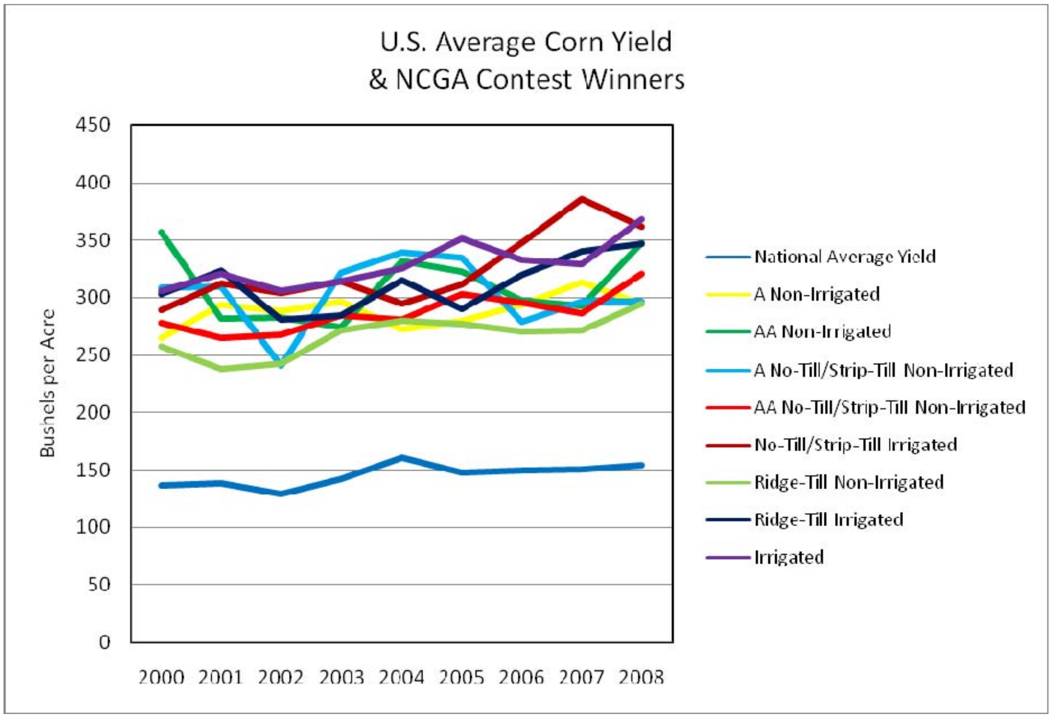
Source: Edgerton, Monsanto

Based on Edgerton estimates, about three-fourths of the yield increases in corn from now to 2030 will come from activities that had only a limited impact on yields through 2005 - marker assisted breeding (29 percent) and biotechnology (49 percent).

Edgerton also reported that the gap between corn test plot yields and average farm yields in Iowa decreased from 48 bushels per acre in 1940 to 29 bushels per acre in 1990. In 2005-2007 this gap has widened again to about 48 bushels per acre indicating that on farm average yields may be headed higher as this new technology works through the seed development process. At Monsanto higher yielding hybrids have a half life of about four years with a complete turn of products in about seven years.

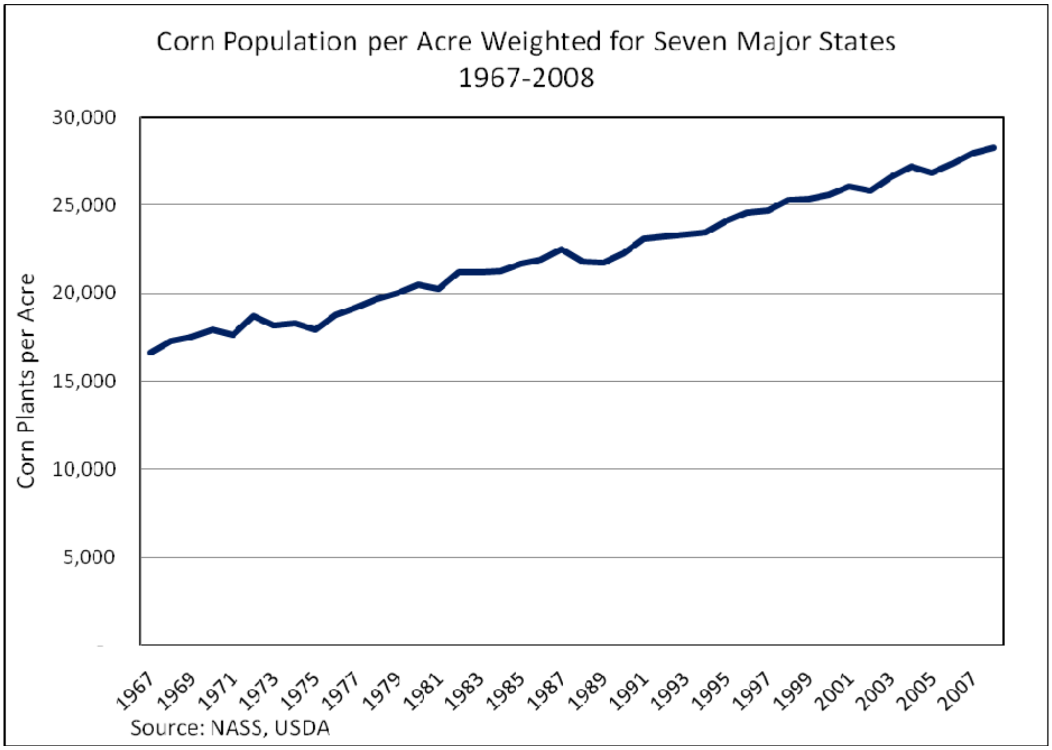
While yields of 300 bushels per acre in 2030 are large compared to national average corn yields in recent years, the yields are not large in relation to those being achieved under the best of conditions using existing corn production technology as shown in recent National Corn Growers Association (NCGA) national corn yield contest. In the 2007 contest David Hula of Charles City, Virginia recorded a yield of 385 bushels per acre. Most of the winners in recent years in the non-irrigated categories had yields of 250-300 bushels per acre. The winners in the irrigated categories had yields of 300-360 bushels per acres. Soil capabilities and rainfall patterns are available to support much higher yields than the average yields of today. Technology is now being developed to achieve those higher yields on a more consistent and wide-spread basis.

Figure 3



One of the reasons for higher corn yields is higher plant density per acre. Of the total dry matter accumulated by a corn plant about 50 percent remains in the stalk and 50 percent accumulates in the grain. Corn plants are bred to tolerate the stress of more plants per acre and that is reflected in higher corn yields. According to data from the National Agricultural Statistics Service of USDA, corn plant populations at harvest time have increased for the seven major Midwestern states from an average of 17,000 plants per acre in the late 1960s to 28,000 plants per acre in 2008. See Figure 4. Edgerton noted that seed corn is currently bred to handle plant populations of 30,000-35,000 per acre in commercial corn production in the U.S., but corn breeding programs are using plant populations of 65,000 plants per acre and higher.

Figure 4

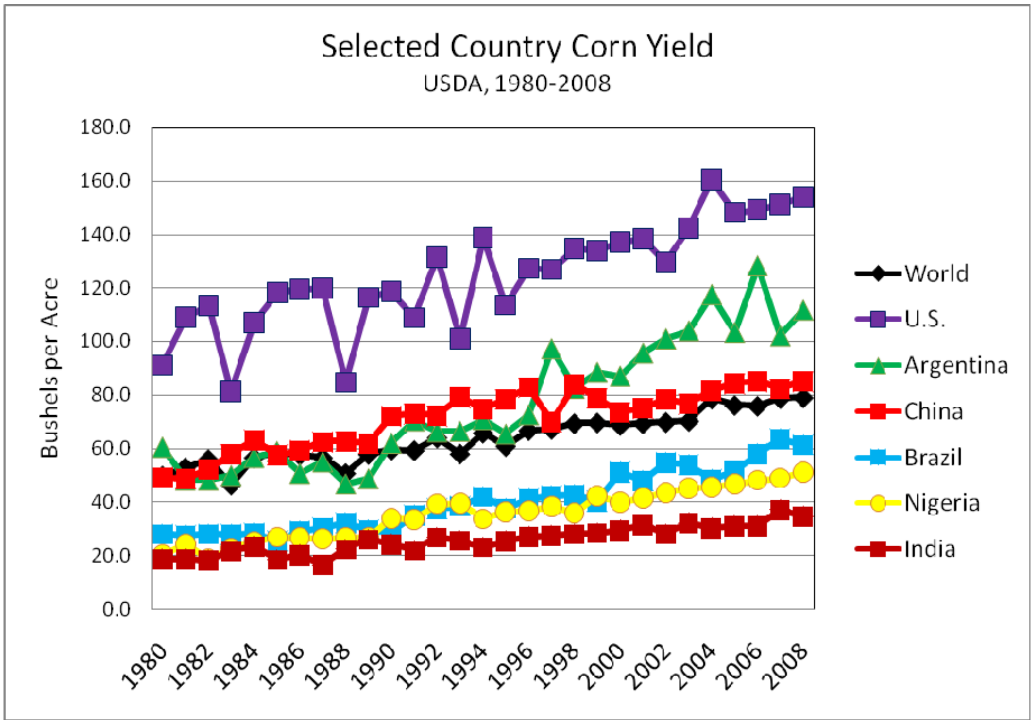


International Corn Yields

The quickest way to achieve higher worldwide corn production would be to increase yields on existing corn land. See Figure 5. The U.S. with 20 percent of the world's corn acreage harvested for grain has yields that are roughly twice the world average. Some of that is due to good soils, a favorable climate and well educated producers, but much of it is due to production practices, including fertilizer, pesticides and high quality seed. China, with the second largest area harvested for grain, has had only minor yield increases for the past 15 years. Argentina's yields are closest to the U.S., but their acreage is relatively small. While Brazil's yields are still low compared to the U.S. they have doubled yields in the last 15 years and the government has approved the use of insect resistant biotech corn. Nigeria has also made great progress. India has not made much progress in corn yields, but has made major progress in cotton yields with hybrid and biotech seed and the same technology is used in corn in other countries.

Corn yields in the developing world show a great long-term potential to increase corn production throughout the world without significantly increasing acres harvested. Brazil was able to double its yields in 15 years without using the latest seed technology. With biotech corn now becoming available yields should continue to increase. Biotech corn could also help countries in Africa make step changes in yields from their current low levels without increasing the use of pesticides. The use of fertilizers would boost yields further and mechanized farm equipment will allow for timelier planting and harvesting.

Figure 5



International Land Use Change

Land use has changed substantially in the world over the last 35 years, but it has had very little to with agricultural production activities in the U.S. Crop producers in the U.S. do not control cropping decisions or consumer demand decisions in the rest of the world; U.S. producers respond to what is happening in other countries.

U.S. acreage of the ten major worldwide annual crops in 2008/09 was roughly the same as in 1975/76. See Figure 6. The U.S. added some acreage during a time of high market prices in the late 1970s and the first three years of the 1980s, but those acres exited during the mid and late 1980s. Non-U.S. acreage increased from 1,550 million acres in the mid-1970s to 1,825 million acres in recent years. Acreage was flat for a few years in the late 1980s and again in the late-1990s. Note the rapid growth in non-U.S. acreage since 2002/03 as it increased from 1,700 million acres to a projected 1,840 million acres in 2009/10.

Figure 6

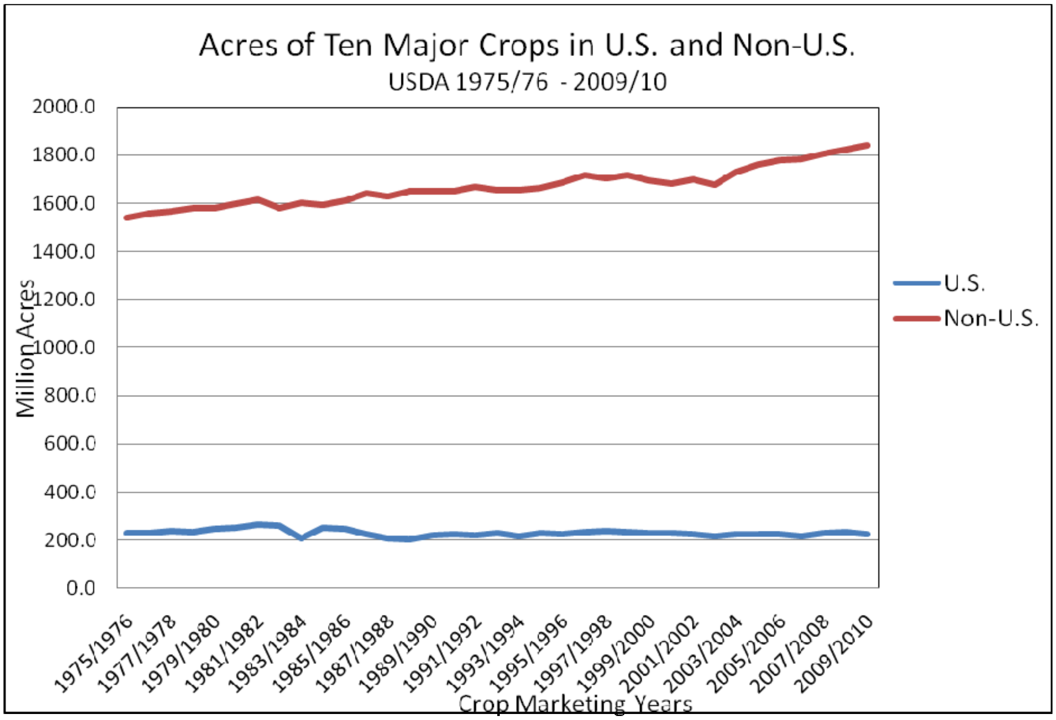
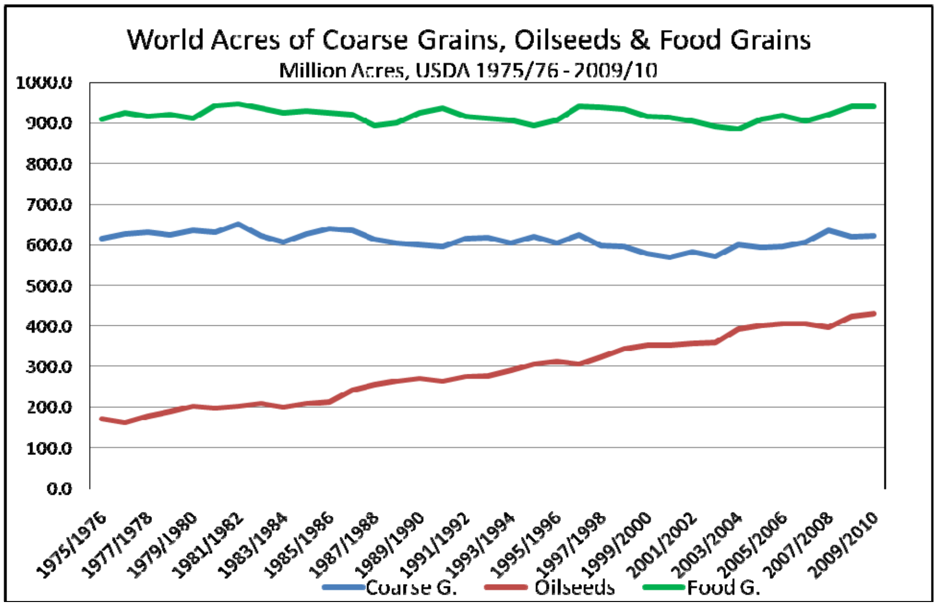


Figure 7 shows the change in harvested area for the world for major categories of the ten crops. Harvested areas for food grains (wheat and rice) and coarse grains (corn, barley and sorghum) have been flat for the past 35 years at 919 million acres and 611 million acres, respectively, with some year-to-year variations. Cotton has ranged from 75 million to 85 million acres. The uptick in food grain acreage in the last two years is mostly due to higher wheat acreage responding to high wheat prices after the two short EU crops in 2006 and 2007. Some of that land is expected to shift to coarse grains and oilseeds over the next few years if wheat stocks remain adequate and other crops offer a better market return.

The big increase in area harvested in the world has been in oilseeds (soybeans, peanuts, rapeseed and sunflowers) from 173 million acres in 1975/76 to 423 million acres in 2008/09. That was caused mostly by the strong demand resulting from rapid economic growth in Asia. USDA projections of trade for the next ten years in soybeans and soybean meal and oil indicate that trend is likely to continue years. World soybean trade is expected to increase from 79.4 million metric tons (MMT) in 2007/08 to 106.0 MMT by 2018/19, while soybean meal trade is expected to increase from 55.3 MMT in 2008/09 to 75.9 MMT in 2018/19 and soybean oil from 10.8 MMT to 14.1 MMT. The three combined are expected to increase from 145.5 MMT in 2007/08 to 196.0 MMT in 2018-19, a 34.7 percent increase.

Figure 7

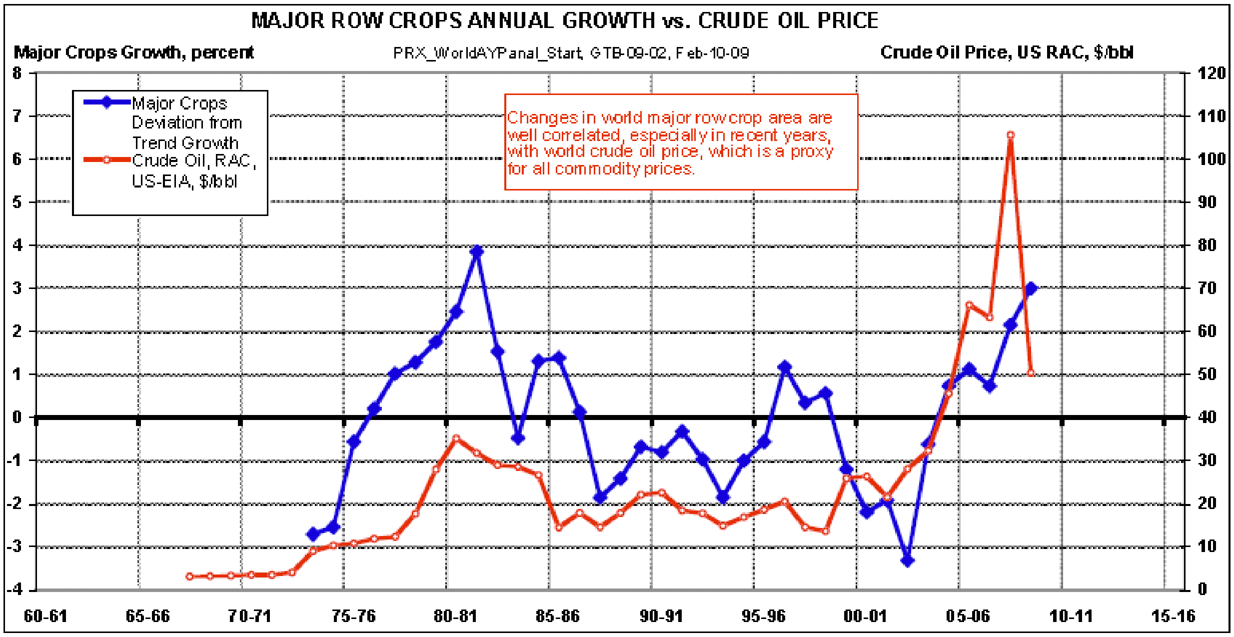


Growth in acres of oilseed crops over the last 35 years has overshadowed changes in coarse grain production, mostly corn. In relative terms, changes in coarse grains acreage have been insignificant in international land use change inside and outside the U.S.

Increases in worldwide crop acreages also cannot be separated from other broader worldwide economic forces. Figure 8 compares the annual percent change in worldwide acreage of major row crops with the price of petroleum in the U.S. The price of petroleum is a proxy for economic growth and monetary/financial policies that impact market prices for all raw materials including agricultural products.

When petroleum prices went sharply higher in the 1970s, land devoted to the major crops increased at an above trend rate as agricultural commodity prices increased. When petroleum prices were in a downtrend in the 1980s and 1990s, the rate of increase in land use for the major crops was below trend. The increase in the price of commodities in this decade as measured by petroleum prices has again set off an increase in major cropland at an above trend rate. If commodity prices are in a period of consolidation in the immediate years ahead, which appears likely based on events of the past year, the increase in major annual crop land in the world is likely to again fall below trend.

Figure 8



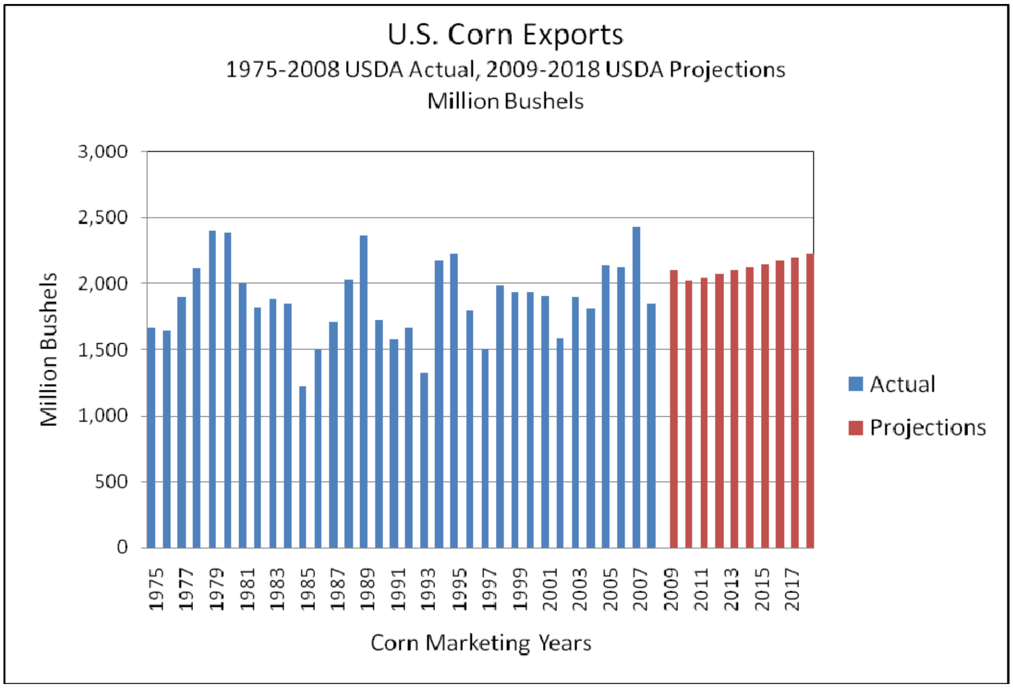
Economic forces far beyond ethanol production in the U.S. have driven land use change in recent years.

U.S. Corn Exports

The land use change issue begins with the idea that U.S. domestic production of ethanol reduces U.S. corn exports. Figure 9 shows U.S. exports by crop marketing year from 1975 to 2008 and USDA projections for 2009-2018. U.S. corn exports have been in a sideways pattern since 1975 in a range of about 1.4 billion bushels to 2.4 billion bushels per year with an average of 1.9 billion bushels. The record corn exports in 2007 of 2.44 billion bushels was caused mostly by two years of reduced wheat crops in the EU that resulted in less wheat used for livestock and poultry feed and increased imports of corn. U.S. exports for 2008 are estimated by USDA at 1.85 billion bushels, down 24.1 percent from 2007.

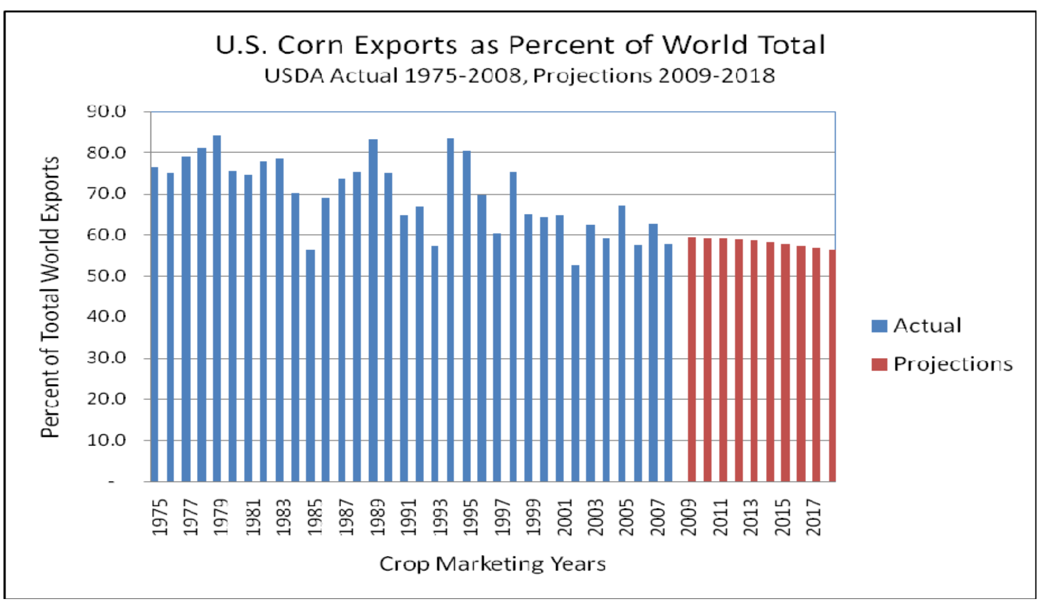
USDA's projection for 2009 is 2.2 billion bushels and above the 34-year average of 1.9 billion bushels. While exports could be higher than the USDA projections in any one year, as occurred in 2007, there is no major new market emerging for corn exports in the years immediate ahead that would change overall market demand. USDA expects that the record world corn trade in 2007 of 98.8 million metric tons (MMT) will not be exceeded until 2018.

Figure 9



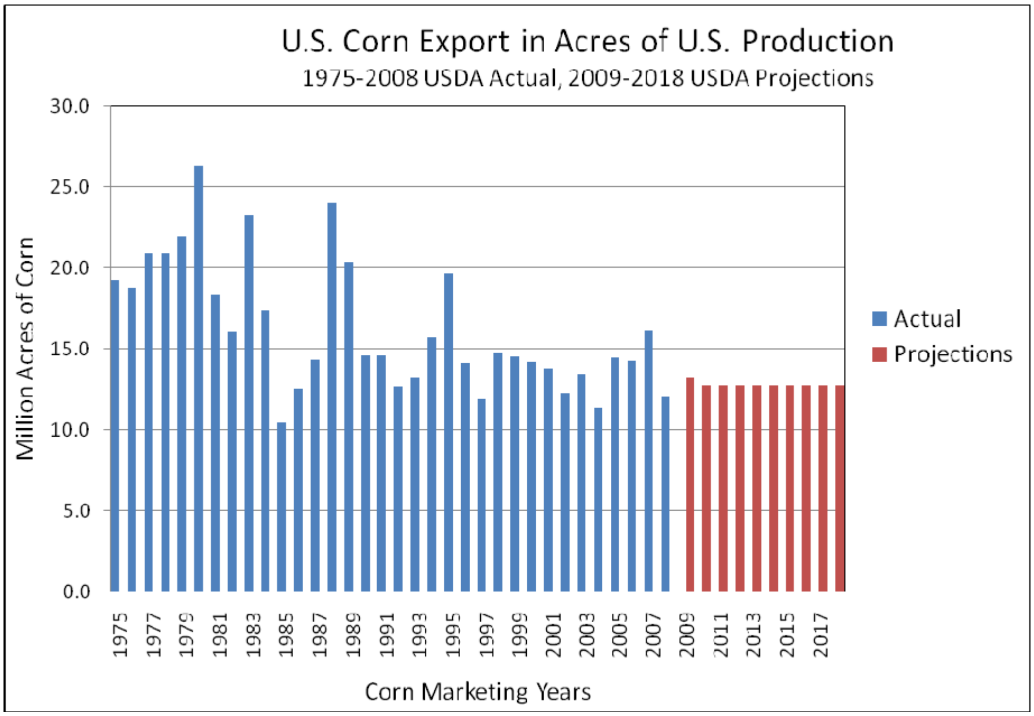
A logical concern could be raised that the world market could be growing rapidly, but the U.S. not gaining much of that market because corn is being bid away for domestic ethanol production. Figure 10 shows the U.S. share of world corn trade from 1975-2008 and USDA projections for 2009-2018. The U.S. share had been on a general downtrend before ethanol production started to increase and USDA expects that down trend to continue at a slower rate over the next ten years.

Figure 10



While corn exports have been trending sideways for the last 35 years, U.S. corn yields per acre have continued to increase. Corn exports on a per acre basis have been going down, freeing up corn acres for other uses and depressing market prices when those new uses have not developed. Figure 11 shows the acres of corn exported for 1975 to 2008 and expectations to 2018 based on USDA long-term yield projections. Yield increases on the acres exported are expected to just about match the increased exports leaving acres of corn exported unchanged at 12.7 million. If yields increase at a fast rate than projected by USDA, acres used for exports would decline further or the amount of corn exported could increase without increasing the acres of corn used for exports.

Figure 11

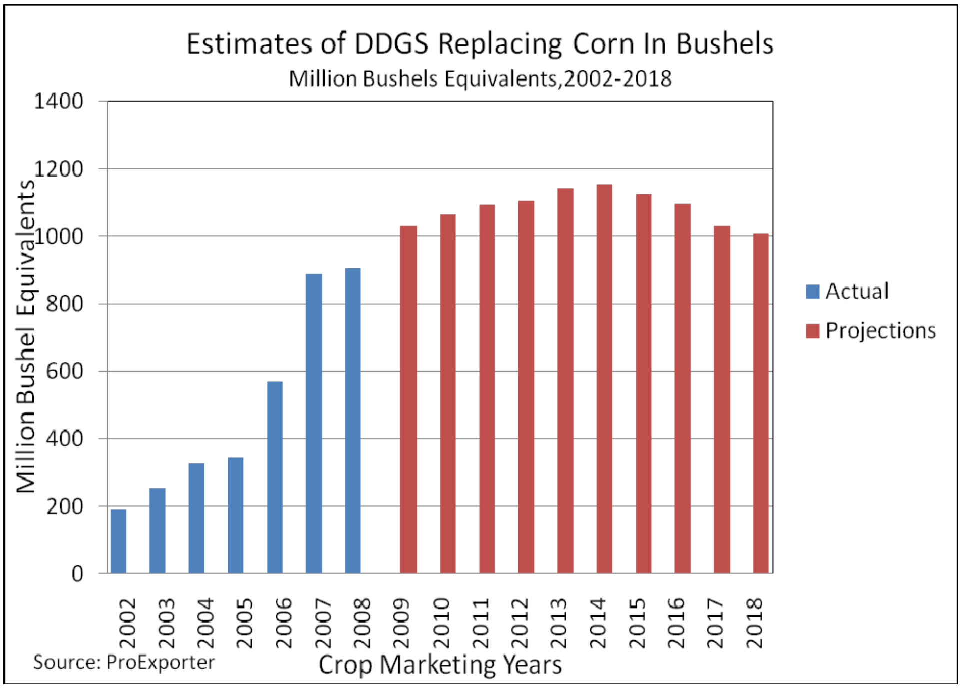


The Role of DDGS

Often forgotten in analysis about domestic feed markets and exports of feed is that distillers dried grains with solubles (DDGS), a co-product of ethanol production, has become a bigger portion of the feed supply as ethanol production has increased. For each bushel of corn used to produce 2.8 gallons of ethanol about 15 pounds of DDGS is also produced. DDGS production has grown from 3.3 million metric tons in 2002/01 to 23.8 million metric tons in 2008/09.

USDA and other government agencies do not publish regular estimates of DDGS production and the amount used in livestock feed. The Bureau of the Census does publish exports of DDGS. The ProExporter Network has made estimates of the amount of DDGS available for livestock feed since the 2002 marketing year with projections for the 2009-2018 corn marketing years as shown in Figure 12.

Figure 12



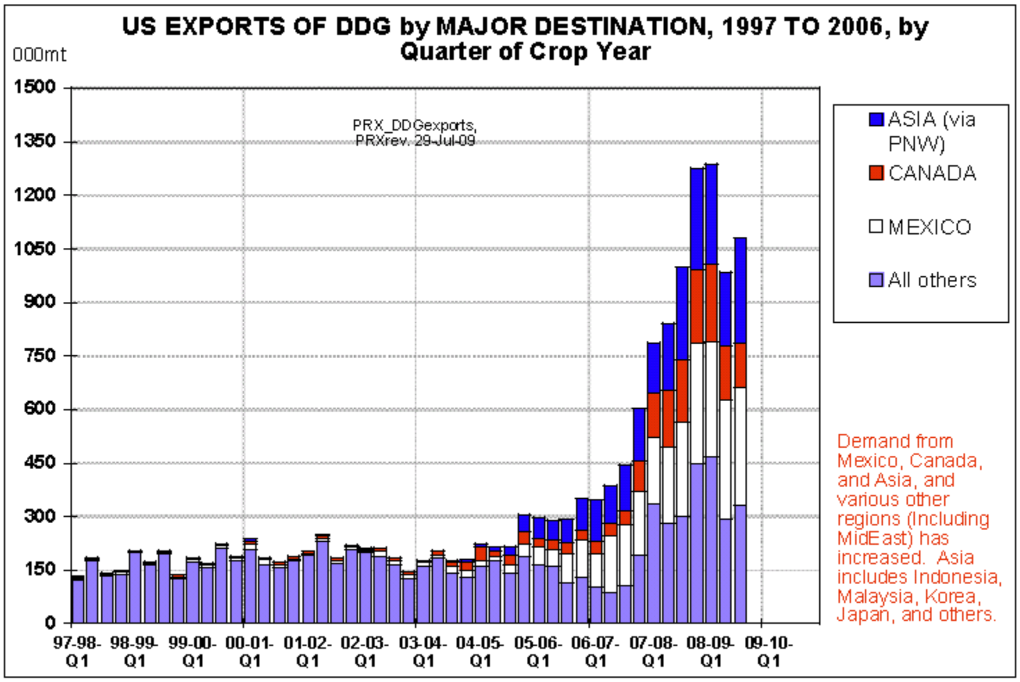
The biggest growth in DDGS production has already occurred. The combination of corn feed and residual and DDGS available for livestock feed will total almost 7.0 billion bushels by the 2018 corn marketing year, compared to 5.75 billion bushels in 2002. This is expected to be an adequate feed supply to meet domestic meat demand and provide for growth in meat exports.

DDGS is a nutrient dense product with 30 percent protein that makes it ideal for exporting long distances. Exports have increased from 0.8 million metric tons in 2000/01 to 3.4 million metric tons in 2008/09. See Figure 13.

According to a study from Argonne National Laboratory in 2008, a pound of DDGS can replace 0.955 pounds of corn and 0.291 pounds of soybean meal. Feed producers in Asia have been particularly interested in DDGS because they have access to starch feeds that are low in protein and other essential nutrients. They can use the higher protein in DDGS to offset the lower protein content in the starch component of the feed ration and use soybean meal to complete balancing of the protein content.

Shipping DDGS in containers has also allowed efficiencies in international transportation linking individual ethanol plants with feed mills in Asia that are not capable of using large volumes of feed components. This “backhaul” compliments the movement of consumer goods from Asia to the U.S. using existing port facilities in the U.S. and Asia.

Figure 13



Land Restrictions for Biomass

The renewable fuels standard under the 2005 energy bill had no requirements on what type of land produced the grain or cellulose used to produce ethanol and had no impact on generation of Renewable Identification Numbers (RINS) under the credit trading program.

EISA takes a much different approach. It prohibits the generation of RINs for renewable fuel made from feedstocks that do not meet the definition of renewable biomass and which do not meet specific land restrictions. There are seven kinds of feedstock which qualify as "renewable biomass":

(1) Planted crops and crop residue;
(2) Planted trees and tree residue;
(3) Animal waste material and animal byproducts;
(4) Slash and pre-commercial thinnings [of forests];
(5) Bio- mass obtained from the vicinity of buildings at risk from wildfire;
(6) Algae; and
(7) Separated yard or food waste (part of Municipal Solid Waste).

Of overriding interest to NCGA is item (1) Planted crops and crop residue. Regulations would restrict planted crops and crop residue to that harvested from existing agricultural land based on mutually exclusive categories of land defined by USDA's Natural Resources Conservation Service (NRCS) in its annual Natural Resources Inventory (NRI) of non-federal U.S. lands. EPA chose to include in its proposed definition of agricultural land three categories – cropland, pastureland, and CRP land. EPA has also included the requirement that the land was cleared or cultivated prior to December 19, 2007, and that, since December 19, 2007, it has been continuously actively managed as agricultural land or fallow, and non-forested.

NCGA believes these definitions of eligible lands for renewable biomass feedstocks are much more restrictive than many corn ethanol and cellulosic ethanol advocacy groups have been thinking. It excludes rangeland and any kinds of cropland, pastureland, and CRP not in cultivation or cleared before December 19, 2007, and not continuously under cultivation since that time.

The 2003 USDA-NRI survey reported:

Cropland 367.9 million acres (includes all row crops)
CRP land 31.5
Pasture land 117.0
Subtotal 516.4 million acres (agricultural land)
Range land 405.1
Forest land 405.6
Other rural land 50.2
Developed land 108.1
Water area 50.4
Federal land 401.9
Total land 1937.7 million acres (all land in lower-48)

Only the top three categories, totaling 516.4 million acres, are eligible for the production of renewable biomass feedstocks which can be used to generate biofuel for EPA's system of tradable RINs. All producers of RINs will be required to document to EPA that their feedstocks have indeed come from land in compliance with this restriction — a very big and costly project. EPA also wants to place similar land use restrictions on foreign suppliers of Renewable Fuels to the US, but recognizes that enforcing such restrictions will be difficult.

By restricting land for biomass to cropland, CRP land and pasture land EPA excludes 860 million acres of land (range land, forest lands and other rural lands that could play some role in cellulosic ethanol feedstock production. This would appear to include the much discussed degraded cropland that would have no direct charge for carbon loss because the carbon level is already low.

For corn ethanol plants the need to document that corn came from one of the three land categories will be a huge challenge. Some corn moves directly from on-farm storage to an ethanol plant. If the corn comes from a single tract of land and was not comingled with corn from other tracts, the verification process should be straight forward. If a producer grows crops on five or six difference farms and the corn is comingled in a central storage facility, the process is more complicated.

If a corn ethanol plant purchases corn from an elevator that buys from hundreds of farmers the verification process is impossible. Number two yellow commodity corn is not identity preserved (IP) as it moves through marketing channels. Some specialties corns are IP, but that is normally a small amount and the marketing channel receives a premium price to cover the additional costs. In many farming areas virtually all of the land used to produce corn meets the definition outlined in the proposed rule. For those areas, the proposed rule creates costs for which there are no offsetting benefits.

Supply and Demand Conditions for the 2009 Crop

While long-term public policy decisions about biofuels, or any other public policy, should not be made based on short-term market conditions, the supply and demand situation for the 2009/10 corn marketing year is instructive on several points that the NCGA has emphasized over the last several years.

The USDA September 2009 World Agricultural Supply and Demand Estimates project a national corn yield of 161.9 bushels per acre of corn harvested for grain. This is the highest corn yield on record exceeding the previous record in 2004 of 160.4 bushels per acre. The 2004 yield was produced with near perfect growing weather throughout the Corn Belt. This year's crop got off to a quick start in the western Corn Belt, but cool, wet weather substantially delayed planting in the eastern Corn Belt and in North Dakota. The crop has had the advantage of ample moisture in most of the growing areas, but the cool summer weather has slowed development. This year's yield validates that superior breeding and the use of biotechnology are pushing corn yields up at a more rapid rate than the trend for the last 30-40 years.

This year's corn crop of 12.954 billion bushels will be produced on 80.0 million acres harvested for grain, compared to 86.5 million acres harvested for grain in 2007. If this year's final corn yield is 161.9 bushels per acre, the yield will be 11.2 bushels higher than the 150.7 bushel yield in 2007 when the record corn crop of 13.038 billion bushels was produced. This year's crop will be 99.4 percent of the record 2007 corn crop, but need only 92.5 percent of the harvested acres. Had we planted more acres and harvested for grain the same number of acres as in 2007, 86.5 million acres, total production would have been 14.004 bushels.

Total use during this marketing year, 2009/10, according to USDA will be record large at 13.025 billion bushels, 288 million bushels more than was used from the 2007 crop in the year it was produced. Use in the 2009/10 marketing year will exceed production by 71 million bushels which will be met by a small drawdown of carryover stocks. That expected drawdown of carryover stocks is far smaller than the sum of all the uncertainties in the production and use estimates at this point in the marketing year.

This year's crop is large enough for USDA to increase their estimate for feed and residual by 100 million bushels for 2009/10 compared to 2008/09 to 5.350 billion bushels even though feed use for dairy, hog, beef and poultry production is likely to be lower than last year because of low profits or actual losses in livestock and poultry feeding. (In addition, the amount of DDGS produced as a co-product of ethanol production will be up by the equivalent of 125 million bushels of corn based on non-USDA estimates.)

Corn used for ethanol production from the 2009 crop is expected by USDA to be up 525 million bushels to 4.2 billion bushels. USDA has also increased the amount of corn exported to 2.2 billion bushels, up from 1.850 billion bushels for 2008/09, an above the 1.9 billion bushel average of the last 35 years. The increased exports will be due to lower production in the rest of the world, not from an overall increase in corn demand in export markets.

In the years immediately ahead the amount of corn used for ethanol will continue to increase, but at a decreasing rate. While some opponents of corn ethanol production have tried to characterize the supply and demand conditions for corn as unworkable in the years ahead, the reality is that the corn industry has been able to keep up with yearly increases in demand and expects to continue to do so in the years between now and 2015.