

## IMPACTS OF ETHANOL CO-PRODUCTS ON 2011/12 CORN AND SOYBEAN SUPPLIES AND ACREAGE

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### KEY POINTS

- While biofuel critics claim 40% of the corn supply is being used for ethanol production, the actual amount is **26% of the corn supply** after animal feed co-products are taken into account.
- Each bushel of corn used for ethanol production produces 2.8 gallons of renewable fuel and roughly 17 pounds of animal feed co-products like distillers grains, corn gluten feed, and corn gluten meal. Thus, nearly one-third of every bushel of corn processed by ethanol plants is actually used as feed and should be counted as such.
- The ethanol industry produced an estimated 38.6 MM MT of animal feed in 2011/12
- Ethanol feed co-products replace both corn and soybean meal in feed rations. Research by university and USDA nutritionists shows that, due to its unique nutritional profile, 1 pound of distillers grains can replace 1.23 pounds of corn and soybean meal. This disproportionate replacement effect means distillers grains extend the feed supply.
- Ethanol feed co-products displaced the need for 1,458 million bushels of corn *and* 9.38 million metric tons of soybean meal in 2011/12.
- Co-product exports were equivalent to 321 million bushels of corn exports and 2.29 million metric tons of soybean meal exports.
- In 2011/12, the U.S. ethanol industry generated an amount of feed that would have otherwise required the harvesting of **20.1 MM corn and soybean acres**.

### BACKGROUND

Biofuel critics incorrectly claim that 40% of the corn supply is being “diverted” to ethanol production. This assertion is incorrect for at least two reasons:

1. In addition to renewable fuel, ethanol plants also produce animal feed co-products. Roughly one-third of every bushel of corn processed by the ethanol industry returns to the animal feed market primarily as distillers grains, corn gluten feed, or corn gluten meal. These feed ingredients are fed to beef and dairy cattle, swine, broiler chickens, egg laying chickens, turkeys, fish, and other meat producing animals around the world. Thus, the portion of corn that is processed by the ethanol industry and returned to the feed market is better characterized as corn for feed & residual use; and the portion of corn ethanol feed co-products that are exported should be counted as corn for export use.

2. Use of the term “diversion” implies that corn that was once used as livestock feed is being removed from that market and used now as feedstock for ethanol production. In truth, no such diversion is occurring. When animal feed co-products from ethanol processing are taken into account, corn supplies have grown large enough to satisfy steady animal feed demand as well as growing ethanol demand.<sup>1</sup>

This paper briefly examines the impact of animal feed co-products from the ethanol industry on corn supply, demand, and acreage. Further, because ethanol co-products displace both corn and soybean meal in livestock and poultry rations, the impacts on soy markets are also examined.

In 2011, farmers planted 91.9 million (MM) acres to corn and harvested 84 MM acres. At an average yield of 147.2 bushels per acre, the 2011 corn crop totaled 12,358 MM bushels (bu.). Supply and demand for the 2011/12 marketing year are summarized in the table below.

2011/12 CORN SUPPLY	MM bu.		
Carry-in Stocks	1,128		
Production	12,358		
Imports	29		
Total Supply	13,515		
2011/12 CORN DEMAND	MM bu.	% of Supply	% of Demand
Feed & Residual	4,547	33.6%	36.3%
Ethanol & Co-products	5,011	37.1%	40.0%
Food, Seed, Industrial	1,426	10.6%	11.4%
Exports	1,543	11.4%	12.3%
Total Demand	12,527		
Carry-out Stocks	988	7.3%	--

Source: USDA WASDE

Biofuel opponents mistakenly cite the 40% figure shown above in an attempt to exaggerate ethanol’s impact on corn supplies. Critics also suggest ethanol accounted for 37% of planted corn acres in 2011. However, as shown below, the net impacts on corn supplies and acres are much smaller, and ethanol co-products also have a significant impact on soybean markets.

## **METHOD FOR ESTIMATING THE IMPACT OF ETHANOL CO-PRODUCTS ON CORN/SOY MARKETS**

### ***STEP 1: Determine share of wet mill versus dry mill ethanol production***

We estimate that 90% of the corn used for ethanol and co-products in 2011/12 was processed by dry mill ethanol plants. These facilities produce approximately 17 lbs. of animal feed (in the form of distillers grains) per 56-lb. bushel of corn processed. Thus, 2011/12 production of distillers grains is estimated at

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<sup>1</sup> It should be noted that the 2012 drought resulted in a smaller-than-normal crop, limiting the availability of corn for all uses, including ethanol, feed, and exports. Despite this one-year anomaly, the long-term trend has been one of steady or growing feed availability.

34.8 million metric tons (MM MT). Wet mill plants account for the remaining 10% of corn use for ethanol and co-products. In addition to ethanol, wet mills produce approximately 3.2 lbs. of high protein corn gluten meal and 13.8 lbs. of corn gluten feed per bushel processed. Thus, 2011/12 production of corn gluten meal is estimated at 728,000 MT, while corn gluten feed output was 3.1 MM MT. In sum, the ethanol industry produced an estimated 38.6 MM MT of animal feed in 2011/12.

**STEP 2: Determine displacement ratios for corn and soybean meal**

To understand the impacts of these ethanol co-products on feed markets, it is critical to examine the feed ingredients they are displacing from the ration. DG displace both corn and soybean meal from animal diets; and based on its superior energy and protein content, 1 lb. of DG can displace more than 1 lb. of corn and soybean meal in some species. DG displacement ratios by species, as summarized by USDA's Hoffman & Baker (2011)<sup>2</sup>, are shown below in table below.

	1 lb. of DG replaces...		
	Lbs. corn	Lbs. soybean meal	Total (lbs.)
Beef	1.20	0.00	1.20
Dairy	0.73	0.63	1.36
Swine	0.70	0.30	1.00
Poultry	0.61	0.44	1.05

For corn gluten feed, it is estimated by Argonne National Laboratory that 1 lb. of CGF replaces 1 lb. of corn, while 1 lb. of CGM replaces 1.53 lbs. corn.<sup>3</sup>

**STEP 3: Determine domestic versus export consumption of co-products**

USDA-FAS data shows DG exports totaled 7.55 MM MT in 2011/12, meaning 27.24 MM MT (78.3%) was consumed domestically. Exports of CGF totaled 843,000 MT, according to USDA-FAS, meaning 2.29 MM MT (73.1%) was consumed domestically. We estimate most CGM (89.3%) was exported, with just 80,000 MT (10.7%) being consumed domestically.

**STEP 4: Determine share of domestic co-product consumption by species**

Next, we estimate the share of co-product consumption by species. Wisner (2011)<sup>4</sup> estimates that beef accounted for 53.4% of domestic DG consumption, followed by dairy (34.1%), swine (6.9%), and poultry (5.6%). For CGF and CGM, consumption by species is unimportant because it is assumed these products displace equal amounts of corn in all animal diets, regardless of species.

**STEP 5: Determine share of co-product consumption by species in export market**

<sup>2</sup> [http://www.ers.usda.gov/media/236568/fds11i01\\_2\\_.pdf](http://www.ers.usda.gov/media/236568/fds11i01_2_.pdf)

<sup>3</sup> We understand it is more likely that CGM replaces soybean meal than corn; however, reliable displacement ratios for CGM are not available and Argonne is the only known source of a displacement factor for CGM. Because CGM represents such a small portion of U.S. ethanol feed co-product output, the assumptions here are largely immaterial to the overall results.

<sup>4</sup> <http://www.extension.iastate.edu/agdm/crops/outlook/dgsbalancesheet.pdf>

While there is no good data on consumption of U.S. co-product feeds by species in the international market, we know anecdotally that swine and poultry represent a much larger proportion of consumption in the export market than in the domestic market. For this analysis, we assume beef and swine each consume 30% of exported DG, while dairy and poultry each consume 20%. Again, the species is irrelevant for CGF/CGM due to the assumption that corn displacement is consistent across all species.

***STEP 6: Determine corn and soybean meal displaced from domestic feed market by ethanol co-products***

Using the assumptions outlined in steps 1-5, we are able to calculate that DG replaced 1,042 MM bu. of corn in the domestic feed market in 2011/12. In addition, DG substituted for 7.09 MM MT of soybean meal in the U.S. market. CGF replaced 90 MM bu. of corn in the domestic market, while CGM replaced nearly 5 MM bu. In sum, ethanol feed co-products displaced the need for 1,137 MM bu. of corn and 7.09 MM MT of soybean meal in the U.S.

***STEP 7: Determine corn and soybean meal exports displaced by ethanol co-product exports***

The 7.55 MM MT of DG exports displaced 249 MM bu. of corn and 2.29 MM MT of soybean meal in the international feed market. Meanwhile, CGF substituted for 33 MM bu. of U.S. corn exports and CGM replaced 39 MM bu. In total, exports of ethanol co-products eliminated the need for 321 MM bu of corn exports and 2.29 MM MT of soybean meal exports.

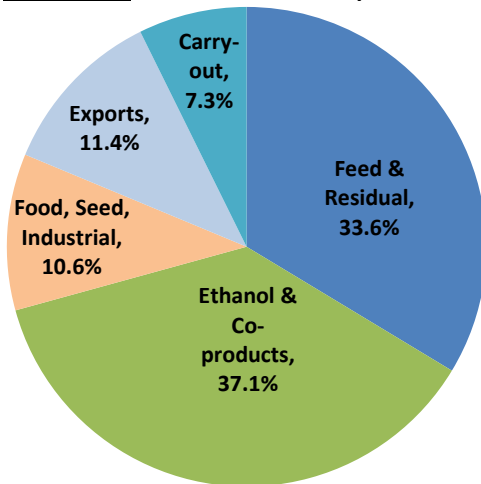
***STEP 8: Calculate total corn and soybean meal displacement***

Adding the figures from steps 7 and 8 results in total corn displacement of **1,458 MM bu. of corn and 9.38 MM MT of soybean meal.**

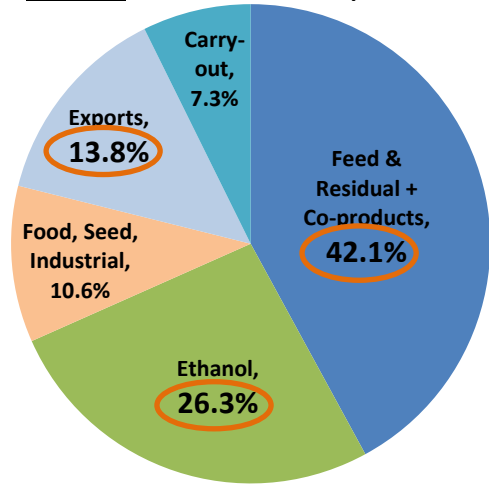
***STEP 9: Calculate net corn use for ethanol and other demand segments***

Subtracting the total corn displaced by DG (1,458 MM bu.) from the gross corn use for ethanol figure (5,011 MM bu.) results in net use of corn for ethanol of 3,553 MM bu. of corn in 2011/12. **This is equivalent to just 26.3% of the total 2011/12 corn supply, or 28.4% of total use—that's a far cry from the 40% cited by critics.** Further, when co-products consumed domestically are added to corn use for feed and residual, it quickly becomes apparent that animal feed remains the top domestic use of corn. When co-products are properly factored in, U.S. livestock and poultry feeders consumed 5,684 MM bu. of corn and co-products in 2011/12—that's 42.1% of the total supply or 45.4% of total use. Further, when co-product exports are taken into account, total exports of corn and co-products rise to 1,864 MM bu.—13.8% of total supply and 14.9% of total use.

2011/12 Corn Usage Shares by Segment,  
Unadjusted for Animal Feed Co-products



2011/12 Corn Usage Shares by Segment,  
Adjusted for Animal Feed Co-products



**STEP 10:** Calculate net corn and soybean acreage impacts

As discussed in step 8, U.S. ethanol co-products displaced the need for 1,458 MM bu. of corn in 2011/12. Thus, at an average yield of 147.2 bu/acre, the amount of corn displaced by **animal feed co-products from the ethanol industry was equivalent to 9.9 MM harvested corn acres**. This reduces the net acres used for fuel ethanol production to 24.1 MM acres, or 26% of planted corn acres.

However, as referenced earlier, ethanol co-products also significantly reduce the need for soybean acres. Because of its high protein content, U.S. ethanol co-products replaced 9.38 MM MT of soybean meal in 2011/12. **Producing this amount of soybean meal would have required the harvesting of an additional 10.2 MM acres of soybeans**. Thus, harvested soybean acres would have needed to be 84 MM, nearly 14% higher than actual harvested acres of 73.8 MM acres.

**In essence, ethanol co-products generated an amount of feed that would have otherwise required the harvesting of 20.1 MM corn and soybean acres.**