ENVIRONMENTAL WORKING GROUP

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Inconvenient Corn Ethanol Truths

By Emily Cassidy, EWG Biofuels Research Analyst

"Ethanol's Broken Promise," Environmental Working Group's May 2014 report, showed that reducing corn ethanol consumption would help lower greenhouse gas emissions. EWG found that lowering the corn ethanol component of the federal Renewable Fuel Standard would reduce emissions by 3 million metric tons, the equivalent of taking 580,000 cars off the road for a year. The report cited a 2010 EPA analysis that projected that over the 30-year periods beginning in 2012 and 2017, corn ethanol would be worse for the climate than gasoline. EWG also relied on previously published findings that 8.4 million acres of grasslands, shrublands and wetlands were plowed under to grow corn between 2008 and 2012, a span that coincided with a *doubling* of the volume of corn used for ethanol production.

Michael Wang and his colleagues at the Department of Energy's Argonne National Laboratory wrote a response claiming that EPA's results were "confusing." They also said EWG's estimate of land use change emissions were too high, but they made the mistake of assuming EWG was attributing all 8.4 million acres of land conversion to corn ethanol alone.

Here are EWG's point-by-point responses to Wang's criticisms:

EPA's emissions results

Wang's comment:

> *...EWG used EPA's land-use change (LUC) GHG emissions results for corn ethanol for year 2012 to calculate high life-cycle GHG emissions for corn ethanol. EPA's intent for including corn ethanol LUC GHG emissions results for 2012 and 2017, however, seems to have been mostly for sensitivity analyses, because these emissions were not discussed in the RFS final rule or its Regulatory Impact Analysis (RIA).*

EWG's Response:

EPA's emissions results, issued with EPA's Regulatory Impact Analysis, included a memorandum that read: "Most spreadsheets also include results calculations for the years 2012 and 2017 as well." This refutes Wang's claim that these emissions data are not results and were just used for sensitivity analysis.

EWG is not the only organization to have used these EPA numbers. The National Research Council, a branch of the prestigious National Academy of Sciences, also evaluated EPA's 2012 and 2017 results in its 2011 report, "Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy." On page 201, the Council's report published this table summarizing how corn ethanol's emissions compare with gasoline's, broken down according to the type of fuel and the type of milling process used (dry versus wet):

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Corn Ethanol Greenhouse Gas Emissions

Positive values indicate higher emissions than gasoline; negative values indicate lower emissions.

Biorefinery Heat Source	Distillers Grains	2012	2017	2022
Natural Gas	Dry	+ 33%	+ 10%	-17%
	Wet	+ 21%	-2%	-27%
Coal	Dry	+ 66%	+ 41%	+ 12%
	Wet	+ 41%	+ 17%	- 10%
Biomass	Dry	+ 6%	- 15%	- 40%
	Wet	- 3%	- 16%	- 41%

To determine life-cycle emissions for all corn ethanol, EPA estimated that 63 percent of corn ethanol is produced by dry milling and 37 percent by wet milling.
Source: EPA's Regulatory Impact Analysis.

The Council concluded, "according to EPA's own estimates, corn-grain ethanol produced in 2011, which is almost exclusively made in biorefineries using natural gas as a heat source, is a higher emitter of GHG than gasoline."

EWG's previously published land conversion data

Wang also took issue with EWG's previously published "Plowed Under" and "Going, Going, Gone" reports. "Plowed Under" found that 23.7 million acres of grassland, shrub land and wetlands were converted to grow crops between 2008 and 2011. Of that total, 8.4 million acres were planted with corn.

Wang's comment:

> *For its analyses of LUC, EWG relied on the USDA CDL. Notably, in developing these estimates, EWG used a pixel-by-pixel approach which they stated may overestimate their estimates of converted lands. It is important to note that the CDL depends upon the National Land Cover Data (NLCD) that the U.S. Geological Survey (USGS) develops. The CDL uses the NLCD to help identify non-agricultural land covers such as grasslands and wetlands. The NLCD, however, is explicitly not designed to be used for pixel-by-pixel or localized analyses. Rather, as the USGS describes, the NLCD is best used for national- or regional-level analyses.*

EWG's Response:

EWG used the U.S. Department of Agriculture's Crop Data Layer (CDL) to do a national analysis of acres of land converted to row crops. To create a more accurate footprint of row crops, we classified land covers into either row crops or vegetative cover, which includes pasture, hay, grassland, etc. USDA'S National Agricultural Statistics Service asserts that this data layer does an excellent job of distinguishing between row crops and vegetative cover: "Generally, the large area row crops have producer accuracies ranging from mid 80% to mid 90%."

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Wang's comment:

> *Wright and Wimberly authored another study that serves as a point of comparison to EWG's results. These authors estimated grassland conversion to corn and soybean farms between 2006 and 2011 in the six-state Western Corn Belt. They estimated a net loss of grassland to corn/soybean farms of 1.3 million acres in the region between 2006 and 2011. This is far less than the 8.1 million acres of grass/shrub lands converted to corn farms EWG estimated. Admittedly, the six-state Western Corn Belt is a smaller land area than EWG considered and does not cover all of the regions in the United States with the potential for conversion to corn farming. But the Belt has been the major region for corn farming expansion, as acknowledged by Wright and Wimberly and EWG.*

EWG's Response:

It is disingenuous to compare the net conversion (1.3 million acres converted to corn and soy) in the six-state Wright and Wimberly study with EWG's national gross total for corn (8.4 million acres).

Plowing up grassland, shrub land and wetlands to grow row crops releases the carbon stored in vegetation and soil into the atmosphere. Determining the total number of acres converted to row crops is essential to determining emissions from land use change because the carbon emitted takes decades or even centuries to be re-sequestered into soil and vegetation. Previous studies have termed this the biofuel "carbon debt." During the decades or even centuries it takes for corn ethanol to pay back its "carbon debt," the emissions contribute to driving up global temperatures.

Many studies don't report the total acreage of converted land. Instead they cite only the net acres converted, which subtracts the acres of land going from row crops back to vegetative cover. But to determine accurately the total carbon emissions from land conversion, it is essential to look at the *total* acreage converted. A better comparison to Wright and Wimberly's land conversion estimates would be with EWG's "Going, Going, Gone" report, which applied two filters to the Crop Data Layer and came up with a net loss of 3.5 million acres of highly erodible land and 1.4 acres of wetlands and wetland buffers across the contiguous United States.

A 2013 Farm Bureau report also found that more than 8 million acres of land had been converted to row crops from 2007 to 2012, 3.6 million of that for corn alone.

Wang's comment:

> *Other data from, for example, the USDA National Agricultural Statistics Service Quick Stats database can also serve as a comparison. Figure 1 plots USDA data for U.S. farm acres for different crops including corn, soybeans, and wheat. The figure shows that, while corn acreage has increased in parallel with the build-up of the corn ethanol industry between 2004 and 2013, total principal crop acreage has remained fairly constant and constitutes 311 million acres in 2013.*

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EWG's Response:

Wang tries to support his argument by saying that this USDA commodity report shows that the footprint of cropland is not expanding. The problem is that this report is subject to multiple revisions throughout the year. For example, from 2011 to 2012 the reported planted area swung by more than 11 million acres. A more reliable gauge of expansion would be the USDA's Ag Census. It shows an increase of 8.7 million harvested acres in major crops from 2007 to 2012.

Wang's comment:

> *Overall, EWG may have overestimated wetland conversion, especially for the conversion of wetlands to corn farms. EWG's inclusion of wetland buffers in estimates of converted wetland areas and the pixel-by-pixel approach they took could account for their seeming overestimation of converted wetland areas.*

EWG's response:

As explained in our methodology, we did include buffers, which may lead to overestimating wetland acres, but to minimize this effect we only looked at contiguous crop areas larger than 10 acres.

EWG's land conversion emissions

Wang's comment:

> *Another concern about the emission factors EWG used is that the final land state is general cropland rather than specifically corn agriculture. It is well understood that spatially specific factors such as precipitation, soil type, and land use history influence CO2 emissions upon land transitions. But the emission factors used by EWG are very general and do not consider these factors. Taking these variables into account, we have developed grassland-to-corn emission factors at a U.S. county level using the CENTURY model over a 30-year time horizon. The range of grassland-to-corn agriculture emission factors we calculated are presented in Table 2 (labeled GREET values). They are on average nearly 70% less than the emission factors EWG used.*

EWG's Response:

Michael Wang correctly pointed out that the emission factors (grams of carbon emitted per acre of land converted) that EWG used in discussing land use change in the United States were too high. We were not aware of the revised U.S.-specific emission factors at the time of the report's publication. The emissions estimated for global wetland acres were much higher than the U.S.-specific estimates provided by Wang.

However, EWG's report only considered converted acreage in the United States, and a similar amount of land is projected to be converted in other nations. According to a 2010 study led by Thomas Hertel (a developer of the GTAP model) in the journal BioScience, 6.4 million acres (2.6 million hectares) of land will be converted to cropland globally in response to the corn ethanol mandate – in addition to land converted in the United States.

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These emissions were not included in EWG's calculations.

In addition, one of the major limitations of the GTAP model Wang used is that it excludes conversion of unmanaged land, which amounts to 34 percent of all land area in the model, from its calculation of conversions to agriculture. The model only includes managed forests – those used for timber production – in its measure of forestland that could be converted. As EPA stated in its Regulatory Impact Assessment:

> One of the major limitations of this methodology is that unmanaged land, which represents approximately 34% of the land cover in the GTAP model, is not allowed to be brought into productive use (e.g., as pasture).

As EPA pointed out, by excluding unmanaged forests GTAP undercounts the true amount of forest conversion, which results in underestimating emissions from land use change. Although EPA pointed out this limitation in 2010, the model has not been updated to reflect conversion of unmanaged land.

GTAP's overestimation of crop yields

Wang's comment:

> *EWG stated that the YDEL (yield elasticity) value of 0.25 used in GTAP is too high. That is, EWG posited that a YDEL of 0.25 overestimates yield increases upon rising corn prices. The organization maintained that this high YDEL value would overpredict corn yields and underestimate LUC and biofuel LUC GHG emissions.*
> *A recent analysis provides evidence that a YDEL value of 0.25 is reasonable. Using econometric models with various assumptions regarding the representation of price changes and using data from the 1996-2010 period, Goodwin et al. estimated a range of interseasonal and intraseasonal price-yield elasticities from 0.15 to 0.46.*

Projecting future crop productivity is a critical factor in estimating the amount of land needed to meet new demands for corn and soybeans. Overestimating future crop yields will *underestimate* emissions triggered by land use change. The GTAP model used by Wang assumes that the yield of all crops around the world will rise at the same rate as corn in the Midwest. This unrealistic assumption downplays land use change.

Moreover, a 2013 paper pointed out that by ignoring the crops' water requirements, the GTAP model underestimates emissions from land use change by about 25 percent.

Conclusion

Michael Wang and his colleagues cherry-picked data to undercount the emissions from land use change to produce corn ethanol. He ignores the fact that corn needs water to grow and that people like food. He also fails to provide any reason for his decision to ignore EPA's 2012 results, which were cited by the National Research Council and showed that corn ethanol is 30 percent worse for the climate than gasoline.

As "Ethanol's Broken Promise" showed, it is time for Michael Wang and his colleagues to face up to corn ethanol's inconvenient truths.