ENVIRONMENTAL WORKING GROUP

Corn Cop Out

By Rebecca Sutton, Ph.D., *and* Andrew Hug, M.A.
Environmental Working Group

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Photos courtesy of USDA NRCS.

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CORN COP OUT

By Rebecca Sutton, Ph.D., and Andrew Hug, M.A.

When it comes to the massive amounts of nitrogen floating down the Mississippi River, lobbyists for the National Corn Growers Association and the American Farm Bureau Federation love to point fingers at everyone else – rather than look in the mirror.

For decades, this nitrogen pollution has created a huge Dead Zone in the Gulf of Mexico every summer. In the latest study of nitrate pollution of the Mississippi River, the US Geological Survey reported this week (Aug. 9) that nitrogen loading to the Gulf has risen 10 percent compared to 30 years ago (Sprague 2011). The increase is largely due to a dramatic 76 percent increase from the Mississippi above Clinton, Iowa, and a 75 percent increase from the Missouri River – areas draining the Corn Belt.

Of the seven other sites the Geological Survey studied, six reported either steady levels of nitrogen loading or a 10-20 percent increase. None showed improvement.

Evidence like this makes little impression on the Corn Growers, however. Trying to counter the growing evidence that agricultural fertilizer use is the main culprit for nitrogen loading, they recently commissioned their own study in a bid to absolve themselves from responsibility for helping to heal our polluted rivers, lakes and streams – and shrink the Dead Zone. But the study is deeply flawed. It ignores a substantial portion of the nitrogen inputs to corn production and relies heavily on a key piece of outdated information. Their claim is that corn production cannot possibly be contributing to the nitrogen pollution in public waters and the Gulf because their corn plants use up more fertilizer than farmers are applying to their fields. Using "N" as the abbreviation for nitrogen, the Corn Growers' report concludes:

"Therefore, under present day cultural practices, the net balance for N applied and N removed in corn is such that there is no excess N available due to fertilizer use. The conclusion then is that any change in N entering the Gulf via the [Mississippi-Atchafalaya River Basin], over time, is probably not related to the use of fertilizer N for corn." (p. 23, NCGA 2009)

We hear this message more and more from the agricultural community. Just last June, Don Parrish, senior director of regulatory relations for the Farm Bureau, told the New York Times, "We

are on the razor's edge. When you get to the point where you are taking more from the soil than you are putting in, then you have to worry about productivity" (Kaufman 2011).

Any corn farmer can spot the gaping holes in the logic of the Corn Growers' study, which used a decades-old estimate of corn's protein content to come up with an inflated estimate of corn nitrogen, and ignored the nitrogen added to soil via soy rotation and manure. This skewed view of the corn industry's impact is also contradicted by numerous studies by universities and government agencies that have repeatedly documented agriculture's contribution to Dead Zone pollution (Turner 2003, Alexander 2008, EPA 2008).

The Harm

Why should anyone care about fertilizer in a river?

Excess nitrogen in waterways causes massive blooms of algae. The algae harm many other plants and animals in the water by blocking sunlight. When the algae die, bacteria consume them, using up all of the oxygen in the process. Fish and other species die from lack of oxygen – thus the term Dead Zone. Wildlife suffers and coastal fisheries are devastated. The Dead Zone

From the StrathKirn homepage:

"With headquarters in Chesterfield, Missouri, StrathKirn® Inc. provides customized consulting in the management of science, new technologies, product development, market planning, due diligence, and business strategies." (www.strathkirn.com)

The founder and CEO of StrathKirn, Inc., is James McLaren. His page on the professional networking site LinkedIn says:

"James McLaren, Ph.D., CMC, is Founder and CEO of StrathKirn Inc., a business consulting firm focused on new technology and emerging markets in agriculture, agribusiness, biotechnology, biofuels and renewable resources. We provide in-depth understanding of the technology-business interface, including the application of science to generate and capture value in specific markets. Our clients include executives and management in multi-nationals, developing companies, public groups/universities, institutes, and government organizations. Key target industries include agriculture, food/feed, biotechnology, bioenergy and biofuels."

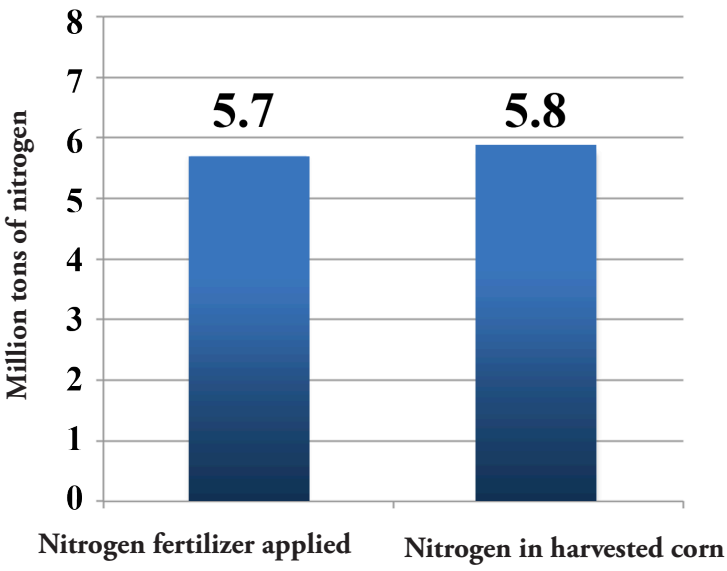
Dr. McLaren was formerly research manager and then director, new product introduction, for Monsanto, and prior to that he taught crop physiology, agronomy and statistics at the University of Nottingham in England. He holds a bachelor of science degree in agriculture and a doctorate in plant physiology.

Mississippi River is the second largest in the world, typically covering an area about the size of Massachusetts.

The Corn Growers' Claim

These claims are based on a report titled, "Hypoxia in the Gulf: An Analytical White Paper," written for the National Corn Growers Association by StrathKirn Inc. of Chesterfield, Missouri, in April 2009. No individual author is listed.

Figure 1. Corn Growers claim all nitrogen applied to corn crops was harvested in 2007



(Reconstructed from a table on p. 23 of Corn Growers' 2009 Report)

The StrathKirn study for the Corn Growers claims that corn plants are soaking up slightly more than the nitrogen applied in fertilizers each year. The implication is that corn crop production can't possibly be causing a pollution problem because all the nitrogen applied ends up in the corn, and not in public waters.

The nitrogen-rich component of corn is protein. The study's calculations assume that typical, modern, hybrid field corn is 10 percent protein, and thus that the corn crop's nitrogen uptake removed 5.8 million tons nationwide in 2007. With this crucial assumption, the calculations conveniently "show" that corn's nitrogen removal equals or exceeds the amount of nitrogen fertilizer applied nationwide.

There's a huge problem with this assumption, however. In the distant past, corn often tested at about 10 percent protein, but current measurements indicate a protein content of 6-8 percent. Corn breeding to increase yields over the past few decades has raised the amount of carbohydrate in each kernel relative to protein, lowering the protein percentage substantially. Corn growers can hardly be unaware of this 20-30 percent drop in the protein content; since the 1800s they have had to report the protein content of livestock feed on the label, and livestock producers are the corn industry's largest customers.

An unbiased analysis would use a more real-

-istic estimate of how much nitrogen actually ends up in the harvested corn. Furthermore, it would focus not on the entire nation but on the 21 states that have at least 50 percent of their landmass within the Mississippi River Basin. Agricultural pollution from corn grown outside of the basin is not likely to affect the Gulf. A more real-world value for how much protein is actually in corn grain is 7.7 percent, based on tests by Iowa State University (Iowa Crop Performance Tests 1995-2003, Jode Edwards, ISU Agronomy, USDA-ARS, personal communication). Plugging that figure into the Corn Growers calculations results in a nitrogen surplus of 1.2 million tons – much of it available to be washed off fields and down the Mississippi to the Gulf.

Corn Growers' Study Ignored Current Farm Practice Guidelines

That is not the only flaw in the Corn Growers' study. A closer look shows that the analysis disregards the guidelines farmers are supposed to follow when figuring out how much nitrogen they need to apply to grow a crop.

Most corn is grown in rotation with soybeans, and as any farmer knows, it is critical to account for the increased amount of nitrogen that is available in the soil following a soybean crop when deciding how much nitrogen fertilizer to apply for the next year's corn crop. Applying the common, but likely conservative, recommendation of 40

Figure 2. Real-world measurements show corn takes up 22% less nitrogen, leaving the rest in farm fields

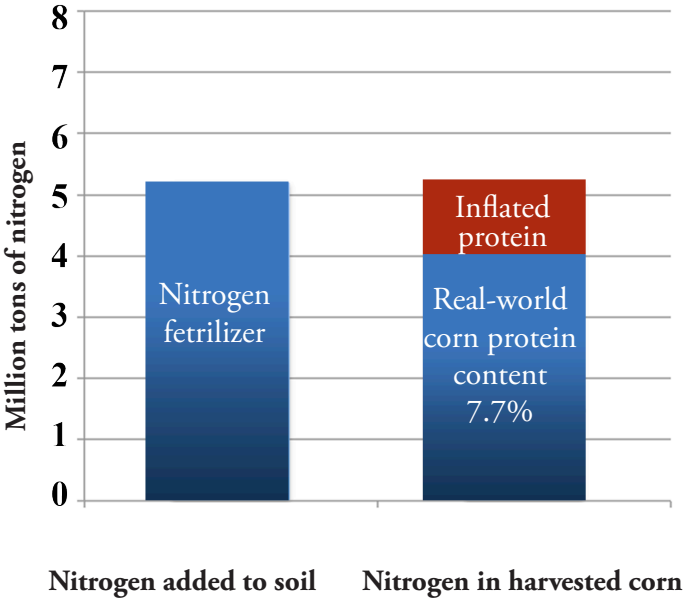
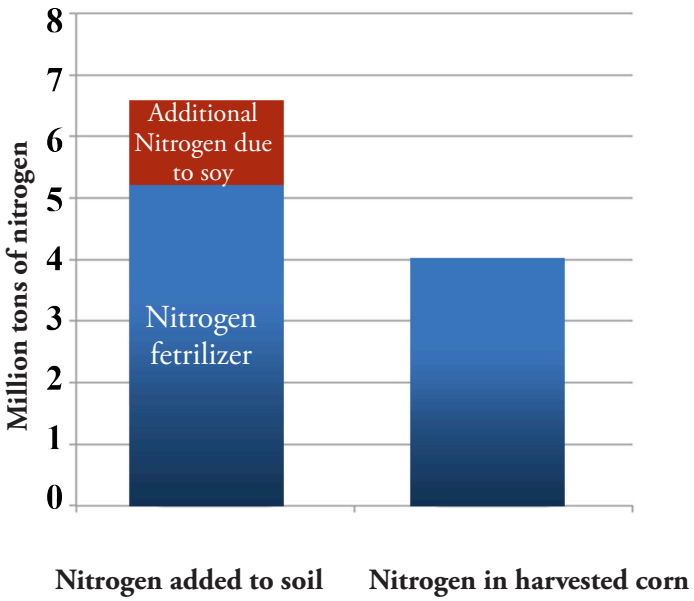


Figure 3. Industry study ignored soybean nitrogen credit



additional pounds of nitrogen per acre (David 2003, Sawyer 2003, Rehm 2009, UWEX undated) for soybeans grown in the 21 states adds another 1.4 million tons more nitrogen to the picture. Again, much of that nitrogen is available to enter waterways and reach the Gulf.

Making those two significant corrections swings the outcome of the calculations from a nitrogen deficit to a surplus of 2.6 million tons of nitrogen.

And we're not done yet. Lots of animals are raised in the 21 corn-producing states, and together they produce vast mountains of nitrogen-containing manure. Farmers must also account for the nitrogen in any manure applied to their fields when deciding how much fertilizer to use.

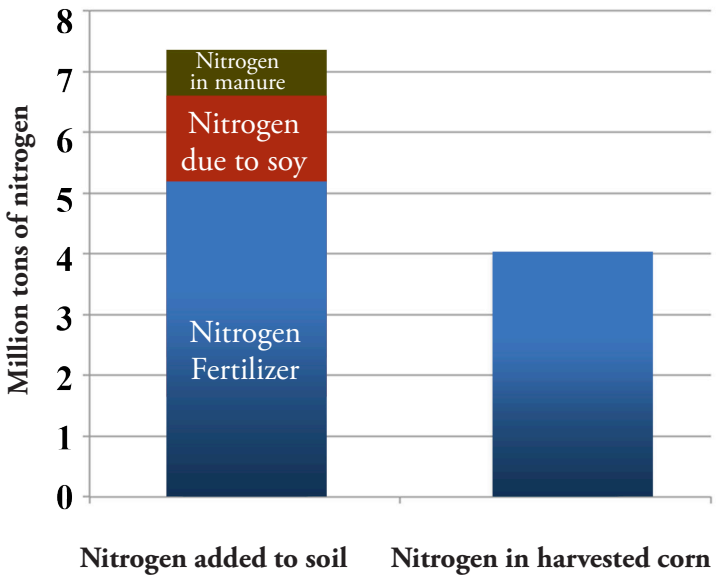
Unfortunately, there is little precise information about how much manure is applied to cornfields in the 21 states. Estimates based on the 2007 Census of Agriculture suggest that there are at least 900,000 tons of nitrogen in "recoverable manure" available to spread on agricultural land each year. If 75 percent of the manure generated in these states is used to fertilize corn – a conservative assumption – an additional 600,000 tons of nitrogen is added to the land each year, for an overall surplus of 3.2 million tons.

That's a far cry from the "nitrogen deficit" trumpeted by agricultural lobbyists.

According to the Environmental Protection Agency, the annual nitrogen load reaching the Gulf of Mexico ranged from 893,000 to 2.4 million US tons between 1985 and 2005 (EPA 2008). Clearly, a total surplus of 3.2 million tons of nitrogen on the cornfields of the 21 states could easily contribute between 893,000 and 2.4 million tons to the Gulf.

Our estimates are made even more conservative because they do not take into account another source of corn-driven nitrogen: the contribution from growing millions of acres of alfalfa, often followed by corn.

Figure 4. Industry study ignores manure, which adds at least 9% more nitrogen to corn fields



Alfalfa's nitrogen contribution is greater per acre than soybeans', but it varies by age and health of the crop, and the lack of data makes estimates difficult.

Pointing Fingers At "The Other Guys"

The Corn Growers' deeply flawed study is just the latest in a long line of efforts to blame others for the nitrogen pollution in the Mississippi Basin. They absolve themselves of responsibility and point their fingers at everyone else – urban lawns, golf courses and sewage treatment plants. This charge has been thoroughly debunked in an exhaustively peer-reviewed study by the US Geological Survey. It found that 9 percent of the nitrogen came from urban sources such as lawns, golf courses, wastewater treatment plants and septic systems and 16 percent came from the atmosphere (Alexander 2008). The bulk of the nitrogen – more than 70 percent – came from agriculture, 52 percent from corn and soy production alone.

It's Time for Agriculture to Take Responsibility

The overall message of the Corn Growers' deeply flawed study is that agriculture is not the source of nitrogen pollution, so it needn't change its ways. But that study's conclusions are false. It is time for the Corn Growers to acknowledge that their cropping system is a major source of the problem, and it is time for them to take responsibility, as non-agricultural industries have had to, and implement pollution control practices. For farmers, that includes lining waterways with grass strips, buffering streams and using wetlands to treat tile-line waters. More than 40 years ago, society ordered other industries to clean up their water pollution, but the agriculture industry fought hard in Washington and won an exemption for itself. It has been able to maintain that exemption ever since.

Instead of putting out clearly faulty studies and blaming others, it is time for corn growers to end the copout and actually become the environmental stewards they claim to be.

Methodology

Reconstructing Corn Industry Quantities

The Corn Growers-funded study of Dead Zone nitrogen sources provided no citations or documentation for the comparison between national nitrogen fertilizer use in cornfields relative to harvested corn nitrogen. EWG staff reconstructed the appropriate values using USDA data sources.

According to the USDA's National Agricultural Statistics Service, 13,037,875,000 bushels of corn were harvested in 2007 (USDA 2011a). Applying the corn industry's preferred protein content of 10 percent and a standard corn protein nitrogen conversion factor of 6.25 results in an estimate of 5.8 million tons of corn nitrogen harvested in 2007.

The Corn Growers-funded study compares this value with the USDA Economic Research Service's estimate of 5.7 million tons of corn nitrogen fertilizer use nationwide in 2007 (USDA 2011b). Fertilizer use is estimated based on voluntary reports by farmers responding to USDA surveys and may underestimate actual applications. The estimate does not include fertilizer applied to corn specifically grown for silage, which makes up less than 5 percent of the U.S. corn acreage and typically receives less fertilizer than corn grown for grain.

A Tight Focus on States within the Mississippi River Watershed

Any meaningful study of the impact of corn cultivation on the Dead Zone in the Gulf of Mexico must focus on the 21 states where the majority of croplands drain to the Gulf through the Mississippi River watershed, not on corn grown across the entire nation. Those states are: Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Montana, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, West Virginia, Wisconsin and Wyoming.

Based on state-specific data, the corn harvest in those states in 2007 (USDA 2011a) totaled 11,550,200,909 bushels. Using the Corn Growers' inflated corn protein content, 5.2 million tons of nitrogen might be harvested as corn grain.

EWG calculated the amount of nitrogen fertilizer applied in the 21 states using state-specific values for acres of corn planted in 2007 (USDA 2007), multiplied by state-specific information on the percentage of acres receiving fertilizer

and average application levels (USDA 2011b). State-specific fertilizer information is available for 2005 and 2010 but not 2007, so the lower of the two values was used in all cases. For those states lacking specific information on fertilizer use, national averages were used.

Corn Protein and Nitrogen Levels are Dramatically Lower than Industry Contends

Most of the nitrogen in corn plants is present as protein, and protein content can be converted to nitrogen content using a factor specific to corn of 6.25 (FAO 2003). A review of state university and agricultural agency estimates of corn protein content provides a range of 6-10 percent protein. All actual testing data sources place the range at about 6-8 percent protein. Only certain outdated industry standard references continue to list protein at 10 percent, a figure which typical hybrid field corn may not have achieved in decades. The corn industry prefers the historical 10 percent value because this value indicates that the corn harvest removes more nitrogen from the soil.

A mid-range value of 7.7 percent protein leads to an estimate of 4.0 million tons of corn nitrogen, 22 percent lower than estimates using industry's preferred protein value. This real-world protein value of 7.7 percent is drawn from the Iowa Crop Performance Tests and is based on hundreds of samples from hundreds of cultivars throughout the state (Iowa Crop Performance Tests 1995-2003, Dr. Jode Edwards, ISU Agronomy, USDA-ARS, personal communication).

Corn Industry Ignores Nitrogen from Soy Crops and Manure in Skewed Calculation

Soy is typically grown in rotation with corn, as this nitrogen-fixing plant can serve to reduce the subsequent corn crop's need for fertilizer. Farmers typically receive a nitrogen "credit" of 40 pounds/acre when they grow soybeans the year before growing corn.

The corn industry ignored this important source of nitrogen in an effort to balance nitrogen inputs and outputs. A simple calculation multiplying state-specific 2006 soy acreage (USDA 2007) for 18 of the 21 states by the 40 pounds/acre nitrogen credit reveals an additional 1.4 million tons of nitrogen added to the land, increasing total nitrogen inputs by 27 percent. (No information is available for Colorado, Montana or Wyoming.)

Manure is a rich source of nitrogen and other nutrients and is often used to fertilize corn. There is little available data on levels of manure applied in the U.S. The USDA's Agricultural Resource Management Survey provides limited data on the manure that farmers apply to corn crops based on voluntary responses in 13 of the 21 states draining to the Gulf (USDA 2011c); unfortunately, in aggregating the data, manure slurries with high water content were lumped with dry or semi-dry forms of manure, leaving no way to estimate the levels of nutrients added to soil (Robert Ebel, USDA/ERS/RRED/Production Economics & Technology Branch, personal communication).

However, an indication of the amount of manure applied to cornfields may be obtained by calculating the total amount of manure produced by livestock in the region in question. Estimates of the livestock populations in the 21 states were calculated using USDA 2007 Agricultural Census data for each state (USDA 2009). Dairy and beef cattle are subsets of the larger cattle population; for the purposes of this calculation, half the remaining cattle population was considered to be heifers and heifer calves, and the other half was considered to be steers, calves, bulls and bull calves. Other populations quantified included hogs, three categories of chicken (broilers, layers and pullets) and turkey. For a limited number of states, census data for specific categories are withheld to protect the confidential business information of farmers with few local competitors. As a result, aggregate animal population estimates likely represent minimum values.

For each livestock category, the manure nitrogen that would be present in applied manure and effluent was calculated using standardized manure characteristics and recovery rates provided by the Natural Resources Conservation Service (1998). In particular, nitrogen levels were calculated using "after losses" values that capture manure nitrogen content expected after volatilization, rather than the nitrogen content of fresh manure. For hogs, the values for breeding hog and pig inventory were used, while for turkey, the values for turkeys for slaughter were used. For beef cattle, recovery rates were adjusted to be consistent with spending 75 percent of the year grazing and 25 percent of the year fattening.

In total, an estimated 0.9 million tons of recoverable manure nitrogen was produced in the 21 states draining to the Mississippi River. If 75 percent of that amount was applied, the level of manure nitrogen ignored by the corn industry rises to 0.6 million tons.

This full accounting of nitrogen applied to corn

crops and removed by the corn harvest results in an excess of at least 3 million tons of nitrogen applied to the land. Much of this excess nitrogen may be carried by the Mississippi River to the Gulf of Mexico each year to feed the toxic algae blooms that create the annual Dead Zone.

References:

Alexander RB, Smith RA, Schwarz GE, Boyer EW, Nolan JV, Brakebill JW. 2008. Differences in phosphorus and nitrogen delivery to the Gulf of Mexico from the Mississippi River Basin. Environmental Science & Technology 42(3): 822-830.

David M., Below F. 2003. U of I Study Reaffirms Significance of the Soybean Nitrogen Credit. University of Illinois-Urbana Champaign, IL. Available at: www.aces.uiuc.edu/news/special-issues/springfarm/Nitrogen.htm

Ebel R, USDA/ERS/RRED/Production Economics & Technology Branch, personal communication, July 7, 2011.

EPA (U.S. Environmental Protection Agency). 2008. Gulf Hypoxia Action Plan 2008. Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Office of Wetlands, Oceans, and Watersheds, U.S. Environmental Protection Agency, Washington, DC. Available at: www.epa.gov/msbasin

FAO (Food and Agriculture Organization). 2003. Food Energy – Methods of analysis and conversion factors. FAO Food and Nutrition Paper 77. Food and Agriculture Organization of the United Nations. Available at: ftp.fao.org/docrep/fao/006/y5022e/y5022e00.pdf

Iowa Crop Performance Tests 1995-2003, Dr. Jode Edwards, ISU Agronomy, USDA-ARS, personal communication.

Kaufman L. 2011. Chemicals in Farm Runoff Rattle States on the Mississippi. New York Times. Published: June 2, 2011, in print on June 3, 2011, on page A14 of the New York edition. Available at: www.nytimes.com/2011/06/03/science/earth/03runoff.html?_r=1&pagewanted=all

NCGA (National Corn Growers Association). 2009. Hypoxia in the Gulf: An Analytical White Paper. For NCGA by StrathKirn Inc. Released April 2009. Available at: www.ncga.com/files/pdf/HypoxiaPaper10-2010.pdf

NRCS (Natural Resources Conservation Service). 1998. Nutrients Available from Livestock Manure Relative to Crop Growth Requirements. Resource Assessment and Strategic Planning Working Paper 98-1. Natural Resources Conservation Service, U.S. Department of Agriculture. Released February 1998. Available at: www.nrcs.usda.gov/technical/NRI/pubs/nlweb.html

Rehm, G. 2009. The Nitrogen Credit for Soybeans. University of Minnesota Cooperative Extension Service. Available at: minnesotafarmguide.com/app/blog/?p=402

Sawyer, JE. 2003. Getting the Most from Nitrogen Fertilizer Dollars. Iowa State University. Available at: www.ipm.iastate.edu/ipm/icm/2003/4-14-2003/nfert.html

Sprague LA, Hirsch RM, Aulenbach BT. 2011. Nitrate in the Mississippi River and Its Tributaries, 1980 to 2008: Are We Making Progress? Environmental Science & Technology, published online August 9, 2011. Available at: pubs.acs.org/doi/abs/10.1021/es201221s

Turner RE, Rabalais NN. 2003. Linking landscape and water quality in the Mississippi River Basin for 200 years. Bioscience. 53(6): 563-572.

USDA (U.S. Department of Agriculture). 2007. Acreage. National Agricultural Statistics Service (NASS), Agricultural Statistics Board, U.S. Department of Agriculture. Released June 29, 2007. Available at: usda.mannlib.cornell.edu/usda/nass/Acre/2000s/2007/Acre-06-29-2007.pdf

USDA (U.S. Department of Agriculture). 2009. 2007 Census of Agriculture Report. U.S.

Department of Agriculture, National Agricultural Statistics Service. Available at: www.agcensus.usda.gov

USDA (U.S. Department of Agriculture). 2011a. Quick Stats. Available at: quickstats.nass.usda.gov/

USDA (U.S. Department of Agriculture). 2011b. Fertilizer Use and Price. Available at: www.ers.usda.gov/Data/FertilizerUse/

USDA (U.S. Department of Agriculture). 2011c. Agricultural Resource Management Survey. Available at: www.ers.usda.gov/Data/ARMS/

UWEX (University of Wisconsin Extension). Undated. Credit Legume Nitrogen and Reap the Profits. UWEX Bulletin A3591. Available at: corn.agronomy.wisc.edu/Management/L025.aspx

Notes: