IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Agriculture and Life Sciences
Experiment Station
138 Curtiss Hall
Ames, Iowa 50011-1050
515 294-2518
FAX 515 294-6800

September 27, 2007

M. Granger Morgan, Ph.D., Chair
Chartered Science Advisory Board (1400F)
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

RE: Hypoxia in the Northern Gulf of Mexico: An Update by the EPA Science Advisory Board

Dear Dr. Morgan:

The College of Agriculture and Life Sciences of Iowa State University convened a task force of research scientists on agricultural nonpoint source landscapes to review the most recent draft report of the EPA Science Advisory Board concerning Hypoxia in the Northern Gulf of Mexico. The reviewers from Iowa State University included:

- Dr. James Baker, University Professor Emeritus, Department of Agricultural and Biosystems Engineering (Chair)
- Dr. Rick Cruse, Professor, Department of Agronomy, and Director, Iowa Water Center
- Dr. Michael Duffy, Professor, Department of Economics
- Dr. Matthew Helmers, Assistant Professor, Department of Agricultural and Biosystems Engineering
- Dr. Tom Isenhart, Associate Professor, Department of Natural Resource Ecology and Management
- Dr. Dan Jaynes, Collaborating Professor, Department of Agronomy, and Soil Scientist, National Soil Tilth Laboratory, USDA Agricultural Research Service
- Dr. Antonio Mallarino, Professor, Department of Agronomy
- Dr. Stewart Melvin, Professor Emeritus, Department of Agricultural and Biosystems Engineering
- Dr. John Sawyer, Associate Professor, Department of Agronomy

The comments of the reviewers are attached and have been summarized into ten major issue areas. Specific comments referenced by page and line numbers to support these summarized issues are available by request, for use by the hypoxia science panel in considering revisions to the draft report.

The reviewers and I both recognize the very substantial efforts and contributions of the scientists and staff of the hypoxia science panel in developing the draft report.

This science report, in addition to informing revisions to the Hypoxia Action Plan, will exist into the future as the comprehensive science overview of nutrients in water resources of Mississippi-Atchafalaya River Basin (MARB) and Gulf of Mexico. The reviewers note that substantial changes in the related sciences have occurred since the 1999 Committee on Environment and Natural Resources (CENR) reports. The hypoxia science panel and report would have been strengthened with inclusion of scientists having direct research experience in the subsurface-drained landscapes of the U.S. Corn Belt. These landscapes are a substantial source of nutrients to the Mississippi River and Gulf.

For these reasons, the College of Agriculture and Life Sciences recommends the hypoxia science panel be re-convened to consider the attached and other comments, as well as to consider extending the deadline for public comments to facilitate broad science input to this report.

Achieving the very significant nutrient reductions in water resources recommended by the science panel at this large watershed scale will be extremely difficult and may not be possible with current technologies given the cropping of landscapes within the Corn Belt. Development of new technologies will be critical to achieving these nutrient reduction targets from cropped landscapes. The Iowa State University College of Agriculture and Life Sciences, in conjunction with other land-grant universities in the Upper Mississippi Basin and the Corn Belt, are proposing to establish the Upper Mississippi River Nutrient Environmental Research Center to provide broader support for development of needed technologies to achieve greater environmental stewardship in cropped landscapes. I recommend the report broaden the call for research and technology development as critical steps to achieve the target nutrient reductions and address Gulf hypoxia.

Again, I urge you to re-convene the panel to consider the attached comments and the comments from other reputable scientists working on this problem. Thank you for the opportunity to provide input to the report.

Sincerely,

Wendy Wintersteen, Ph.D.
Dean, College of Agriculture and Life Sciences

Attachment

IOWA STATE UNIVERSITY
College of Agriculture and Life Sciences

Review of the "Science Advisory Board (SAB) Hypoxia Panel Draft Advisory Report" dated August 30, 2007

Submitted on September 27, 2007, by the College of Agriculture and Life Sciences, Iowa State University, Ames, Iowa 50010

This review considers ten major issues listed below. If the hypoxia science panel is re-convened to address these issues, specific comments referenced by page and line numbers relative to these issues are available by request.

Issue 1: The 2015 goal for reduction of hypoxia and 45 percent reduction targets for nitrogen (N) and phosphorus (P) transport to the Gulf of Mexico

- Setting the year 2015 — or any year in the next two decades — for reducing hypoxia to an average of 5,000 square kilometers seems to greatly increase the potential for failure and criticism. If, as the draft report states, we are only at the point of moving "in a directionally correct fashion," then why set an unachievable specific goal?

- Given that the volume of freshwater discharged to the Gulf is an important factor in determining the "degree" of hypoxia, and is a factor over which human efforts have little to no control, should not the goal be adjustable based on changes in flow volume?

- Should there not be a better determinant of the "degree" of hypoxia than a simple one-time measurement of the hypoxic area in late July or August?

- The modeling used to establish the 45 percent N loss reduction goal seems weak, in part based on modeling and models that earlier indicated a 30 percent reduction would be adequate. The modeling used for the 45 percent P loss reduction goal may be even weaker; no explanation of the model and its processes are provided, just a citation of a paper "in review."

- If the large reduction in total N and nitrate-N delivered to the Gulf in the last five years (calculated to be at least 20 percent) did not decrease the size of the hypoxic zone, what guarantee is there that a 45 percent reduction of N (and P) will achieve the stated area goal?

- To maintain the confidence of the producers who are asked to make changes, there must be confidence that the changes will produce the desired effect. Once lost, confidence will be hard to regain.

Issue 2: Need for expanded and improved monitoring

As part of its charge, the SAB panel was to focus its evaluation on research and information gaps in monitoring, documentation of nutrient sources, and impacts of practices employed. While some recommendations for monitoring and research are found in nearly every section of the report, a greatly increased emphasis on expanding and improving monitoring is warranted given the complexity of the issue and uncertainties remaining. The following examples are a few that illustrate the need for expanded monitoring:

- There remains a large variance in calculated nutrient loads for the Mississippi-Atchafalaya River Basin (MARB) depending on data and models utilized. The fact that many of these estimates are based on a small number of samples (i.e. < 20) per year illustrates the need for more and better river monitoring.

- Despite the research needs identified in the Integrated Assessment, fewer river and streams are monitored today than in 2000.

- Use of adaptive management is cited numerous times. Success of these approaches depends on accurately determining the effects of individual actions, requiring extensive monitoring. Even with extensive monitoring, separating the effects of individual actions will be very difficult when a suite of practices are implemented across an entire watershed.

- An accurate assessment of the development, persistence, and areal extent of hypoxia is imperative. Current one-time annual measurements provide a limited understanding of the temporal and spatial extent of hypoxia and the processes controlling its formation.

- Two diverse examples of missing information needed in developing relevant programs and policies are: measured (rather than estimated) nitrogen and phosphorus fluxes from municipal and industrial point sources; and better documentation of what practices producers are actually currently using.

Issue 3: Impacts of costs, feasibility, and policy

- The SAB panel was asked to discuss options for reducing hypoxia in terms of cost, feasibility, and social welfare. However, the panel failed to discuss impacts related to the costs or feasibility of its recommendations. Adding a table similar to Table 18 that compares relative costs of the proposals would have been informative. This could simply be a categorization of costs similar to what was presented in Table 18. In addition, who bears the costs and how they are distributed is necessary information when evaluating the recommendations.

- Also not addressed by the panel were the issues of private costs versus public costs, and whether or not costs for a certain practice can be justified based on the benefits.

- The panel did not address the changing structure of agriculture. Animal production has become more concentrated, changing the dynamics of manure nutrients and cropland needs. Land is farmed in larger blocks, influencing the costs and feasibility of alternative recommendations. Finally, the changing structure of farmland ownership will have significant influences on the way land is farmed and managed in the future. For example, in Iowa, almost a fourth of the land is owned by people over the age of 75. This means that ownership of a significant portion of the land will change over the next decade. With the changing ownership will come increased cash rent, which has traditionally been done on a year-to-year basis. Such changes will have significant impacts on the feasibility of the recommendations under consideration.

- The Corn Belt is best-suited for production of corn and soybeans. Changing rotations will require the development of new markets and significant changes in the existing marketing infrastructure. The report does not adequately address these costs.

Issue 4: Limitations of water quality impacts of some practices

- The nutrient loss reductions ascribed to some of the practices described may be overly optimistic because the practices are still in the experimental stage or have not been fully tested. Specifically, few data are available that quantify the water quality impact of many of these options at the watershed scale. In addition, the ability of many of these options to be fully integrated within existing agricultural production systems remains unproven. Many of these practices should be studied at the watershed scale before major investment of public or private funds.

- Some of the practices described (and the loss reductions ascribed to them) are derived from studies conducted in regions with soils and weather conditions significantly different from the Corn Belt.

- Some of the nitrogen management practices described may not result in the loss reductions ascribed to them:
    - Corn plant N stress monitoring has not proven to be a viable nitrogen management system for reduction in nitrate-N loss to surface water systems unless that monitoring results in reduced total nitrogen rates. In fact, published research indicates that N application at late corn vegetative growth stages increases nitrate-N loss in tile drainage flow.
    - On medium-textured to fine-textured soils, spring preplant and sidedress N fertilizer applications usually result in similar nitrate-N losses in drainage water.
    - Very limited research has been done on the effect of controlled release N products on nitrate-N loss in tile flow or from watersheds in the Corn Belt. Also, Iowa research to date has not shown a consistent N-rate change with use of controlled release N fertilizers. Fertilizer costs are significantly higher for these materials.
    - Research in the Corn Belt on use of nitrification inhibitors with fall-applied N has shown only marginal benefit in reducing nitrate-N loss in tile flow (0 to 14 percent).

- Of the many N management practices outlined, N application rate is the most important one that can effect change in nitrate-N loss in drainage water. However, rates below the economic optimum result in economic losses to producers and in the potential to "mine" organic matter, resulting in reduced soil quality.

- Due to cold temperatures in the northern half of the Corn Belt, there are questions on the feasibility on using practices such as interseeding of leguminous cover or relay cropping to reduce nitrate-N loss.

- While conservation buffers have the potential for reducing nonpoint source pollutant loadings, the discussion should appropriately recognize that buffers' performance can vary significantly depending on factors such as presence of concentrated flow, area of buffer receiving flow, whether subsurface flow is short-circuited through the buffer through tile drainage, and maintenance of the buffer relative to vegetation and short-circuiting of flow. A significant need exists to evaluate buffers under these "real-field" conditions.

- Care should be taken to be realistic in assessing the benefits of practices. For example, on the idea of "synergism" among practices to reduce nutrient losses beyond that of single practices applied alone, the combination of practices usually gives a multiplicative effect, which is less than even an additive effect (e.g., two practices, each with a 50% reduction, would combine for a 75% reduction).

Issue 5: Costs and risks of the recommendation to discontinue fall N application for corn

- The costs of this recommendation need to be carefully considered. In Iowa, about a third of the total nitrogen fertilizer is fall applied (including 50 percent of the anhydrous ammonia). Also, approximately 11 percent of farmers are responsible for production on 42 percent of the harvested crop acres in Iowa. Due to a limited number of days suitable for field activities, moving to an all-spring nitrogen application practice would result in delayed plantings and reduced crop yields.

- If all nitrogen is applied in the spring, the fertilizer industry infrastructure would need to be greatly expanded to meet transportation, storage, and delivery needs. This would lead to increased nitrogen costs and possible shortages and delayed product availability.

- If, as a result of this recommendation, farmers and agribusiness representatives become even more time-constrained in the spring, especially with adverse soil and weather conditions, their risks increase for additional safety and stress issues.

- Soil compaction resulting from the likelihood of field trafficking on wet soils would increase, having both production and water quality — reduced infiltration would increase surface runoff, erosion, and nutrient losses in surface runoff.

- The all-spring nitrogen application practice needs to be treated with the same reservations and caution that other point and nonpoint practices have received in the report.

- Based on this proposed change in time of application, the suggested 15 to 30 percent nitrate-N loss reduction to streams is more likely to be 0 to 15 percent. If many nitrogen products are applied too early in the spring due to spring workload and time constraints, reductions may be even less.

- The estimated reductions in nitrate-N mass load loss based on a 20 to 40 kg/ha/yr are too large when losses are actually more in the 10 to 30 kg/ha/yr range across the Corn Belt.

- In many Corn Belt states, there has been a successful campaign to voluntarily limit the primary nitrogen application in the fall for corn until the soil is below 50 degrees and cooling (e.g., see http://extension.agron.iastate.edu/NPKnowledge/ for Iowa). This delay in timing reduces the conversion to nitrate and the potential for loss from the soil, thus achieving part of the potential benefit of switching to all-spring application.

Issue 6: Nutrient mass balances limitations and implications for soil and water quality

- While the SAB panel is correct that most soil carbon studies have found little effect of near optimum N rate on soil organic carbon (SOC), the panel failed to recognize that the N imbalances computed by Jaynes et al. (2001) are of such a magnitude to be below the accuracy of measurement for most SOC change studies.

- Besides the field-scale N mass balance studies presented by Jaynes and Karlen (2006), watershed-scale N mass balance studies also have concluded that very similar losses of soil organic nitrogen are a likely explanation for why N exports exceed N imports (David et al. 2001 and Fig. 26 of the panel report, for example).

- While accurate and complete mass balance computations can serve as irrefutable evidence in determining whether soil organic matter content is changing, limitations in data often force an assumption that the soil N pools are in a steady state. This ignores the effect of practices that potentially sequester soil organic matter, such as fall cover crops or extended rotations, as well as practices that potentially consume soil organic matter, such as the priming effect observed when small amounts of added N fertilizer can cause proportionately greater N losses (from soil organic matter) to tile drainage (see Cookson et al, Nutr. Cycl. Agroeco., 56:99-107, for example).

Issue 7: The basis of manure management in the Corn Belt

- The report misses the real basis of animal manure management problems in the Corn Belt. Unlike the east and southeast United States, it is not a problem of excesses on a large or regional scale. It is a local problem of applying manure in a manner so that it can be utilized efficiently without significant environmental losses.

- In the Corn Belt, the challenges are associated with the ability to incorporate manure into the soil to avoid losses to air and water; knowing the content and availability of nutrients in the manure applied; applying it uniformly and at the rate desired; and thus being able to confidently "give credit" for its addition to the soil for crop production.

- Manure is quite valuable in most areas where cropland is nearby. It is sought-after by local crop producers to offset the current high cost of fertilizer.

- Figures and data used in the report and termed "excess manure" N and P are incorrect. They should be labeled "recoverable manure" N and P, and as such are the amounts that can be incorporated into a farm nutrient management plan to meet the nutrient requirements for that farm (and not nutrients that exceed nutrient requirements and are thus susceptible to loss to water resources).

- The implication given in the Concentrated Animal Feeding Operation (CAFO) permit data does not reflect the current situation regarding manure utilization on farms and ranches. All states in the MARB now have manure management requirements to control nutrient application on land; most have phosphorus indices to minimize the surface water pollution hazard; and most control the rate of manure application based on P as well as N.

- It is agreed that reducing farm-gate inputs of N and P in animal feed is one of the best nutrient management opportunities. But most of these strategies are already being put into action because of the high cost of feed. Phytase use for poultry and swine is common. Phosphorus feeding has been reduced considerably, with the exception of animal production systems using diets containing distillers dried grains and solubles (DDGS), a co-product from biofuels production plants. These diets contain higher concentrations of phosphorus than conventional diets.

- In general, animal manure impacts on N and P delivery to the MARB have decreased over the last 30 years as a result of lower numbers of animals and a higher level of management and regulation.

Issue 8: Water quality impacts of bioenergy production

- The report identifies "conflicts between certain aspects of current agricultural and energy policies on the one hand and the goals of hypoxia reduction and improving water quality on the other." These conflicts are a key point. Even though there is discussion of the issue in Section 4.5.9, putting only the above quote in the conclusions of the Executive Summary does not do justice to highlighting the trade-offs being created. Also, more research should have been recommended to address the issues surrounding these trade-offs.

- Corn is the single most important ethanol feedstock and will continue to be so, unless significant changes occur. Most of the report's recommendations to improve the hypoxic conditions will lead to decreased corn production; for example, taking land out of row-crop production, lengthening rotations, and changing fertilization rate and timing. Articulation of the barriers to this change (in addition to those purely economic ones), such as the changing structure of agriculture and what this means to farmer adoption of new systems, would give a much clearer picture of the challenge that is faced.

- Currently, research is underway to change the feedstock for ethanol. But cellulosic ethanol appears to be several years from commercial production, which will make nutrient loading reduction and timing goals even harder to obtain.

- Multiple statements of a very significant nature are made in this section without scientific references. Most are made based on somewhat reasonable logic, but likely will be challenged by the scientific community due to lack of science-based support.

Issue 9: Conclusions unsupported by science

Great care must be taken to accurately state the SAB panel's conclusions and interpretations of the science because statements from the document will be used by many without a clear understanding of the causes and uncertainties of Gulf hypoxia. Examples include:

- On page 6, the panel indicates that hypoxia in the northern Gulf of Mexico (NGOM) may soon enter a "point of no return." Nowhere in the discussion of Gulf science are data presented that indicate that such a point either exists or will be reached in the foreseeable future. Phrases such as "point of no return" are inflammatory and may be used by casual readers to sensationalize the hypoxia issue.

- The page 6 statement continues with the line: ". . . where even larger nutrient reductions are required to reduce the area of hypoxia." This statement is in direct conflict with the concept of a "point of no return," which implies that no reductions of any magnitude would eliminate hypoxia. More importantly, the panel found little data indicating that even larger nutrient reductions will be required in the future. Given the uncertainties of the factors controlling Gulf hypoxia, this statement appears at best a working hypothesis for future research and at worst unnecessarily alarmist.

Issue 10: Relationships among variability in Mississippi Basin hydrology and nutrient loads and causal factors of Gulf hypoxia

Specific charges of the SAB panel were to evaluate the changes in hydrologic processes in the Gulf of Mexico and the Mississippi River Basin, and to evaluate the importance of various processes in nutrient delivery and effects. Nutrient loads, concentrations, speciation, seasonality, and biogeochemical processes have been suggested as important causal factors in the development and persistence of hypoxia in the Gulf. A robust understanding of these relationships is important in informing management decisions for agriculture within the Mississippi River Basin. Examples cited within the panel's report illustrating the importance of reducing uncertainties in these relationships include:

- Reductions in nitrogen loadings to the Gulf have decreased at least 20 percent in last five years with no apparent effect on the hypoxic area.

- Over the last 25 years, spring and annual total-N fluxes in the MARB have declined. This is seemingly incongruent with the expressed concern that the hypoxia problem is increasing because of nutrient loadings and that immediate action is needed.

- Understanding why the nitrate-N load from the Missouri River Basin has decreased dramatically since the 1990s could have profound implications for the other MARB basins.

- Predictive nutrient-based models indicate that the area of the Gulf hypoxic zone is correlated to river discharge. Given this strong relationship to hydrology, can nutrient-reduction goals alone result in reaching the hypoxia area goals, without a simultaneous reduction in river discharge?

- Much is made of the fact that the Upper Mississippi and Ohio River basins contribute the majority of the nutrient loads, while representing only 32 percent of the MARB drainage area. While true, this comparison is misleading because the Upper Mississippi and Ohio River basins also contribute 71 percent of the total flow of the MARB. It is flow volume that in great part determines load, not the area drained.