

Dr. John W. Day, Jr.
Distinguished Professor Emeritus
Dept. of Oceanography and Coastal Sciences
Louisiana State University

Review of EPA Nitrogen Report

The report is a detailed treatment of reactive nitrogen in the US. It is comprehensive and a wealth of detail is provided. But the report suffers because different topics are treated in different detail. Many of the conclusions and recommendations are so general that they don't provide a clear idea of what should be done next.

Climate change is dealt with very briefly in spite of the fact that climate will certainly have a dramatic impact on nitrogen dynamics. The loss of nitrogen from agricultural watersheds is strongly dependent on rainfall. Predicted increases and decreases in rainfall will likely have a dramatic impact on nitrogen export from ag fields. For example, precipitation is predicted to increase in the upper Mississippi watershed, and other factors being equal (but see below), N export should increase (e.g., Justic et al.). In the southwest, more winter precipitation is expected to fall as rain rather than snow. This may impact agriculture throughout the region and lower N export. The southeast may also have lower rainfall. Such topics should be dealt with in more detail because climate change may increase or decrease the need for dealing with excessive N in rivers. There is an extensive literature on this topic much of which is summarized in a series of PEW Center reports.

Energy is a topic that is not covered at all in the report but which will likely have dramatic impacts on both N dynamics and our ability to study them. There is a growing consensus that the world society is transitioning from a century of relatively cheap energy to a future where energy will be much more expensive and scarce. There is strong evidence that conventional world oil production has peaked or will peak soon. There is a quite robust literature on this subject that the report should refer to and analyze. In a time of energy scarcity, natural resource management will have to change to a less energy intensive approach. And the kinds of studies that scientists do will also be constrained by energy availability. For example, during the run up in oil prices last year, the price of fertilizer increased substantially. Although oil prices have fallen, the long-term trend is certainly for increasing energy prices. It is likely that in a decade or two, the price of fertilizer will be so high that farmers will be very efficient in its use resulting in greatly reduced fertilizer runoff from farm fields. When the economy of Eastern Europe collapsed in the 1990s, fertilizer use declined dramatically and Mee reported that hypoxic conditions in the Black Sea nearly disappeared in a short time period. It is likely that agriculture will return to what Boody et al. (Boody et al. 2005 *BioScience*) called multifunctional agriculture. The implication of this is that problems related to fertilizer runoff from ag fields (eutrophication of rivers, streams, and coastal waters, hypoxia, etc.) are likely to decrease. This information should be included in the report as possible future scenarios.

I suggest that the role of wetlands in controlling N pollution should be treated more extensively and comprehensively in the report. There is some mention of this subject but in not much detail and it is scattered throughout the report. I suggest that it should be treated in its own chapter and this could be referred to throughout the report. Mitsch and colleagues have proposed a comprehensive program for the Mississippi basin. This should be discussed as an example of what can be done.

Specific comments (page number listed first)

13, fig 2. Denitrification doesn't seem to be a pathway.

16, Management strategies. Nutrient removal by wetlands should be specifically included in this list.

18, Recommendation C. Academic scientists should be included in the task force. It is clear from the literature that the great majority of work done on Nr has been done by academic scientists and they should be integrally involved in all stages of the effort.

19. Wetlands should be included in best mgt practices.

22. An discussion of the role of cheap energy, especially oil, in the agricultural revolution is completely lacking. The globalized food system uses about 10 cal of oil (or its equivalent) to produce one cal of food. N pollution is likewise a result of cheap energy. Energy is central to understanding this whole problem and it must be dealt with.

79-80. Recommendations. A comprehensive scientific program of the role of wetlands as sinks should be included in this list. For example, Mitsch and colleagues (refs cited in the report) called for a comprehensive research effort in the Miss basin on the use of wetlands. This could be cited here as an example of what needs to be done.

In a broader sense, these recommendations will require considerable funds (and energy). In an energy scarce future, hard decisions will have to be made about what is done. Study efforts should be directed at energy efficient approaches for controlling N pollution.

89. Forests. The sentence on lines 22-23 "Changes in C..." is awkward. The statement is that the highest rate of tree growth is in the Pacific northwest. Is the rate of growth higher than cypress forests in the southeast. In addition, there is a climate aspect here. A recent study (van Mantgen et al. 2009. Science. 323:521) reported that tree mortality in the west had increased as a result of climate change. This is another way that climate may impact N dynamics if trees are dying more rapidly.

106. It is interesting to note that in fig. 21, the Everglades is treated as a separate unit while the Miss delta is grouped with arid south Texas. Likewise, the wet northwest is grouped with parts of arid southern CA.

107. With regard to thresholds, there is a considerable literature on nutrient loading rates to wetlands and nutrient assimilation that seems appropriate to included in this section or elsewhere in the report.

159. Target goal 2. A discussion of multifunctional agriculture (mentioned above) should be included in this discussion. And as mentioned above, there should be a much more detailed treatment of the role of wetlands.

182. The report should have a general review of the types of models that could be used rather than mentioning only one.