Crop management strategies key to a healthy Gulf, planet

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Improved management of crops and perennials could go a long way toward alleviating the problem of hypoxia, which claims thousands of fish, shrimp and shellfish in the Gulf of Mexico each spring.

An assessment by a team led by Virginia Dale of Oak Ridge National Laboratory's Environmental Sciences Division concludes that low oxygen levels in water, or hypoxia, causes problems throughout the ecosystem. The death zone, scientifically documented in the Gulf since 1985, has consistently covered about 6,000 square miles, usually off the coast of Louisiana west of the Mississippi River's mouth.

The problem is caused in part by fertilizer run-off from agricultural activities in the Mississippi basin, which drains about 48 percent of the U.S. land. These nutrients combined with stratification caused by warm freshwater from the Mississippi and Atchafalaya rivers running into the colder saltwater of the Gulf sets up the deadly process. Algae grows, then dies and sinks to the bottom, where it decomposes, using up oxygen in the process.

"The oxygen-depleted water at the bottom is not replenished because of the lack of circulation," Dale said. "The more water that flows into the Gulf and the more nutrients in the water, the worse the hypoxia becomes."

While scientists initially believed nitrogen was the major culprit, the assessment team for the Science Advisory Board of the Environmental

Protection Agency realized that phosphorus also plays a significant role. The team is recommending a 45 percent reduction in phosphorus and nitrogen from the 1980-1996 average flux during the spring (April, May and June) on a five-year running average.

The assessment team found that the most significant opportunities for nitrogen and phosphorus reduction in the Mississippi Basin are promotion of the production of environmentally sustainable biofuel and other perennial crops, improved infield management of nutrients, construction and restoration of wetlands, tighter nitrogen and phosphorus limits on municipal and industrial sources and improved targeting of riparian buffers.

Other recommendations include using cellulosic biofuels such as switchgrass and poplar hybrids, but the assessment team acknowledged that field implementation of cellulosic biofuel crops is under development. In the meantime, cellulosic ethanol is being produced from corn stover -- the cobs, leaves and stalks left in a field after harvest.

Dale is proposing research to establish landscape design that will help farmers and land management agencies determine where and how biofuel feedstocks can be grown with minimal environmental impacts.

“In our report to the EPA, we’re recommending planting perennials, promoting environmentally sustainable biofuel production and using no-till farming as key land management strategies,” Dale said. “Reducing the amount of nutrients on fields and restoring wetlands are other important parts of the panel’s land management recommendations.”

At a recent Department of Energy conference, “Biomass 2008: Fueling our Future,” researchers discussed multiple aspects of bioenergy crops.

“Choices about what crops are grown and how they are planted,

fertilized and harvested influence the effects of biofuels on native plant diversity, competition with food crops and effects on water and air quality," Dale said.

Decisions in this area also affect economic viability because the distance that biofuels must be transported has a large effect on the market cost of biofuels as well as the quality of life for those who live in communities through which the bulky fuel is transported, Dale said.

Dale and colleagues at ORNL are now focusing on watershed studies to determine what is happening between fields and the Gulf using models at different scales to interpret the data.

"Understanding these intermediate layers is crucial to filtering out the noise and figuring out how to shrink the hypoxic zone," Dale said. "The approach we're developing considers aspects of the landscape, including environmental and socioeconomic conditions, the bioenergy features and ecological and biological feedbacks."

While water availability and quality emerges as one of the most limiting factors, the linkage between water and bioenergy choices on medium and large scales is poorly qualified, according to Dale. An approach that considers environmental and socioeconomic changes in land use and landscape dynamics provides a way to quantify the influence of alternative bioenergy choices on water quality and other components of the environment.

Source: Oak Ridge National Laboratory