The Wetlands Initiative

Can wetlands address global warming?

Nutrient farms could reduce fossil fuel use and sequester carbon

As society considers ways to reduce the accumulation of carbon dioxide and other greenhouse gases in the atmosphere, its first strategy must be to reduce the use of fossil fuels. An important secondary strategy is to capture and store carbon in natural ecosystems, such as forests, agricultural lands, or wetlands. Using restored wetlands as nutrient farms addresses both of these strategies.

Reducing Fossil Fuel Use

The Wetlands Initiative estimates that if cities and industries use nutrient farms to meet future water quality standards for nitrogen and phosphorus,[1] they could use 56% less energy than conventional concrete and steel treatment technology. For example, when the Illinois EPA requires municipal and wastewater treatment facilities to reduce their nutrient discharge levels, the Metropolitan Water Reclamation District of Greater Chicago (MWRD) estimates that it will take approximately 180,310,000 kwh of energy to annualy treat its effluent to remove nitrogen and phosphorus pollution. Alternatively, TWI estimates that only 79,200,000 kilowatt hours would be needed to run pumps for wetland nutrient farms on 189,000 acres to do the job (Figure 1). Less kilowatt hours expended means less fossil fuel consumed, which means less greenhouse gases emitted.

Storing Carbon in Ecosystems

Ecosystems effectively sequester carbon if they can take in and store more carbon dioxide through photosynthesis than they release through plant respiration, decomposition, erosion, fire, or other land use changes.

Although forests store carbon at a faster rate than wetlands can, that carbon will be released as soon as the tree is chopped or burned down. This may mean that the tree only stored carbon for a few decades, or whatever is the lifespan of the tree. But even if that tree lives for several centuries, it will cease sequestering additional carbon after it is fully grown. When compared to other ecosystems, particularly wetlands, forests are less durable and less sustainable carbon sinks (Table 1).

Alternatively, as long as a wetland remains wet, it will continue to store the accumulated carbon and will sequester additional carbon. (If the wetland is drained, however, the soil is exposed to the air and will oxidize, releasing the carbon to the atmosphere.) Both wetland plants and soils

Figure 1. Comparison of Energy Usage for Wetland and Conventional Wastewater Treatment Technology[2]

(Millions of kwh)

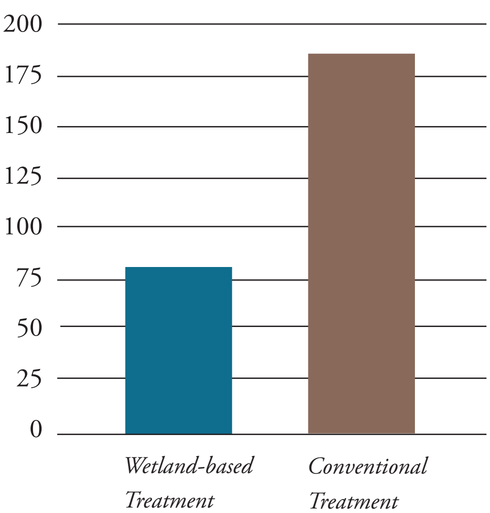
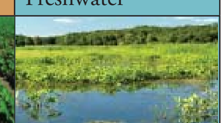


Table 1. Comparison of Ecosystems as Carbon Sinks

	Forest Pine Plantations	**Agriculture** No till row crops	**Wetland** Freshwater
			
Sequestration Rate (metric tons/year/hectare)	3.6	0.06-0.2	1.5
Location of Storage	In biomass	In soil	In soil, biomass, and peat
Durability	Low	Medium	Very High
Sustainability	Unsustainable	Sustainable (no till only)	Sustainable (up to millennia)

Source: Miquel Gonzalez-Meler, University of Illinois at Chicago[3] play an important part in sequestering carbon. Wetland vegetation temporarily stores carbon dioxide, and when the plants die, the organic-rich soils provide long-term sequestration for that carbon. Extensive peat deposits throughout the world underlying many current and former wetlands demonstrate the long-term effectiveness of wetlands in storing carbon.

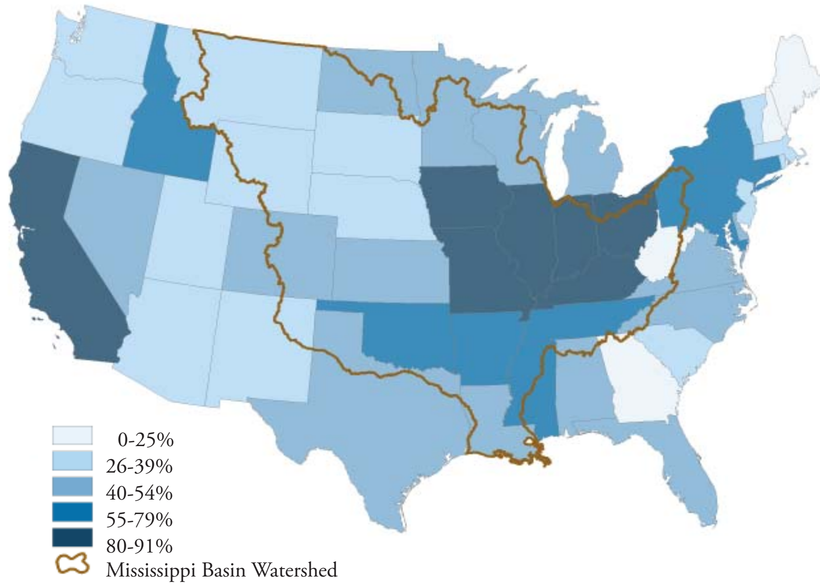
The efficiency of wetlands to store carbon is reduced, however, by the fact that wetland microbes naturally release trace emissions of methane and nitrous oxide—two greenhouse gases that impact global warming. Nonetheless, many scientists believe that a net reduction in greenhouse gases occurs by restoring wetlands, particularly given their capacity to store a large amount of carbon over a significantly long period of time.

Scientists from the University of Illinois at Chicago used the Wetlands Initiative's Hennepin & Hopper Lakes Project in Hennepin, Illinois, to investigate how much carbon is sequestered by restored wetlands. Scientists observed that soil in the now-restored wetlands had increased concentrations of carbon and other nutrient concentrations, compared to Midwestern agricultural soils.[3] They estimated that the wetland soils currently contain a total of 500g of carbon per square meter, but estimate that these same areas could be storing nearly ten times that amount by the year 2040 due to the accumulated vegetation and soils.

Lost Wetlands Reduce Carbon Sinks

Development of farms, cities, and industries in the United States has led to aggressive destruction of millions of acres of wetlands. The U.S. Fish and Wildlife Service estimates that prior to European settlement, 221 million acres of wetlands were present on the land that was to become the conterminous United States. By the mid-1980s, more than half of those had been drained, tiled, or destroyed; six midwestern states lost 80 percent or more of their original wetland acreage (Figure 2).

Figure 2. Percent Wetlands Lost, 1778-1980



Source: Dahl, T.E., and C. E. Johnson. 1991. Wetlands—Status and trends in the conterminous United States, mid-1970's to mid-1980's: Washington, D.C., U.S. Fish and Wildlife Service.

These drained wetlands released an enormous amount of carbon into the atmosphere from the exposed peat soils. If reclaimed, these lost wetlands could again become rich carbon sinks, while also providing cleaner water, wildlife habitat, and floodwater storage.

Futher Research

An Illinois River Nutrient Farming Pilot Project will create a comprehensive demonstration of how wetlands efficiently and effectively remove nutrients from the water (e.g., nitrogen and phosphorus) and carbon from the air. An interdisciplinary team of scientists will measure the biological, chemical, and physical processes of nutrient removal activity in the wetland. The data will be used to help form a new nutrient farming industry, which could have a positive impact on reducing greenhouse gas emission while sequestering carbon.

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[1]Nutrient levels recommended by the U.S. EPA for rivers and streams in Corn Belt States are 2.18 mg/L for total nitrogen and 0.076 mg/L for total phosphorus. Actual water quality standards, when adopted by state EPAs, may vary from these levels.

[2]Computed by Jill Kostel, TWI, based on data from Hey, Kostel, Hurter, Kadlec. 2005. Nutrient Farming and Traditional Removal: An Economic Comparison. Water Environment Research Foundation #03-WSM-6CO. This assumes effluent discharge standards of 3.0 mg/L total nitrogen and 1.0 mg/L total phosphorus.

[3]Gonzalez-Meler, M. and N. Sturchio. Report for Goose Pond and Hennepin-Hopper Lake Biogeochemistry, Water, Nutrient, and Sediment Analyses. Prepared for The Wetlands Initiative, September 2007.

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