Volume 24 / Issue No. 1 / Summer 2022

BIOSOLIDS DIGEST

PUBLISHED BY THE WESTERN LAKE SUPERIOR SANITARY DISTRICT

FIELD GREEN® The wiser fertilizer™

What's at the Root of Rising Fertilizer Prices?

Local farmers are being hit hard by rising commercial fertilizer costs. At the end of 2021, prices for 4 out of 8 major fertilizers were at an all-time high, including anyhydrous ammonia, urea, UAN 28, and UAN 32, according to a UMN Extension Podcast (11/22/22). UMN Extension Educator for St. Louis County, Troy Salzer, noted, "farmers are now paying $120-150 per acre, when last year they were paying $60 per acre. And it's not just fertilizer prices on the rise—seed prices and other inputs are up as well". Let's dig a little deeper to see what's at the root of the problem and how farmers can manage through it.

Higher Energy Costs
Higher energy costs equate to higher fertilizer prices. Coal, natural gas and gasoline are used to produce fertilizers and to transport them. For example, natural gas is important in the production of ammonia, NH_3—it provides the hydrogen that binds to nitrogen. The high price of natural gas, and hurricane damage, have contributed to reduced U.S. production, increased nitrogen imports, and higher nitrogen fertilizer prices in 2021 and 2022.

Tight Global Inventories
Another reason for increased prices is reduced fertilizer production worldwide and/or its availability to the global market. Major global suppliers, like China, are exporting less. Exports from Russia and Ukraine have been impacted by current events. Potash imports and prices may have been impacted by the brief Canadian Pacific Railway strike in March. Overall, world inventories are tight and have been made worse by transportation constraints.

Advice to Farmers
UMN's Troy Salzer has some suggestions:

1. Invest in a soil test to understand what nutrients are required and how much. With a dry year in 2021, there may be more soil carry-over of nitrogen, phosphorus and potassium.
2. Shift to nitrogen-fixing crops, like field peas and soybeans; or to lighter-feeding crops, like oats, sorghum and millet.
3. Fertilize crops that will have the greatest yield response to added nutrients, such as alfalfa, meadow fescue and red clover.

The Corn Nitrogen Rate Calculator is an online resource for corn growers to maximize yields and cut input costs. For more information: Dan Kaiser, dekaiser@umn.edu (Minnesota); Carrie Laboski, laboski@wisc.edu (Wisconsin).

Good to know!

Farmers in Douglas County can get FREE help for nutrient management planning from the Land Conservation Office.

Contact:
Ashley Vande Voort
Land Conservationist
715-395-1266

WLSSD: Mercury Pollution Prevention—30 Years and Counting

Mercury exists naturally in the environment. In water, it can become methylmercury that bioaccumulates in fish. It is a neurotoxin in humans, so reducing exposure to it—primarily though eating contaminated fish—is important. WLSSD works hard to reduce mercury in wastewater, which in turn, means exceptionally low amounts of mercury in Field Green® biosolids. For more than three decades, WLSSD has been working with the community to reduce mercury pollution, refining processes in our plant to capture more mercury, and researching new mercury-removal technologies—all to reach our permit goals and to protect the environment and public health.

Mercury moves differently and has different impacts in aquatic environments than it does in soil—add to that our location on the Great Lakes—and the result is a very strict limit for the cleaned-up wastewater we return to the river. We are now within 1 nanogram per liter (or 1 part per trillion) of mercury from reaching our goal, which is less than 1 drop in 28 Olympic-size swimming pools. Our efforts to achieve this goal enhance the quality of Field Green®, which tests well below our mercury limit for land-applied biosolids (see table).

Reducing mercury used in the community is easier than removing it from wastewater

WLSSD literally wrote the book, ***Blueprint for Mercury Elimination,*** on mercury pollution prevention programs that have effectively reduced sources of mercury in our community. Our mercury thermometer exchange program is one example of many success stories. Another is our work with regional dental offices to install amalgam separators that capture mercury-containing "silver" fillings during dental procedures—the first program like it in the country. The US EPA now requires the use of separators nationally. We continue to partner with a variety of businesses and industries to help reduce the mercury in wastewater sent to us.

Research on mercury removal technologies holds promise

In 2019, WLSSD conducted a pilot study with a new technology—the Advanced Biological Nutrient Recovery (ABNR) System—that uses algae to remove phosphorus and nitrogen from wastewater; our scientists wondered if it could also remove mercury. The small pilot study provided proof of concept for mercury removal. This means that while the algae was living its best life soaking up sunshine, and slurping up nutrients in our wastewater, the system was also removing tiny organic bits with mercury attached—enough mercury to meet our goals for wastewater. This was great news—IF this system could be scaled to handle up to 48.4 million gallons of wastewater every day. A feasibility study completed in 2021 disappointingly showed that implementation of this system, at the scale required for WLSSD, just wasn't a feasible option for many reasons. One reason being that the energy required to run the system would add mercury to the environment and counter the amount of mercury being removed. On the bright side, this research elucidated some characteristics of mercury in wastewater that may lead to new solutions.

What is the secret for removing dissolved mercury?

Dissolved mercury is a rascal because it is so small and difficult to capture. We now know that roughly 60% of the remaining mercury in wastewater is in the dissolved form, but our plant, like others, is not designed to remove such elusive particles. However, we are on to something. During our studies with ABNR, we noticed a correlation between the color of wastewater and dissolved mercury levels. This led scientists at WLSSD to hypothesize that if we can remove the finer suspended solids like those that determine color in wastewater (i.e., tannins), we may be able to remove dissolved mercury along with it. WLSSD will collect more data on this finding and experiment with filtration systems that can remove these finer particles.

While our quest for mercury removal continues, farmers can be confident in the quality of Field Green®. It meets all of the standards set by the US EPA, Wisconsin DNR and the Minnesota Pollution Control Agency for public health and environmental protection.

Please help reduce mercury pollution. Safely dispose of mercury-containing items like fluorescent bulbs, fever thermometers and old thermostats at a hazardous waste facility in your community.

	Metal Limits Set by MPCA (pounds/acre)	Metals in WLSSD Biosolids (pounds/acre)	Number of Applications Before Reaching Cumulative Limit
Chromium	No Limit	0.24	No Limit
Zinc	2500	5.90	423
Cadmium	35	0.06	583
Copper	1339	1.90	704
Arsenic	37	0.04	925
Lead	268	0.22	1218
Mercury	15	0.01	1500
Selenium	89	0.04	2225
Nickel	375	0.11	3409

Based on surface applications of 4.1 dry tons/acre (100 pounds available nitrogen).

Increase Carbon Storage & Mitigate Climate Change with Biosolids

First, Let's "dig" into carbon. Carbon is a naturally occuring element that cycles through the environment in soils, oceans, living things, and in the air. As plants grow, they pull carbon dioxide (CO_2) out of the air and use it to make sugars and starches (both contain carbon)—and then they leave carbon in the soil as biomass. Soil microbes and other organisms use plant and animal materials as a food source and release $C0_2$ as they digest the organic matter. Living things in the oceans and on land use carbon in various forms and release carbon gases as a byproduct of respiration and in some cases, digestion.

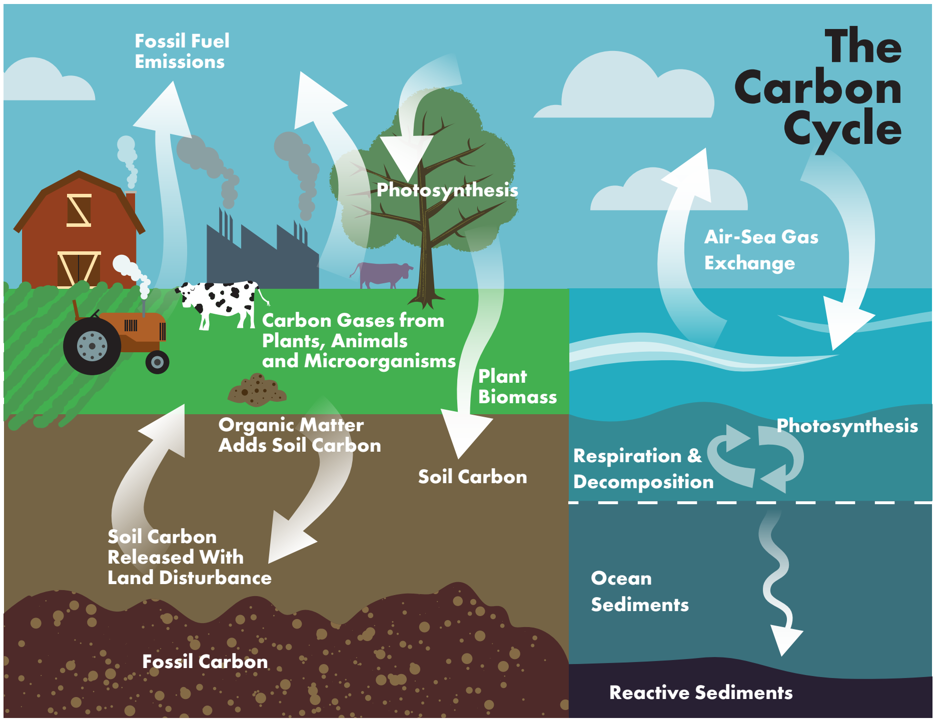
The carbon cycle is naturally balanced. However, human activities push more carbon dioxide into the air than is naturally ocurring, i.e. burning fossil fuels. Too much CO_2 in the atmosphere can be a problem and act as a greenhouse gas. It holds heat around the earth, causing our climate to warm. Warming results in erratic changes in weather patterns like increasing droughts, and more frequent and severe storms.

Land use and management methods can contribute to greenhouse gas emissions. The approach farmers take to agriculture can be one small step toward balancing the carbon cycle, although drastic cuts in worldwide CO_2 emissions are essential. Improving plant growth that absorbs carbon dioxide, adding carbon to the soil directly as organic matter, and returning plant residue to the soil—all capture carbon. Farmers can choose management strategies that not only capture carbon, but also preserve it's long-term storage in the fields.

A feature of healthy soil is a buildup of carbon in the form of organic matter, which is made of decayed materials from living things like plants, animals and microbes. Biosolids are organic matter and directly add carbon to the soil; they can also reduce the use of energy-requiring commercial fertilizers and related carbon emissions. Biosolids slowly release nutrients that are beneficial for plant growth, increasing leafy greens to pull CO_2 out of the air. If the plants are retained in the soil and allowed to decompose, the carbon and other nutrients are also recycled for soil organisms and plant life.

Scientists are researching ways to store more carbon in the soil, known as carbon sequestration, or carbon storage. In 2021, researchers at the University of California, Merced, analyzed soil organic carbon (SOC) in fields where various amounts of biosolids had been applied for 20 years, and compared the results to adjacent fields without biosolids. Overall, fields with biosolids treatment had more soil carbon, especially when considering the full soil profile of 0-100 cm. The difference in SOC of the fields with biosolids applications was concluded to be influenced by land management and environmental factors. In summary, the study suggests that farmers can control carbon storage by adding organic matter, modifying irrigation and tillage practices, and should consider soil texture as an important variable. (Y.B. Villa & R. Ryals. 2021. Soil Carbon Response to Long-Term Biosolids Application. Journal of Env. Quality. Vol. 50, Issue 5.)

Farmers in our region are most likely to increase stored carbon by adding organic matter, reducing tillage and planting perennial crops. Farmers may want to ask university extension experts in their counties about the most effective strategies for carbon storage in their fields. Extension educators can also advise on how to reduce the overall carbon footprint, and how "carbon farming" can be profitable.



The carbon cycle. The arrows show the movement of carbon in the environment. Adapted from NASA.

Practices that improve carbon storage:

1. Reduce tilling to preserve soil carbon (less tilling also reduces use of diesel fuel).
2. Add organic matter: biosolids, manure, etc.
3. Plant cover crops.
4. Plant perennial crops and trees; plants that live longer accumulate more carbon-rich biomass.
5. Keep grasses and perennial crops long; more grass and leaf surface area means more $C0_2$ absorption and more carbon in the soil.
6. Use grass or residual plant material as mulch to return carbon to soil. Mulch also retains moisture, adds nutrients, and prevents erosion.
7. Prevent over-grazing and allow some forage to return to the soil.

Field Green® Program
Western Lake Superior Sanitary District
2626 Courtland Street
Duluth, MN 55806

Clear Answers for Clean Water℠

Contact us

Already a customer? Schedule a field or ask questions about a recent application:

Paul Wilken, Lead Land Application Operator
(218) 348-9457 or paul.wilken@wlssd.com

New customer or community member? Enroll in the biosolids program, or ask for information:

Dori Decker, Environmental Programs Coordinator
(218) 740-4808 or dori.decker@wlssd.com

General questions?

Todd MacMillan, Biosolids Program Supervisor
(218) 740-4767 or todd.macmillan@wlssd.com

Field Green® Fee Schedule

WLSSD charges a nominal fee for land application of biosolids. If the farmer would like the biosolids tilled into the soil, there is an additional fee. A delivery fee is applied for distances greater than 40 miles from WLSSD's treatment plant.

SERVICE	RATE
First 300 tons/year	$19/acre
300-900 tons/year	$17/acre
900+ tons/year	$15/acre
Primary Tillage	$12/acre

FIELD GREEN® The wiser fertilizer™

FIELD GREEN® PROGRAM
Western Lake Superior Sanitary District
2626 Courtland Street
Duluth, MN 55806

Recycled paper made with 30% post-consumer waste, processed chlorine-free and acid-free