WATER MATTERS

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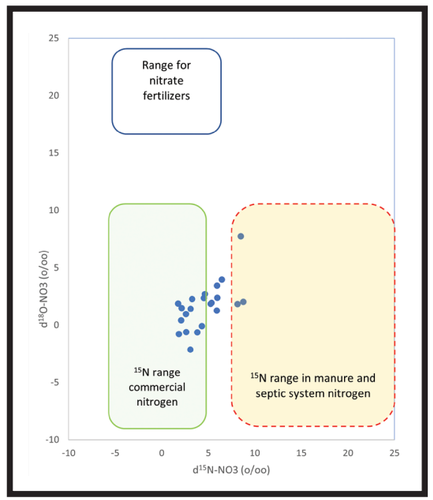
Characterization of Groundwater Nitrates in Area 29

Technicians with the Lower Loup Natural Resources District collected 22 samples from 20 irrigation wells and 2 domestic wells in northeast Wheeler County for this project during summer 2022. Samples were chemically and isotopically characterized to help determine the potential source of nitrogen.

This type of analysis is described as 'fingerprinting,' a method for tracing sources of contaminants such as nitrate. By understanding the isotopic composition, the lab can determine if the nitrate originated from inorganic sources like commercial fertilizer, or from organic sources such as animal waste. Ammonia, total organic carbon, and chloride concentrations were also measured as potential indicators of organic nitrogen (e.g. livestock manure) sources to groundwater.

Dan Snow, director of the University of Nebraska's Water Sciences Lab, provided the included plot comparing the isotope composition of nitrate



with different potential sources. The isotope composition suggests a mix of multiple nitrogen sources, both organic and inorganic. The majority of the wells are impacted strictly by commercial fertilizer sources. Three wells had all organic sources of nitrogen.

Proper nitrogen fertilizer management is key, no matter if commercial fertilizers are used or if manure is applied. Next steps are to investigate the results and compare well depth and hydrogeology. The LLNRD will also collect samples within the vadose zone (soil profile below the root zone) to evaluate potential nitrogen losses, which ultimately end up in the water table.

For more information about the isotope study, please contact Jason Moudry, Lower Loup NRD, (308) 728-3221.

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Over-Irrigation can Leach Nitrogen and Reduce Yield

Excess water in farm fields can damage crops, reduce yield, and can contribute to the leaching of nitrates and other nutrients into water sources. Proper management of irrigation activities is required to provide optimal moisture levels in the root zone, which is a major factor in achieving optimal yield.

Excess water can increase weed pressure and create conditions favorable to disease. On top of that, research has shown that each inch of leached water carries 5 to10 pounds of nitrogen with it. Considering that producers within the Lower Loup Natural Resources District (LLNRD) plant approximately 800,000 acres of irrigated corn each year, those leaching 3 inches of unused water lost an estimated 1.2 to 2.4 million pounds of nitrogen in 2022 alone.

That amount of leached, unused nitrogen may seem shocking. If that nitrogen was spilled in a small area, it would make headlines as an environmental disaster. When it is spread over nearly a million acres of the LLNRD it becomes invisible … except for the nitrates that end up in groundwater. Nitrate pollution rates in many areas of the LLNRD are climbing. What can irrigators do about it?

• Installation of flow meters allows producers to see how much water they are using. Producers can track the amounts used year to year and compare that with yield. Using flow meter data, when it is determined that irrigation water used exceeds the need, producers can reconsider the irrigation rate and frequency. Maximizing irrigation efficiency saves water and saves producers from paying for fertilizer and water that washes away without being used by crops.

• Conversion from gravity irrigation to center pivots increases the water application efficiency and reduces the likelihood of nitrate leaching.

• Installing programmable control panels on pivots allows for precise application.

• Install your own remote weather station and do not irrigate if rain is in the forecast.

• Use a soil probe to determine soil moisture levels and the need for irrigation. Sandy hilltops require a different rate and frequency of irrigation compared to heavier organic matter soils.

Considering the many other costs of farming, optimizing irrigation – and gaining the economic benefits that come with it – should be the goal of every irrigator.

Learn more in NebGuide G1904, at: https://cropwatch.unl.edu/documents/g1904.pdf

LOWER LOUP NATURAL RESOURCES DISTRICT

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Corn Nitrogen Use Efficiency (NUE) is the sum of Total Nitrogen Available divided by the corn yield.

NUE for LLNRD Water Quality Management Areas (2022) was 1.5 lbs. of nitrogen (N) per bushel of corn.

It takes 0.7 lbs. of N to produce a bushel of corn, much less than what is applied.

Inclusion of soybeans in rotations reduces nitrogen losses.

Chemigation can be an effective method to improve NUE. The LLNRD licenses over 3,000 permits annually.

Advance Soil Sampling Cost-Share Program

During the March 2023 meeting of the Lower Loup NRD Board of Directors, the Directors approved funding for a new district-wide Advanced Soil Sampling Cost-Share program. The approved amount is $75,000 annually, with $50,000 being committed to district-wide sampling and the remaining $25,000 committed to the Phase II Water Quality Management Areas and vulnerable fields identified by the LLNRD's new Nitrogen Vulnerability Model.

The purpose of the Lower Loup NRD's new Advanced Soil Sampling Cost-Share program is to encourage landowners to adopt advanced soil sampling analysis with the intent of reducing nutrient input and improving soil health across the entire Lower Loup Natural Resources District. Examples of advanced soil sampling include the Haney Test, Soil Health Assessment, and the Complete Soil Analysis Test. These advanced tests look at many different factors to determine the quantities of each nutrient that are available to the crop and to the microbes in the soil.

To qualify for the LLNRD Advanced Soil Sampling Cost-Share program, landowners must have certified irrigated acres and must use an approved soil testing method. The LLNRD would then cost-share up to $55 per soil sample up to eight soil samples per year for four years. Landowners will also be required to conduct 36-inch-deep soil nitrate tests, the cost of which will be covered by the Lower Loup NRD up to $15 per soil sample.

The funding for this program will be available in the next fiscal year, which begins July 2023. Landowners will be able to sign up at their local NRCS office at a date yet to be determined.

LLNRD Agronomist Mike Lorenz taking soil samples in Wheeler County.

UNL: Nitrates Can Draw Uranium into Groundwater

Researchers from the University of Nebraska – Lincoln are shedding light on the interaction between nitrates – a chemical common in fertilizer and animal waste – and naturally occurring uranium underground.

Uranium occurs naturally in aquifers around the world. Typically, the element does not dissolve into the water. But a recent UNL study shows that when the level of nitrate pollution approaches 10 parts per million – the Environmental Protection Agency's maximum contaminant level recommendation for safe drinking water – that elevated nitrate pollution in groundwater can make naturally-occurring uranium more soluble. From there, it can end up in wells, drinking water, and the human body.

In an article appearing on the *Omaha World-Herald's* website, Omaha.com, Karrie Weber, an associate professor at UNL's School of Biological Sciences and Department of Earth and Atmospheric Sciences, said domestic well owners should know what is in their well water and test for human-caused contaminants and naturally occurring ones. She also said that municipal water managers should consider where they place wells.

The study involved taking a pair of 60-foot-deep soil cores from an aquifer underlying Hall County west of Grand Island. Natural uranium deposits exist in the area that drains groundwater to the Platte River. Mimicking natural rates of groundwater movement, researchers subjected the samples to a variety of tests, the results of which bolstered the findings of a 2015 study indicating that aquifers contaminated with high nitrate levels – including the Ogallala Aquifer underlying much of Nebraska – contain uranium thresholds exceeding limits set by the EPA.

Cancer, and methemoglobinemia (blue baby syndrome), are among the myriad of serious illnesses caused by exposure to nitrate contamination in drinking water. High uranium levels can cause kidney damage in humans. The results of the study were published in the peer-reviewed scientific journal, *Environmental Science & Technology*.

The Nebraska Department of Environment and Energy requires that the state's community water systems be tested each year for nitrate contamination, and every nine years for uranium contamination. Many rural domestic wells are not tested. Eighty-five percent of Nebraska's drinking water comes from groundwater, so it is important that all sources get tested to ensure its safety.

Learn more at www.news.unl.edu.

LLNRD Directors to Revisit Proposed Fall Fertilizer Ban

The Lower Loup NRD continues seeking solutions to the issue of rising groundwater nitrate levels within the District. To combat nitrates getting into water where it threatens public health, at its December 2022 meeting, the LLNRD Board of Directors proposed a rule change to prohibit fall application of commercial nitrogen fertilizer on irrigated land.

The median nitrate level in Nebraska has doubled since 1978 and continues to climb. High nitrate levels in drinking water have been linked to pediatric cancers, of which Nebraska has some of the highest rates in the U.S. Though no longer a common practice in parts of Nebraska, some producers farming within the Lower Loup Natural Resources District apply commercial nitrogen fertilizer to their fields shortly after harvest. That practice leaves nitrogen in/on the ground – for up to 6 months or longer – with no plants to use it.

Precipitation can sweep that unused fertilizer into waterways. Nitrogen that doesn't run off can sink through the soil profile beyond where the next crop's roots can absorb it, allowing the chemical to creep toward groundwater aquifers. That unused nitrogen is a lose-lose: the money spent by producers to purchase and apply it is wasted, and the lost nitrogen ends up in the water supply where it puts public health at risk.

Limiting application of commercial fertilizer to spring/summer reduces the possibility of it running off or leaching before it can be used by crops. It makes better economic sense, is more efficient, and it reduces the risk to groundwater aquifers, surface water, and municipal water supplies.

A series of public meetings were held in early 2023 to answer questions and inform the public about the proposed fall fertilizer ban. The proposed rule change was also discussed at a public hearing. Following testimony from producers indicating that they would prefer to work with the LLNRD rather than be subject to additional regulations, the Board voted to not implement the fall fertilizer rule change, instead opting to revisit the issue in one year.

The Lower Loup NRD's technicians are continually working across the District to gather the scientific evidence that guides the LLNRD Board of Directors in their decision-making process. Some of these efforts include a legacy nitrates study that determines nitrate concentration and age of groundwater to develop a history of nitrate loading to the groundwater system, isotope analysis to determine the source of contamination, well sampling in cooperation with the UNL Water Center, and vadose zone research to measure the movement of nitrate that has escaped the root zone but not yet reached groundwater resources. Future studies include producing well vulnerability models – and in cooperation with producers – the use of portable equipment for in-season nitrate mobilization studies in fields of growing corn.

The Lower Loup NRD Board of Directors has committed to revisiting the proposed ban of commercial fall fertilizer at its February 2024 meeting.

Other rule changes went into effect on April 15, 2023, and can be viewed at www.llnrd.org.

A farmer applying anhydrous ammonia near the Boone-Nance county line.