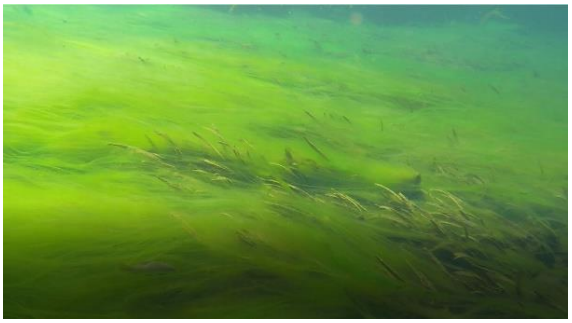
THE INSTITUTE FOR
WATER AND ENVIRONMENTAL
RESILIENCE
STETSON UNIVERSITY

SUSTAINABLE FARMING FUND

NITROGEN REDUCTION PRACTICES

One of the largest threats facing the Suwanee River Basin is the nitrogen pollution that is degrading the springs within the basin. Every year, nearly 10 million pounds of nitrogen leach into the groundwater beneath the basin, eventually reaching the region's springs and contributing to harmful algae blooms. Florida DEP estimates that 60% of this nitrogen pollution is from farm fertilizer and another 21.5% is from livestock waste. Thus, 81.5% of nitrogen pollution in the springshed is agriculture-related, and this evidence provides an opportunity to increase the efficiency of farm-operations in the region while simultaneously restoring the health of the region's springs.



Algae Bloom in a Florida Spring

This document provides an overview of practices that are effective at reducing nitrogen.

CONTENTS

Fertilizer Waste Reduction Projects

1) Precision Fertilizing & Side-Dressing Equipment: Sustainable Agriculture is based on the 4 R's: Right Source, Right Place, Right Timing, and Right Rate. Because soil sampling currently mandated by BMPs cannot be used to detect Nitrogen levels, applying the right rate of Nitrogen has been a challenge for the region, leading to the leaching and pollution problems previously discussed. Precision Fertilizer Equipment, like the types listed below, allow farmers to precisely identify the amount of N needed to be applied to their crops, reducing inputs and thus saving money and pollution.

A) Nitrogen Sensors: While map-based precision fertilizer has helped reduce inputs for Phosphorous and Water, sensor-based precision fertilizing has the potential to do the same for Nitrogen. A sensor is attached to a vehicle- or hand-held sprayer, and it measures the amount of N that individual areas need by comparing its data to a N-Rich strip. When sensors are combined with rate-controlling sprayers and software like Geo-Scout, this variable rate application (VRA) technology has been shown to reduce N inputs by 33-35 lb-N/acre.

B) Rate-Controlling Sprayers: When partnered with a spray-control console, these sprayers vary their rate of spray based on readings from N sensors. They are critical to reaping the benefits of N sensing, and they should be partnered with N sensors and Spray-Control Consoles for farmers who side-dress with sprayers (vs. drip fertigation) are not already using this technology.

C) Spray-Control Console/Display: This piece of equipment translates the readings from the N sensor and sends the information to rate-controlling sprayers to ensure the optimal amount is applied to crops. Common models include the Raven 440 and the John Deere GreenStar.

2) Controlled-Release Fertilizer: While side-dressing equipment can allow for more precise N applications, controlled-release fertilizers (CRFs) can potentially eliminate the need for later applications of N altogether by targeting the release of N to match the needs of crops at different growth stages. Unlike conventional fertilizers, CRFs are not water-soluble and thus do not leach away during the rainy season. This not only reduces nutrient loading into the groundwater, but also eliminates the need for post-leaching N applications that are currently permitted through conventional fertilizer BMPs. Past research has shown that CRFs can reduce N inputs between 25–50 lbs/acre.

Agroecological Techniques

1) Cover Crops: Certain cover crops add nitrogen to the soil and thus reduce the need for synthetic fertilizers. Nitrogen-producing cover crops convert nitrogen from the air into ammonia nitrogen during their life, and upon termination soil microbes convert this ammonia nitrogen into nitrate that can be utilized by the next crop. Relevant considerations to maximize N uptake and reduce leaching include proper timing of cover crop termination (to maximize Ammonia N returned to soil) and proper timing of cash-crop planting (to maximize available Nitrate-N to plants while avoiding leaching of Nitrate-N to groundwater during rain events). Projects aimed at using cover crops to reduce N inputs will seek to refine this timing, quantify the expected N benefits, reduce inputs of synthetic N fertilizer accordingly, and track this data accordingly. Further information on successfully implementing cover crops is found here: https://www.southernsare.org/Educational-Resources/SARE-Project-Products/Fact-Sheets/Annual-Cover-Crops-in-Florida-Vegetable-Systems

2) Alternative Treatment of Livestock Waste: Use of livestock waste as fertilizer is already embodied in Florida BMP's for Cow-Calf & Dairy operations, and farms are required to monitor their applications in accordance with soil samples. For mixed farm/ranch operations, see below for details on alternative treatments to manage livestock waste that exceeds plant nutrient needs or to concentrate the nutrients in manure into a more concentrated form that can be used for more precise fertilizer placement.

Livestock Waste Reduction Projects

1) Alternative Treatment of Livestock Waste: Use of livestock waste is already mandated as a BMP for both Cow-Calf and Dairy operations, and farms are required to apply amounts in accordance with soil test results. However, using livestock waste as fertilizer still results in nutrient leaching when manure is applied with imprecise location, rate, or time. These alternative treatments of manure either concentrate nutrients into a form that can be more precisely applied or prevent nutrient leaching from manure in excess of recommended application amounts.

A) Plant-Based Nutrient Removal in Constructed Wetlands: DEP's BMPs mention the potential of this technology to remove up to 95% of nutrients, and research at the University of Florida confirms this statement. Constructed wetlands are tanks or pools filled with diluted liquid manure that contain macrophytes (aquatic plants) known for their nutrient reduction potential. Bacteria break down the nitrogen in manure to a usable form, plants uptake the nitrogen as they grow, and the plants are harvested as necessary to maintain space. We recommend that farmers pair this technology with solid-liquid separation to maximize its efficiency, and experiments suggest that additional pairing with anaerobic digestion can further maximize nutrient reduction benefits.

B) Solid-Liquid Separation Systems: These technologies partially remove solids from manure slurry, giving ranchers and dairy producers more control over the nutrients within. Solids are more easily transported, and the nitrogen-rich liquid can be applied at more precise rates and locations as a quick-release fertilizer. A variety of technologies exist, from simple structures like weeping wall basins to more complex mechanical agitation systems. While these systems do not reduce any nutrients on their own, they can be paired with technologies like constructed wetlands or precision fertilization to maximize those technologies' effectiveness.

C) Anaerobic Digestion: Anaerobic digestion decomposes livestock waste in the absence of oxygen, and it can take place in specialized tanks or covered lagoons. While anaerobic digestion is most known for its greenhouse gas reduction & biogas production capabilities and actually concentrates rather than reduces nutrients like nitrogen, it still plays a role in nutrient management. The nutrient-rich liquid can be more precisely applied to crops as a quick release fertilizer, or it can be incorporated into a constructed wetland to be more effectively absorbed by the macrophytes within.

D) Aerobic Digestion (Composting): Composting breaks down the nutrients in manure into nutrient-rich soil that can be either used, sold or given away, and it is a responsible alternative to manage manure in excess of what crops or pasture can utilize. While composting is already a BMP for dairy operations, it is not yet mandated for cow-calf operations.

E) Lined Dairy Waste Storage Ponds: Installation of HDPE liners and ancillary equipment such as biosolid separation systems for liquid waste storage ponds on a dairy farm. This practice can achieve 100% Nitrogen reduction.