THE IMPACT OF ECOFRIENDLY AGRICULTURAL LAND MANAGEMENT ON THE WATER QUALITY OF THE LOWER ESOPUS CREEK, NEW YORK

Shafiul Chowdhury and SUNY New Paltz Undergraduate Students (2017 to Present)

Short Summary: The Lower Esopus Creek's water quality faces contamination risks from anthropogenic influence, and this study evaluates the Hudson Valley Farm Hub's (HVFH) impact. HVFH transitioned to resilient farming methods in 2013, reducing overall contamination of the water flowing through the HVFH drainage system. Altered fertilizer practices led to improved nitrate and phosphate levels, and changes in calcium and chloride in total dissolved solids were noted. Flow rate variations complicated parameter comparisons, prompting analysis of nitrogen isotopes for nitrate source identification. Distinct isotopic signatures were observed, with detailed findings expected by March 2024. Ongoing research will determine the continuation of water quality assessments.

Broad Summary: Like all streams passing through developed environments, water quality in the Lower Esopus Creek is at risk of contamination. Analysis of water chemistry was performed over a growing season to evaluate water quality evolution in a selected reach of the drainage basin. The intention was to determine the effectiveness of alternative farming practices applied by the Hudson Valley Farm Hub (HVFH) in Hurley, New York. Water quality variations were observed and contamination from the HVFH was distinguished from the effects of other regional land use.

Prior to 2013, the HVFH relied on traditional farming procedures. Since then, HVFH has implemented new resilient farming techniques such as no tilling, bed scale agriculture, and eco-friendly applications of fertilizers and pesticides. An earlier study on Esopus water quality, prior to the implementation of new methods, included measurements of: pH, Temperature, Dissolved Oxygen, Ammonia, Nitrate, Conductivity, and Turbidity. The previously collected data provided a basis for understanding the current health of Esopus Creek. Additionally, the inclusion of a simulated rainfall experiment assessed soil erosion tendencies: Runoff yielded 340 Nephelometric Turbidity Units (NTU) on a tilled green bean parcel compared to 16.3 NTU on an untilled corn parcel, indicating significant reduction of soil erosion. Temporal changes in phosphate and nitrate concentrations were observed between six sampling dates. In an agriculturally dominant landscape, sites of unknown anthropogenic influence were observed having nitrate levels ranging between extreme values of 5.6 mg/L and 13.2 mg/L. Phosphate values ranged between 0.35 mg/L and 2.43 mg/L for these sites. Relative to all detected land use within the region, the positive impact of improved fertilizer application practices was credited to the HVFH. Results for total dissolved solids and several cation and anion species displayed a unique behavior with respect to calcium content. After June, calcium overtook chloride as a dominant contributor to the amount of total dissolved solids measured within the farm hub. This is likely due to chloride returning to background concentration levels as the deicing salt applied earlier got diluted.

The comparison of water quality parameters was complicated by the fact that the rate of flow differed from year to year which can affect the concentration if the load of the contaminants remains constant. For example, if the quantity of nitrate remains constant but discharge gets low

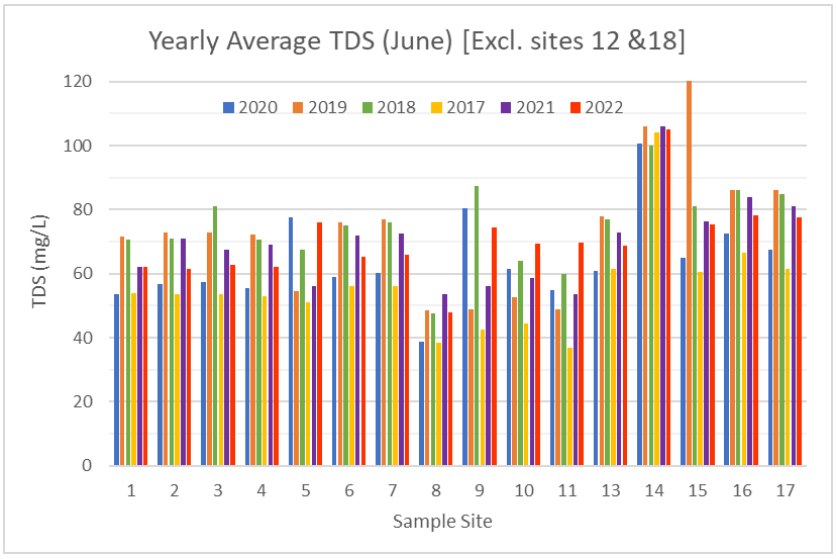
on the following year's sample collection day, the concentration should increase. To account for that, we attempted to measure the discharge of selected sample locations during the collection and then tried to normalize the concentration for better comparison. However, this approach did not work properly due to the release of water from the Ashokan reservoir, which causes a mixing of water of two different types which makes normalization very difficult.

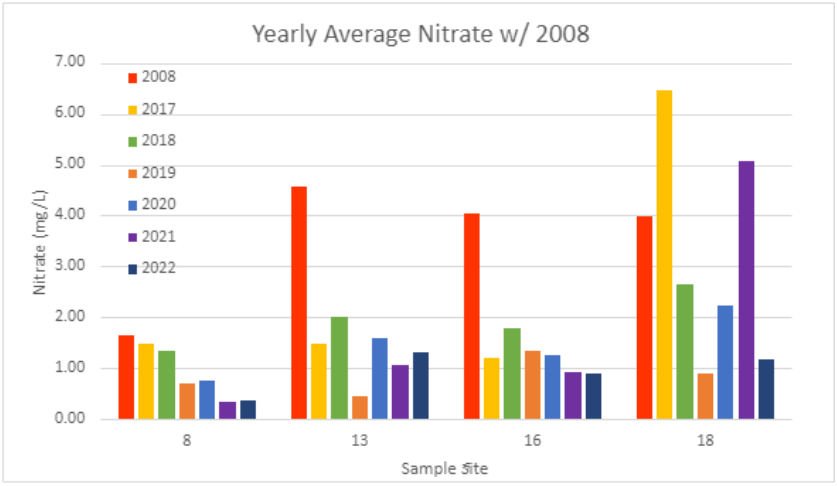
To tackle that, we analyzed the nitrogen isotope of the collected water samples to infer the sources of nitrates. Nitrogen isotopic ratios have been used to identify the source of nitrates from synthetic and organic fertilizer, human waste, and natural sources by scientists.

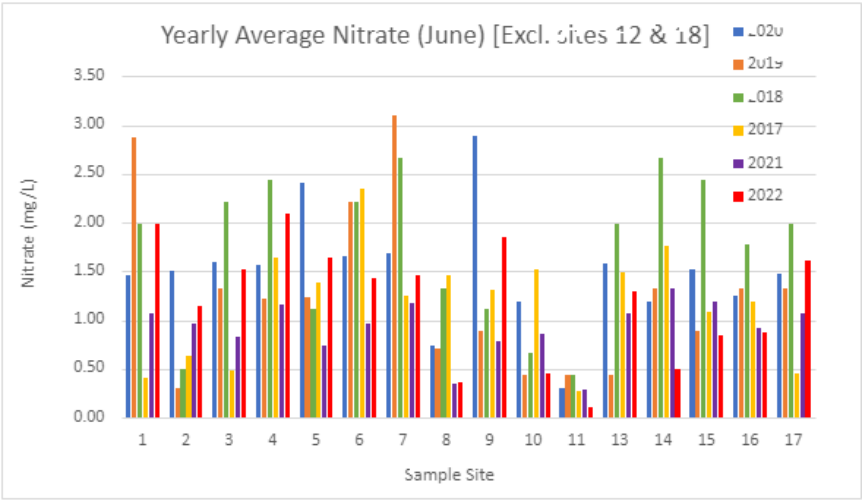
We found some distinct nitrogen isotopic signatures from samples collected from different locations. The findings of this approach will be shared in more detail once the 2023 data is analyzed (hopefully by March 2024).

We will continue to assess water quality parameters this year and decide whether we should continue with this for next year or not. Additional research in the coming years will be helpful to further support current claims regarding agricultural land use.

Sample Location Map


Yearly Average TDS (June) [Excl. sites 12 &18]
2020
2019
2018
2017
2021
2022
TDS (mg/L)
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
11
13
14
15
16
17
Sample Site


Yearly Average Nitrate w/ 2008
2008
2017
2018
2019
2020
2021
2022
Nitrate (mg/L)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
8
13
16
18
Sample Site


Yearly Average Nitrate (June) [Excl. sites 12 & 18]
2020
2019
2018
2017
2021
2022
Nitrate (mg/L)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1
2
3
4
5
6
7
8
9
10
11
13
14
15
16
17
Sample Site