Can Practices from USDA Organic Farming be Applied by Traditional Farms to Lessen Harmful Impacts on Riparian Ecosystems?

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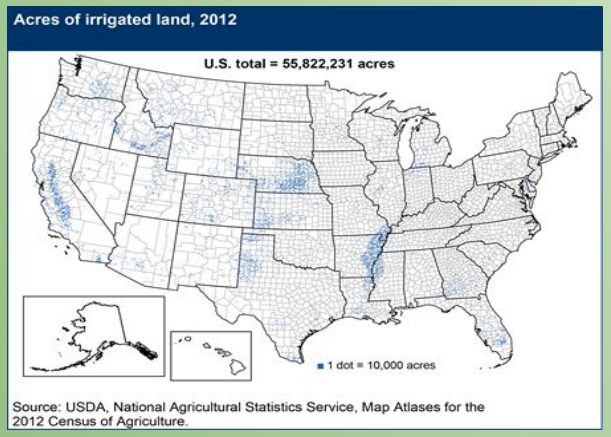
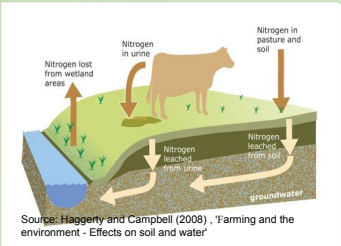
Background and Motivation

- Agriculture accounts for 80% of water usage in the United States. Industrial farms in river basins are the most efficient at producing large crop yields, but this comes with an increased risk of runoff and pollutant dispersal (USDA, 2019).
- Insects, fish, and plants that depend on riparian areas and streams to survive tend to be indicator species that respond very poorly to nutrient imbalances, changes in pH, or toxins. Loss of these species greatly reduces the stability of ecosystems.
- Industrial agriculture poses a tremendous threat toward the health and biodiversity of riparian ecosystems, due to heavy use of fertilizers and pesticides. Applying principles of sustainable agriculture to industrial practices may be a way to reduce these risks without significantly reducing short term crop yield (Rodale, 2021).
- **We intend to evaluate how different agricultural practices influence the health of the organisms living in riparian ecosystems.**



Hypothesis

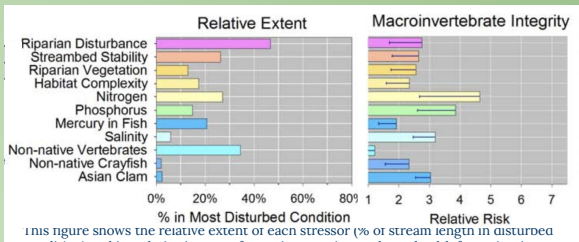
We hypothesize that there is a significant difference between the health of streams and riparian ecosystems near organic farms and traditional farms.



The figure to the left shows how nitrogen leaches into the soil and accumulates in runoff from agricultural sources. As land-use intensifies, nitrogen pollution can become a major threat to riparian ecosystem health.

Study Design

- This study will primarily consist of a series of observational studies followed by lab experiments. Expert interviews with farm owners and agricultural scientists will be conducted to gain additional insight into farming processes.
- We have identified the independent variable as the location that the runoff is derived from (organic farm, traditional farm, or control). The dependent variable is stream health (based on our calculated stream health index)
- **STEP 1:** We plan to survey each individual farm that will be studied in order to determine what compounds are being used that may be leaching into the soil.
- **STEP 2:** We will observe the impact of different types of farming on riparian ecosystems by collecting quantitative data on biodiversity, nitrogen/phosphorus levels, and pH from each location. This data will be used to determine overall indexed stream health at each location.
- **STEP 3:** We will systematically review our data (see Intended Analysis).



This figure shows the relative extent of each stressor (% of stream length in disturbed condition) and its relative impact of aquatic macroinvertebrate health from riparian ecosystems in the Western United States. Nitrogen and phosphorus levels (from fertilizers) pose a major risk to macroinvertebrates in riparian ecosystems (Stoddard et. al, 2005)

Intended Analysis

- We intend to use a T-test to see if there is a significant difference between the data from our farm plots and the control. If there is a significant difference, we will then do a secondary T-test to look for a correlation between our farm types and our indexed stream health.
- A statistically significant difference in the data would indicate that one method of farming is distinctly more damaging to local ecology than the other.

Greater Impact

Global requirements for food will continue to increase as populations expand, but this comes at the cost of pressure on environmental boundaries (Steffen et al.). Reducing biogeochemical flows and other farm based pollutants is vital to ensuring the integrity of social needs for food and clean water in coming generations. Methods to reduce environmental impact without severely reducing farm productivity are vital for ensuring the continued efficacy of farming. Our data could serve as a key tenant in legislation banning the use of certain pesticides or fertilizers that are especially damaging, thereby guiding future agricultural policy towards sustainability.

Literature Cited: Pisani, O., Bosch, D. D., Coffin, A. W., Endale, D. M., Liebert, D., & Strickland, T. C. (2020). Riparian land cover and hydrology influence stream dissolved organic matter composition in an agricultural watershed. *Science of The Total Environment*, *717*, 137-165. https://www.sciencedirect.com/science/article/pii/S0048969720306756?via%3Dihub. Snyder, N. J., Mostaghimi, S., Berry, D. F., Reneau, R. B., Hong, S., McClellan, P. W., & Smith, E. P. (1998). IMPACT OF RIPARIAN FOREST BUFFERS ON AGRICULTURAL NONPOINT SOURCE POLLUTION 1. *JAWRA Journal of the American Water Resources Association*, *34*(2), 385-395. https://doi.org/10.1111/j.1752-1688.1998.tb04143.x. Stoddard, J. L., et al. "An ecological assessment of western streams and rivers." *US Environmental Protection Agency: Washington, DC.) Available at http://www. epa. gov/nheerl/arm/documents/EMAP. W. Assessment. final. pdf [accessed 3 December 2010]* (2005).Rahma n, M., Thompson, J., Flower, R. (2016). An enhanced SWAT wetland module to quantify hydraulic interactions between riparian depressional wetlands, rivers and aquifers. *Environmental Modelling & Software, 84*, 263-289. https://doi.org/10.1016/j.envsoft.2016.07.003 Zobrist, K., Gehringer, K. & Lippke, B. (2004). Templates for Sustainable Riparian Management on Family Forest Ownerships. *Journal of Forestry, 102*(7), 19-25 https://search.proquest.com/docview/220793585/fulltext/39D4D77647264EE9PQ/1?accountid=14679 Steffen, W. et al (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, *347*(6223), 1259855. https://doi.org/10/1126/scinece.1259855