RIPE
Rural Investment to Protect our Environment

Methodology and Sources for Nutrient Management

Ecosystem Service	$/Acre/Year	Citation
GHG Mitigation (at $51/tonne CO2e)	$11	The Duke University report "Greenhouse Gas Mitigation Potential of Agricultural Land Management in the United States: A Synthesis of the Literature" (Eagle et al., 2012) estimates that improved land manure application can reduce N2O emissions by an average of 0.32 tonnes per acre. *Farming for Our Future* (Rosenberg & Lehner, 2021) reports that improved synthetic fertilizer management can reduce GHG emissions by 0.11 tonnes per acre. The average of these estimates yields a value of 0.22 tonnes per acre. At $51 per tonne CO2e, this average benefit is valued at $11 per acre.
Air Quality Benefits (Human Health)	$554	A number of studies demonstrate that closed-slot manure injection typically reduced ammonia emission by up to over 90% (e.g., Thompson et. al. 1987, Weslien et al. 1998, Hansen et al. 2003, Webb et al. 2010, Pote et al. 2011, Dell et al. 2012, Carozzi et al. 2013, and Kulesza et al. 2014). Annually, incorporation and injection can reduce ammonia emissions by 6 to 13 kg NH3 per acre (Powell, et al., "Dairy slurry application method impacts ammonia emission and nitrate in no-till corn silage," *USDA-ARS*, 2011). The public cost of ammonia is $54,900 per ton NH3 in 2022 dollars (Heo, et al. "Public Health Costs of Primary PM2.5 and Inorganic PM2.5 Precursor Emissions in the United States," *Environ. Sci. Technol.*, 2016).

Water Quality Benefits	$46	A long-term study conducted by Iowa State University researchers found that reduced poultry manure application rates reduced nitrate loss to water sources by nearly 10 kg per ha per year, or 4.02 kg per acre per year (Nguyen et al., "Long-Term Effects of Poultry Manure Application on Nitrate Leaching in Tile Drain Water," *American Society of Agricultural and Biological Engineers*, 2013). Incorporation and injection are found to reduce N loading by an average of 10% in the Chesapeake Bay (Chesapeake Bay Program, "Manure Incorporation and Injection Practices For Use in Phase 6.0 of the Chesapeake Bay Program Watershed Model," 2016). Manure land application on average loses 486 kg of nitrate per ha per year, or 197 kg per acre per year, to water sources (UC Davis, "Nitrogen Sources and Loading Groundwater," 2012). At 10% reduction would equate to 19.7 kg per acre per year in reduced nitrate pollution. The average of 4.02 kg nitrate per acre and 19.7 kg nitrate per acre is 11.86 kg per acre. In "The Social Costs of Nitrogen," Keeler et al. (2016) found the social cost of nitrogen pollution in water to be on average $0.01 per kg nitrate, based on water treatment costs.* In "Final Report - Low Cost Retrofits for Nitrogen Removal at Wastewater Treatment Plants in the Upper Long Island Sound Watershed" (2015) the Long Island Sound Study found that nitrate removal costs an average of $7.71 per kg of nitrate in 2022 dollars, amortized over ten years. Similarly, the EPA cited a cost of $8.82 per pound of nitrate removal in stormwater runoff (EPA, "A Compilation of Cost Data Associated with the Impacts and Control of Nutrient Pollution," 2015). The average of $7.71 per kg of nitrate and $0.01 per kg of nitrate is $3.86 per kg. 23.72 kg of nitrate per acre multiplied by $3.86 per kg of nitrate equals a total value of $45.77 per acre. *This is a low-end estimate and excludes potential health, recreational, or aesthetic values. More comprehensive estimates of

		the public cost of Nitrate in water sources would yield a higher water quality value for nutrient management.
Total	**$611**	