

Methodology and Sources for Nutrient Management

Ecosystem Service	\$/Acre/Year	Citation
GHG Mitigation (at \$51/tonne CO ₂ e)	\$11	<p>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.</p> <p><i>Farming for Our Future</i> (Rosenberg & Lehner, 2021) reports that improved synthetic fertilizer management can reduce GHG emissions by 0.11 tonnes per acre.</p> <p>The average of these estimates yields a value of 0.22 tonnes per acre.</p> <p>At \$51 per tonne CO₂e, this average benefit is valued at \$11 per acre.</p>
Air Quality Benefits (Human Health)	\$554	<p>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,” <i>USDA-ARS</i>, 2011). The public cost of ammonia is \$54,900 per ton NH₃ in 2022 dollars (Heo, et al. “Public Health Costs of Primary PM_{2.5} and Inorganic PM_{2.5} Precursor Emissions in the United States,” <i>Environ. Sci. Technol.</i>, 2016).</p>

Water Quality Benefits	<\$1	<p>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,” <i>American Society of Agricultural and Biological Engineers</i>, 2013).</p> <p>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).</p> <p>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).</p> <p>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.*</p> <p>*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.</p>
Total	\$565	