RIPE
Rural Investment to Protect our Environment

Methodology and Sources for Conservation Crop Rotation

Ecosystem Service	$/Acre/Year	Citation
GHG Mitigation (at $51/tonne CO2e)	$12	The USDA COMET-Planner tool demonstrates that conservation crop rotation reduces GHG emissions by a national average of 0.23 tonnes CO2e per acre. At a value of $51 per tonne CO2e, the public benefit is $12 per acre.
Reduced Soil Erosion (water quality benefits)	$9	The average sheet and rill erosion rate on cropland in the United States equals 2.67 tons of soil per acre (USDA, Cropland Soil Erosion, 2017). According to "Cropping System Diversity Effects on Nutrient Discharge, Soil Erosion, and Agronomic Performance," (Hunt et al., *Environ. Sci. Technol.*, 2019), longer crop rotations reduce soil erosion by an average of 50%. Applying this 50% reduction to the average national erosion rate equals 1.33 tons of soil saved per acre. The water quality value of reduced sheet and rill soil erosion is $7 per ton of soil in 2022 dollars (Final Benefit-Cost Analysis for the Environmental Quality Incentives Program (EQIP), NRCS, 2010). 1.33 tons of soil per acre multiplied by $7 per ton equals $9 per acre.
Biodiversity	$5	Conservation crop rotation reduces required herbicide application by an average of 0.54 kg per acre (Hunt et al., "Reducing Freshwater Toxicity while Maintaining Weed Control, Profits, And Productivity: Effects of Increased Crop Rotation Diversity and Reduced Herbicide Usage," *Environ. Sci. Technol.*, 2017). Reducing herbicide or pesticide use provides biodiversity benefits valued at $10 per kg of herbicide in 2022 dollars (D. Pimentel. "Environmental and Economic Costs of the Application of Pesticides Primarily in the United States," *Environment, Development, and Sustainability*, 2005). 0.54 kg of herbicide per acre multiplied by $10 per kg equals $5.40 per acre.

Air Quality/Public Health	$185	This estimate averages a high-end and a low-end value of reduced ammonia emissions: High-end: Conservation crop rotation reduces fertilizer usage by 50% (Hunt, et al. "Fossil Energy Use, Climate Change Impacts, and Air Quality-Related Human Health Damages of Conventional and Diversified Cropping Systems in Iowa, USA," *Environ. Sci. Technol.*, 2020). The baseline nitrogen application averages of 84.5 pounds of nitrogen per acre for continuous corn, cotton, soy, or wheat (USDA NASS Agricultural Chemical Use Program, 2021). Converting nitrogen to emitted ammonia yields an average of 50 pounds NH3 reduced per acre (Goebbes et al., 2003; Mikkelsen, 2009; Dari et al., 2019; Jones et al., 2020). A 50% reduction equals 8.5 pounds of ammonia per acre. The human health cost of ammonia is $27 per pound (Heo, et al. "Public Health Costs of Primary PM2.5 and Inorganic PM2.5 Precursor Emissions in the United States," *Environ. Sci. Technol.*, 2016). 8.5 pounds of ammonia per acre multiplied by $27 per pound equals $229.50 per acre. Low-end: In "Fossil Energy Use, Climate Change Impacts, and Air Quality-Related Human Health Damages of Conventional and Diversified Cropping Systems in Iowa, USA," Hunt, et al. (2020) find that diversified crop rotations provide an average value of $140 per acre in air quality benefits due to reduced nitrogen fertilizer use.

Soil Quality	$3	The average sheet and rill erosion rate on cropland in the United States equals 2.67 tons of soil per acre (USDA, Cropland Soil Erosion, 2017). According to "Cropping System Diversity Effects on Nutrient Discharge, Soil Erosion, and Agronomic Performance," (Hunt et al., *Environ. Sci. Technol.*, 2019), longer crop rotations reduce soil erosion by an average of 50%. Applying this 50% reduction to the average national erosion rate equals 1.33 tons per acre. Reduced erosion provides $2 per ton of soil in soil quality benefits ("Final Benefit-Cost Analysis for the Environmental Quality Incentives Program (EQIP)," NRCS, 2010).
Total	$214	