THE COSTS OF CAFOS

IMPACTS ON YOUR WALLET AND YOUR HEALTH

Iowa
Environmental
Council

Published November 2023

INTRODUCTION

Farms with livestock operations have dotted Iowa's landscape for more than a century, but the number of livestock reared in Iowa has exploded in the last 30 years. Most of the growth has been in the form of large concentrated animal feeding operations, (CAFOs), especially large hog and hen confinements. Large is defined as an operation with 1,000 or more animal units. In 1990, Iowa had 789 large CAFOs.[1] By 2023, Iowa had 4,000 large CAFOs.[2] The total number of animal feeding operations in the state is far bigger, including more than 2,500 facilities that operate just below the "large CAFO" threshold to avoid increased regulatory scrutiny, as well as thousands of smaller operations.[3]

The growth in CAFOs has exponentially increased the animal manure, urine, and wastewater in the state, which is contributing to Iowa's water pollution issues. Iowa's Nutrient Reduction Strategy calculated that 92 percent of nitrogen and 80 percent of phosphorus in surface water comes from nonpoint sources – primarily agriculture.[4] The amount of livestock manure Iowa now generates is equal to the waste produced by 168 million people, or half the entire U.S. population.[5] Most of this manure is not treated before being applied to cropland as fertilizer, which then can run off fields in stormwater, infiltrate soil and pollute groundwater, or reach surface waters via tile drainage. The volume of manure often leads to manure application at rates exceeding crop needs (especially with continued application of commercial fertilizer).[6] This excess manure application leads to nitrate and phosphorus pollution.

Excess nitrate in sensitive areas increases the risk that nitrate enters groundwater or drinking water sources. Nitrate in drinking water poses such serious human health threats that the Safe Drinking Water Act requires nitrate concentrations in public water supplies to stay below 10 mg/L.[7] Nitrate in drinking water can cause blue-baby syndrome, birth defects, bladder cancer, thyroid cancer, and other cancers.[8] However, research is increasingly showing that concentrations below the Safe Drinking Water Act standard of 10 mg/L may cause a range of health problems, including cancer.[9]

Manure runoff from CAFOs into local water sources can also promote the growth of harmful algal blooms, leading to illness in both animals and humans such as liver damage, neurological damage, gastrointestinal problems, and various flu-like reactions.[10] Manure can also contaminate surface water and groundwater with fecal bacteria that can cause gastrointestinal and respiratory illness.[11]

1 Jamie Konopacky and Soren Rundquist, "EWG Study and Mapping Show Large CAFOs in Iowa Up Fivefold Since 1990," Environmental Working Group, Jan 21, 2020.
2 *Id.*; IEC analysis of DNR AFO database, available at https://programs.iowadnr.gov/animalfeedingoperations/.
3 IEC analysis of DNR AFO database, available at https://programs.iowadnr.gov/animalfeedingoperations/.
4 "Iowa Nutrient Reduction Strategy – A science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico." Updated December 2017. Section 1.2 at 8.
5 Chris Jones, "50 Shades of Brown," June 6, 2019, available at https://www2.iihr.uiowa.edu/cjones/50-shades-of-brown/.
6 Chris Jones, "Make America MRTN Again," June 21, 2019, available at https://www2.iihr.uiowa.edu/cjones/make-america-mrtn-again (showing that manure produced in some Iowa counties meets or exceeds crop needs for phosphorus and nitrogen, despite continued sales of commercial fertilizer).
7 40 C.F.R. § 141.62.
8 "Nitrate in Drinking Water: A Public Health Concern For All Iowans," Iowa Environmental Council (Sept. 2016), available at https://www.iaenvironment.org/webres/File/Nitrate_in_Drinking_Water_Report_ES_Web.pdf (citing Brender, Jean D; Weyer, Peter J; Romitti, Paul A; et al. 2013. Prenatal Nitrate Intake from Drinking Water and Selected Birth Defects in Offspring of Participants in the National Birth Defects Prevention Study. *Environmental Health Perspectives*, Vol. 121(9):1083-1089. http://ehp.niehs.nih.gov/1206249/).
9 *Id.*
10 *Id.*
11 "Recreational Water Quality Criteria," U.S. EPA (2012), at 12, available at https://www.epa.gov/sites/default/files/2015-10/documents/rwqc2012.pdf.

Iowans pay significant costs for polluted water caused by livestock operations. Removing nitrates through water treatment, rather than preventing them from entering waters at the source of pollution, is costly and often out-of-reach for public water systems and private well owners.[12] The increased costs of poor water quality have disproportionate impacts on low-income Iowans, such as increased drinking water costs and healthcare costs. This is especially troubling for individuals and communities that already suffer from poor air quality, pesticide contamination, and other environmental degradation.

If the current amount of nitrogen pollution from farm fields and CAFOs continues, Iowans will be responsible for paying up to $333 million over the next five years to remove nitrates from drinking water.[13] Rural Iowans can pay as much as $1,200 per person per year for nitrate treatment of drinking water.[14] Cities large and small struggle to cope with the cost of nitrate removal as well, facing high treatment costs for removal. High concentrations of nitrate have forced communities like Pierson, Iowa, to issue a bottled water advisory.[15] Harmful algal blooms driven by fertilizer and manure pollution produce toxins and have forced Des Moines Water Works to explore spending $30 million to drill new wells in order to provide safe drinking water to nearly 600,000 people.[16]

On January 10, 2023, Governor Kim Reynolds signed Executive Order 10. The Order required each state agency to "perform a retrospective analysis" of its rules, as well as rescind and re-adopt any rules the agency wants to adopt. The Order also requires a "rigorous cost-benefit analysis of existing administrative rules." In conducting the cost-benefit analysis of all proposed rules, the Iowa Department of Natural Resources (DNR) must ensure that it accounts not only for the direct cost of implementing rules, but for the environmental, public health, and economic costs associated with not implementing the rule as well as the benefits provided by the rules.

In evaluating the benefits and costs of rules, agencies are to use a "red tape review rule report"[17] template created by the Governor's office. The template requires agencies to describe the benefits of the rule, whether the benefits are being achieved, the costs to the public, the costs to the agency implementing the rule, and whether the costs justify the benefits.

CAFO and fertilizer pollution that leads to poor water quality externalizes costs and negative impacts of agricultural production, imposing a burden on other Iowans and Iowa's downstream neighbors in the Mississippi River Basin. This burden includes a range of costs to the public in terms of health effects, economic impacts, and degradation of ecosystem services. As the state reviews CAFO rules and regulations, the benefits of pollution reduction and costs of not implementing and enforcing strong, effective rules must be considered as part of the cost-benefit analysis.

12 "Rural Iowans Bear Brunt of Water Treatment Costs for Nitrate Pollution from Farms and CAFOs." Union of Concerned Scientists, 14 Jan. 2021, www.ucsusa.org/about/news/rural-iowans-bear-brunt-water-treatment-costs-nitrate-pollution-farms-and-cafos.
13 *Id.*
14 *Id.*
15 "Pierson Iowa Officials Issue Bottled Water Advisory," KTIV (Sept. 13, 2022), available at https://www.ktiv.com/2022/09/13/pierson-iowa-officials-issue-bottled-water-advisory/.
16 Kate Payne, "Des Moines Water Works Advances Plans To Build New Wells In Light Of River Pollutants," Iowa Public Radio (Apr. 22, 2021), available at https://www.iowapublicradio.org/ipr-news/2021-04-22/des-moines-water-works-advances-plans-to-build-new-wells-in-light-of-river-pollutant
17 "Red Tape Review Rule Report Template," Iowa Department of Management, available at https://dom.iowa.gov/resource/red-tape-review-forms-templates/red-tape-review-rule-report-template (last visited June 14, 2023).

HEALTH COSTS OF POOR WATER QUALITY

Poor water quality, particularly nitrate pollution, increases the incidence of cancer, birth defects, and other health problems. These problems are not just theoretical; long-term medical research has revealed these effects specifically in Iowans. In particular, nitrate in drinking water can cause blue-baby syndrome, birth defects, bladder cancer, thyroid cancer, and other cancers.[18] Even concentrations below the Safe Drinking Water Act standard of 10 mg/L may cause a range of health problems, including cancer.[19] Individual and public expenses come with health impacts, including healthcare costs and loss of productivity due to illness.

A 2019 analysis published in *Environmental Research* assessed the potential health impacts of nitrate exposure at a large scale, calculating the disease cases attributable to elevated nitrate in drinking water.[20] The analysis concluded that each year, "2,939 cases of very low birth weight, 1,725 cases of very preterm birth, and 41 cases of neural tube defects could be related to nitrate exposure from drinking water." In addition, the estimate of nitrate-attributable cancer cases per year ranged from 2,300 to 12,594. This risk is not evenly distributed across the country. As applied to Iowa, the estimated annual cancer cases attributed to nitrate range from 2.3 to 10.43 per 100,000 people, or as many as 313 cases statewide each year.[21] For comparison, Iowa's estimated minimum nitrate-attributable cancer rate (2.3 per 100,000) is greater than the estimated maximums of its neighbors to the north and south (2.1 and 1.99 per 100,000 for Minnesota and Missouri, respectively), and Iowa's estimated maximum is nearly 100 times greater than the state with the lowest estimated maximum (0.11 in Mississippi).[22]

These health outcomes lead to significant medical costs. The Environmental Research article estimated medical costs due to nitrate-attributable cancer cases nationwide between $250 million and $1.5 billion annually.[23] While Iowa's share of the nation's population is less than one percent, Iowa's share of cancer cases was about 2.5 percent of the national total;[24] if medical costs are applied proportionally, Iowa's medical costs attributable to nitrate in drinking water range from $6.25 million to $37.5 million per year.

Indirect losses related to the health effects are even larger, accounting for IQ point losses from preterm births, economic losses from disability, and life-years lost due to premature death.[25]These estimates total $1.4 to $6.7 billion annually nationwide.[26] Iowa's proportional share would be $35 million to $167.5 million per year.

These estimates of healthcare costs are likely low as applied to Iowa. The study used only public water supply data and assumed that private well data would be similar to the public water supplies. Public water supplies must meet the Safe Drinking Water Act (SDWA) standard of 10 mg/L nitrate.[27] Private wells are unregulated under the SDWA, with monitoring and treatment left to the well-owner. Nearly 8 percent of Iowans rely on private wells for drinking water.[28] Monitoring data from Iowa's private wells reveals that, in fact, private wells have significantly higher nitrate concentrations: 12 percent of tested wells from 2002-2017 had average nitrate concentrations that exceed the SDWA standard.[29] The cost estimate above "presents a conservative scenario with respect to private well users' exposure to nitrate."[30]

Health-related costs represent Iowans' expenses for currently promulgated rules. Reducing agricultural pollution by strengthening rules would provide cost savings to Iowans. Relaxing rules would result in increased health costs.

18 "Nitrate in Drinking Water: A Public Health Concern For All Iowans," Iowa Environmental Council (Sept. 2016), available at https://www.iaenvironment.org/webres/File/Nitrate_in_Drinking_Water_Report_ES_Web.pdf (citing Brender, Jean D; Weyer, Peter J; Romitti, Paul A; et al. 2013. Prenatal Nitrate Intake from Drinking Water and Selected Birth Defects in Offspring of Participants in the National Birth Defects Prevention Study. *Environmental Health Perspectives*, Vol. 121(9):1083-1089. http://ehp.niehs.nih.gov/1206249/).
19 *Id.*
20 Temkin, A., Evans, S., Manidis, T., Campbell, C., & Naidenko, O. V. (2019). Exposure-based assessment and economic valuation of adverse birth outcomes and cancer risk due to nitrate in United States drinking water. *Environmental Research,* 176, 108442.
21 See "Interactive Map: Nitrate Attributable Cancer Cases for each state," EWG (2019), available at https://www.ewg.org/interactive-maps/2019_nitrate/map/ (last visited June 8, 2023).
22 *Id.*
23 Temkin (2019).
24 See "Estimated Nitrate Attributable Cancer Cases for each State," Environmental Working Group, available at https://www.ewg.org/interactive-maps/2019_nitrate/map/ (last visited June 13, 2023).
25 Temkin (2019) at 8.
26 *Id.*
27 40 C.F.R. § 141.62.
28 Iowa DNR. "State of Iowa Public Drinking Water Program: 2022 Annual Compliance Report." June 2023. https://www.iowadnr.gov/Portals/idnr/uploads/water/wse/Iowa%20ACR%20Full%20Report.pdf.
29 See "Iowa's Private Wells Overrun With Agricultural Contaminants," Iowa Environmental Council (Apr. 24, 2019), available at https://www.iaenvironment.org/newsroom/water-and-land-news/iowas-private-wells-overrun-with-agricultural-contaminants (last visited June 8, 2023).
30 Temkin (2019). The cost estimates are in 2014 dollars, and with inflation would be approximately 27 percent higher in 2023 dollars. See https://www.bls.gov/data/inflation_calculator.htm.

DIRECT ECONOMIC IMPACTS OF WATER QUALITY TREATMENT

Beyond health effects, poor water quality forces water utilities to increase treatment. Iowa DNR has identified 260 communities that face increasing nitrate in their drinking water supplies.[31] The potential costs of water treatment if agricultural sources do not reduce their contributions will be disproportionately felt by smaller and low-income communities. These communities have a few options: dig deeper wells to access a cleaner aquifer, connect to a surface water supply, connect to a regional drinking water provider, or treat the groundwater before distribution.[32] Almost 50 Iowa communities have already been forced to take such actions to address nitrate contamination in drinking water supplies.[33]

The 2019 *Environmental Research* paper referenced previously also assessed potential drinking water treatment costs. Nationwide, the treatment costs for communities with elevated nitrate range from $102 million to $765 million for ion exchange systems, or as high as $1.47 billion for reverse osmosis systems.[34] On a per capita basis, ion exchange treatment for very small systems would amount to $666 per person per year.[35]

Des Moines Water Works has an ionization treatment system that can cost $10,000 per day to operate.[36] It serves to reduce nitrate concentrations to the maximum contaminant level of 10 mg/L, rather than eliminating nitrate altogether; thus, these costs do not fully avoid all costs associated health effects described in the previous section. From 2012 - 2022, the nitrate removal facility ran for 405 days, totaling nearly $5 million that was passed on to customers.[37] Des Moines Water Works has also begun a multi-year, $30 million project to drill new wells to acquire cleaner source water.[38] The utility estimates it will need to raise water rates by 9-10% each year for five years to cover the cost.[39] The new wells are also to ensure compliance with drinking water standards, rather than to completely eliminate pollution.

The City of Cedar Rapids entered a five-year capital improvement plan in 2020 with estimated water utility improvement expenses of $83.9 million.[40] Concurrently, the city launched the Cedar River Source Water Partnership (CRSWP)[41] to prevent nutrients from contaminating the Cedar River, the city's drinking water source.[42] With thirteen partners and funding from the USDA Natural Resources Conservation Service, the CRSWP will invest $16 million in agricultural conservation practices upstream of the city's wells.[43]

31 Donnelle Eller, "High nitrate levels plague 60 Iowa cities, data show," Des Moines Register (July 4, 2015), available at https://www.desmoinesregister.com/story/money/agriculture/2015/07/04/high-nitrates-iowa-cities/29720695/.
32 Tang, C., Lade, G. E., Keiser, D., Kling, C. L., Ji, Y., & Shr, Y. H. (2018). Economic Benefits of Nitrogen Reductions in Iowa. Center for Agricultural and Rural Development, Iowa State University.
33 *Id.* at 11.
34 Temkin (2019) at 12.
35 *Id.*
36 Des Moines Water Works, "NEWS RELEASE: Des Moines Water Works begins operation of Nitrate Removal Facility because of nutrient spikes in raw source water," (June 9, 2022), available at https://www.dmww.com/news_detail_T37_R328.php.
37 Jason Clayworth, "Des Moines' $50M water nitrate fix-it plan," Axios Des Moines (Jan. 25, 2023), available at https://www.axios.com/local/des-moines/2023/01/25/desmoines-water-nitrate-wells-pollution.
38 Kate Payne, "Des Moines Water Works Advances Plans To Build New Wells In Light Of River Pollutants," Iowa Public Radio (Apr. 22, 2021), available at https://www.iowapublicradio.org/ipr-news/2021-04-22/des-moines-water-works-advances-plans-to-build-new-wells-in-light-of-river-pollutants.
39 Amy Kahler & Michael J. McCurnin, "MEMORANDUM: 2024-2028 Five-Year Capital Improvement Plan," Des Moines Water Works (Jun. 6, 2023), available at https://cms9files.revize.com/desmoineswater/2024-2028%20Five-Year%20CIP%20Memo.pdf
40 "Modernizing Cedar Rapids water plant one of many high-cost needs," The Gazette (Mar. 28, 2019), available at https://www.thegazette.com/government-politics/modernizing-cedar-rapids-water-plant-one-of-many-high-cost-needs/.
41 "City of Cedar Rapids Earns $7 Million Funding Agreement for Watershed Work," City of Cedar Rapids (Apr. 28, 2021), available at https://www.cedar-rapids.org/news_detail_T6_R1563.php.
42 City of Cedar Rapids, "Our Watershed," available at https://www.cedar-rapids.org/residents/utilities/our_watershed.php (last visited Sept. 11, 2023).
43 *Id.*

DNR estimated the costs for wastewater treatment of nutrients in source water, including nitrogen and phosphorus, in early 2019.[44] The projections were untenable. DNR concluded that wastewater treatment by 19 facilities serving 9,515 people would cost $205 million.[45] The average treatment costs in DNR's estimate equal $21,544 per person, or $10.7 million per facility.

Point of use treatment in individual households can cost even more per capita.[46] A 2012 study found the costs listed in Table 1, as subsequently summarized by Iowa State University analysts, for individual households and small public water supplies.[47] Adjusting those costs for inflation would increase the costs by approximately 40 percent.[48]

Table 1. Cost ranges for treatment of nitrate in drinking water.

Estimated Annual Cost Range (Adapted from Vivian B. Jensen et al. 2012)		
	Single Household	**Small Public Water Supply (1,000 Households)**
Water Blending	N/A	$200,000 - $365,000
Well Reconstruction	$860 - $ 3,300	$80,000 - $100,000
Drill New Well	$2,100 - $3,300	$40,000 - $290,000
Install POU, Reverse Osmosis Unit	$250 - $360	$223,000
Pipeline Connection to Existing System	$52,400 - $185,500	$59,700 - $192,800
Trucked Water	$950	$2,850
Bottled Water	$1,339	$1.34 M
Note: All costs are discounted over a 20 year period at a 5% discount rate, except for the POU estimate and trucked and bottled water costs.		

Applying these costs to Iowans facing high nitrate concentrations reveals the economic impact of treating water. Iowa has 96,497 active private wells[49] and 12 percent of the 55,000 tested between 2002 and 2017 exceeded the drinking water standard for nitrate.[50] Installing point-of-use treatment at those wells, the lowest-cost upfront option, totals more than $4 million after accounting for inflation. Treatment of wells at 5 mg/L or higher would raise the total cost to $7.4 million. This total does not account for the ongoing operation and maintenance costs or the trend of rising nitrate concentrations in groundwater that will increase the number of wells requiring treatment.

Farmers stand to benefit as well. Agricultural producers would save money by reducing manure and fertilizer application to protect source water quality. The science assessment in the state's Nutrient Reduction Strategy found that applying fertilizer at the maximum return to nitrogen (MRTN) would result in annual savings of $32 million/year while achieving a significant reduction in nitrate pollution.[51] Manure provides a significant fraction of crop needs, with some counties having all crop needs met by manure alone.[52]

44 Iowa Department of Natural Resources, "Fiscal Analysis of Impacted Facilities Spreadsheet" (Attachment 2 of Environmental Protection Commission Denial of Petition for Rulemaking), Feb. 12, 2019, available at https://www.iowadnr.gov/Portals/idnr/uploads/epc/20190219epc.pdf?ver=QoO-SQ2XwBs_ezPGHchk6w%3d%3d#page=78.
45 *Id.*
46 Tang (2018) at 13.
47 *Id.* (citing Jensen, Vivian B., Jeannie L. Darby, Chad Seidel, and Craig Gorman. 2012. "Drinking Water Treatment for Nitrate. Technical Report 6 in: Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater." Report for the State Water Resources Control Board Report to the Legislature. University of California, Davis: Center for Watershed Sciences).
48 See "CPI Inflation Calculator," U.S. Bureau of Labor Statistics, available at https://www.bls.gov/data/inflation_calculator.htm (last visited June 8, 2023). The Jensen paper used 2010 dollars in its calculations. See Jensen (2012) at 28.
49 "Private Well Services," Iowa Department of Public Health, available at https://tracking.idph.iowa.gov/Environment/Private-Well-Water/Private-Well-Services (last visited June 10, 2023).
50 See "Iowa's Private Wells Overrun With Agricultural Contaminants," Iowa Environmental Council (Apr. 24, 2019), available at https://www.iaenvironment.org/newsroom/water-and-land-news/iowas-private-wells-overrun-with-agricultural-contaminants (last visited June 14, 2023).
51 NRS, supra note 2, §2.2 at 27.
52 "Too Much Manure? Can Iowa use all its manure for fertilizer?" Iowa State University Extension, Publication AE 3608 (Apr. 2017). Available at https://store.extension.iastate.edu/product/15121.

RECREATIONAL AND TOURISM VALUE OF WATER

Poor water quality also affects Iowa's recreation and tourism industries. Iowa State University and DNR have conducted a Lake Valuation Project using surveys of Iowa residents.[53] In the most recent survey (2019), more than ten percent of respondents stated they took an overnight trip to a lake out of state.[54] Iowans spent more than $1 billion in 2019 on single-day trips to Iowa lakes.[55]

Iowans took 21 percent as many overnight trips to lakes in other states as overnight trips to in-state lakes.[56] Overnight trips lead to three times more spending than same-day trips, but by going out of state Iowa loses the economic value of that spending.[57] Having more Iowans stay in state and attracting more out-of-state residents to visit Iowa would increase the economic impact of recreational visits.

The 2019 study concluded that "Iowa households continue choosing water quality as their most important factor when choosing a lake destination."[58] Just for recreational benefits at lakes, Iowans would be willing to pay an additional $30 million per year for cleaner water.[59]

Water quality directly affects the ability of trout to survive and reproduce, thereby affecting trout fishing. Trout fishing is a major source of recreational spending in Iowa and the Driftless region, which extends across northeast Iowa, southeast Minnesota, southwest Wisconsin, and northwest Illinois. A 2016 study analyzing all economic impact of angling in the Driftless area found the economic impact to be more than $700 million.[60] These trout fishing trips have substantially higher economic impact than the average lake recreational visit, with typical spending of $475 per trip.[61] Many of the visits are by people from out-of-state, resulting in substantial economic input to the states in the Driftless area.[62] These visits are part of the $6.1 billion dollars that visitors spend on tourism in Iowa each year.[63]

53 Wan, X., Ji, Y., & Zhang, W. (2021). A Report to the Iowa Department of Natural Resources-The Iowa Lakes Valuation Project 2019: Summary and Findings (No. 21-sr115). Center for Agricultural and Rural Development (CARD) at Iowa State University.
54 *Id.* at 41.
55 *Id.* at 102.
56 *Id.* at 41.
57 *Id.* at 8.
58 *Id.* at 134.
59 Tang (2018) at 21.
60 Donna Anderson, "Economic Impact of Recreational Trout Angling in the Driftless Area," Nov. 2016, at 11.
61 *Id.* at 9.
62 *Id.* at 10.
63 "Economic Impact of Visitors in Iowa 2021," Tourism Economics (prepared for Iowa Economic Development Authority), Nov. 2022, available at https://industrypartners.traveliowa.com/UserDocs/research/2021_iowa_tourism_economic_impact.pdf.

ECOSYSTEM SERVICES PROVIDED BY REDUCED POLLUTION

Water provides a range of functions and benefits that are less easily quantified. "Ecosystem services" are the many and varied life-sustaining benefits provided by nature and natural processes.[64] Beyond the directly quantifiable health costs and economic impacts of water quality for drinking and recreation, indirect services such as support of wildlife, biodiversity, and climate resilience can provide additional benefits.

Appropriate fertilizer application rates and methods will reduce the externalized losses, providing additional ecosystem benefits. These benefits are distinct from human health and recreational benefits, such as climate benefits from reduced volatilization (or vaporization) of nitrate fertilizer, reduced energy inputs, and increased soil organic matter. Properly applying manure use efficiency will also create improved conditions for aquatic and terrestrial life in Iowa and downstream.

Agriculture is the largest source of greenhouse gas emissions in Iowa.[65] Manure management accounts for 23 percent of the agricultural greenhouse gas emissions.[66] Fertilizer practices affect greenhouse gas emissions related to soils, which are another significant source.[67] The method of fertilizer application affects the direct emissions of nitrous oxide (N_2O), which has a significantly higher global warming potential than carbon dioxide.[68]

Aquatic and terrestrial life in Iowa would also benefit from reduced nitrate losses. Minnesota recently concluded that water above 5 mg/L nitrate presents risk to sensitive aquatic life, and 8 mg/L presents risk to aquatic life more broadly.[69] Many Iowa waterways regularly exceed those concentrations. Hundreds of Iowa waters have suffered from fish kills over the last 40 years.[70] Iowa has a limited number of Outstanding Iowa Waters and trout streams; high pollution concentrations have affected the quality of waters across the state.

64 See, e.g., Keeler, B. L., Polasky, S., Brauman, K. A., Johnson, K. A., Finlay, J. C., O'Neill, A., ... & Dalzell, B. (2012). Linking water quality and well-being for improved assessment and valuation of ecosystem services. Proceedings of the National Academy of Sciences, 109(45), 18619-18624.
65 "2021 Iowa Statewide Greenhouse Gas Emissions Inventory Report," Iowa DNR (Dec. 27, 2022), at 7, available at https://www.iowadnr.gov/Portals/idnr/uploads/air/ghgemissions/2021%20GHG%20REPORT.pdf.
66 *Id.* at 8.
67 *Id.*; "2021 Iowa Statewide Greenhouse Gas Emissions Inventory Report Technical Support Document," Iowa DNR (Dec. 27, 2022), at 9, available at https://www.iowadnr.gov/Portals/idnr/uploads/air/ghgemissions/202%20GHG%20TSD.pdf.
68 "2021 Iowa Statewide Greenhouse Gas Emissions Inventory Report Technical Support Document," Iowa DNR (Dec. 27, 2022), at 7, 9, available at https://www.iowadnr.gov/Portals/idnr/uploads/air/ghgemissions/202%20GHG%20TSD.pdf.
69 Philip Monson, "Aquatic Life Water Quality Standards Draft Technical Support Document for Nitrate," Minnesota Pollution Control Agency (Oct. 2022), available at https://www.pca.state.mn.us/sites/default/files/wq-s6-13.pdf.
70 Monica Cordero, "Animal waste and agrochemicals are leading cause of fish kills in Iowa waterways," Investigate Midwest (June 1, 2023) available at https://investigatemidwest.org/2023/06/01/animal-waste-and-agrochemicals-are-leading-cause-of-fish-kills-in-iowa-waterways/.

CONCLUSION

In total, the externalized pollution costs for health care, water treatment, recreational impacts, and ecosystem services in Iowa are significant. Strong rules and enforcement of CAFO manure storage and manure application could significantly reduce nitrate entering Iowa's surface water and drinking water, thereby reducing or avoiding those costs. Table 2 summarizes the potential costs of manure pollution for each category, much of which could be avoided by adequate regulation.

Table 2. Estimates of Annual Costs of Nitrate Pollution in Iowa.

Category	Lower estimate	Upper estimate
Medical expenses	$6,250,000	$27,500,000
Indirect medical costs	$35,000,000	$167,500,000
Public water supply treatment costs[71]	>$52,200,000	>$91,700,000
Private well treatment costs	$4,000,000	$7,400,000
Recreational impacts	>$30,000,000	>$30,000,000
Ecosystem services	Unknown	Unknown
Total	**$127,450,000**	**$324,100,000**

CAFO regulations currently being considered, and those created in the future, must be designed to prevent water pollution,[72] thereby reducing or avoiding many of the public costs above. For example, the Nutrient Reduction Strategy found that applying nitrogen at the maximum return to nitrogen (MRTN) rate would result in a 9 percent reduction in nitrate in surface water. Since the NRS was adopted, nitrogen application rates have resulted in an 11 percent increase in nitrate, which has more than offset conservation practices.[73] By setting a standard manure application rate such as MRTN and preventing leakage from manure storage structures, the CAFO rules have the potential to reverse this trend and achieve an estimated 20 percent reduction in nitrate loading in surface water.

Reducing over-application of nitrogen has an outsized effect on water quality because a higher share of nitrogen is lost as the application rate increases.[74] It is also the simplest and most cost-effective way to reduce nitrate pollution in waterways. The cheapest nitrate reduction is the nitrogen that is never applied in the first place.

CAFO rules cannot single-handedly stop all nitrate impacts in drinking water sources and recreational waterways, but several facts suggest they can make a difference. CAFO siting correlates with groundwater quality degradation.[75] Manure makes up a significant portion of total nitrogen fertilizer applied in the state.[76] The science assessment in the Iowa Nutrient Reduction Strategy found proper manure application could achieve a significant reduction in nitrate pollution.[77] Ensuring manure is properly applied can lead to significant water quality improvements and reduce health impacts.

In conducting its cost-benefit analysis of CAFO rules and regulations, DNR and the Governor's office have an obligation to fully account for the potential benefits of reducing manure pollution and protecting water quality. Accounting only for the direct costs of rule compliance to CAFO facility owners would ignore the public benefits provided by clean water. The accumulation of impacts demonstrates that even a partial reduction in nitrate loading to surface and groundwater would provide significant economic benefits to Iowans across the state.

---

71 Low estimate includes 2024 water treatment expenses for Des Moines Water Works and Cedar Rapids; high estimate assumes Des Moines Water Works and Cedar Rapids' annual water capital improvement expenses and the Cedar River Source Water Partnership. The estimates do not include potential nitrate treatment costs for Iowa's 1,836 other public water systems.

72 Iowa Code § 459.311(3).

73 See "Iowa Nutrient Reduction Strategy – Water Quality," Iowa State University, available at https://www.arcgis.com/apps/dashboards/29460d40c6a74379a90b42f3e770db07 (last visited June 14, 2023) (showing 11 percent increase in nitrate load due to corn-soybean N application rates).

74 See Vetsch, J. A., Randall, G. W., & Fernández, F. G. (2019). Nitrate Loss in Subsurface Drainage from a Corn–Soybean Rotation as Affected by Nitrogen Rate and Nitrapyrin. *Journal of Environmental Quality,* 48(4), 988-994.

75 Zirkle, K. W., Nolan, B. T., Jones, R. R., Weyer, P. J., Ward, M. H., & Wheeler, D. C. (2016). Assessing the relationship between groundwater nitrate and animal feeding operations in Iowa (USA). *Science of the Total Environment,* 566, 1062-1068.

76 "Too Much Manure? Can Iowa use all its manure for fertilizer?" Iowa State University Extension, Publication AE 3608 (Apr. 2017). Available at https://store.extension.iastate.edu/product/15121.

77 NRS, supra note 2.

Iowa Environmental Council

505 Fifth Ave, Ste. 850 • Des Moines, IA 50309

Phone: 515-244-1194

Web: iaenvironment.org

Email: iecmail@iaenvironment.org

Connect With IEC

@IAEnvironmentalCouncil

@iaenvironmentalcouncil and @iowawaterwatch

@Iowa_Env

Iowa Environmental Council

@IowaEnviro