

Executive Summary

Concentrating on Clean Water: The Challenge of Concentrated Animal Feeding Operations

Carol J. Hodne

April 2005

A report for

The Iowa Policy Project

318 2nd Avenue North, Mount Vernon, Iowa 52314

319-338-0773 (phone) – 319-354-4130 (fax)

www.iowapolicyproject.org

April 2005

Concentrating on Clean Water: The Challenge of Concentrated Animal Feeding Operations

By Carol J. Hodne

Public concern over the quality of water in Iowa includes unease about the potential effects of concentrated animal feeding operations (CAFOs) on water quality. CAFOs involve the production of large numbers of animals confined in buildings or feedlots. Such operations necessarily produce large, concentrated amounts of manure. This report summarizes contemporary scientific literature on CAFO-related water quality issues, regarding:

- Structural changes in livestock production;
- Agents (e.g., nitrogen) and sources (e.g., manure spills) of water quality impairment;
- Effects of impaired water quality on the environment and human health;
- Socioeconomic effects; and
- Regulation and policymaking.

Structural Changes in Livestock Production: From Diversified Farms to CAFOs

The industrialization of agriculture is integrally related to the production of livestock in large-scale CAFOs. The main characteristics of CAFOs – large numbers of animals, confinement, minimal land base, and external sources of grain – have fundamental implications for environmental quality, including water quality. The large amounts of CAFO-generated manure are not readily usable as a source of nutrients for grain production within CAFOs, given their minimal land base, and can exceed needed nutrient levels when applied in a surrounding area. Thus, CAFO manure, particularly when inadequately managed, can become a source of pollution.

CAFOs are inherently disconnected from crop production and an integrated land base. This is a fundamental cause of the greater amounts of pollution generated by CAFOs than by the combined livestock-crop production that has characterized traditional diversified family farms. Although traditional farming causes some water pollution, areas with high levels of CAFO production experience additional water pollution risks. As large-scale, vertically-integrated CAFOs have taken over livestock production, fewer conditions exist for manure management that is closely integrated within holistic conservation programs managed by farm family members with a tradition of historic, intimate knowledge of the quality, topography and nutrient needs of soil.

U.S. livestock production has seen major restructuring in ownership, management and labor relationships from the intensified industrialization of agriculture over the last 50 years. The number of independent, family farm operations engaged in livestock, poultry and dairy production has declined. Production is increasingly dominated by large vertically integrated operations. Aspects of production, processing and distribution are coordinated through common ownership and management.

Confinement production is sometimes seen as a way to start or maintain a family farm. Over time, however, family farmers' entrepreneurial, management and marketing autonomy has eroded. Many now feed confined livestock and poultry through contractual relationships with vertically integrated corporations. Contract producers follow corporate directives that can restrict options for manure management

Carol J. Hodne, Ph.D., is involved in research and public education on CAFO issues, farmers' health issues, and various rural health issues.

and other practices that may affect water quality. For example, independent producers raise the majority of the feed for their livestock, while contractors generally supply feed to growers. Therefore, the components of feed additives, which affect water quality, are largely determined at corporate, not producer, levels, as are veterinary services and medicines.

The portion of Iowa farms with hogs dropped from 70 percent in the early 1960s to about 12 percent in 2000. Still, because large firms dominate production, Iowa, a state of less than 3 million people, ranked No. 1 in the number of hogs and pigs (15.9 million) and in the value of hogs on farms (\$1.106 billion), as of Dec. 1, 2003. Iowa led the nation in egg production, with 10,446,000,000 eggs produced in 2003. Over the last three decades, a large share of fed cattle production moved from Midwestern family farms to the large, vertically integrated feedlots of the lower Great Plains and Southwest. Iowa ranked eighth nationally in the number of all cattle and calves, with 3,450,000 head as of January 1, 2004.

Agents and Sources of Water Quality Impairment from CAFOs

Manure has historically been and remains an important fertilizer and soil conditioner. Manure provides major plant nutrients, such as nitrogen, phosphorus and potassium, and releases them more slowly than does commercial fertilizer, thus increasing their use by plants and decreasing water contamination. Manure can significantly improve the chemical, physical and biological qualities of soil.

While well-applied manure has numerous positive attributes, excessive amounts of manure from large-scale CAFOs have generated considerable concern over its potential to impair water quality. As one research team observed, "Intensively managed livestock production systems have exacerbated conditions where manure use in crop production is more akin to waste disposal than beneficial fertilization."¹ CAFOs annually produce approximately 575 billion pounds of manure, according to the USDA's Agricultural Research Service. Manure from CAFOs has been the main focus of research and policies regarding water quality impacts of CAFOs, and is, therefore, the focus of this report. As the structure of animal production has shifted since the early 1980s toward fewer, but larger, operations, a significant increase has occurred in the number of counties in the United States in which the nutrients from manure exceed the assimilative capacity of cropland and pastureland.

In addition to the manure-related impacts of CAFOs on water quality at local levels, potential broader effects on water quality include heavy water usage and impacts beyond the region, such as the Dead Zone of low oxygen waters in the Gulf of Mexico and elsewhere. Large amounts of water are needed for animal consumption and lagoon management (i.e., cleaning, flushing, filling, recharging). In addition, the processes used in siting CAFOs inadequately consider water quality issues at regional and watershed levels.

Agricultural production (crops, grazing, CAFOs, aquaculture) causes much of the impairment of U.S. rivers, lakes and estuaries. While there is more evidence of water pollution from fertilizers and pesticides than from CAFO manure, several aspects of CAFO manure pollution are important. The main components of CAFO manure that may cause water pollution are nutrients (i.e., nitrogen, phosphorus and potassium), ammonia, pathogens (e.g., bacteria), feed additives (e.g., antibiotics, hormones), salts and trace elements, organic matter, and solids.

Processes of Water Quality Impairment

CAFOs can cause pollution of surface waters and groundwater through: lagoon spills, discharges, and seepage; discharge of pollutants to air and deposition to water and soil; and poor siting (involving aquifers, flood plains, high water tables, and sandy soils). Heavy rains can cause dramatic lagoon spills and runoff. Seepage from earthen manure storage lagoons may contaminate groundwater, especially as depth to groundwater decreases, soils are more coarse-grained, and lagoon linings contain less clay.

¹ Cooperband, L. R., & Good, L. W. (2002). Biogenic phosphate minerals in manure: Implications for phosphorus loss to surface waters. *Environmental Science & Technology*, 36(23), 5075-5082.

Pollutants can reach surface and ground waters by the runoff of manure from open feedlots and misapplication of manure on land. Risks of runoff increase with: nearness to surface waters; high rainfall; and over-application and misapplication of manure (e.g., to flood plains, steep slopes, and soil that is frozen, snow covered, saturated, or of low porosity). CAFO manure is sometimes applied to land in excess of crop nutrient requirements because of inadequate land area for manure application or failure to follow manure management plans. Phosphorus is more often over-applied because phosphorus and nitrogen are nearly equally present in manure, yet crops need much more nitrogen than phosphorus.

Nitrogen and phosphorus contribute to the excesses that cause eutrophication (i.e., nutrient over-enrichment) and related algae blooms (i.e., rapid growth of microorganisms) on a large scale. The resulting serious decreases in the oxygen levels in water bodies cause fish kills, decline of native plants, reduced biodiversity, growth of toxic algae, and water quality problems.

Manure Spills in Iowa

The Iowa Department of Natural Resources (DNR) documented the source of 259 of 329 spills from livestock (mostly swine) facilities in Iowa from 1992 through 2002. Confinements caused 69 percent of the spills, while open feedlots caused 27 percent. DNR documented causes of 307 of the 329 spills: 74 manure storage structure failures or overflows, 73 equipment failures, 56 incidents of uncontrolled runoff from open feedlots, and 43 spills each due to improper manure application and transportation accidents.

Over 2.6 million fish were killed in Iowa, due to 108 of the 329 manure spills from 1992 through 2002, based on the analysis of DNR data by the Iowa Environmental Council. CAFO spills in some areas did not cause fish kills because chronic water pollution had already made the water unsuitable for fish life. The DNR may assess damages for fish kills, but has a history of minor, if any, assessments. Greater assessments could help recapture the externalized costs related to these fish kills. Updated DNR maps of Iowa CAFOs and related manure spills, fish kills and vulnerable water bodies are available online from the DNR at www.iowadnr.com/afo/index.html.

Impaired Water Quality and Effects on Health

Research and public concern has focused on risks to human health from CAFO-related environmental health hazards. Nitrate contamination of groundwater and drinking water, bacterial contamination of drinking water and recreational waters, and antibiotic-resistant bacteria contamination have been documented. Elevated nitrate concentrations in rural water bodies, rural private wells and urban water systems arise from agricultural practices including large CAFOs. Shallow, private wells used in rural areas are particularly vulnerable to contamination. Water-borne pathogens such as *E. coli* bacteria can contaminate drinking-water systems and recreational waters, causing diarrheal illnesses and gastroenteritis. The risks and consequences of such problems are particularly serious for vulnerable populations such as

Treating waste differently

A comparison of amounts, biological treatment and regulation of CAFO manure to human manure indicates the significance of CAFO manure. Daily averages of wet-weight manure (feces and urine) for livestock (pounds per 1,000 pounds live unit weight) are*:

- Dairy – 86 pounds
- Broiler – 85 pounds
- Swine – 84 pounds
- Layer – 64 pounds
- Beef – 58 pounds
- Turkey – 47 pounds.

These averages contrast with 30 pounds per human (again, 1,000 pounds live unit weight).

Waste for humans, while of the least weight, is highly regulated and usually treated, in contrast to animal waste. CAFO waste is more voluminous and dependent on oxygen to decompose than human waste.

*American Society of Agricultural Engineers, 1999.

infants, the elderly, pregnant women and people with compromised immune systems. Antibiotic-resistant bacteria are increasingly present in human and natural environments, including water bodies, due to overuse of antibiotics in human medicine and subtherapeutic use of antibiotics in CAFOs. Various forms of transmission of antibiotic resistance seriously threaten the effectiveness of traditional antibiotic treatments, including those that are the sole treatment or one of few treatments for a particular disease.

Socioeconomic Impacts

Some policymakers, development planners and rural residents still assume and assert that rural residents need to trade off their goals for a healthy environment for the benefits of local economic growth from CAFOs. However, many studies suggest this is an illusory trade-off; people often lose their quality of life without gaining the purported economic benefits. The local socioeconomic problems of large-scale, vertically integrated CAFOs may include local business revenue decline, property devaluation, social strife and other externalized costs. Other, water-related costs are external costs of industrial agriculture production that involve passing the costs of environmental, health and social problems to the public – particularly to the residents, businesses and governments of rural communities.

The environmental, health and socioeconomic burdens faced by rural counties that bear the externalized costs of large-scale CAFO production may be especially heavy in counties that experience diminished property tax revenues associated with large-scale CAFOs. One 1998 study showed that large-scale farrow to finish swine operations in Iowa generated the least net local and state government revenues per sow, compared to three smaller sizes of operations, while moderate-sized operations generated the most government revenues.

Property tax policies can contribute to diminished revenues from CAFOs. Large amounts of property tax exemptions are allowed CAFOs in Iowa. The Pollution Control and Recycling property tax exemption removed \$154.2 million dollars from county tax assessment rolls in Iowa, equivalent to approximately \$5 million in unrealized tax revenue.

Regulation and Policy-Making

Large-scale CAFOs are being provided advantages over diversified, family farm livestock operations through public policies such as government-subsidized cheap grain, tax exemptions, weak environmental regulatory enforcement, and weakened local control over CAFO siting.

Some researchers have discussed the benefits of targeting regulatory processes in a manner that emphasizes the risks from larger-scale CAFOs. This is because smaller operators pay more per head in meeting standards and may have more financial difficulties in affording expensive technologies. This “regressivity” violates the principle that a pollution tax should increase as the amount of pollution increases. Some suggest that a probability-based, risk-based regulatory system would provide environmental protection for high-risk operations, while benefiting those small producers who operate low-risk CAFOs or experience economic hardship from meeting environmental regulatory standards.

Conclusion

Large-scale CAFOs generate or pass on several costs to society. They include:

- Contamination of water with excess nutrients, pathogens, antibiotics, etc.;
- Health problems linked to impaired water quality;
- Fish kills and threatened biodiversity;
- Costs of remediation;
- Government subsidies (e.g., property tax exemptions, federal subsidies for cheap grain);
- Declines in business and government revenues;
- Property devaluation; and
- Diminished quality of life (social cohesion, equity, amenities).

Policy Goals and Recommendations

Iowa's rich natural heritage and leadership in agricultural production behooves Iowa to more responsibly shape a sustainable future for producers, rural communities, the environment and the general public. A sustainable livestock production industry in Iowa requires research, producer education, equitable producer-consumer relationships and effective environmental regulation. Policies should be pursued with the following priorities:

- Enhance economic viability and health of livestock producers, particularly those with moderately sized, diversified operations;
- Strengthen the economic and social well-being of rural communities and the state;
- Respond to the increasing demand from domestic and global consumers for safer, healthier meat options; and
- Restore and protect water quality, soil health, and the general environment.

Iowans have options to reverse policies that favor unsustainable practices in livestock production. New policies could promote sustainable livestock production. Options for new policies:

■ ***Strengthen Iowa DNR enforcement of the federal Clean Water Act (CWA).***

The Iowa DNR needs to regularly inspect CAFOs, issue National Pollutant Discharge Elimination permits as required by the CWA, enforce monitoring and reporting requirements, and issue proper penalties against noncompliant CAFOs. A moratorium on new CAFO construction and expansion of existing CAFOs, until the regulatory framework is strengthened, would protect Iowa's water systems "until additional scientific data on the attendant risks to public health have been collected and uncertainties resolved," as recommended by the American Public Health Association. North Carolina has a moratorium on new construction, as did the Netherlands in the mid-1980s, allowing development of regulations.

■ ***Strengthen local control in livestock production regulations and siting decisions.***

Greater local control over pollution regulatory processes and siting decisions would increase consideration of local water quality and could minimize regressivity based on size of operation.

■ ***Toughen regulation of use of antibiotics in livestock production.***

Limitations to the use of subtherapeutic use of antibiotics in livestock production are an essential part of protecting the efficacy of antibiotics in human and livestock medicine. Clinicians, public health officials, livestock producers and veterinarians need to continue and strengthen collaborative efforts to protect the health of livestock, livestock producers, and the general public. A phasing out of certain classes of antibiotic growth promoters in the United States, especially of antibiotics that are crucial for human medicine, would contribute to multinational efforts to limit unnecessary use of antibiotics.

■ ***Assure inclusion of phosphorus in manure management plans.***

Phosphorus is often over-applied because phosphorus and nitrogen are nearly equally present in manure, yet crops need much more nitrogen than phosphorus. The Iowa Environmental Protection Commission and the Department of Natural Resources must assure phosphorus is included in manure management plans, which need to be well-implemented and monitored in order to ensure reduction of pollution from phosphorus.

The Iowa Policy Project

For the full report, see
www.iowapolicyproject.org

The Iowa Policy Project was founded in the summer of 2000 to produce and disseminate research on a broad set of issues of importance to the citizens of Iowa. We are a non-profit and non-partisan organization. We engage scholars to produce sound, independent research.