# Comparative Standards for Intensive Livestock Operations in Canada, Mexico, and the United States

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# Executive Summary

Livestock farming has been transformed in the past twenty years from a business dominated by relatively small producers to one dominated by large facilities raising thousands of animals. A side effect of this development has been a new set of environmental concerns unique to this industry. While regulation of livestock agriculture has historically been a state/provincial and local matter, governments from the local to the federal level have found themselves grappling with the issues created by these new, concentrated facilities. This Report surveys the current environmental requirements for "intensive livestock operations" (ILOs) in the United States, Mexico and Canada. The Report draws conclusions about current regulatory regimes and makes recommendations on the management of environmental issues associated with ILOs.

## ILOs and the Production of Livestock

No single definition for ILOs exists for the three countries of North America. "ILO" generally refers to facilities that have a large number of livestock in confined conditions. In the US, the preferred term is "concentrated animal feeding operation" or "CAFO." For decades, poultry have been raised in large, enclosed facilities. In recent years, the swine industry in particular has also consolidated its operations into large, indoor facilities. Over recent decades, the size of fed-cattle and swine operations has dramatically increased, while the number of operations has diminished. This concentration has already occurred in the United States and Canada and has begun to occur in Mexico.

According to an industry magazine, for example, in 2001, the eight largest commercial pork producers in Canada owned 275,800 sows; the three largest in Mexico owned 131,500; and, the twenty-five largest in the United States owned 2,485,075. In the United States, 110 operations control 47% of the hog inventory.[1] In 2000, operations with 5000 hogs or more comprised 50% of the US hog inventory. It has been estimated that 50% of Mexico's swine production comes from intensive operations.

One aspect of this concentration is the dominance of a small number of companies, often meat processors, who increasingly own the animals, feed mills and brand-names of the finished product through a process called "vertical integration." These companies contract with producers, or farmers, to produce a pre-specified quantity of livestock. When these companies are meat processors, livestock production facilities tend to cluster around the processors. One report states that hogs produced under contract in the US went from 10 percent in 1993 to greater than 50 percent in 1999.

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[1] Compiled by the CEC from information provided in *Successful Farming Magazine*, October 2001, www.agriculture.com/sfonline/sf/2001/october/pork_powerhouses.pdf

The consolidation of these industries has helped contribute to lower meat prices. In constant dollars, the real, retail price of chicken in the US has decreased 61% since 1955; retail pork prices decreased 8% from 1990 to 1998.[2] This consolidation has also raised serious public health and environmental issues.

**The Production of Livestock in North America**

The decline in prices has accompanied increased demand for and production of pork and poultry products in North America. From 1980 to 2000, while beef consumption remained about the same, domestic consumption of broilers in North America rose from 6 million metric tons to 14 million metric tons; in the same time period, domestic consumption of pork rose from 9.6 million metric tons to 11 million metric tons. [3] In 2002, the US Department of Agriculture estimates that the United States, Canada and Mexico produced 43,926,000 metric tons of beef, pork and chicken, up from 39,086,000 metric tons in 1997 [4]

The livestock markets of Mexico, the United States and Canada, are becoming increasingly integrated into a North American market. In 2001, the United States exported US $103 million worth of pork to Canada; US $217 million worth of beef; and, and US $155 million worth of poultry. Canada, meanwhile exported US $619 million worth of pork to the United States, US $1 billion worth of beef, and, US $28 million worth of poultry. [5]

The lowering of tariff barriers under NAFTA has contributed to a surge in exports of livestock from the United States to Mexico where production has not kept pace with demand. From 1990 to 2000, the value of US exports of beef, pork and poultry to Mexico increased from $364 million to $971 million.[6]

Despite the dominance of US imports, in 2002, Mexico is expected to export 1.3 million head of cattle, most destined for feedlots in the United States, and it will maintain a strong export market of meat products to Japan and a small but rapidly expanding export

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[2] Martinez, Steve W. 2000. Price and quality of pork and broiler products: What's the role of vertical integration? Washington, DC: Economic Research Service. *Current Issues in Economics of Food Markets*; Agriculture Information Bulletin No. 74-02.

[3] USDA Foreign Agricultural Service, Production, Supplu and Distribution, www.fas.usda.gov/psd/complete_files/default.asp

[4] Compiled by the CEC from, "Livestock and Poultry: World Markets and Trade, March 2002, Circular Series, DL&P 1-02, USDA, FAS, www.fas.usda.gov/dlp/circular/2002/02-03LP/dlp1_02.pdf

[5] Compiled by the CEC from information provided in, "Proposal for Global Agricultural Trade Reform: What is at Stake for Pork," www.fas.usda.gov/info/factsheets/WTO/commodities2002/Pork2.pdf , "What is at Stake for Beef," www.fas.usda.gov/info/factsheets/WTO/commodities2002/Beef2.pdf , "What is at Stake for Poultry," www.fas.usda.gov/info/factsheets/WTO/commodities2002/poultry3.pdf

[6] Compiled by the CEC from, "U.S. Imports and Exports," USDA, www.fas.usda.gov/dlp/histdata/html

market of pork to the United States.[7] Mexican exports of pork increased from 511 tons in 1990 to 31,711 tons in 2000.[8] This growth has been fuelled by increased vertical integration, an expansion of companies with more than 500 sows, and increased US investment.

**ILOs and the Environment**

The proper handling of the manure and wastewaters produced by ILOs is critical to protecting human health and the environment. The volume of these by-products from the largest farms can rival the sewage output of a sizable city. For example, the 1600 dairies in the Central Valley of California produce more manure than a city of 21 million people produces biosolids. A 50,000 acre swine operation in southwest Utah designed to produce 2.5 million hogs annually, has a potential output greater than the entire city of Los Angeles.[9] In the United States, Mexico and Canada, livestock operations are prohibited from discharging untreated manure and wastewaters directly into waterbodies (with some exceptions for extraordinary storm events). ILOs ultimately dispose of most of their manure on land, often using it as fertilizer. Because of these practices, the design, location and manure management practices of ILOs are critical components in ensuring an adequate level of protection of human health and the environment.

The improper management of manure and wastewaters can cause both water and air pollution. These ILO by-products can emit significant levels of pollutants into the air, such as ammonia, hydrogen sulphide, carbon dioxide, particulate matter and methane. They can also contain pathogens, antibiotics and hormones. Runoffs and leaks from animal feeding operations have contaminated surface and ground water, including drinking water supplies.

The amount of manure produced by an ILO can exceed the options for beneficial re-use, such as the application of the manure to local lands as fertilizer. Excessive application can create soils over-enriched with nutrients and threaten local watersheds with runoff that can cause algal blooms, loss of habitat, changes in aquatic biodiversity, and the depletion of dissolved oxygen. Transporting manure from areas of excess to areas of need appears to be prohibitively expensive.

The extensive use of antibiotics to control diseases in food-producing animals may lead to certain drug resistance problems in humans. The American Medical Association has passed a resolution urging the termination or phase out of the prophylactic use of antibiotics in livestock operations.[10] Likewise, the World Health Organization has said

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[7] Compiled by the CEC from, "Livestock and Poultry: World Markets and Trade, March 2002," pp. 13,22, Circular Series, DL&P 1-02, USDA, FAS, www.fas.usda.gov/dlp/circular/2002/02-03LP/dlp1_02.pdf

[8] Pérez Espejo and González Padilla, 2001.

[9] Report compiled by the minority staff of the U.S. Senate Committee on Agriculture, Nutrition, and Forestry for Senator Tom Harkin, D-IA.

[10] AMA Resolution 508 (June 2001) www.ama-assn.org/ama/pub/article/1818-5001.html.

that antibiotic use in food-producing animals must be curtailed to prevent the increase of drug-resistant diseases.[11]

Public concern has grown about whether these facilities are regulated in a way that protects human health and the environment, resulting in headlines throughout North America. Major waste spills from ILOs during hurricanes in North Carolina in the 1990s devastated some streams for weeks. Contamination of a water supply in Ontario by manure was blamed for several deaths and thousands of illnesses (though the facility was not a large, intensive operation). Excessive application of manure to soils in Yucatan has generated concerns both for the soils and for the area's relatively shallow aquifers.

Public attention has also been focused on the increasingly global nature of intensive livestock operations. A recent story in *The Ottawa Citizen,*[12] headlined "Canada: The World's Barnyard," reports that the Dutch government is "paying its livestock farmers to stop farming because of their manure problems" and that Dutch farmers are using the money to buy farms in Canada. In the United States, an animal welfare group teamed up with Polish farm activists in a public attempt to stymie the efforts of the largest American pork producers to introduce large-scale livestock operations in Poland.[13]

**Environmental Regulation and ILOs**

Within North America, ILOs are not subject to uniform regulations or standards. Instead, the countries rely on a mix of local, state and federal regulations. In Canada, ILO regulation is almost exclusively a provincial matter; in some provinces, regulatory authority is further delegated to local municipalities. In Mexico, the controlling regulations, to the extent that they exist, are principally a matter of federal law—though oversight and enforcement issues are most often handled at the local level. In the United States, a recent revision to the federal regulations has imposed a broader federal mandate on ILOs than previously existed, but state-level regulation still adds significantly to the federal scheme. In all three countries, the regulations that do exist vary significantly from state-to-state and province-to-province.

Strong federal jurisdiction over ILOs has not been a tradition in any of the three countries. In particular, in Mexico, where discharges into waterways are governed by federal law, a federal regulatory system for addressing environmental concerns has not been developed; federal water law could apply to ILOs, but Mexico's environmental agency, Semarnat, has not developed technical standards specific to waste discharges from ILOs into waterways. In Canada, federal involvement in ILOs is generally limited to agricultural research and not regulation—with the exception of federal fisheries legislation that protects fish habitat from many pollution sources. A newly revised

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[11] World Health Organization, "Antibiotic Use in Food Producing Animals Must be Curtailed to Prevent Increased Resistance in Humans," Press Release WHO/73, Geneva (October 20, 1997).

[12] Tom Spears, August 4, 2001.

[13] "U.S. Pork Producer Hogtied in Polish Venture," *Washington Post,* July 3, 2000, p.A01

federal rule in the United States has instituted new national requirements for nutrient management plans, manure and soil testing, and record-keeping at ILOs or CAFOs.[14] It has also clarified that all facilities meeting the definition of a CAFO must apply for a federal water permit or for a "no potential to discharge" determination. Under the prior rule, the US Environmental Protection Agency estimated that although more than 13,000 livestock operations were large enough to require federal water permits, fewer than 20% of those actually did—partly as a result of disagreement about what the law required.

Numerous data gaps complicate the regulation of ILOs. Because very little on-farm monitoring for environmental parameters is required of ILOs, there is a general lack of data on their specific impacts on air, surface water, and groundwater quality. Very little information exists on the long-term effects of the land-application of manure on soil biota. Data on compliance rates and enforcement actions at ILOs is limited; where it exists at a local level, it is often not aggregated at the state or provincial level.

**Environmental Regulations and the Siting of ILOs**

The data is also inconclusive as to whether variations in environmental regulations influence siting decisions for livestock operations. Environmental considerations are one cost of many that operators consider when making siting decisions, including proximity to feed sources and processors, proximity to markets, the climate, political support within the particular jurisdiction, local financial incentives, tax consequences and labour costs. To determine whether less stringent environmental standards alone or in combination with other factors would create enough cost savings to attract new ILOs, the relative cost of environmental requirements, including local land use restrictions and design requirements, would need to be considered in relation to these other costs.[15]

US industry sources, however, report that that they feel "stymied by a myriad of new laws and regulations in the United States" and are looking to Canada and Mexico for new growth opportunities.[16] While precise data is not available, significant US investment has gone into the pork industry in Mexico. In North America, Mexico has the lowest level of environmental regulations or standards for ILOs and very low labour costs. In

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[14] 40 CFR Part 122 and 40 CFR Part 412. The regulations themselves and extensive documentation are available at cfpub.epa.gov/npdes/afo/cafofinalrule.cfm Note that the preferred term in the U.S. is CAFO (concentrated animal feeding operation).

[15] A recent study indicates that environmental regulatory stringency is generally not as important as other economic variables in the location choices of livestock producers. In the two sectors (hog and dairy) where significant regional production shifts have occurred, major drivers appear to be relative prices and business climate. "SPATIAL Dynamics of the Livestock Sector in the United States: Do Environmental Regulations Matter?" Deepananda Herath, Alfons Weersink and Chantal Line Carpentier, *Journal of Agricultural and Resource Economics*, 1st Submission, 1 March 2003.

[16] "Making Moves in Mexico," *Successful Farming Magazine*, October 2001, www.agriculture.com/sfonline/sf/2001/October/0111pork_powerhouses.html ; "Sow Herd Building Again: This Time it's Canada Making the Move," *Successful Farming Magazine*, October 2000, www.agriculture.com/sfonline/sf/2000/october/0011powerhouses.html

addition, Mexico does not produce enough pork or poultry to meet its domestic demand and Mexico imposes duties on imports over quota limits. As a consequence, Mexico is viewed by industry as possessing great potential for domestic expansion.

Foreign firms are working to be part of this expansion. US-based Smithfield Foods, for example, has teamed up with the Mexican company AMSA to develop swine units in the state of Veracruz. Within five years they expect to have 56,000 sows. Smithfield has also teamed up with the Mexican company Agroindustrial Del Noreste in the state of Sonora to export pork to Japan. The US company Cargill operates a feed mill in the Yucatán to supply feed for GPM, Mexico's largest pork producer.[17] Tyson Foods has a joint venture in Mexico, Trasgo & Citra Poultry, producing chickens for domestic consumption.[18]

These changes are almost certainly occurring in response to Mexico's increasingly favourable business climate, its growing domestic demand for meat products, and its potential as an exporter. However, specific connections between environmental controls, or the lack thereof, and these economic influences are beyond the scope of this study.

**Types of Environmental Requirements**

The three countries address public health and environmental concerns associated with ILOs through the following requirements:

1. *Permits*. In each of the three countries, some type of permit is required for operations above a certain size. Especially in Mexico, the permits may simply be construction permits or operating permits with little or no environmental content beyond the restrictions that may be imposed on siting (e.g., distance from urban areas). To the extent that they are environmental permits, they are almost exclusively concerned with water pollution issues in all three countries. Permits with specific concern for air pollution from ILOs—beyond the "setback" requirements that separate the operations from their neighbors—are rare.

2. "*Nutrient management plans (NMPs)"* or *"manure management plans (MMPs)":* Increasingly, these plans are a part of the regulation of ILOs in Canada and the United States, but their stringency varies across jurisdictions. Most commonly, manure from ILOs is applied to lands in the vicinity of the operation as fertilizer. At their most detailed, NMPs include liner requirements for storage facilities, testing of manure and of the land where it is to be applied to prevent excessive nutrification, detailed record-

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[17] "Making Moves in Mexico," *Successful Farming Magazine*, October 2001, www.agriculture.com/sfonline/sf/2001/October/0111pork_powerhouses.html ; "Livestock-Hungry World: South America and Mexico," *Successful Farming Magazine*, March 1998, www.agriculture.com/sfonline/sf/1998/March/livestock/1.html

[18] "Livestock-Hungry World: South America and Mexico," *Successful Farming Magazine*, March 1998, www.agriculture.com/sfonline/sf/1998/March/livestock/1.html

keeping for manure shipped off-site, application schedules, and certification of the plan by a qualified professional. At their simplest, they enforce at least a systematic accounting for an operation's manure handling practices. Seldom, even in their more stringent versions, are NMPs concerned with pollutants other than "nutrients" (typically nitrogen and phosphorous)—and often they are only concerned with nitrogen, neglecting phosphorous. The implications of antibiotics and hormones in these wastes remain outside the current regulatory purview. Mexico has not required NMPs to date.

3. *Setback or "minimum distance separation (MDS)" requirements:* Odour issues have been dealt with primarily by setback requirements (called MDSs in Canada). The specifics vary widely across jurisdictions, and may be cast as requirements for minimum distances between property lines, from other structures, from water bodies or from other livestock operations. Setbacks may apply to production facilities, to the land where manure is applied, or both. Mexico does not presently prescribe setback requirements, though some municipal laws in Mexico can require a livestock operation to re-locate if urban development encroaches too closely on the farm. In the United States and Canada, state and provincial right-to-farm laws can act to protect farms from urban encroachment in rural areas.

4. *Public information and public notice requirements:* Here, too, specifics vary widely. The trend, however, is toward greater disclosure of information about the potential environmental impacts of ILOs. At one end, Georgia requires notice by certified mail to all property owners within one mile of a new or expanding swine operation with more than 3000 "animal units;" at least one public meeting must also be conducted. In many cases, however, in all three countries, public notice and public information requirements are still minimal.

5. *Professional certification.* A minority of US states and Canadian provinces has mandated that NMPs (or MMPs) for ILOs be certified by appropriate professionals. Though the certification process lacks standards (or sufficient history for critique), it does suggest how a professional cadre can supplement the work of under-staffed environmental agencies.

6. *Financial guarantees.* A few US and Canadian jurisdictions require that bonds (or some other form of financial guarantee) be posted to ensure the proper closure of manure management facilities should a livestock operation go out of business.

7. *Technical assistance:* Agriculture in all three countries has traditionally operated as a favoured sector, strategically important to each nation's economy. Numerous government programs have provided advice and technical support to agriculture. Livestock operations benefit from such programs and the technical assistance has frequently been in the area of reducing environmental impacts, especially in the United States and Canada.

Schematically, major points of comparison can be summarized as follows:

## Country-by-Country Comparisons

| | CANADA | MEXICO | UNITED STATES |
|---|---|---|---|
| **Definitions of ILO/CAFO** | Defined in 8 of 10 provinces; varies from 50-400 "animal units" (AU). "Unit" definitions vary. Sometimes defined by animal density. | None | At federal level, "large CAFOs" = 700 dairy cows, 2500 swine, 30,000 chickens, etc., (formerly termed "1000 AU"). State definitions vary from 300 to >1000 AU, with a few as low as 10 in sensitive areas (shorelands, MN) |
| **Permits/approvals required?** | Yes in 8 of 10 provinces, conditionally in the other 2. | Some construction and operating permits re-quired. Varies by state and municipality. National water discharge standards must be met for any discharge to public waters. | Federal water pollution control permit required for "all CAFOs." Most states require various state permits, but a few only require the federal water permit. |
| **Public notice required?** | May be recommended or required by municipalities or provinces. Zoning changes require notice. | Generally, no. Some notice for fiscal matters, the utilization of public utilities, etc. | Yes. |
| **Separation/Setback Distances** | Yes, in all provinces. Requirements vary widely. For example: 20 metres from watercourse or wetland (Prince Edward Island) to 1 mile from a dwelling in a city, town, village or hamlet (Saskatchewan). | None required. | In federal law, 100 feet between land application and surface waters (less with vegetated buffer or approved "alternative practices.") Yes, in most states, with wide variation based on size, type, new/existing, landscape features. For example: 100 feet from stream (Alabama) to 1 mile from dwelling, school or incorporated municipality |

| | CANADA | MEXICO | UNITED STATES |
|---|---|---|---|
| | | | (Colorado). |
| **Geophysical Requirements?** | Yes, in 8 of 10 provinces. Some as separation distance from water bodies or water tables; some to avoid flood plains. | ILOs are banned in zones of water scarcity. Some floodplain restrictions. | None in federal law. Yes, in 16 of 20 states, generally to avoid the 100-year floodplain. |
| **Government review of site required?** | Yes, under some circumstances, in 6 of 10 provinces. | Changes from forestry to agriculture require EIA. | Yes, under some circumstances, in 13 of 20 states. |
| **Government approval of plans?** | Yes, under some circumstances in 6 of 10 provinces. | No. | Yes, under some circumstances, in federal law and in all 20 states. |
| **Nutrient Management Plan required?** | Yes, in 6 of 10 provinces; encouraged in others. | No. | Yes, in federal law and in all 20 states (some more stringent than federal requirements). |

## The Future

The environmental impacts of ILOs will likely remain a significant public health and environmental issue in the three countries. Given the decentralized nature of the current regulatory environment, it is unlikely that environmental requirements and incentives will become uniform within a particular country or among the three countries. But technical innovations, driven in part by litigation in the United States, may play a role in helping governments understand the best technologies and practices for managing large concentrations of animal manure and wastewaters.

In North Carolina, for example, a settlement with Smithfield Foods in 2000 has generated a $15 million project to identify "superior technologies" for the management of manure from large animal operations. The project is examining ways to reduce the volume of manure produced, ways to reduce the environmental impact of the manure, and processes for the more efficient treatment of manure and wastewaters. All farms operated by

Smithfield Foods are required to adopt technologies deemed environmentally and economically superior within the context of the agreement; the hope is that any advances made in that project will ripple through the industry. Another settlement, in Missouri, may generate as much as $50 million for research to develop and install wastewater treatment technologies at ILOs; it also requires the companies involved (Premium Standard Farms and Continental Grain Company) to calculate and report on their air emissions for possible air permitting.

The success of these experimental efforts will depend on their efficacy when expanded to full-scale operations and on governments' willingness to incorporate these advanced technologies into enforceable permit conditions or regulatory requirements.

**Conclusions**

1. The livestock industry, particularly the swine industry, has undergone dramatic concentration in the past twenty years.

2. A North American market exists for livestock.

3. Joint ventures are increasingly likely between US, Mexican and Canadian livestock producers.

4. The concentration of manure and wastewaters, as a consequence of those changes in the industry, can be a serious environmental and human health problem; legislation has not always been able to keep pace.

5. Environmental regulation of livestock operations has generally focused on water pollution, but air and soil pollution are also issues at large facilities, as are concerns for worker health and for the industry's extensive use of hormones and antibiotics.

6. Environmental regulation varies significantly across jurisdictions.

7. Though variations in regulations can provide incentives to site new facilities in jurisdictions with the least stringent regulations, evidence that disparities in regulation influence those siting decisions is only anecdotal. Data for tracking foreign investment in livestock operations is difficult, if not impossible, to obtain. The United States, for example, requires foreign investors to complete Form FSA 153, but the form aggregates all agricultural investments.

8. Enforcement of environmental regulations at livestock operations varies widely. The agencies responsible for enforcement are frequently under-staffed and/or not trained specifically in livestock issues. In some cases, jurisdictional issues arise between environmental agencies and agricultural agencies.

9. Mandatory "nutrient management plans" and "setbacks" are becoming primary regulatory tools.

10. Public information requirements for ILO siting and operation are uneven but of increasing importance in several jurisdictions.

11. Professional certification of manure management plans is increasingly a requirement, but there is no standardization of the details of certification.

12. Research is underway that could reduce the impacts of manure and wastewaters from ILOs, though the efficacy and costs of these new technologies are yet to be determined.

**Recommendations**

1. Greater uniformity in the coverage of regulations within (and among) NAFTA countries could minimize incentives to site ILOs in the least-regulated jurisdictions. Though countries, states, provinces or local governments may be justified in having standards different from their neighbours, caution must be exercised to avoid the "race to the bottom" effect. Variations from "state of the art" environmental standards should be based on a meaningful assessment of environmental risks in the context of other economic, social and geological concerns.

2. Specifically, greater uniformity in requirements for nutrient management plans, setbacks, public information, public participation, and professional certification would be beneficial. "Public participation" should mean more than an invitation to a public meeting after all important decisions have been made.

3. Where governments have both agricultural and environmental agencies, they should carefully consider the relative responsibilities of those agencies in relation to ILOs. Agricultural agencies have historically functioned as promoters of agriculture and may be ill-equipped to handle an enforcement role. Environmental agencies may need training in agricultural systems, but their traditional role as regulators typically makes them better-suited for the enforcement task. Environmental agencies may also have more experience with public participation in regulatory matters.

4. Development and implementation of new manure and wastewater treatment and pollution prevention technologies, which consider the lifecycle of these by-products, should be encouraged, especially in areas with excess nutrients.

5. Systems that impose some responsibility for environmental impacts on "integrators," as well as livestock producers, where the integrators own the animals, would be more equitable and would likely result in improved environmental performance at the producer level.

6. Improved systems should be developed in each of the three countries to collect information on the environmental conditions associated with ILOs and to periodically survey environmental regulation and enforcement in each country.

7. Better data collection systems should be implemented for tracking foreign direct investment in ILOs in each of the three countries in order to help determine whether they are relocating to meet that country's domestic demand or whether they are relocating to export back to the country from which they moved and thereby avoid regulatory costs.

8. Worker health, antibiotic, hormone and specific pathogen issues are beyond the bounds of current environmental regulation and, therefore, of this study. Each deserves improved data collection and significant public attention.

# Introduction

This section provides extensive background on the nature of intensive livestock operations, their growth, and the environmental issues associated with them. Readers familiar with this material may wish to go directly to the discussion of regulatory regimes, beginning with "Regulations in the United States."

A combination of technical innovations and economic forces has wrought a revolutionary concentration in the livestock industry. Between 1982 and 1997, the number of large feeding operations (more than 1000 "animal units") in the United States increased by 47%, while the livestock inventory remained relatively constant. In the same period, the number of hog farms decreased by about 75%. As of December 2001, US Department of Agriculture (USDA) statistics indicated that 110 operations, with more than 50,000 animals per farm, represented 47% of the entire hog inventory in the United States The largest farms can produce more than two million hogs per year. Increasingly, through a process called "vertical integration," a single company owns multiple stages of the meat-production process (the animals themselves, slaughterhouses, feed mills, and finished product brands) and contracts with farmers to raise the animals. In 2001, the number of hogs raised by contractees accounted for 33% of the total US hog inventory (Agricultural Statistics Board, US Department of Agriculture).

One consequence of consolidation in the industry has been relatively cheap meat for consumers. In constant dollars, the retail price of chicken in the United States has decreased 61% since 1955; retail pork prices decreased 8% from 1990 to 1998 (Martinez 2000).

The decline in prices has accompanied increased demand for and production of pork and poultry products in North America. From 1980 to 2000, while beef consumption remained about the same, domestic consumption of broilers in North American rose from 6 million metric tons to 14 million metric tons; in the same time period, domestic consumption of pork rose from 9.6 million metric tons to 11 million metric tons. In 2002, USDA estimates that the United States, Canada and Mexico produced 43,926,000 metric tons of beef, pork and chicken, up from 39,086,000 metric tons in 1997.

The livestock markets of Mexico, the United States and Canada, are becoming increasingly integrated into a North American market. In 2001, the United States exported $103 million worth of pork to Canada; $217 million worth of beef; and, and $155 million worth of poultry. Canada, meanwhile exported $619 million worth of pork to the United States; $1 billion worth of beef; and, $28 million worth of poultry.

The lowering of tariff barriers under NAFTA has contributed to a surge in exports of livestock from the United States to Mexico where production has not kept pace with demand. From 1990 to 2000, the value of US exports of beef, pork and poultry to Mexico increased from $364 million to $971 million.

Meanwhile, Mexico exports significant numbers of cattle (1.3 million head in 2002) to the United States, most destined for feedlots. Mexico also maintains a strong export

market for meat products to Japan and a small but rapidly expanding export market in the United States. This growth has been fuelled by increased vertical integration, an expansion of companies with more than 500 sows, and increased US investment.

Another consequence of consolidation of the industry is the concentration of manure and wastewaters from these large operations. Most often, the manure and urine is collected and stored in open-air anaerobic pits (known as lagoons) until it can be applied to nearby fields, typically by spraying. Inadequate storage infrastructure or application practices can cause nutrients, bacteria and other contaminants to enter surface or ground water, or to overload the assimilative capacity of soils. All three countries have areas where more nutrients are produced by livestock operations than can be used on crops in the local area. Gaseous releases can be the source of odours and air pollution. Increasingly, concerns also surface about worker health at ILOs, about the use of hormones and antibiotics at these facilities, and about the ultimate fate of those substances in the environment.

Manure statistics are impressive. According to a report compiled by the staff of a US Senate Committee: "The 1600 dairies in the Central Valley of California produce more waste than a city of 21 million people. . . a 50,000 acre swine operation in southwest Utah designed to produce 2.5 million hogs annually, [has] a potential waste output greater than the entire city of Los Angeles." [19]

Canada has recently attracted significant Dutch and Taiwanese investment in intensive livestock operations, as opportunities for such development in those countries diminishes. And ILOs have engendered controversy; news reports have asserted that "the federal government['s] . . . own investigations show [that] industrial-scale farms are causing air and water pollution and posing a significant health hazard to people working in them."[20]

Industry representatives note that Mexico is "just at the start of the curve" and that "the mood among large pork producers [in Mexico] . . . is similar to that in the United States ten years ago when our industry stood poised for massive expansion, integration and consolidation."[21] In Veracruz, one operation has 80,000 hogs and is embarked on a growth program that could double that number in 5 years.

The present report analyzes the comparative regulation of the environmental impacts of large animal feeding operations in Canada, the United States, and Mexico. Regulation of the livestock feeding industry matured in a world of smaller farms. The agricultural sector, generally, has benefited from many exemptions from environmental regulation. But this new concentration of manure and wastewaters from large feeding operations has motivated an evolution of regulatory policy. Specific motivations have included large

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[19] Report compiled by the Minority Staff of the U.S. Senate Committee on Agriculture, Nutrition, and Forestry for Sen. Tom Harkin, D-IA.

[20] *The Ottawa Citizen*, August 21, 2001 and March 19, 2002 (Tom Spears, citing 590 pages of "internal government documents" released to him under an Access to Information request.)

[21] "Making Moves in Mexico," *Successful Farming Magazine*, October 2001. Available at www.agriculture.com/sfonline/sf/2001/october/0111pork_powerhouses.html

manure spills in North Carolina, first in 1995, then associated with hurricanes in 1996, 1998 and 1999; several deaths believed to be associated with contamination of drinking water by manure in Canada; and nitrate over-loading of soils in some areas in Mexico that has raised concerns both about the health of cows grazing on the over-nitrated soils, the degradation of the soils themselves, and the pollution of aquifers.

The new generation of regulation is a mix of efforts at the national, state/provincial, and local levels in all three countries. Though there is great variety in the detail, broad commonalities among the developing requirements include:

- Setbacks, of some minimum distance, of the feeding operations themselves from property lines, residences, town limits, water sources, and the like.
- Minimum separation of the manure—both when stored and when land applied—from groundwater, streams, roads, neighbours, etc.
- Nutrient management plans (NMPs), which can be quite detailed in their requirements for monitoring and reporting on application/disposal practices.
- Professional certification of facility designs and NMPs, and certification of those who land-apply manure.
- Leak detection systems.
- Notice to neighbors prior to spreading manure.

**Defining Terms**

The three countries employ modestly different terms to describe the operations that are the subject of this report. Federal law in the United States uses the term "concentrated animal feeding operation" (CAFO), defined by regulation as one of a minimum size[22] or one that is directly impacting water resources, even if of a smaller size. States within the United States use a variety of terms. Mexico and Canada often use a more generic term, "intensive livestock operation" (ILO).

No single ILO definition exists throughout Canada, and the regulatory landscape there is changing rapidly. Though ILOs are a growing phenomenon in Mexico, the law has yet to address (or define) them directly. General water laws there can impact ILOs, and local building or operating permits may have environmental aspects.

The definition of ILO is typically structured around numbers of animals, types of confinement, and types of manure handling practices. In the United States, for example, 30,000 chickens with a liquid manure handling system would be regulated the same as 125,000 chickens with any other system.[23] Each would be a "large CAFO." ILO

[22] See full discussion under "Regulations in the United States," below.

[23] 40 CFR 122.23(b)(2).

definitions often employ the term "animal unit" (AU) as a way of comparing species. In some systems, one cows equals 2.5 hogs, for example. Or, put another way, 1000 cows and 2500 hogs would each equal 1000 animal units. But definitions of *animal unit* also vary. Some are based on weight, so that 1000 pounds of "live weight" might equal one animal unit. Some draw precise connections with manure. Canada's prairie provinces, for example, define an animal unit on the basis of the amount of nitrogen excreted over a 12-month period. "Thus a beef cow and her calf are 1.25 AU, a dairy cow is 2.0 AU, a feeder pig is 0.143 AU, etc."[24] Depending on the jurisdiction, Canada's ILO regulations begin to operate somewhere between 50 and 400 animal units. Governments typically begin to consider livestock operations "large" in the 500-1000 AU range. AU is a useful term, both for regulatory definitions and for statistical analysis. Despite its imprecision, the term AU is necessarily used throughout this Report.

Some jurisdictions use animal units as a regulatory measure; some use animal numbers and others use "steady state live weight." Statistics in Mexico are often in absolute numbers of animals.

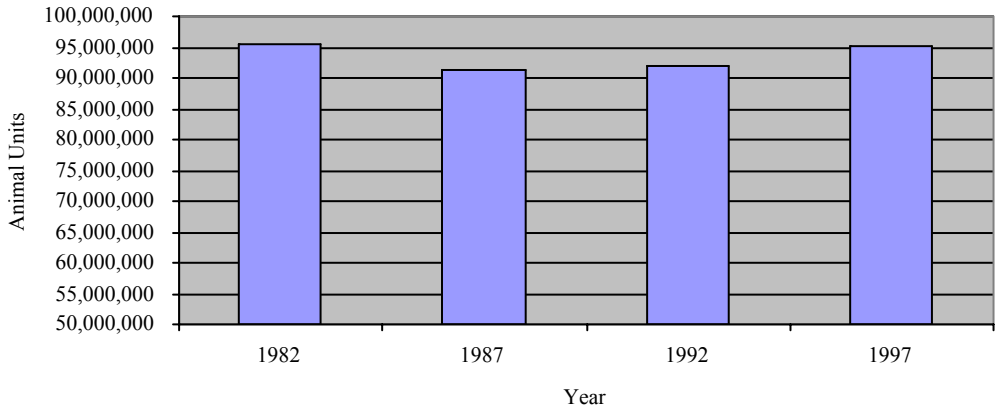
## ILO Trends and Patterns

The trend toward fewer, larger confined livestock operations is clear. In the United States, total animal units (confined and unconfined) remained relatively constant from 1982 to 1997, though the increases in some geographic regions have been dramatic; North Carolina's hog population, for example, quadrupled between 1990 and 2000. The total number of livestock operations decreased by 24%, again with significant regional variability. The number of US operations with more than 1,000 AUs increased by 47% from 1982 to 1997, and the number with more than 300 AUs increased by 67%. The number of confined AUs on livestock farms with at least 1,000 AUs increased by 88% during this period (Kellogg *et al*., 2000). In short, livestock operations became fewer and larger, and the largest among them became even larger. In Canada, 36% of all AUs were produced on operations of greater than 300 AUs, with 60% of these on farms with very high stocking rates (greater than 2 AUs/acre) (Beaulieu, 2001). Half of Mexico's milk and pork and over 90% of its chickens are estimated to be produced in intensive operations.

The following charts demonstrate the relative stability in "total animal units," the decline in the number of farms, and the dramatic increase in the number of animals on large farms in the United States, where the most comprehensive data is available.

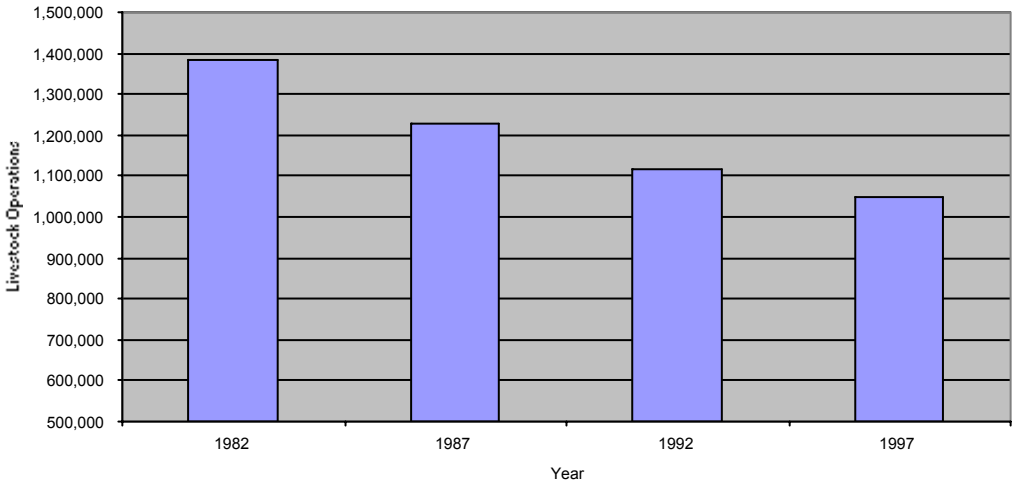
[24] Alfred Beck, Manager, Environmental Livestock Program, Manitoba Conservation, personal communication, December 2002.

**Figure 1.** Total animal units on U.S. livestock operations



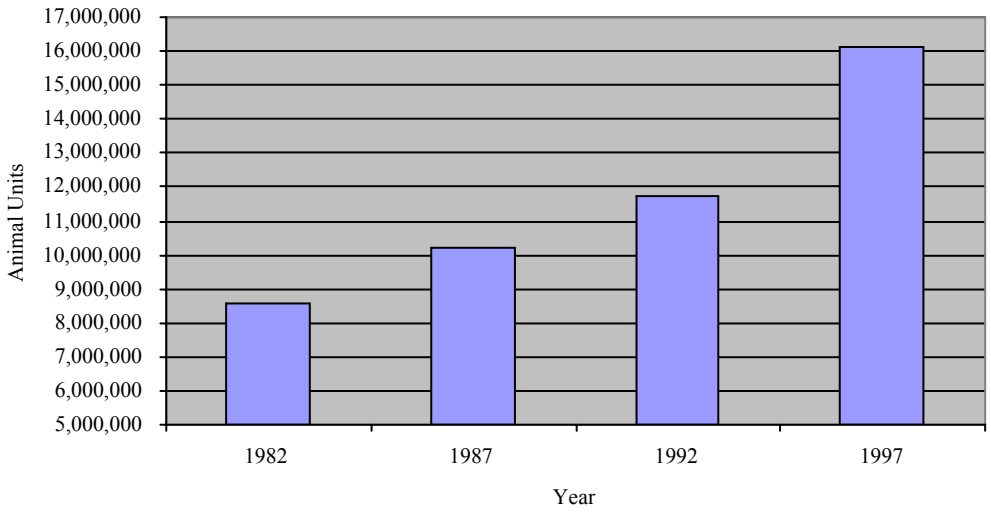

Source: Kellogg *et al*., 2000.

**Figure 2.** Total number of U.S. livestock operations




Source: Kellogg *et al*., 2000.

**Figure 3.** Total animal units in confinement on U.S. livestock operations with at least 1,000 animal units




Source: Kellogg *et al*., 2000.

Another reason for concern regarding ILOs is the trend in spatial distribution. The census data compiled by Kellogg et al. (2000) for the US show that the increase in the number of large livestock operations is concentrated in geographic pockets. These areas include 1) from Wyoming and southern Montana east through Iowa, southern Minnesota, and central Wisconsin, 2) from eastern Texas north through western Arkansas and Missouri, and 3) pockets in the east from northern New York south through North Carolina. Many of these areas have traditionally had the highest livestock populations in the country, but a few, such as North Carolina, grew dramatically over the past 15 years. Map 1 (*see appendix*) shows the increase in large confined livestock operations throughout the United States

In Canada, the greatest concentration of AUs is in the "feedlot alley" of central and southern Alberta and along the southern tier of Ontario and Quebec (Beaulieu, 2001). Map 2 (*see appendix*) shows the estimated distribution of livestock manure for Canada in 1996 based on Census of Agriculture data. A large proportion of dairy (78%), poultry (74%), and swine (60%) are located in the most populous and fastest growing provinces (Caldwell, 1998). The provinces with the greatest increase in manure production from 1970 to 1995 were British Columbia (45%), Alberta (43%), and Manitoba (25%) (Statistics Canada, 2000). Increased numbers of animals in areas of already high livestock densities further tax the ability of local soils to assimilate the increased manure nutrients associated with production, though regulations (in at least some provinces) attempt to match nutrients in applied manure with the capacity of the vegetation.

**Factors Affecting ILO Growth**

Several factors are influencing the re-structuring of the livestock production industry in North America. The primary influences are economic. Livestock production is characterized by a large number of producers selling a nearly homogeneous product. Producers have little control over the price that they receive for their products. Although cyclical in nature, product prices often do not keep pace with the increase in prices for supplies or the rate of inflation, resulting in reduced profit margins (Moss, 1992). Often, producers must decide whether to increase their size to gain economies of scale and reduce production costs per animal, or to leave the industry. As some producers exit the industry, others expand the size of their operations. Technical innovations (including new breeds) have also made it feasible to house larger and larger numbers of animals at one facility, with reduced labour costs.

The use of "vertical alliances" or "vertical integration" in certain livestock sectors, replacing more traditional market mechanisms, is also having a pronounced effect on the structure of the livestock industry. Vertical integration in the livestock industry refers to the consolidated ownership of various phases of the production process (the animals, meat processing facilities, and sometimes grain operations, feed mills and even retail stores) and involves the use of "production contracts." Production contracts typically involve an incentive-based fee paid to the farmer, or "contract grower," for production of a pre-specified quantity of livestock. With production contracting, some combination of production inputs, management decisions, technologies, and financing are often supplied by the integrator, which is often the processor.

The trend toward vertical integration in the livestock sector is driven largely by the integrator's desire to reduce costs. Very large processing plants constructed during the past decade require large and continuous shipments of livestock to keep costs low. A single, modern slaughterhouse can process as many as 30,000 hogs per day (roughly 10 million per year). Transaction, administrative, and transportation costs can be reduced by contracting with fewer, larger producers in close proximity to the processing facilities. Securing a uniform, dependable flow of homogeneous product also reduces the costs associated with measuring and sorting livestock for quality assurance.

For risk-averse producers, production contracts can be desirable because they transfer much of the risk of fluctuating market prices to the integrator. This reduced risk, in turn, encourages producers to increase the size of their operations (Martinez, 2000). All these factors contribute to the trend toward fewer, larger farms and to the concentration of producers, especially in the poultry and swine industries, around processing plants.

Vertical alliances have dominated the US poultry sector since the late 1950s. According to the USDA, 95% of poultry were produced under contract in 1998 (Perry and Banker, 2000). A similar pattern has emerged in the swine industry during the 1990s. Hogs produced under contract in the United States went from 10 percent in 1993 to greater than 50% in 1999 (Perry and Banker, 2000).

The four largest US beef processing firms increased their combined market share greatly during the 1980s; it has remained at roughly 81% since 1993 (USDA-GIPSA, 2001). The four largest US pork processors increased their market share from 40 to 56% during the 1990s (USDA-GIPSA, 2001). In theory, this level of concentration in the processing sector should not affect prices paid to farmers, if sufficient competition among the remaining processors continues. However, with fewer purchasers of livestock, there are fewer market options through which producers can sell their product, which can result in lower average prices to producers, due to such factors as increased transportation expenses to reach the closest processor.

In production contracting, the producer often does not own the commodity being produced. Essentially, the farmer's labour and facilities are hired by the integrator. Most often, however, compliance with environmental regulations is the sole burden of the producer, even if the integrator owns the animals producing the manure. Recent policy debates have focused on whether integrators should share the responsibility for the environmental performance of these operations.

## Spatial and Size Distribution of ILOs by Sector

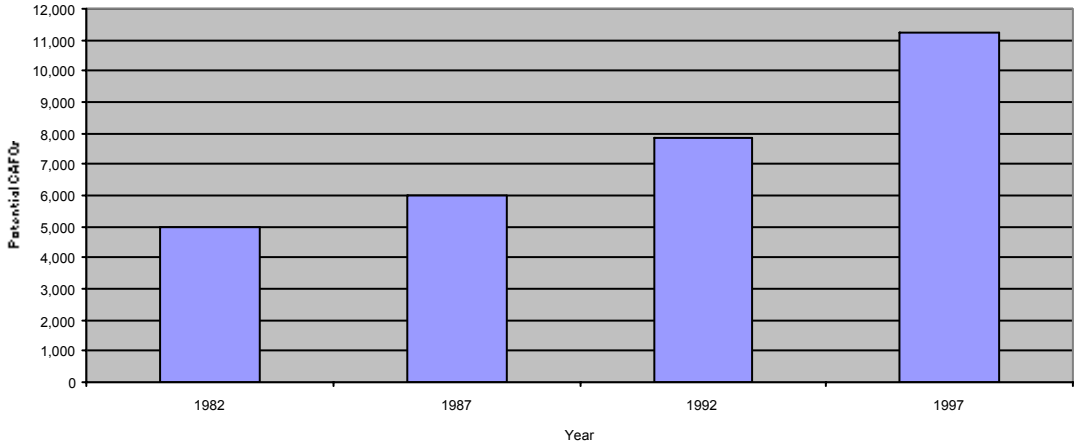
This report focuses on four sectors of livestock production: beef, dairy, swine, and poultry. The following is an overview of the economic and spatial distribution of livestock production for each sector by country, based on available data.

### *United States*

The US definition of CAFOs is based on the *average* number of animals at a facility throughout the year. The US Census of Agriculture, however, the most complete source of statistics, collects data as of a single day at facilities. To bridge this distinction, Kellogg and others, who have done the most recent study of livestock production statistics, employ the term "potential CAFO." According to their research, 11,242 operations met their criteria as "potential CAFOs" in 1997 among all four types of livestock operations. While this represents only 1.1% of all livestock operations in the United States, it is an increase of 127% in the number of potential CAFOs since 1982 (figure 4). In 1982, AUs at potential CAFOs represented 9% of the total AUs produced in the United States. By 1997, this number had increased to 17% (Kellogg *et al*., 2000).

The trends in the number of potential CAFOs varies widely by livestock sector. Because of rapid changes in the swine and poultry sectors during the 1980s and 1990s, 72% of all potential CAFOs in 1997 were in these two sectors. Beef finishing and dairy operations together comprised the remaining 28% (Table 1).

**Figure 4.** Livestock operations categorized as potential CAFOs




Source: Kellogg *et al*., 2000.

**Table 1. Number of potential CAFOs by livestock type, 1982 and 1997**

| Year | Beef | Dairy | Swine | Poultry |
|---|---|---|---|---|
| 1982 | 2,325 | 451 | 1,040 | 1,185 |
| 1997 | 1,897 | 1,296 | 4,374 | 3,763 |
| Change | -18% | 187% | 321% | 218% |

Source: Kellogg *et al.,* 2000

**Table 2. Total animal units by livestock type, 1982 and 1997**

| Year | Beef | Dairy | Swine | Poultry |
|---|---|---|---|---|
| 1982 | 9,706,927 | 14,652,378 | 7,330,637 | 4,032,844 |
| 1997 | 9,588,189 | 12,289,085 | 8,522,082 | 6,122,411 |
| Change | -1% | -16% | 16% | 52% |

Source: Kellogg *et al.,* 2000

*Beef*

The number of beef cattle AUs in finishing operations (fattened cattle) in the United States was fairly constant from 1982 to 1997 at just under 10 million. Almost all of the animals in this sector are confined. While beef production accounted for only 17% of the total number of potential CAFOs in 1997, and decreased over time, no other sector shows farm size distribution so skewed toward the largest farms. The number of beef finishing operations (of all sizes) decreased by 50% from 1982 to 1997, while the total beef AUs decreased by only 1%. The greatest number of confined beef cattle and the fastest growth rate are in the Central Great Plains and the West.

*Dairy*

This is the only sector that showed a significant decrease (16%) in total animal units from 1982 to 1997 (Table 2). It is also the only sector that retains a majority of animal units on smaller farms. However, the number of farms with fewer than 150 AUs has fallen by 61% from 1982 to 1997 (Kellogg *et al*., 2000). The predominant regions for dairy production are the traditional Dairy Belt (Northeast and North Central states) and the West. The West, and the Southwest in particular, has experienced very rapid growth in dairy production in recent years, mostly in the form of very large confinement operations. There are also pockets of dairy expansion in New York, Pennsylvania, northern Florida, and Texas. The number of farms with greater than 1,000 AUs nearly tripled between 1982 and 1997 (Table 1).

*Swine*

The total number of swine AUs increased by 16% from 1982 to 1997 (Table 2). By 1997, 97% of US swine production was in confinement. Farms with fewer than 150 AUs decreased by 70%, while the number of potential swine CAFOs increased by 321% (Table 1). Operations with 5,000 hogs or more comprised 50.5% of the US hog inventory in the year 2000, up from 40% in 1995 (USDA-GIPSA, 2001). This rate of increase in economic concentration in the swine sector in the United States is greater than in any other livestock sector.

The spatial concentration of swine production in the United States is dramatic. The focal point is Iowa and surrounding areas, North Carolina, the panhandle of Texas, and

Arizona. Many parts of the Midwest have experienced declining swine numbers in recent decades. (See Map 1.)

*Poultry*

The poultry sector experienced the greatest increase (52%) in total AUs from 1982 to 1997 (Table 2). At the same time, the number of poultry operations decreased by 46% and the number of potential CAFOs increased by 218% (Table 1). The areas of greatest growth since 1982 have been central Minnesota, the mid-Atlantic region (especially North and South Carolina), northern Alabama, and western Arkansas.

### *Canada*

The distribution of AUs per operation by livestock sector in Canada is quite different from the United States The Canadian livestock sector is dominated by beef production, with dairy a distant second. The following data rely on the 1996 Canadian Census of Agriculture (the most recent census). Information on the spatial distribution of manure production shows that the areas of greatest livestock concentrations are in southern Alberta (predominantly beef) and the southern tier of Quebec and Ontario (mostly dairy, beef and swine) (See Map 2).

*Beef*

The beef industry in Canada has approximately 6.8 million AUs, and is responsible for 51% of the total livestock AUs and manure production in the country (Beaulieu, 2001). Beef production is dominated by Alberta, where 78% of the AUs are beef cattle. Fifty percent of the AUs nationwide are on farms with more than 400 total animal units. Western provinces host an even greater percentage of large operations. In Alberta, 79% of beef cattle are on operations with more than 400 animal units (Beaulieu, 2001).

*Dairy*

In Canada, dairy comprises 17% of the total AUs. Dairy production is concentrated in Quebec and Ontario, with limited production in Alberta, British Columbia, and the Atlantic provinces. As in the United States, the Canadian dairy industry is still dominated by smaller farms. In 1996, 84% of the dairy AUs were on operations of less than 200 total animal units (Beaulieu, 2001). The government's supply management (i.e., quota) system guarantees a "fair" price to farmers for milk produced up to each farm's quota. Acquiring the necessary production quota to increase farm size is often quite difficult. Thus, the quota system contributes to the dominance of smaller dairy farms in Canada.

*Swine*

The swine industry represented only 8% of Canadian livestock AUs, comprising just less than 1.1 million total animal units in 1996. Quebec and Ontario are the leading pork producing provinces. Historically, production in these provinces has been on smaller farms. Currently, the number of AUs on swine operations is relatively equal among

small, medium and large farms (Beaulieu, 2001), suggesting that larger swine operations are increasing their share of the Canadian swine sector.

*Poultry*

The poultry sector, measured in AUs, is the smallest of the Canadian livestock industry, accounting for only 5% of animal units. Ontario is the leading poultry producing province, followed by Quebec. Like pork production, poultry AUs are distributed fairly uniformly across farm sizes.

### *Mexico*

Most livestock sectors in Mexico are dominated by small-holder operations using non-intensive production systems. However, like Canada and the United States, the number of large operations has increased significantly during the past decade. Data limitations regarding farm size prevent precise estimates of the number or increase in ILOs, yet some trends are apparent.

*Beef*

Traditionally, in Mexico, cattle are grazed, and cattle production still occupies slightly more than 50% of the nation's territory. Confinement operations for finishing (fattening) beef cattle have established a significant presence in Mexico only in the last two decades. In the mid-1980s, approximately one-million tons of dressed beef were produced from feedlots. This has increased by 40% to 1.4 million tons in the year 2000. Currently, more than 80% of cattle raised for slaughter in Mexico are still extensively grazed. Fifty-six percent of the beef production is concentrated in eight states, with 30% in Veracruz, Jalisco, and Chiapas alone (Pérez Espejo and González Padilla, 2001). The following chart provides an estimate of the number of intensive beef operations for selected states where the data is available:

**Intensive Livestock Operations – Beef Cattle**

**Feedlots**

| State | From 1,000 to 5,000 head | More than 5,000 head |
|---|---|---|
| Baja California | 8 | 4 |
| Coahuila | 11 | 5 |
| Chihuahua | 18 | 4 |
| Jalisco | 20 | 5 |
| Michoacán | 2 | |
| Nuevo León | 26 | 8 |

| | | |
|---|---|---|
| San Luis Potosí | 10 | 2 |
| Sinaloa | 12 | 6 |
| Sonora | 25 | 8 |
| Tamaulipas | 20 | 4 |
| Veracruz | 3 | 1 |
| Zacatecas | 5 | |
| Total | 160 | 47 |

Sources: FIRA, AMEG, private consultants, and feedlot operators.

Based on estimates from the Mexican Association of Feedlot Operators (*Asociación Mexicana de Engordadores de Ganado*—AMEG), 1.6 million animals were fattened in the year 2000. In general, each feedlot goes through between 2 to 3.5 fattening cycles in a year. A 1998 study by the Trust Fund for Poultry and Livestock Production (*Fideicomiso Fondo de Garantia para la Avicultura y la Ganaderia* – FIRA*)* indicates that 53% of feedlots, having an average of 11,000 animals, were in the hands of 10% of AMEG members.

*Dairy*

There has been a marked increase in the number of confined dairy animals throughout Mexico during the 1990s, though Mexico remains one of the world's largest importers of powdered milk. This increase is partly due to a liberalization of milk pricing policies. The total dairy herd is estimated to be 3.98 million cows, with approximately 50% of the milk produced by intensive facilities (Pérez Espejo R. and González Padilla E., 2001).

Nine states produce 71% of the milk in the country. Specialized milk production operations are concentrated in the western and north-central parts of the country. The Laguna (Durango and Coahuila) region produces 32.6% of the nation's milk. It is followed by Guanajuato (Bajío) with 12.7%; Jalisco (Altos and Ciénega) with 8.1%; Aguascalientes with 8.0% and Chihuahua (Delicias and Juárez) with 5.4%. Both La Laguna and Chihuahua host facilities with 2000–6000 cows. Though the most common herd size for larger, modern farms is 100–500 cows, the general trend in Mexico is toward total confinement production systems that produce more milk with increasingly large herds.

The following chart provides an estimate of the number of intensive dairy operations for selected states where the data is available:

**Intensive Livestock Operations – Dairy Cattle**

**Herds of dairy cattle**

| State | From 500 to 1,000 head | More than 1,000 head |
|---|---|---|
| Aguascalientes | 30 | 10 |
| Chihuahua | 2 | 10 |
| Hidalgo | | 1 |
| Jalisco | 8 | - |
| La Laguna | 60 | 60 |
| Michoacán | 10 | - |
| Querétaro | 25 | 6 |
| Sonora | 2 | - |
| Total | 137 | 87 |

Sources: Private consultants

*Swine*

Mexican exports of pork increased dramatically during the 1990s—from 511 tons in 1990 to 31,711 tons in 2000 (Pérez Espejo and González Padilla, 2001). Although data do not exist on the size of the farms from which the exports originated, it is likely that the larger, intensive operations were supplying a large share of the export market. It has been estimated that 50% of the nation's swine production comes from intensive operations.

Central Mexico has been the dominant area for swine production. The largest intensive pork production zones are the Valle del Mayo, Valle del Yaqui and Costa de Hermosillo areas of Sonora; Los Altos, Jalisco; Santa Ana Pacueco, Irapuato, Abasolo and León, Guanajuato; La Piedad, Michoacán; Tehuacan and Tecamachalco, Puebla. Recently, large operations have been established in the Zona Henequenera, Yucatán and in Perote, Veracruz (Pérez Espejo and González Padilla, 2001). Jalisco, Sonora, Guanajuato, and Yucatán now account for 53% of all pork production in the country.

The most notable case of growth in intensive swine operations is Yucatán, where the herd grew from 1.2% of the total in the first half of the 1980s to 7.2% for the last half of the 1990s, a consequence of the opening of three new, large operations in the state.

The intensification of swine production is also apparent in Veracruz. Though aggregate statistics do not reflect a major change, small and medium-sized operations have largely given way to major agribusiness operations. One company in Veracruz runs about 80,000 total animals at a time, and is projected to double its size in less than 5 years.

A significant factor in this growth is the involvement of companies from outside Mexico. US-based Smithfield Foods, for example, has teamed up with the Mexican company AMSA to develop swine units in the state of Veracruz. Within five years they expect to have 56,000 sows. Smithfield has also teamed up with the Mexican company Agroindustrial Del Noreste in the state of Sonora to export pork to Japan. The US company Cargill operates a feed mill in the Yucatán to supply feed for GPM, Mexico's largest pork producer.

The following chart provides an estimate of the number of swine operations, by various sizes, in selected states where the data is available. Note that the definitions of small, medium, and large vary from state to state, as indicated in the parentheses.

**Intensive Livestock Operations**
**Swine inventory**

| State | Small | Medium | Large |
|---|---|---|---|
| Guanajuato | 1,371 (up to 100) | 127 (101-500) | 37 (more than 500) |
| Jalisco | 2,364 (up to 70) | 500 (71-250) | 349 (more than 250) |
| Michoacán | 594 (up to 70) | 82 (71-250) | 74 (more than 250) |
| Sonora | - | 78 (200-500) | 187 (more than 500) |
| Veracruz | - | - | 1 (more than 5,000) |
| Yucatán | 108 (up to 250) | 15 (251-500) | 6 (more than 500) |
| Total | 4,437 | 802 | 654 |

Sources: Regional Pork Producers Unions, Regional Livestock Unions, and private consultants.

*Poultry*

Poultry production in Mexico more than doubled during the 1990s. The technology and scale of poultry operations are thought to be on par with that of the United States (Pérez

Espejo and González Padilla, 2001). Large operations are common. Production is highly concentrated, with more than 90% of the laying hens in intensive operations. Six companies account for 28% of national egg production, and four companies control 46% of the broiler chicken market. This concentration is increasing as a result of recent purchases of medium-sized poultry enterprises by the largest Mexican firms. Production is also highly concentrated geographically. Two states alone, Jalisco and Puebla, account for approximately 50% of egg production, for example (Pérez Espejo and González Padilla, 2001).

**Summary of ILO Status and Trends**

The available data clearly show trends toward economic and geographic concentration within each country in the major livestock industries. The search for economies of scale, and the increasing frequency of production contracting, especially in the United States, are fostering the development of larger livestock operations.

In the United States, the majority of "potential CAFOs" are in the swine and poultry sectors. Dramatic growth in specific regions, such as the coastal plain of North Carolina, the Delmarva Peninsula (of Delaware, Maryland and Virginia) and north-central Iowa, during the past two decades has prompted increasing concern about the environmental impacts of these large swine and poultry operations. Dairy CAFOs are also on the rise, mostly in non-traditional dairy regions in the South and West.

In Canada, beef ILOs have historically been the greatest concern, but large-scale swine operations are an emerging issue. Canadian beef production is concentrated in south and central Alberta. Considerable expansion in swine production has occurred recently in Manitoba, Saskatchewan and Alberta. The potential for manure nutrient problems is also large from the abundance of smaller dairy, beef, and swine operations in southern Quebec and Ontario.

In Mexico, as in the United States, the greatest concerns are from the swine and poultry sectors. Rapid growth in these sectors, combined with an increase in the use of modern production systems are taxing the current regulatory system.

**Environmental and Human Health Concerns**

The increase in ILOs has triggered several environmental and human health concerns. Water quality, air quality, soil contamination, and antibiotic and hormone use are among the major issues (US EPA, 2001). Worker health is a growing concern, as is the health of people downwind and downstream of ILOs. Research to assess the potential problems is expanding, but is still small and incapable of establishing a relative ranking of the risks. Indeed, the risks vary over the countries and their regions according to the different pressures caused by ILOs and the environmental capacities of the regions to tolerate the increased animal numbers and wastes. The environmental and health risks caused by an ILO depend on the type of manure handling technologies and practices used and on the

quality of management. It is often difficult to scientifically isolate the environmental and human health impacts caused by ILOs. The potential problems stem from concentrating so many animals in one location that the manure cannot be disposed on land, or the associated gases released into the air, without causing damages to the surrounding ecosystem, its inhabitants, and downstream (and downwind) residents. This may be termed a 'stocking density' problem (Gollehon, Heimlich and Ribaudo, 2001). If an ILO has adequate nearby lands to apply manures in ways that do not cause environmental and human health problems, serious issues may not arise. It is possible for smaller livestock operations to cause pollution and human health problems if their stocking densities are too high or they are poorly managed. Hence, all ILOs should not be interpreted to cause the same types of environmental and health risks. Again, the data generally do not permit quantitative estimates of the relative risks from different types of ILOs. Nonetheless, the sheer size of ILO manure flows increases the probability of catastrophic pollution events, compared to smaller and non-confined livestock operations.

Despite the caveats, the recent imposition of compulsory environmental standards for ILOs in the United States and Canada indicates serious public concerns. Traditionally, environmental programs for agriculture in the United States and Canada have differed from those for other industries, both because of the difficulty of controlling diffuse (nonpoint) pollution sources over a vast land base, and because of political preferences for treating family farms and ranches differently than other industries. Voluntary approaches have been most commonly used to control environmental impacts from agriculture, often accompanied by compensation to encourage participation.

Over the past decade, widely publicized pollution problems involving ILOs have contributed to an increasing use of regulatory approaches. Manure spills into rivers and estuaries, bacterial contamination of water supplies, nutrient pollution in groundwater in some areas, and highly offensive odours have given political legitimacy to the imposition of direct controls for the environmental and health risks. This growth in regulations for ILOs has come predominantly at the state and local levels in the United States (though a new, revised set of federal regulations have recently added new national requirements), and the provincial and municipal levels in Canada (Carpentier and Ervin, 2002; Fox and Kidon, 2002). Mexico's regulation of ILOs has also tended more to the state and municipal level in recent years, though the applicable law is primarily federal.

### ***United States*** [25]

#### *Water Quality*

Agriculture's contributions to water pollution have gradually risen in policy importance in the United States The early emphasis on regulating industrial and municipal point-

[25] This discussion of environmental concerns in the U.S. draws from a chapter by C. Line Carpentier and D. Ervin, "USA" in *Public Concerns, Environmental Standards, and Agricultural Trade* (F. Brouwer and D. Ervin, eds.) CAB International, 2002.

source discharges significantly reduced water pollution flows from many non-agricultural sources. Yet, many rivers, lakes and streams in the United States remain unfit for their designated uses.

Data from state assessments of water quality collected by the US Environmental Protection Agency (EPA) suggest significant agricultural pollution of surface waters. Only 64% of the nation's surveyed rivers, 61% of lakes, and 62% of estuaries met the 'swimmable and fishable' quality goals in 1996 (US EPA, 1998a). Of the sampled waters not meeting the goals, farming and ranching were sources of water-quality impairment in 70% of the river miles, 49% of lakes, and 27% of estuaries.

Findings from the US Geological Survey's (USGS) National Water Quality Assessment affirm that agriculture plays a significant role in surface-water quality (USGS, 1998). Their scientists have estimated that 71% of total farmland lies in watersheds where at least one agricultural pollutant violates criteria for recreation or ecological health (Smith *et al*., 1994). A national assessment for the US Congress identified the impairment of surface waters as particularly significant in the Midwestern Corn Belt, where pesticide residues, sediment and nutrients, some from animal wastes, are concentrated in many streams, rivers, and lakes (US Congress, 1995). Contamination of groundwater sources of drinking water is also an issue of concern, with nitrates from fertilizers and manure causing serious problems in certain regions.

With the growth in large feeding operations, the contribution of animal agriculture to water pollution has become increasingly evident in the United States, CAFOs, as ILOs are known in the US, can cause several types of water pollution (US EPA 2001). Nitrogen and phosphorus constitute both the largest magnitude of water pollutants from CAFOs and the most important nutrient sources of water-quality problems in the US generally (USDA, 1997a). Other water contaminants that may be produced by livestock operations, of whatever size, include: organic compounds, mineral salts and trace elements, such as zinc.

Pollutants from CAFOs can enter surface water and groundwaters in several ways:

- accidental breaching of manure storage structures, with flows entering surface waters directly or running into groundwater through sinkholes or fractures;
- runoff from cropland and pasture where manure has been applied, or from feedlots, into surface waters;
- leaching through the soil profile to groundwater caused by rainfall or irrigation; and
- atmospheric deposition of ammonia nitrogen from lagoons and sprayfields.

Quantifying the extent of animal agriculture's effects on water quality across the United States is a very difficult task due to incomplete monitoring data. However, recent analyses provide some estimates. For example, animal operations are estimated to be responsible, in part, for at least 50,000 kilometres of impaired waters in 22 states that have categorized impacts by type of agriculture (USDA, 1998b). In 1998, states that

categorized the sources of water pollution impacts on rivers estimated that intensive animal operations caused 15 percent of the impairments due to agriculture (US EPA 2001). USGS scientists estimate that nitrogen from manure was the major contributor to nutrient enrichment problems in six of 16 watersheds studied, mostly in the Southeast and Mid-Atlantic states (Puckett, 1994).

Mallin identifies the root source of the problems as too many 'new nutrients,' i.e., importing more nutrients in livestock feed than can be safely applied on local cropland when that feed is converted to manure. If applied to land in excess of the ability of crops to utilize them, the nutrients can cause algal blooms, loss of habitat, changes in aquatic biodiversity, and the depletion of dissolved oxygen. (NRC, 2000). Transporting these nutrients from areas of excess to areas of need appears to be prohibitively expensive.

Nutrient problems can be regional in scope. In one high-profile case, the federal government and states surrounding the Chesapeake Bay have undertaken a massive program (mostly voluntary to date) to reduce nutrient pollution in the Bay, about one third of which is attributed to agricultural sources--cropland runoff and animal manure, mostly from large chicken operations. In another regional issue, USGS scientists (1999) found that hundreds of thousands of metric tons of agricultural contaminants end up in Louisiana's Gulf Coast estuaries, contributing to an off-shore 'dead zone.' They concluded that 70% of the total nitrogen delivered to the Gulf originates above the confluence of the Ohio and Mississippi Rivers, transported over distances in excess of 1,500 kilometres ul

expansion in the pork industry was moving to Canada because producers were finding themselves "stymied by a myriad of new laws and regulations" in the United States[26]

In addition to degrading surface water quality, nutrients from agriculture can affect groundwater through leaching and run-in (i.e, direct flows into groundwater through sinkholes, fractures, etc.). Groundwater supplies half of the US population with drinking water and is the sole source for most rural communities. For this reason, contamination of groundwater often tops the list of public environmental concerns. The extent of groundwater pollution from agricultural nutrients is less well-documented than for surface waters. The most serious problem sources appear to be nitrates from inorganic fertilizer and animal manure.

Though the levels of nutrients applied to farmland via commercial fertilizers are five times as large as from animal manure (NRC, 1993), groundwater contamination may be linked to ILOs in certain areas. Findings from a national water-quality assessment showed that 12% of domestic wells in agricultural areas exceed the maximum contaminant level (MCL) for nutrients (Mueller and Helsel, 1996). This rate of contamination was twice as high as for domestic wells in the vicinity of other land uses. Later analysis of groundwater nitrate sampling data concluded that areas showing the highest levels have high nitrogen input (such as from fertilizer and manure), well-drained soils, and less-extensive forested areas relative to cropland (Nolan *et al*., 1998).

*Manure spills*

Though animal sources account for a smaller proportion of water pollution from nutrients than crop production, ILO spills can cause significant acute damages in localized areas. Mallin (2000) has assessed a variety of damages to rivers and estuaries in North Carolina due to ruptures and breaches in CAFO hog and poultry manure and wastewater lagoons during the 1990s. Three themes emerge. First, the large concentrations of pollution from the accidents often cause conditions to fall short of water quality standards by multiple factors, e.g., five or more. For example, one spill reduced dissolved oxygen levels to one fifth of the minimum water quality standard and resulted in phytoplankton blooms nearly eight times the maximum standard; such blooms may contain harmful algal species such as *Pfisteria piscicidas*. Second, the spills release not only nutrients but other contaminants as well; high bacteria levels (likely from fecal coliform) were also present. Third, nutrient and bacteria pollutants remained in the water system for extended periods of time—as long as 60 days. The presence of the pollutants for long periods continues to degrade water quality conditions that are necessary for healthy stream biology.

Data to describe such lagoon spills and overflows during large rain events for the entire United States have not been collected and analysed to determine the frequency and extent of such problems.

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[26] "Sow Herd Building Again: This Time It's Canada Making the Move," *Successful Farming,* Oct. 24, 2000.

*Pathogens*

Livestock manure can carry many forms of pathogens, including bacteria, protozoa, and viruses. Multiple types of pathogens may be transmitted from manure entering into surface and ground waters (US EPA, 2001), and water pollution risks from pathogenic contamination by bacteria have been broadly associated with animal agriculture in the United States (Gollehon et al, 2001). The survivability of bacteria depends on the soil type, manure application rate, and soil pH. *Cryptosporidia* and *Giardia*, important etiologic agents linked to beef and dairy herds, may cause outbreaks of waterborne diseases (CDC, 1996). Other sources of bacteria include inadequately treated human waste and wildlife. EPA has estimated the cost to drinking water utilities for improved bacterial control at approximately $20 billion over 20 years, with half required immediately to meet existing standards (U.S. EPA, 1997). But the linkages between such bacterial contamination and ILOs, specifically, or smaller livestock operations, have not been generally established in the literature.

*Air Quality*

Large animal feeding operations release a variety of air pollutants, including: hydrogen sulphide, ammonia, dusts, endotoxins, and methane (USDA, 1997a). Although water quality problems have received the most scientific (and regulatory) attention, air quality concerns are another force propelling a re-consideration of ILO regulations. Total ammonia emissions from agriculture in the North Carolina Coastal Plain have been estimated at approximately 97.7 million kilograms of nitrogen; hog operations were responsible for 63% of these emissions (Rudek, 1997). This atmospherically deposited nitrogen then contributes to water pollution and to deleterious impacts on wetlands, aquatic life, coastal ecosystems, etc. (NRC 2000). Data from the National Atmospheric Deposition Program in the North Carolina Region indicates that ammonia in rain there has doubled in the past decade, a period in which the hog population of the area has also roughly doubled. (DAQ 1999). Exposure to hog farm fumes has caused human-health problems in workers and is an issue rising in importance at the local and state level.

To date, the Clean Air Act and its 1990 amendments have had very few impacts on farming. CAFOs are not required to implement air pollution or odour monitoring or control. Research in the US has estimated some effects of air pollution by CAFOs on human health. For example, Wing and Wolf (2000) surveyed residents of three rural communities, one in the vicinity of a 6,000-head hog operation, another in the vicinity of two intensive cattle operations, and a third without livestock operations. Certain respiratory and gastrointestinal problems, such as headaches, runny noses, sore throats, excessive coughing, diarrhea, and burning eyes, were significantly higher among residents in the vicinity of the hog operation than among the residents of the community with no intensive livestock operations. Quality of life, as indicated by the number of times residents could not open their windows or go outside even in nice weather, was similar in the control (i.e., non-CAFO) area and the community in the vicinity of the cattle operation, but greatly reduced among residents near the hog operation. The authors noted that their findings were consistent with the results of previous studies of workers in intensive swine operations and of the neighbours of such facilities.

*Soil Contamination*

Animal manure may also contain pollutants that contaminate soils (Copeland and Zinn, 1999). For example, the manures may include trace amounts of heavy metals, such as copper, selenium, zinc, cadmium, molybdenum, nickel, lead, iron, manganese, aluminium, boron, and some salts that can be transported to the environment via the application of animal manure to land. These pollutants can impact soil and aquatic environments, including plants, aquatic organisms and terrestrial organisms (US EPA, 2001). For example, accumulations of zinc, a feed additive, can be toxic to plants. Notably, several of the trace elements are regulated as part of the US Clean Water Act in treated municipal sewage sludge, but not in animal manure (US EPA, 2001). Long-term effects on soil biota of repeated applications of manure has also been a concern in some circles. Research that documents such soil contamination problems, the linkages to ILOs, and the magnitude and extent of the environmental risks is generally not available.

*Antibiotic and Hormone Use*

Intensive livestock and poultry producers commonly use antibiotics and hormones to control diseases among animals confined in close quarters and to maximize growth. The use of rBST (recombinant bovine somatotrophin) in dairy production is an example. The US Food and Drug Administration (FDA) regulates these compounds to be safe for human consumption, but not for their ultimate fate or potential environmental impacts. The genetically modified version of a naturally occurring protein hormone in cows, rBST is injected into dairy cows to boost production. It was approved by the FDA in 1993 and is used in 30% of dairy herds in the USA.

The use of antibiotics in animal feed has become a high-profile public policy issue in the United States More strains of antibiotic-resistant pathogens are emerging. Antibiotic-resistant forms of *Salmonella, Campylobacter, Escherichia coli*, and *Listeria* have been identified or are suspected (US EPA, 2001). One form of antibiotic-resistant bacterium was detected in groundwater under farmland treated with swine manure, but was nearly absent in water under lands where swine manure had not been applied (US EPA 2001). An official of the federal Center for Disease Control and Prevention (CDC) has stated publicly that there is a relationship between widespread antibiotic use in animal agriculture and the remarkable increase in resistant foodborne pathogens (Argulo, 1998). He also argued that the EU's recent ban of four animal antibiotics is scientifically justified.

One indication of the breadth and volatility of this argument can be found in the current (January 2003) webpage of the Union of Concerned Scientists (UCS):

> UCS's Food and Environment Program's newest project focuses on reducing the use of antibiotics in food animals . . . .
>
> Antibiotic-resistant bacteria are on the rise . . . . And as more bacterial strains develop resistance, more people will die because effective antibiotics are not identified quickly enough or because the bacteria causing the disease are resistant to all available antibiotics.

> Why have bacterial strains become resistant? The short answer is overuse of antibiotics [by physicians, veterinarians and farmers] . . . .
>
> About 25 million pounds of antibiotics are fed every year to livestock for growth promotion and disease prevention, almost eight times the amount given to humans to treat disease. Both the Centers for Disease Control and the World Health Organization have called for an end to the use of antibiotics that we depend on in human medicine as growth promoters.
>
> One of our top priorities is to convince the Food and Drug Administration to severely curtail the numbers and kinds of antibiotics available for use in livestock production—starting with those drugs important to human medicine.[27]

The American Medical Association has passed a resolution opposing the prophylactic use of antibiotics, urging their termination or phase out in livestock operations.[28] Likewise, the World Health Organization has said that antibiotic use in food producing animals must be curtailed to prevent the increase of drug-resistant diseases in humans.[29]

### ***Canada***[30]

Environmental policy for agriculture in Canada is undergoing dynamic change. Although the federal, provincial and municipal governments all play roles, there is a trend toward more enforcement of environmental standards at the municipal level (Fox and Kidon, 2002). Concerns for water contamination are a driving force. But recent emphasis on developing "minimum distance separation" (MDS) policies for livestock operations (regulating the distances that new livestock facilities must be from neighbours, roadways, property boundaries and watercourses) suggests that air quality and odour problems are also important.

#### *Water Quality*

Available evidence suggests that bacterial contamination of ground and surface water, excess nitrate in groundwater and displaced sediment and phosphorous in surface water pose tangible and immediate risks to environmental quality and human-health in various areas of Canada (Fox and Kidon, 2002). Based on an extensive review of the evidence,

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[27] www.ucsusa.org/food_and_environment/antibiotic_resistance/index.cfm?pageID=10

[28] AMA Resolution 508 (June 2001). Available at www.ama-assn.org/ama/pub/category/7205.html

[29] World Health Organization, "Antibiotic Use in Food Producing Animals Must be Curtailed to Prevent Increased Resistence in Humans," Press Release WHO/73, Geneva (October 20, 1997)

[30] The discussion of environmental concerns in Canada owes much to a chapter by Glenn Fox and Jennifer Kidon "Canada" in *Public Concerns, Environmental Standards, and Agricultural Trade* (F. Brouwer and D. Ervin, eds.) CAB International, 2002.

Fox and Kidon suggest that the leading cause of groundwater contamination in rural Canada is bacterial contamination, followed by nitrate contamination, with pesticide contamination a distant third. The authors note that whether the bacterial contamination can be attributed to agricultural sources continues to be a controversial question. Rural residential septic systems are another potential source of such contamination.

*Pathogens*

A bacterial contamination episode of *E. coli* with connections to animal agriculture occurred in Walkerton, Ontario in the spring of 2000. The contamination emergency, which is thought to have caused seven deaths and more than 2000 cases of intestinal problems, led to the shutdown of the municipal water supply for several months and raised public awareness of the risks from bacterial contamination of groundwater. New standards for management of livestock manure in the province of Ontario are being considered. (It should be noted that the Walkerton facility where the problem arose was not a large, intensive operation.)

Diseases caused by enteric bacteria (e.g., *E. coli, Salmonella, Campylobacter*) come, in many cases, from animal reservoirs (Van Donkersgoed *et al*, 2001). The researchers conclude that an elevated risk of the particular *E. coli* infection in a rural population could be associated with living in areas with high cattle density. The study also suggests that the importance of contact with cattle and the consumption of contaminated well water or locally produced food products may have been previously underestimated as risk factors for this condition (Michel *et al*, 2001). Alberta, the Canadian province with the largest number of beef feedlot operations, also has the largest number of cases of *E. coli* related illness on a population adjusted basis (Gannon, 2001). A high prevalence of this pathogen in the feces of cattle at slaughter and in surface waters in areas that drain from intensive cattle operations has been found. Similar linkages may exist for other pathogens such as *Salmonella, Campylobacter and Cryptosporidium* (Gannon, 2001).

*Nutrients*

Nutrient pollution is a growing environmental problem in some regions of Canada, although generally less serious than in countries with a longer history of settlement and agricultural production, such as the United States and many European nations (Chambers *et al*, 2001). It is reasonable to expect that Canada's problems, without elevated attention, will track the experience of countries with a longer history of large-scale animal husbandry. Animal operations have been identified as an important source of nutrient pollution in certain areas. For example, manure is a local concern in the Fraser River Valley because of its connection with rising nitrate levels in local water supplies (Chambers *et al*, 2001). In the high intensity animal agriculture areas of Quebec, Ontario and Alberta, more nutrients are available than are required by crops grown in some areas. Chambers and colleagues (2001, p. 173) note that phosphate levels in soils are accumulating, and its migration to surface and ground waters poses risks of contamination, especially in the humid regions of Canada.

Despite these local concerns, the evidence linking manure management to deteriorating water quality conditions is generally not robust. Harker *et al.* (1997) concluded that "Within the context of the Canadian Water Quality Guidelines, there is no significant body of evidence to indicate the wide-spread contamination of surface and ground waters from agricultural activities on the prairies" (Harker *et al.*, 1997, p. vii).

Nitrate contamination of groundwater is one of the more common water quality problems associated with intensively fertilized and irrigated croplands on the prairies. The potential for nitrate contamination varies across regions as a result of differences in the intensity of manure and fertilizer application as well as because of precipitation differences and local variations in soils and topography.

Linking agricultural sources of nitrogen, including manure, to excessive levels of nitrate in groundwater has proven difficult because natural background levels in the prairie provinces are high (Harker *et al.,* 1997, p. 44). Baseline data for individual aquifers is limited and further research is needed, especially for areas of intensive land use, for locations where aquifers are shallow, and for areas with high precipitation or where irrigation is used intensively (Harker *et al.,* 1997, p. 49). The combination of high levels of manure application and irrigation has been linked to high nitrate levels in groundwater in an experimental trial near Lethbridge, Alberta (Chang and Entz, 1996).

#### *Air Quality*

The air quality issue most commonly associated with ILOs is offensive odours. With the increase of large beef and swine ILOs in some provinces, public concern about air quality has followed. The siting and operation of these facilities are generally subject to municipal permitting and codes of practice (Fox and Kidon, 2002).

Air quality degradation from ILOs that do not conform with applicable provincial Codes of Practice can trigger criminal and civil penalties. No general assessment of the extent and degree of air quality problems associated with ILOs across Canada exists.

#### *Antibiotic Resistance*

Use of antibiotics for growth promotion causes increased antibiotic resistance in bacteria from animals and an increase in the antibiotic resistance of certain bacterial species from humans. e.g. *enterococci* and some *salmonellas* (Gannon, 2001a). Work on this question has begun in Alberta, but is not yet completed.

### ***Mexico***

The negative impacts of intensive livestock operations on surface waters are directly linked to contamination by fecal matter and other organic wastes produced by large operations, slaughterhouses and meat processing facilities. In some intensive dairy operations in arid regions, overdraft of groundwater for production of forage crops is an additional problem. Groundwater contamination from manure or agro-chemicals from livestock operations is only beginning to raise concerns.

The most serious water impacts are associated with slaughterhouses and hog farms that lack adequate treatment processes for their effluents. Although the problem is localized, it is estimated that these activities account for the release of more organic matter into watercourses and bodies of water than the entire human population of the country.

Until the early 1980s, hog farms were designed to discharge their manure and wastewaters directly into rivers and streams. The situation is particularly critical in part of the Lerma basin, where the majority of hogs are produced. Another area of concern is the Yucatán Peninsula, whose topography, soil structure and shallow aquifers can exacerbate the problem of water pollution if the effluents from the large hog farms and slaughterhouses are poorly managed.

In closed basins in northern Mexico (La Laguna), where groundwater is used for irrigation, overdraft has lowered the water table by about one metre per year. Forage crops for intensive dairy production and beef cattle fattening, the main crops in these areas, contribute significantly to this problem, which could be mitigated with appropriate water-saving irrigation technologies and fodder production systems.

A lesser, more localized impact on soil quality has been the excessive use of manure. This is being monitored more closely in the irrigated areas of La Laguna, where some dairy operations now apply up to 100 tons of manure per hectare per year, which can cause nitrate buildup in the soil. Certain health problems observed in cows in the area have been linked to nitrate concentrations in plants, as well as mineral imbalances that may be caused by changes in soil pH.

### *Status And Outlook For Natural Resources*

Opinions among Mexican experts interviewed for this report varied, depending on the resource and region of the country. For soil, the prevailing opinion is that the situation is bad but not yet critical; overgrazing and poor management are seen as much more important factors in soil degradation than ILOs. Soil degradation is seen as a worsening trend which can only be curtailed through major investments to promote and support the use of appropriate technology.

Water pollution by intensive animal production systems and slaughterhouses is serious, but it is deemed critical in only a few areas. The situation shows signs of improving; but experts note that a significant effort and major investments targeted at the source of the problem will be required.

### *Comparisons with the European Union*[31]

Many European Union Member States have also confronted environmental and health problems associated with concentrated animal feeding operations. The policy response there has generally been to implement more direct controls than in North America.

Nutrient management has been the most prevalent concern. The World Health Organization's standard of a 50 milligram per litre concentration of nitrates in drinking water, comparable to United States and Canadian standards, is exceeded for approximately one fifth of the agricultural lands in EU countries. Nutrient contamination occurs especially in regions where there are concentrations of intensive livestock production (mainly swine and poultry). Parts of Belgium, Denmark, France, Germany, and the Netherlands have been affected. The large hog feeding farms around Rotterdam are a well-publicized example of excessive nutrient pollution.

Control over the land application of manure is increasingly exercised. In addition to EU-wide requirements, some member countries, particularly in Northern Europe, put additional restrictions on the maximum amount of animal manure that may be applied. In Germany, for example, the application of livestock manure must not exceed 170 kilograms of nitrogen per hectare on arable land (200 kilograms per hectare on grassland). Belgium, Denmark, Germany, the Netherlands, France and Italy enforce limitations on "stocking densities," or the number of animal units that may be housed per hectare—an indirect method of limiting manure application.

A moratorium on new intensive operations and on increases in production has been instituted in the Netherlands, in an attempt to limit manure production application to 125 kilograms of phosphates per hectare. Manure storage requirements are also in place in many regions, especially those with a concentration of intensive livestock facilities.

Odour and other air quality issues are major nuisance concerns at the local level in regions with intensive livestock production units. Ammonia is a particular concern in regions with a high concentration of intensive livestock operations. Over 90% of total ammonia emissions in the EU (and the subsequent acid deposition) originate from agricultural activities, primarily animal production systems.

Odour problems are addressed through a variety of development and land use planning laws, both national and local. Permits are required for new installations of a certain size. Rules vary between Member States, but most have been tightened over time. Permits may include storage capacity specifications and requirements for on-farm treatment facilities.

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[31] The discussion of environmental and health concerns in the European Union draws heavily from a chapter by Floor Brouwer, Janet Dwyer and David Baldock "European Union" in *Public Concerns, Environmental Standards, and Agricultural Trade* (F. Brouwer and D. Ervin, eds.) CAB International, 2002.

Other public concerns in the EU related to ILOs include:

- the potential residual effects of hormones which may be used to stimulate animal growth or milk outputs;
- antibiotic resistance from the use of antibiotics in livestock feed; and
- other veterinary residues.

Four antibiotics have been forbidden as feed additives in the EU since 1999: bacitracin zinc, spiramycin, virginiamycin and tylosin phosphate. Three Member States have implemented separate bans. Sweden has a total ban on the use of anti-microbial feed additives. The Danish farmers' union established voluntary programs in 1997 to ban anti-microbial feed additives for all poultry, cattle and fattening pigs. Finland had banned two products (spiramycin and tylocin phosphate) prior to the EU legislation. There are also active programs in many EU Member States to control the spread of *Salmonella* and *E. Coli*.

**Summary of Environmental and Human Health Issues**

The increasing number of ILOs and their large manure output pose multiple environmental and human health concerns. Water pollution caused by nutrients from excessive field manure applications and ruptures in manure lagoons appears to be the most extensive problem. However, case studies also suggest that pathogenic contamination may be a problem in certain locations. Air pollution problems are serious in certain areas, with some documented human health impacts to ILO workers and to nearby residents. Soil contamination and antibiotic-resistance concerns are emerging, but little research has been done in these areas. The lack of broad-scale environmental and human health monitoring data related to livestock operations of all types inhibits the identification of the most pressing issues, the specific roles of ILOs, and the design of sound remedial policies.

# Regulations in the United States

## Overview

Since 1972, United States federal law has regulated large-scale animal facilities as point sources of water pollution requiring a permit, called a National Pollutant Discharge Elimination System (NPDES) permit, under the Clean Water Act. The Act is administered by the United States Environmental Protection Agency (EPA). In general, the Act requires discharge permits for "point sources" (discharges of pollutants from a discrete conveyance) but not "nonpoint sources," such as runoff from farms and fields. But the statute specifically defines point source to include "concentrated animal feeding operations [CAFOs]…from which pollutants are or may be discharged."[32]

Thus, at the federal level, regulation of CAFOs is primarily a matter of water permits. Recently a requirement for nutrient management plans (NMPs) has been added to the United States federal regulations, but the NMPs remain focused on water pollution concerns. A wide range of state and local requirements are also in place, many of which go beyond federal requirements. "Setbacks," for example, meant to deal with odour and other nuisance concerns, are a significant component of state and local laws. Some state and local jurisdictions also impose stricter requirements for NMPs, for discharge limitations, for monitoring and reporting, etc., than does the federal government. Typically, permits must be periodically renewed, and permittees are required to report discharges that violate the permit.

At the federal level, a CAFO is defined as an AFO (animal feeding operation) of a certain size, or an AFO of any size that is "designated" a CAFO because it has been shown to be a source of water pollution. An AFO is defined as "a lot or facility" where animals are "stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period," and where crops are not grown.[33]

Prior to the 2002 amendments to the regulations, CAFOs were defined in terms of "animal units" (AUs)—a scheme that equated 2.5 hogs to one cow, for example, in an effort to facilitate comparisons of manure output (and other factors) across species. The new regulations abandoned "animal units" in favour of absolute numbers of animals.

CAFOs are characterized as large, medium, or small. A large CAFO is an AFO with at least 700 dairy cows, or 1000 cattle (other than dairy), or 2500 swine over 55 pounds each, or 30,000 chickens with a liquid manure handling system, or 125,000 chickens with

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[32] 33 U.S.C. § 1362(14).

[33] 40 CFR 122.23(b)(1).

any other kind of manure handling system. A medium CAFO is an AFO with 200-699 dairy cows, 3,000-9,999 swine each weighing less than 55 pounds, etc. A small CAFO is any AFO with fewer than any of the minimum numbers in the definition of a medium CAFO.[34]

Prior to the December 2002 revisions, NPDES permits, in practice, simply prohibited *all* discharges of manure and wastewaters from CAFOs to the "waters of the United States," though there was an exception when storm events caused an overflow from a facility designed to withstand a 25-year, 24-hour storm event.

The newly revised regulations have expanded the requirements of the federal permitting process to include:

— "a nutrient management plan . . . based on a field-specific assessment of the potential for nitrogen and phosphorous transport from the field and that addresses the form, source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals, while minimizing nitrogen and phosphorous movement to surface waters."[35]

— a "determination of application rates" for manure that "must minimize phosphorous and nitrogen transport from the field to surface waters in compliance with the technical standards for nutrient management established by the Director."[36]

— manure sampling once annually for nitrogen and phosphorous content.[37]

— soil analysis (where manure is applied) at least once every five years for phosphorous content.[38]

— a setback of 100 feet between the land application of manure and surface waters (or a 30-foot vegetated buffer or a demonstration of acceptable "alternative practices").[39]

— maintaining records on-site for five years (of numbers of animals, amounts of manure generated and transferred off-site, etc.), as well as records for five years of the land application areas (amounts of manure applied, dates, weather conditions, sampling results, etc.).[40]

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[34] CAFOs are defined at 40 CFR 122.23.

[35] 40 CFR 412.4(c)(1). Note: the NMP is not required until December 31, 2006.

[36] 40 CFR 412.4(c)(2).

[37] 40 CFR 412.4(c)(3).

[38] *Id.*

[39] 40 CFR 412.4(c)(5).

[40] 40 CFR 412.37(b)-(c).

Some critics have complained that the new regulations will create new expenses for producers and "threaten the economic survival of some small feeding operations."[41] Others complain that the new regulation "has no enforceable federal measures for dealing with land applications—it merely requires CAFO operators to write up a nutrient plan which they can then stick into a drawer and ignore."[42] Others have expressed disappointment that the new regulation "fail[s] to encourage large operations to find a replacement for lagoons."[43] The new regulation may be challenged in court.

A basic feature of permitting in the United States is "state delegation." A state that is willing and able to implement the Clean Water Act permit program, for example, may seek approval from EPA to do so, and may issue NPDES permits in place of EPA once its application is approved and the program is delegated. All but seven states operate delegated programs, issuing NPDES permits. The seven are Alaska, Arizona, Idaho, Maine, Massachusetts, New Hampshire, and New Mexico. An eighth state, Oklahoma, administers the NPDES program for most purposes but has not been authorized to administer the NPDES program for CAFOs.

Under the US system of dual sovereignty, states may also impose their own regulatory and permitting requirements on operators in addition to EPA requirements. State law may not conflict with federal requirements, but states are free to impose additional requirements and to regulate more conduct, more operations, and more stringently than the federal NPDES requirements.

NPDES permits may be issued on an individual basis, or, where there is great similarity and uniformity within an industrial sector, EPA or a delegated state may issue a "general permit" which applies to those operations that conform to the minimum requirements, give notice, and seek to be covered under the general permit.

The universe of animal operations in the United States is quite large. EPA estimates that there are approximately 376,000 AFOs nationwide. The potentially regulated CAFO universe is a small fraction of this number but still quite large. EPA estimates that, under its old regulations, there were approximately 9,000 large CAFOs that should have had NPDES permits, and that approximately 4,000 medium CAFOs were "dischargers" and should have had NPDES permits. However, only about 2,250 CAFOs nationwide had NPDES permits, under the old regulation. About half of those were under general permits and half had individual permits.[44] The remaining 10,000+ CAFOs potentially subject to the old regulations did not have NPDES permits, in part because of differences

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[41] Ed Maixner, "EPA Posts Animal Waste Management Rules," in *Farm Progress*, www.farmprogress.com/frmp/articleDetail/1,1494,11411+19,00.html (quoting a National Pork Producers Council statement).

[42] *Id.*, (quoting Martha Noble, Senior Policy Analyst, Sustainable Agriculture Coalition).

[43] Charles Abbott, Reuters, Dec. 17, 2002 (quoting Dan Whittle, Environmental Defense), available at www.environmentalobservatory.org/News/news.cfm?News_ID=1896

[44] *See* 66 Fed. Reg. 2968-2969 (Jan. 12, 2001).

in interpretation of the law. Under the old system, about a quarter of the states and numerous operators articulated their position in this way:

- The NPDES program required permits only for point source discharges to the waters of the US, and CAFOs were defined in the statute as point sources only if "pollutants are or may be discharged" from them.
- The effluent guidelines for CAFOs prohibited discharges (except in 25-year/24-hour storms); complying CAFOs did not discharge, nor were they likely to (except during the allowed exception).
- Therefore, most CAFOs did not need NPDES permits.

As recently as 2001, seventeen states authorized to issue CAFO NPDES permits had never done so.[45] Still others issued them only to CAFOs where there was proof of repeated discharges resulting in water pollution. For example, until 2002 North Carolina did not require its CAFOs to obtain NPDES permits, but law suits by citizens drove a number of CAFOs in the state to seek NPDES permits under consent orders or settlements.[46]

Though the new federal regulations seek to clarify that "all CAFO owners or operators must apply for a permit," they also provide for individualized determinations of "no potential to discharge," which can exempt owners or operators from the permit requirement.[47]

The NPDES permitting situation has gradually changed in many states due in part to litigation by environmental organizations.[48] States have also revised their interpretations of the Clean Water Act's permitting requirements for CAFOs, in part in anticipation of the new revisions to the federal NPDES rules and as a result of increasing EPA pressure and, also in part, because of their own increasing recognition of the potential water impacts of livestock operations. [49] Finally, litigation against specific CAFOs has also helped drive the NPDES permit process in states that have resisted it.[50] Litigation filed in 1989 by the Natural Resources Defense Council also helped promote the new federal

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[45] 66 Fed. Reg. 2969.

[46] *See American Canoe Association v. Murphy Farms* (E.D.N.C. Dec. 15, 1998)(granting preliminary injunction) (subsequently settled on consent in 2001).

[47] 40 CFR 412.4(d).

[48] *See, e.g., Concerned Area Residents for the Environment v. Southview Farm*, 34 F.3d 114 (2d. Cir. 1994).

[49] See *U.S. EPA - U.S. Department of Agriculture Unified National Strategy for Animal Feeding Operations* (1999). http://www.cleanwater.gov/afo/

[50] E.g., *Citizens Legal Environmental Action Network v. Premium Standard Farms*, No. 97-6073-CV-SJ-6 (W.D. Mo. Nov. 20, 2001, consent decree).

regulations by establishing a timetable for EPA to carry out several rulemakings required under the Clean Water Act.[51]

## Comparison of State Programs

Many states regulate AFOs and CAFOs under separate state laws and programs. EPA notes that over 45,000 state authorizations and permits of various kinds have been issued to AFOs and CAFOs through state programs apart from the NPDES program.[52]

For this report, the AFO/CAFO laws and regulatory programs of the federal government and twenty states, including the states with the greatest volume of animal production, were examined to determine which facilities and operations are regulated, how they are regulated, what regulatory standards apply, and how compliance with standards is monitored and enforced. This study examines a consistent set of issues across all of the programs to determine what conduct is regulated and how the existing federal and state programs interact.

The states examined were Alabama, Arkansas, California, Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Maryland, Minnesota, Mississippi, Nebraska, New York, North Carolina, Ohio, Oregon, Pennsylvania, Texas, and Wisconsin

### *Primary Applicable Laws and Responsible Government Authority*

#### *Federal and State NPDES Programs*

Delegated state NPDES programs are almost always operated by the state environmental agency. In a few states, the NPDES authority for animal agriculture has been assigned to the state agriculture department. For example, in Ohio, the state legislature recently transferred NPDES permitting of CAFOs from the Ohio Environmental Protection Agency to the Ohio Department of Agriculture because of concern that the Ohio EPA might be insufficiently sensitive to the interests of farmers.

Of the states studied, only New York relies solely on its NPDES program for CAFO permitting and regulation. The other states all have some additional level of state AFO/CAFO regulation—permitting operations with smaller numbers of animals, imposing additional requirements on some CAFOs, or requiring registration of animal feeding operations with the state environmental agency. Others (e.g., Oregon and Texas) rely on NPDES permitting for CAFO regulation but also have watershed programs with enforcement mechanisms that can reach pollution events caused by non-regulated entities, including some AFOs.

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[51] *Natural Resources Defense Council v. Reilly*, Civ. No. 89-2980(RCL)(D.D.C. Jan. 21, 1992 consent decree, since modified).

[52] 66 Fed. Reg. 2969 (Jan. 12, 2001).

*Non-NPDES Permits*

The state environmental agencies responsible for NPDES permitting in most of the studied states also issue other state permits (such as construction and operating permits) that can impact discharges from CAFOs. In some states these permits apply to smaller operations that are not subject to NPDES permitting under the federal regulations. In others, they regulate particular structures, such as containment facilities, or particular operations, such as feedlots.

A significant number of states issue both NPDES permits for operations that meet the federal CAFO definition and other state permits for smaller operations. For example, Minnesota requires feedlots of 50 AUs or more to register and obtain a certificate (10 AUs or more in shoreland areas). Kansas requires registration and permitting of AFOs with more than 300 AUs. Indiana requires "approvals" from the Department of Environmental Management for all "confined" feeding operations with more than 300 cattle, 600 swine, or 30,000 fowl.

*Other State Registrations, Livestock Facility Regulation, and Enforceable Nonpoint Source Programs Applicable to Animal Feeding Operations.*

Some states, in addition to water permits, also regulate construction and operation of animal feeding operations above a certain size; they may require preparation of a manure management plan, or regulate retention basins, for example. The leading role in this type of regulation is often played by the state department of agriculture or a state resource agency that deals with soil erosion and agricultural runoff. Of the twenty states examined in this study, eight have some form of permitting or regulation by an agriculture department or soil conservation agency, apart from the state environmental agency and apart from the NPDES program. Some of these programs simply require AFOs to "register" with the state; others impose regulatory requirements for the operation of manure containment facilities, or require the preparation and implementation of nutrient management plans for the land application of manure. Oregon and Ohio have a different approach; they can use state enforcement authority for agricultural nonpoint sources to address discharges from AFOs that are not within the NPDES program.

*Local Regulation of AFOs.*

In a few states, local governments participate in the regulation of AFOs. For example, a number of states explicitly authorize local and county governments to establish setback provisions for manure containment facilities (California, Minnesota, Wisconsin, Mississippi).[53] Some (including California, Minnesota, Wisconsin) also allow counties to impose additional substantive requirements on AFOs, in the interest of protecting water quality and other public interests. In such states, requirements may differ

[53] It should be noted, however, that the North Carolina Supreme Court recently struck down county regulation of swine CAFOs in that state on the grounds that the state legislature had "occupied the field" with a "complete and integrated regulatory scheme." *Craig v. County of Chatham*, 356 N.C. 40, 565 S.E.2d 172 (2002).

significantly from county to county. These differences and their implications are covered in greater detail below.

In a few states, soil conservation districts (sometimes called soil and water conservation districts, or natural resources districts) have a quasi-regulatory role in addressing water pollution from AFOs. These local government entities are elected by the landowners of the area and traditionally perform the nonregulatory role of providing technical assistance and cost-share funding to their local farmers. However, they have been integrated into mandatory manure management planning, nutrient planning, and runoff controls in Pennsylvania and even into some complaint and enforcement functions in Ohio.

In sum, environmental jurisdiction over AFOs and CAFOs has historically been vested in the states, subject to US EPA oversight with respect to the delegated states' handling of NPDES permitting. State requirements, however, apply to animal operations of various sizes, and may require notices, registrations, plans, and permits for many AFO entities not regulated under the NPDES regime. A few states allow county or local regulations to address issues of setbacks and other location requirements. Significant changes have been effected by the revised "CAFO rule" of December 2002. Its federal requirements for nutrient management plans, manure and soil sampling, and record-keeping will provide a new "floor" for CAFO regulation in the United States But the bulk of regulatory activity will still take place at the state level, especially in "delegated states."

### *Permits and Thresholds*

States have their own requirements for their programs, and these vary widely. Alabama, for example, requires a Notice of Registration for any AFO with greater than 100 AUs if it is located in a priority watershed, and for an AFO of any size with a liquid manure management system but lacking a manure management plan.[54] Arkansas requires a state permit for construction and operation of a "confined" animal feeding operation of any size with a liquid manure management system.[55] Colorado does not require state permits for most CAFOs, but does require a state permit for a swine AFO that maintains 800,000 pounds or more of swine.[56] Georgia requires swine and non-swine operations with more than 300 AUs to obtain a state permit.[57]

Indiana requires confined feeding operations of more than 300 cattle, 600 swine, or 30,000 fowl to obtain regulatory approval.[58] Kansas requires AFOs with greater than 300 AUs to register; and some of these to be permitted.[59] Maryland does not require small AFOs to be permitted, but does require all AFOs with more than 8 AUs to prepare a

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[54] Al. Admin. Code 335-6-7-.10(4).

[55] Ark Reg. 5.301.

[56] Colo. Rev. Stat. 25-8-501.1.

[57] DNR EPD Rule 391-3-6-.20, 391-3-6-.21.

[58] 327 IAC 16-2-5.

[59] Kan. Stat. Ann. 65-171d.

nutrient management plan.[60] Minnesota requires all feedlots with more than 10 AUs in shoreline areas, and more than 50 AUs in other areas, to register and obtain a certificate of compliance.[61] Mississippi requires a state permit for all feedlots, Grade A dairies, poultry operations with more than 9000 birds, swine operations with 10 or more sows or 50 or more swine.[62] Nebraska requires all livestock operations with 300 or more AUs to file a request for inspection in order to evaluate them for possible permitting.[63] North Carolina requires state "non-discharge" permits for animal operations with at least 250 swine, 100 confined cattle, 75 horses, 1000 sheep, or 30,000 poultry with a liquid manure system.[64]

Ohio does not require NPDES permits for AFOs with fewer than 1000 AUs, but does have authority through its Division of Soil and Water Conservation to abate pollution from those smaller AFOs. Oregon requires permits for all "confined" AFOs without specifying the size.[65]

Pennsylvania does not use AU, but its own term "animal equivalent units (AEU)," defined as one thousand pounds live weight of livestock; it regulates facilities based not only on the total AEUs, but also on the concept of Concentrated Animal Operations (CAO). A CAO is defined as an agricultural operation where the animal *density* exceeds 2 AEU per acre suitable for application of manure.[66] It requires individual NPDES permits for new or expanded animal feeding operations with more than 1000 AEUs and for a CAO with 301-1000 AEU in a Special Protection Waters Area. Pennsylvania also requires nutrient management planning by all CAOs.[67]

Texas requires permits or registration for operations with more than 300 AUs through its Dairy Outreach Program Area.[68] Wisconsin's priority watersheds program reaches AFOs below the federal thresholds in priority watershed areas.[69]

### *Permit Overview*

This section provides a brief overview and comparison of the requirements of state permitting programs regarding:

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[60] Md. Stat.Ann. Agric. 8-801.

[61] Mn. Rules 7020.

[62] DEQ Reg. WPC-1.

[63] Neb. Rev. Stat. 54-2403.

[64] NCGS 143-215.10B(1).

[65] ORS 468B.205.

[66] 25 Pa. Code 83.201.

[67] 3 P.S. 1701-1718.

[68] 30 Tex. Admin. Code 321.32.

[69] Wis. Stat. Part 281.

- Notice to the public of a CAFO application (and any opportunity for public comment);
- Siting, design, and construction requirements;
- Nutrient management plans;
- Financial guarantees (by the operator that the permit requirements will be followed and facilities properly closed); and
- Permit fees.

*Public Notice and Review.*

Under federal NPDES regulations, the public must be notified of an *individual* NPDES CAFO permit, and the public must have an opportunity to comment on such permits. The public must also be notified of a proposed general permit, and have an opportunity to comment on the permit's terms. However, no public notice or comment is required when a CAFO applies for a certificate of coverage under a general permit that has already been adopted. ("General permits" are issued for a class of facilities. If a facility meets the definition of the class, adheres to the permit conditions, and files a "Notice of Intent," it is deemed to have a permit and is subject to the permit's restrictions without actually going through a formal permitting process.) Effectively, under federal law, there is little public notice or opportunity to comment on CAFOs that do not obtain individual NPDES permits.

Some states provide for additional levels of notice for large operations or particular kinds of operations. For example, Georgia requires new or expanding swine operations with more than 3000 AUs to "notify [by certified mail] all adjoining property owners and all property owners who own property located within one mile of any boundary of the swine feeding operation of that person's intent to construct the swine feeding operation." The notice must include detailed information about the proposed operation and identify the person preparing the manure management plan. In addition, the owner or operator must conduct a minimum of one public meeting to present the plan and receive written comments.[70]

*Siting and Design.*

The federal NPDES permit includes requirements to construct and maintain manure storage sufficient to address all process wastewater plus all run-off from a 25-year, 24-hour rainfall event. Spill control measures are required, and liners for containment structures are required where there is a "direct hydrologic connection through groundwater" to the waters of the United States. The permits typically affect the design of the facility but not siting. In contrast, many of the state permits affect both design and siting. (See Siting and Design Requirements, below).

[70] DNR EPD Reg. 391-3-6(8)(e).

*Nutrient Management Plan.*

Federal NPDES permits now require a site-specific "comprehensive nutrient management plan," including practices to prevent the land application of animal manure from degrading water quality. Virtually all of the studied states also require nutrient management plans as a condition for state permits, some with more extensive requirements than the federal rule. Pennsylvania and Maryland have separate nutrient management planning laws that are not tied to the permitting program but apply to all AFOs, whether permitted or not. In part, those laws were adopted to address pollution issues of Chesapeake Bay, and the states did not want to limit the coverage only to permitted operations. NMPs are discussed in greater detail below.

*Financial Assurance.*

The federal NPDES permit program does not require the posting of financial guarantees to assure proper closure of manure management facilities at CAFOs. Of the twenty states studied, five have adopted some form of financial guarantee requirement for selected facilities. Colorado, Kansas and Georgia require financial guarantees for large swine facilities. Illinois requires financial assurance for any new or modified manure management lagoons.[71] Georgia requires use of a trust fund, an irrevocable letter of credit, insurance, or a surety bond.[72] In contrast, Colorado allows the permittee to submit any form of assurance, but authorizes the state agency to reject the form proposed "upon a determination of insufficiency."[73] Kansas requires only a demonstration by the operator that it has sufficient financial ability to cover the costs of closure.[74] The regulations allow a trust fund, surety bond, letter of credit, insurance, or self-insurance.[75] Iowa has adopted a program that creates a Manure Storage Indemnity Fund, supported in part by fees, that helps assure proper closure of abandoned manure storage facilities.[76]

*Permit Fees.*

EPA charges no permit fees; but delegated states are free to charge such fees. Most do, but fee amounts vary substantially. Some states have flat fees for the filing and processing of permits (e.g. Arkansas, Illinois, many others); others base the fees on the number of animal units (Nebraska) or gross weight (Iowa) or the volume of water discharge (Maryland). Some have annual fees, sometimes based on the number of animal units (e.g. Nebraska) or animal weight (Colorado), that are intended to support inspections and the ongoing administration of the AFO program.

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[71] 8 Ill. Admin. Code 900.702.

[72] Ga. DNR EPD Rule 391-3-6-.20(11).

[73] Colo. Reg. 61.

[74] KRS 65-1-89, -90.

[75] K.A.R. 28-18a-24.

[76] 11 IC 455J.

### *Siting and Design Requirements*

State permits may also contain a variety of other elements, such as:

- setback requirements specifying how far the feeding operation or its manure management facilities must be from property lines, occupied dwellings, schools, churches, hospitals, waterways, wells, and other features;
- geophysical requirements and other siting standards, pertaining to land areas, slope, soils, and other limitations:
- requirements for regulatory agency review and approval of the site;
- storage capacity limits;
- technical and design standards for the facilities; and
- monitoring requirements.

Some states also provide incentives and cost-shares to encourage enhanced environmental controls.

*Setbacks.*

Until the 2002 revisions, the federal NPDES program did not specify setbacks or siting standards. Federal regulations now require a 100-foot setback between the land application of manure and surface waters; with a "vegetated buffer," only a 30-foot setback is required. Many states havehad setback requirements for years, as well as a limited number of geophysical requirements and limitations, and other features.

For example, fourteen of the twenty states have adopted state-wide setback standards for CAFO facilities and/or the manure management facilities associated with them, while Maryland requires setbacks but does not prescribe numbers in its regulations (leaving the setback to be prescribed permit-by-permit). Another state, Ohio, is developing state-wide standards. Several other states rely on local ordinances (California, Oregon, Wisconsin) to prescribe required setbacks, and others allow county setbacks in addition to state standards (Minnesota). Setback requirements generally apply only to facilities constructed after the date the setback requirement was adopted. Typical subjects for setback distances are drinking water sources, private and public water wells, streams and watercourses, residences, noncommercial buildings, commercial buildings, adjacent property owners, and municipal boundaries. Virtually all of the states have state or local setback provisions aimed at protecting water and water resources. The ranges for setback distances differ substantially among states (compare Nebraska's prescribed distance of 1000 feet from a public water supply and 100 feet from a private well, with Pennsylvania's 100 feet from a drinking water well or public water intake). Of the states studied, only Alabama, Georgia, Indiana, Mississippi, and Pennsylvania prescribed distances from "property lines." Numerous states prescribed distances from residences or groups of residences -- Alabama (1320 ft), Arkansas (1320 ft.), Colorado (1 mile - large swine operations only), Georgia (700 ft-1750 ft - large swine operations only), Illinois

(1/4 mi.-1/2 mile), Kansas (1320 ft - 5000ft), Mississippi (1000 ft), and North Carolina (1500 ft – swine only).

*Geophysical Requirements.*

The federal NPDES program does not specify geophysical limitations. It simply prescribes that the facility be designed to prevent discharges, except those caused by a 24-hour, 25-year rain event. Liner requirements are evaluated on a case-by-case basis; both synthetic and clay liners have been approved. Various states have their own liner requirements. Most states have few geophysical limitations, except for a fairly common prohibition of manure retention structures in the 100-year floodplain (either prohibited outright or unless protected from such flooding). Other than that, the most common limitations address the presence of karst geology (which might allow a leak to travel rapidly to groundwater and lead to contamination far from the immediate site). Many states require investigation and certification of the site by a professional.

*Minimum Capacity Requirements.*

Most states in the study do not prescribe minimum capacity requirements for manure management facilities. Most rely on the federal standard that the facility be designed and managed to withstand a 25-year/24-hour storm event, and advisory standards by the US Department of Agriculture's Natural Resource Conservation Service (NRCS) prescribing a minimum 1-2 feet of freeboard in lagoons and similar retention structures. (NRCS develops technical standards for manure management, and its conservation specialists provide technical assistance to farmers.) A few states have prescribed further capacity requirements in an effort to assure that retention and management structures are not under-designed. This can be important to prevent situations in which growers are unable to spread manure on the land because of weather or other constraints. For example, Alabama requires that facilities be designed to manage 180 days of manure outputs in northern Alabama and 120 days in southern Alabama.[77] Illinois requires 150 days capacity;[78] Nebraska 180 days;[79] Minnesota 9 months;[80] (and Iowa 14 months for liquid manure systems.[81]

*Technical Standards.*

Technical standards for manure management and retention facilities vary by state and by the type and size of facility. States commonly reference “best practices” and Natural Resource Conservation Service (NRCS) standards, such as those found in NRCS'

[77] AAC 335-6-7.20(24)(a).

[78] 510 ILCS 77/13(a)(1)(B).

[79] NAC 130.8.001.

[80] Minn. R. 7020.2100(3)(A).

[81] 567 IAC 65.15(5).

*National Handbook of Conservation Practices.*[82]

Many state programs require that lagoons and other manure management structures be designed by registered engineers or other certified professionals (often available through NRCS). Government review and approval of these structures is required in all of the states studied.

*Monitoring and Reporting.*

Under the federal NPDES provisions, monitoring requirements apply only in the event of a discharge, and operators must report discharges. Self-inspection of containment structures is required to assure their structural integrity and to assure that adequate freeboard is maintained. Requirements for environmental monitoring and sampling are most frequently case-by-case[83] and as prescribed by permits (as under the federal NPDES system, California's Waste Discharge Requirements, and many others). In fact, on-farm monitoring for environmental parameters is rare. Many state programs require that an "operating record" be maintained at the facility.[84]

*Incentives and assistance.*

Incentives and cost-shares are not available to CAFOs under EPA programs, but a US Department of Agriculture program known as the Environmental Quality Incentives Program (EQIP) and some state cost-share programs can help defray the operator's cost of constructing manure management facilities for smaller CAFOs. Until recently (2002), the law prohibited use of the funds for manure facilities at farms with more than 1000 animal units, but that restriction has been lifted. States have broad latitude to administer the federal EQIP monies.

Among state programs, the most generous is Maryland's, which will fund up to $75,000 on a cost-shared basis. In contrast, Ohio offers only up to $15,000. A few of the studied states offer tax credits for certain pollution control equipment (Kansas, Maryland, Nebraska). In general, however, the cost of the structures required for manure and wastewater management at CAFOs falls substantially upon the producer.

### *Nutrient Management Plans*

The federal NPDES program now requires a comprehensive nutrient management plan at CAFOs, but NMPs were already a feature of many permits in state programs prior to the new federal rule.

Every state studied has some nutrient management planning requirements. In some states these are linked solely to the NPDES permitting program, while in others they apply to a broader array of AFOs. Nutrient management plans are even required in some states for

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[82] http://www.ftw.nrcs.usda.gov/nhcp_2.html

[83] *E.g.*, 567 Iowa Admin. Code 63.5(1).

[84] *E.g.* 327 Indiana Admin. Code 16-9-5.

AFOs that do not need either federal or state permits. For example, Maryland requires nutrient management plans for agricultural operations with 8 or more AUs.

*Preparation and Location of Plan.*

The plans are prepared by the operator (or by a certified nutrient planner on behalf of the operator). The states differ as to whether the plan must be submitted to a state or county agency or simply be maintained onsite by the operator (as is the minimal federal requirement). Fourteen of the twenty studied states require submission of the plan to a governmental agency for review. Submission of a document generally makes it public and subject to public scrutiny. There are exceptions, however. Maryland, for example, requires the state Department of Agriculture to keep the plan confidential, and has legislative hurdles even to the Department of the Environment obtaining access to the plan. Other states require submission of plans under some circumstances (e.g. Arkansas - if requested; Illinois - if the operation has 5000 AUs; Kansas – for swine facilities with >100 AUs; Oregon - for new CAFOs). Still others require the operator to maintain the plan but do not expressly state whether it should be submitted; presumably, agencies have access to the plan on request (California, Mississippi).

Nutrient management planning requirements are largely based on NRCS and USDA Agricultural Extension Service practice. Nebraska's requirements are among the more detailed of those states that have adopted nutrient management planning regulations linked to permitting. Under Nebraska's CAFO regulations, a "comprehensive nutrient management plan" must be submitted to the state's DEQ. It must include a legal description of planned manure application areas, as well as the number of useable acres, slope, soil type, cropping practices, historic yields, distance to surface water, location of wetlands and use by other operations; manure sampling and analysis procedures; land application soil sampling and analysis procedures; planned application rates, methods, and frequencies; appropriate record-keeping of locations and quantities of livestock manure land applied, sold, or given away; and sample results. Any areas not owned by the operation must include the landowner's name, address, legal description, number of acres and an agreement signed by the landowners allowing for the planned use of the land and any restrictions.[85] Land application of livestock manure may not be in excess of agronomic rates for nitrogen and owner/operators shall sample and analyze the soil for nitrogen and phosphorus prior to the application of manure.[86] (The "agronomic rate" is the rate at which nutrients will be taken up by crops. Application at greater than an agronomic rate will leave excess nutrients in the soil that may be washed out into the groundwater or surface waters or may degrade the soils themselves). In Nebraska, the frequency and methods of sampling and analyzing nitrogen and phosphorus must be based on planned crops, crop rotation and other site-specific requirements and defined in the comprehensive nutrient management plan.[87] Owner/operators must report all

[85] NAC 130.3.001.04H.

[86] NAC 130.11.006.02-3.

[87] *Id.*

analyses that exceed 150 parts per million for soil phosphorus.[88] Upon reviewing the data and evaluating the potential for contamination of waters of the State, DEQ may require the owner/operator to modify the comprehensive nutrient management plan.[89] Owner/operators must maintain records for at least 5 years of the estimates and analyses of the nutrient value of livestock manure utilized to determine land application rates for manure; and, if requested, submit to DEQ the results of the sampling events.[90] All owner/operators must attend a "land application training program," with additional training every 5 years.[91] . Owner/operators must notify the Department of any changes in the land application areas.[92]

Neither the NPDES program nor the various state programs that include manure management planning impose restrictions on the kinds of crops that may be grown on lands where manures are applied, nor do they proscribe application of manures that contain pathogens, antibiotics, etc.

*Nutrients Addressed.*

The plans are generally focused on nutrients that are water pollutants. Most of the studied states require analysis and establishment of application rates for nitrogen. About half also include phosphorous, or provide that phosphorous must be addressed in the plan when the state determines it is necessary to do so (or when soil testing indicates the likelihood that phosphorous will become an issue). Many of the states also require soil tests to address metals, salts, pH, and other factors that may affect nutrient mobilization.

*Limits on Land Application of Manures.*

State standards for land application fall into three general categories:

(1) Limitations on rates of application, variously described as "agronomic rates" (e.g. Colorado, Illinois, Indiana, Nebraska, Oregon, Pennsylvania, Texas), rates appropriate for "optimum crop yields" (Iowa), "reasonable rates" (California), or other similar terms with reference to NRCS or professional standards (Alabama, others).

(2) Setbacks of land application areas from surface waters, wells, property lines, residences, etc. These are similar to the setbacks for the animal confinement facility and the manure management facilities themselves.

(3) Limitations on the manner and timing of land application. These include prohibitions on land application when ground is frozen or snow-covered, as well as requirements in some states that certain manure (such as swine manure) be applied in a way so as to minimize odour and runoff (e.g. prohibitions on spray applications).

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[88] NAC 130.11.006.03.

[89] *Id.*

[90] NAC 130.11.006.07.

[91] NAC 130.5.005.05.

[92] NAC 130.5.005.06.

Most of the states have all three types of standards or limits. Setbacks for land application include state-wide numerical standards in Georgia, Illinois, Indiana, Iowa, Maryland, Minnesota, Mississippi, Nebraska, North Carolina, Pennsylvania, and Texas. Like the similar setbacks for manure management facilities, these can vary significantly. For example, North Carolina requires land application of swine manure to be set back 75 feet from a residential property line or perennial stream. In contrast, Georgia requires swine manure to be applied at least 150-200 ft. from a property line, and 100-150 ft. from surface waters. Other general manure application setbacks include: Illinois (200 ft. from surface waters), Maryland (50 ft. from surface waters), and Alabama (50 ft. from surface waters). Minnesota county setbacks vary from 50-750 feet from surface waters. Again, Nebraska is fairly illustrative of waterway setback requirements: Manure may not be applied within 30 feet of any streams, lakes and impounded waters specifically designated by the Nebraska DEQ, unless in accordance with an approved comprehensive nutrient management plan.[93] When manure is land applied within 100 feet of a stream, lake, or impounded water, DEQ may impose other requirements, such as an additional buffer or injection of the manure.[94]

Specific limitations based on weather conditions and soil saturation exist in eight of the 20 states studied. The other states had performance standards such as requiring the operator to "prevent water pollution" or "follow planning requirements," which could have the same effect. A few states authorize application of manure on frozen ground subject to conditions. Illinois allows it if the slope is 5% or less or there are adequate erosion control measures in place; Pennsylvania allows it if a 100 foot setback from surface waters is observed (200 feet if the slope is 8% or greater).

*Monitoring.*

Groundwater monitoring is not typically required for the land application of animal manure, but it may be required by a permit condition in any of the states studied. A few states have specifically required (or authorized) groundwater monitoring for the land application of swine manure from large facilities. These include Kansas[95] and Georgia.[96] California provides for a "Waiver of the Waste Discharge Requirement" on assurance that there will be "no discharge." Some California regional water quality control boards have imposed groundwater monitoring as a condition for the waiver.

In Nebraska, groundwater monitoring is generally not required for facilities under 1000 AUs unless (a) a spill or non-permitted release from the facility has occurred, (b) percolation from the facility exceeds the allowable percolation rate, or (c) DEQ determines it necessary to maintain ground water quality.[97] Groundwater monitoring

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[93] NAC 130.11.006.04.

[94] NAC 130.11.006.04.05.

[95] K.A.R. 28-18a-18.

[96] Reg. 391-3-6-.20.

[97] NAC 130.13.002.

may be required for larger facilities based on a site-specific review.[98] Information used to determine the need for groundwater monitoring includes: the materials and methods used in the construction of the facility; the size of the livestock operation; depth to ground water; type of soils; type of consolidated or unconsolidated sediments above and below the water table; local and regional use of groundwater for drinking water and other beneficial uses; and other criteria, including, but not limited to, location of the nearest public water supply wells, use of local Rural Water District, and location of on-site wells.[99] If groundwater monitoring is required, an applicant may ask DEQ to reconsider by submitting additional site-specific hydrogeologic information.[100]

*Odour and Air.*

Odour and air requirements are quite uneven among the states. The federal Clean Air Act does not require states to establish standards for odours or for many of the air pollutants associated with animal feeding operations. Even where standards do exist for organic air pollutants (ammonia, hydrogen sulphide, methane), they are seldom required to be applied to releases from animal operations or from the land application of animal manure. Nevertheless, some states have adopted odour or air pollution requirements. In most of the states studied, these are quite rudimentary and frequently make reference to the use of "best management practices" (BMPs) developed by the NRCS and others for the control of odours. Colorado explicitly requires preparation and implementation of an odour management plan for large swine operations. Kansas and Nebraska also require such plans. Arkansas requires annual training in odour control methods. Alabama has a general performance standard under which operators are to minimize odours "to the maximum extent practicable."[101] A recent citizen's suit in Alabama led to an injunction requiring a hog operator to submit an odour control plan for state approval. Mississippi's two-year moratorium on new CAFOs that expired in January 2000 led to the adoption of air and odour requirements, and CAFOs are now required to obtain air permits or multimedia permits that include air standards.[102] Texas provides for an "air quality standard permit authorization" (which includes an air quality management plan) for CAFOs that meet the requirements for registration or individual permitting under the water pollution regulations.[103] The Texas regulations prohibit CAFOs initiated after August 19, 1998 from locating any "permanent odour sources" within 1/2 mile of any occupied residence or business structure, school, church, or public park without written consent from the landowner (1/4 mile with an "odour abatement plan").[104] North Carolina's odour rules are complaint-driven and require the use of BMPs if state regulators confirm that the complaint is valid.

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[98] NAC 130.13.001.

[99] *Id.*

[100] NAC 130.13.003.

[101] AAC 335-6-7-.04(1).

[102] Reg. APC-S-2.

[103] 30 TAC 321.46.

[104] *Id.*

*Discharges and Emergency Planning and Reporting.*

All of the states require CAFOs and AFOs operating under permits to self-report on spills and discharges, and many of them require the preparation of a contingency plan.

### *Liability and Enforcement*

Under the federal NPDES program, EPA or state personnel may inspect permitted CAFOs and determine whether they are in compliance. In addition, permitted operators are required to notify the regulatory agency of any discharges or violations of permit conditions. Enforcement measures include orders, injunctions, civil penalties, and criminal penalties. State enforcement of delegated NPDES programs must be consistent with federal standards.

In general, the studied states focus on the owner/operator of the facility. There has been little attempt in state legislation to identify or attach liability to an integrator or owner of the animals who may be using contract growers; however, states have used common law principles in some individual enforcement cases to determine who is the real "party in interest." North Carolina has adopted regulations addressing integrators that provide 250 or more animals to swine operations and retain ownership or control of the animals. This law requires contract growers in North Carolina to identify the integrator when they obtain a permit or apply for coverage under a general permit, and requires the state DENR to notify integrators of violations by growers; however, the law does not expressly make the integrator liable for violations.[105]

Because of the general lack of on-farm monitoring requirements, detection of noncompliance is heavily dependent upon complaints and self-reporting, though all of the states have some inspection capacity. A number of states rely heavily on county inspectors or other personnel to identify violations (Minnesota, Wisconsin, Ohio, Pennsylvania). Most states begin compliance efforts with a "notice of violation" or "warning letter," with the emphasis on achieving compliance rather than on imposing a penalty. Ohio's program for small AFOs and other agricultural nonpoint source pollution allows the chief of the soil and water conservation division of the DNR to issue a "chief's order" to abate the pollution; but the statute explicitly prohibits enforcement of any chief's order that would require an operator to spend money on construction unless the state is also able to provide cost-share funds.[106]

Penalties may be imposed in all states for violations of permits. Violations of NPDES permits can result in civil penalties of up to $25,000 per day of violation, but amounts at that level are rarely assessed. Authorized state penalties for permit violations range widely, but typically are set in the low thousands of dollars. Penalties for failures to comply with nutrient management plans are typically lower than penalties for permit

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[105] General Assembly of North Carolina, Session Law 1998-188, available at www.ncga.state.nc.us/html1997/bills/CurrentVersion/ratified/house/hbil1480.full.html

[106] Ohio Rev. State 1511.02(H).

violations and spills from manure containment facilities (e.g. Maryland - $250, Pennsylvania - $500).

Very little information is available on enforcement against CAFOs and AFOs. Most states either do not track this information or track it only for the current year, and many of these track only the initiation of enforcement related actions (such as notices of violation) without tracking the outcomes. States with decentralized programs, such as California, Minnesota, Wisconsin, and Pennsylvania, do not have information available on a statewide basis for these programs. The same is often the case with inspections. Most states with NPDES programs have few, if any, inspectors dedicated solely to CAFOs; typically they use inspectors who also have other duties. Some states have dedicated CAFO permitting staff, but rely on others (often in regional offices or counties) for inspections.

*Right to Farm.*

Right-to-farm legislation is found in virtually every state. The purpose of such legislation has generally been to prevent homeowners and others from filing lawsuits against agricultural operations (including AFOs) as a public or private nuisance. The premise is that people moving into an agricultural area should expect to encounter agricultural odours and related impacts. Some state right-to-farm laws also prohibit local units of government from enacting ordinances that declare agricultural practices a nuisance. But right-to-farm laws have no effect on CAFO/AFO regulation by states. None of the statutes constrains the state legislature or state regulatory agencies nor offers any defence from enforcement actions taken under permit and regulatory programs. All of the statutes in the studied states are explicitly limited to providing a defence against court actions in the nature of nuisance, or limiting the power of local governments to adopt regulations. The chief effect of right-to-farm laws in the AFO/CAFO arena is to limit the ability of local citizens and local governments to bring such actions against animal feeding operations. This is most significant in the area of odours and air pollution where there is little regulatory leverage and where nuisance is by default the primary tool. A number of states explicitly exclude from protection those operations that are conducted negligently or that pose a threat to public health or safety. Minnesota's statute, moreover, explicitly excludes large animal feedlots from coverage by the statute.[107]

### *Moratoria, Anti-Corporate Farming, and Other Provisions*

The federal NPDES program does not provide for or include moratoria. Two of the studied states (Mississippi and North Carolina) imposed temporary moratoria on certain types of CAFOs in order to permit the development of additional regulatory programs and management plans. The Mississippi moratorium has expired; the North Carolina moratorium has been extended by legislation. Mississippi used its moratorium to develop regulations for air pollution and odour control. North Carolina has used its moratorium

[107] Minn. Stat. 561.19.

to encourage the development of local zoning regulations and for research and development of alternative manure and wastewater technologies.

Federal law and regulations do not impose any limits on the forms of business entities that may operate CAFOs. A few states in the Midwest, however, do not allow corporations (except family-owned corporations) to engage in the business of agriculture (Iowa, Kansas, Minnesota, Nebraska, Wisconsin, and several others not included in this study). This does not mean that CAFOs cannot operate in these states, but it does mean that the growers in these states must be individuals or partnerships or family corporations rather than other public or private corporations. In some of these states, corporations may still exercise substantial control as customers or even owners of the livestock; however, Iowa's law also outlaws this form of "contract farming" control. Of the states that do prohibit corporate ownership, Kansas allows feedlots and poultry confinement facilities to be owned by corporations, as well as swine and dairy operations in counties that wish to opt out of the state prohibition.

Another significant development is the use of voluntary compliance and performance improvement programs. The US EPA has entered into agreements with the National Pork Producers Council and the US Poultry and Egg Association, for example, to improve industry awareness of regulatory requirements and to encourage adoption of processes that would lead to compliance. In November 1998, EPA and the National Pork Producers Council reached agreement for a Compliance Audit Program whereby pork producers that voluntarily sought inspection of their operations would be granted amelioration of penalties for violations that might be discovered, assuming that the problems were promptly remedied. A voluntary program was agreed to in December 1998 by the poultry and egg producers aimed at introducing and promoting implementation of poultry litter management plans and related actions. States also have voluntary programs and provisions. Colorado offers an Environmental Leadership program for large swine operations. North Carolina is promoting the voluntary adoption of environmental management systems (EMSs) by large hog producers; in a separate development, farms owned-by Smithfield Foods will adopt EMSs as part of the settlement discussed in “Recent Developments” below. Pennsylvania promotes adoption of nutrient management planning by AFOs not subject to state or NPDES permitting requirements.

North Carolina conducted a program to buy conservation easements on a limited number of hog operations located in the 100-year floodplain after hurricanes resulted in catastrophic failures of manure lagoons and pollution of the state's rivers. The state-funded buy-out paid growers to remove existing manure lagoons from the floodplain based on priority risks and costs; the number of facilities wishing to participate exceeded the available funding.

Some states are also beginning to require detailed information on corporate parents, owners and controllers of livestock operations, including their compliance history. The information is used to determine whether to grant or deny permits and also, in part, to determine whom the permittee should be and where liability should rest. Ohio and

Nebraska are among the states seeking such information in their permit programs. Georgia has very detailed background and "bad actor" provisions for large swine facility operations, requiring substantial disclosure by applicants and mandatory disapproval of permits under certain circumstances, including prior violations by applicants and their owners or controllers.[108]

**Recent Developments**

Litigation was the driving force behind a major effort to develop new technology for swine manure management in North Carolina, an effort that may have implications for the industry throughout North America.

An out-of-court settlement with Smithfield Foods resulted in commitments for $15 million dollars to develop superior technology, $50 million (over 25 years) for "environmental enhancement" in the state, plus commitments to test and implement the new technology at company-owned farms.[109]

The performance standards expected of this new technology are:

- Eliminate all discharges to water
- "Substantially eliminate" ammonia emissions
- "Substantially eliminate" odours beyond the property line
- "Substantially eliminate" the release of disease vectors and airborne emissions
- "Substantially eliminate" nutrient and heavy metal contamination of soil and groundwater
- The agreement recognizes the importance of economic feasibility and establishes factors to be considered in that regard, including:
- The 10-year annualized "cost per 100 pounds of steady state live weight for each category of farm system"
- The 10-year annualized cost of the current system
- The projected revenues from any by-product utilization or other cost savings
- Any available financial or technical assistance, tax incentives, or credits that may be available to support such technology development
- The impact that adoption of the new technology would have on the competitiveness of the state's swine industry

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[108] DNR EPD Reg. 391-3-6(10).

[109] *See* North Carolina State Univ., The Water Resources Research Institute, "The 'Smithfield Agreement': What does it say?" at www2.ncsu.edu/ncsu/CIL/WRRI/news/so00smithfield.html The full agreement is available at www.p2pays.org.ref/11/10597.pdf

The Parties agreed that alternative technology may be deemed "feasible" even if it costs more than the status quo.

Implementation of the Agreement is managed by a "Designee" of the Chancellor of North Carolina State University, which has a major agricultural school. The Chancellor designated the director of the University's Animal and Poultry Waste Management Center. The Designee is required to seek the advice of various experts and to appoint a multi-stakeholder "peer review panel."

The Companies agreed to:

- Identify their buildings or lagoons located in the 100-year floodplain and to propose measures to protect state waters
- Identify company-owned farms with "potential to adversely impact water quality" and to propose measures to correct those problems
- Identify wetlands and natural areas on company-owned farms that protect water quality and propose measures to preserve them
- Identify abandoned lagoons and propose methods for closure
- Submit a plan for implementing environmental management systems that are certifiable to ISO 14001 (the international standard) at all company-owned farms
- Prioritize company farms for conversion to the Environmentally Superior Technology and submit the priority list to the Attorney General

The Companies also agreed to convert all company-owned farms to the Environmentally Superior Technology as soon as the new technology is deemed feasible and to provide financial assistance to contract farmers to facilitate their conversion.

The Agreement includes a dispute resolution process that begins with a 30-day mediation period, followed by submission to the local state court (Superior Court of Wake County) if the issue is not resolved in mediation.

Meanwhile, it is agreed that the Attorney General will "undertake a comprehensive review of the operation of the swine industry in North Carolina to ensure . . . all appropriate steps . . .[are being taken] to ensure that they remain at all times in compliance with the law." The Agreement does not limit State or private enforcement of past, present, or future violations.

The Agreement called for the Designee to issue a report on his findings within two years; he recently requested a one-year extension of that mandate. More than a dozen pilot projects are underway, involving constructed wetlands, bio-gas recovery, the separation of liquids and solids, and other techniques.

A similar settlement in Missouri may generate as much as $50 million for research to develop and install new manure and wastewater treatment technologies; it also requires the companies involved (Premium Standard Farms and Continental Grain Company) to calculate and report on their air emissions for possible air permitting.[110]

[110] *See* U.S.E.P.A, "Fact Sheet," November 19, 2001. Available at www.epa.gov/compliance/resources/cases/civil/mm/psffs.pdf

# Regulations in Canada

## Overview

The Canadian constitution assigns provinces primary responsibility over property and civil rights.[111] Therefore, provincial governments have the lion's share of control over the regulation of intensive livestock operations (ILOs). Several provinces have delegated this responsibility to local governments (primarily rural municipalities) to regulate ILOs through their land use planning and zoning powers. With the exception of Quebec, where the bulk of environmental regulations pertaining to ILOs falls under the jurisdiction of the Ministry of Environment, departments of agriculture, not environmental departments, typically retain the primary responsibility for regulating livestock operations. Departments of agriculture typically deal with the siting and licensing of livestock operations whileenvironment departments licence water use and become involved when pollution or contamination problems arise.

The federal government has some minimal environmental responsibility through its exclusive jurisdiction over federal lands (including Indian reserves) and through national legislative programs for agriculture, fisheries and the environment, but ILOs are not an issue on federal lands. The federal *Fisheries Act*[112] and the *Canadian Environmental Protection Act*[113] might be triggered should there be contamination from an ILO. The Fisheries Act provides, for example, that there shall be no deposit of deleterious substances into water frequented by fish. A manure spill affecting fish could be the subject of a federal Fisheries prosecution. A 1998 prosecution under the Federal Fisheries Act and the Environmental Protection Act resulted in fines and penalties of $120,000 against Western Feedlots Ltd.[114] Recently, two charges have been laid under the federal Fisheries Act §36(3) as a result of watershed surveys in southeastern Ontario by the Department of Fisheries and Oceans (DFO). One case involves direct discharge into water frequented by fish by a large scale farming operation. The second case involves the failure of a smaller farming operation to comply with an inspector's directive. Neither case has yet been definitively resolved. But, on the whole, federal legislation is only of secondary impact and does not involve direct regulation of the livestock industry.

Generally, federal involvement in ILOs in Canada is in the area of agricultural research rather than regulation. Often federal assistance is directed through provincial initiatives. For example, in the province of Ontario, literature on best management practices has been developed by the provincial and federal agriculture ministries under the Agricultural

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[111] *Constitution Act 1867,* §92(13).

[112] R.S.C. 1985, c. F-14.

[113] R.S.C. 1999, c. 33.

[114] See report available at www3.gov.ab.ca/env/protenf/enforcement/1998-99_EnforcementActionsReport-Fiscal.pdf, at p. 18.

Green Plan Initiative. The purpose of these booklets is to provide information to promote environmentally sound agricultural practices. The federal government, primarily through cost-share grants, also provides funds to local and regional programs that encourage best practices. However, none are specifically directed toward the livestock industry, nor are there the broad-scale financial assistance programs to encourage best management practices like the Environmental Quality Incentive Program in the United States.

All provinces in Canada, through environmental legislation, guidelines or regulations prohibit the deposit of pollutants into water bodies, except as may be allowed by a permit or approval.[115] ILOs in Canada require a number of permits and authorizations, including those relevant to design and construction. The order of such permits and the level of sophistication of the application varies from province to province. Certain common threads emerge, however. In most provinces, the operator of an intensive livestock operation would be required to obtain a building permit from the local government in order to commence construction. Commonly, departments of agriculture also receive detailed information regarding the siting and design of the facility and its manure storage and management plans. But whether such information is forwarded for separate approval and review or is made available to the province at all, is dependent upon the individual jurisdiction.

The regulation of ILOs assumes a variety of different forms: legislation, regulations, codes of practice, standards, guidelines and recommendations. At the risk of over generalizing, it is fair to say that statutes, regulations, and municipal bylaws[116] have the force of law, but unless incorporated into a legal instrument, guidelines, standards, and policies or codes of practice do not. Specific terms and conditions in a licence or permit also become legally enforceable and bind the operator.

Normative standards established in guidelines or other non-legal form are worth noting for a number of reasons, however. First, codes or guidelines established by a senior level of government are often incorporated legislatively by a lower level of government. For example, municipal bylaws will often directly adopt provincial codes of practice to take advantage of research and expertise unavailable locally and to make the standards enforceable. Second, the existence of standards in the trade, as articulated in guidelines, is strong evidence of "normally accepted agricultural practices." Any operator conforming to such standards may be able to use such conformance as a defence against civil actions or statutory complaints under "right to farm" legislation. Finally, the existence of a guideline, legal or otherwise, offers a standard of practice against which to measure ILO performance or operation.

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[115]See for example, the *Environmental Management and Protection Act*, S.S. 1983-84, c.E-10.2 Saskatchewan. See also New Brunswick *Clean Water Act*, S.N.B. 1989, c. C-6.1, s. 12(1). and Quebec *Environmental Quality Act. L.R.Q., c. Q-2, ss. 20 and 22, Règlement sur les exploitations agricoles* (Regulation Respecting Agricultural Operations), R.R.Q., Q-2, r.11.1,ss.4-5

[116] In Canada municipal "ordinances" or "laws" are referred to as "by-laws" due to the subordinate status of municipalities, which are wholly creatures of provincial statute.

## Siting

### *"Minimum distance separation," setbacks, and water quality*

All Canadian provinces with ILOs dictate standards in relation to the siting of new and expanded facilities. All include a requirement for "minimum distance separation" (MDS), the preferred Canadian term for setbacks when specifically referring to the distance between a livestock facility and its neighbours. The MDS provides a recommended minimum separation between new or expanded facilities and non-agricultural development (commercial, recreational or residential). Some provinces simply set the MDS in regulation; others offer a formula for calculation on a site-by-site basis. In several cases, provinces provide a minimum standard in addition to an MDS calculation. For example, in Alberta, in no case shall the MDS be less than 150 metres.[117]

When scouting a site for a new ILO, proponents are well-advised to "select a location that will impact on as few neighbours as possible."[118] But inevitably, neighbours must be dealt with, and their right to the use and enjoyment of their own land respected.

Factors relevant to the determination of the MDS may include: the size of the operation, the type of manure storage, the presence of other uses in the vicinity and the density of those other uses, the livestock type and, in some provinces, prevailing winds.[119] On Prince Edward Island, for example, the minimum separation distance may be reduced by up to 25% if prevailing summer winds are favourable to reducing nuisance odours to neighbouring dwellings.

Alberta, Quebec and New Brunswick have developed a formula for MDSs. In New Brunswick, for example, the minimum distance between ILOs and private dwellings is calculated as A x B x C, where A equals 500 metres, B equals the "manure factor" and C equals the "livestock factor."[120] The manure factor is based on the type of manure and the type of storage (e. g., solid manure/open pile storage, liquid or semi-solid manure, earthen or non-earthen open tank). The livestock factor is a combination of the type of livestock and the method of housing (e.g., caged or uncaged). So, for example, solid manure in an open pile has a manure factor of 0.8, the livestock factor for barn-housed pigs is 1.5, and the formula in that instance would yield an MDS of 600 metres (500 X .8 X 1.5). Alberta's recently developed formula is even more complex, incorporating "odour factors," "dispersion factors," and "expansion factors."[121]. In Quebec,MDSs are

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[117] *Standards and Administration Regulation,* A.R. 267/2001. s.3(4).

[118] Prince Edward Island Department of Agriculture and Forestry, Department of Fisheries, Aquaculture and Environment, (2001). Best Management Practices: Agricultural Waste Management. www.gov.pe.ca/af/agweb/library/documents/bdest_management_practices/bmp_book.pdf.

[119] Prince Edward Island Department of Agriculture and Forestry, Guidelines for Manure Management for PEI, (1999) s. 7.2. www.gov.pe.ca/af/agweb/library/documents/manureguide/index.php3.

[120] N.B. Reg. O.C. 99-262, Schedule A.

[121] The result is a series of tables. See *Standards and Administrative Regulation*, A.R. 267/2001, Schedule 1.

calculated based on seven parameters; number of animal units; base distances; odour coefficient per category of livestock; type of manure; type of project; mitigation factors; use factor; and siting standards with respect to various neighbors..[122]

In addition to the MDS between competing land use structures, some provinces also establish minimum setbacks for the ILO from the boundary of the parcel on which it is located. New Brunswick, for example, sets a minimum 20 metres setback from the property boundary,[123] while Manitoba demands that any manure storage facility have a minimum setback of 100 metres from the boundaries of the operation.[124]

Although generally not included within MDS requirements, some provinces have included provisions for separation distance from public highways. Nova Scotia, for example, considers a 50 metre separation necessary.[125] Prince Edward Island goes so far as to require that a permit be obtained to confirm the setback.[126]

Some jurisdictions differentiate between MDS requirements for new operations and those for the expansion of existing operations. Nova Scotia, for example, distinguishes between expansions of up to 50%, which must meet the existing guidelines, and expansions between 50-100%, and greater than 100%. In the latter two cases, the MDS recommendations have been expanded in order to address the increased size of the operation.

The articulation of MDS standards relative to other rural land uses is important in light of right-to-farm legislation in the Canadian provinces. Right-to-farm legislation protects farming activities from nuisance actions, provided the operation conforms with "normally acceptable agricultural practices." Many of the impacts such as odour, dust and noise associated with ILOs are immune from civil action provided they meet the standard of the trade. Neighbours are expected to endure some level of inconvenience. MDS requirements, whether in legislation, regulations or guidelines, serve two functions. For neighbouring residents, they provide a standard of protection. For producers, adhering to the MDSs may serve as evidence of their conformance with accepted practices in the industry. It is important, therefore, that the opinions and desires of all rural stakeholders be considered in establishing MDS requirements.

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[122] *Les Orientations du gouvernement en matière d'aménagement, La protection du territoire et des activités agricoles. Document complémentaire révisé.* Government of Quebec, December 2001.

[123]New Brunswick Department of Agriculture, Fisheries and Aquaculture, (1999b). General Regulations Under the *Livestock Operations Act*, O.C. 99-262, s. 12(1).

[124]*Livestock, Manure and Mortalities Management Regulation*, Man. Reg. 42/98, Schedule A.

[125]Nova Scotia Department of Agriculture and Marketing, (1991). Guidelines for the Management and Use of Animal Manure in Nova Scotia, Publication No. R-91-2000.

[126]Prince Edward Island Department of Agriculture and Forestry, Department of Fisheries, Aquaculture and Environment (2001). Best Management Practices: Agriculture Waste Management, pp. 13-14.

All Canadian jurisdictions address the issue of setback requirements relative to water and water bodies, but the nature of the water bodies subject to protection varies from jurisdiction to jurisdiction. In some jurisdictions the protection of drinking water sources receives the most attention, while other water sources are subject to less stringent setback standards.

In the case of new facilities, requirements for setback from springs and wells, varies between 30 metres in New Brunswick[127] and 100 metres in Alberta.[128] Generally, provinces have tended to increase the required distances in recent years. Where possible contamination of open water is an issue, a distinction between surface water for domestic use and for other uses is made. The former usually requires a setback double the latter.[129]

In Quebec, new facilities and expansion of existing ones are subject to a setback requirement of 15m. from lakes, wetlands, swamps, pounds, and sections of streams whose total discharge area is higher than 2 $m^2$.[130] Specific requirements for setbacks apply in the vicinity of an underground water catchment system where the water is to be used for human consumption.[131]

Only two provinces, Alberta and Manitoba, make reference to the location of storage facilities relative to the flood plain. Alberta demands siting one metre above the highest known flood level, and prohibits manure facilities within the 25-year flood plain.[132] Manitoba provides that no storage facility can be built within the boundaries of the 100-year flood plain in that province.[133]

The definition of "water body" in Prince Edward Island is unique in that it specifically includes wetlands as subject to setback protection of 90 metres from newly constructed livestock operations.[134] In addition, the legislation introduces the requirement that existing livestock operations establish and maintain a wetland buffer zone of 20 metres around all buildings and around newer storage facilities where the slope of the land is 9% or less and a 30 metre buffer zone where the slope is greater than 9%. Since grandfathering of standards is the norm in most provinces, the buffer zone minimum for existing facilities is somewhat unique.

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[127]Reg. 90-79 under *Clear Water Act*, O.C. 90-531, s. 22(2).

[128] *Standards and Administration Regulation,* A.R. 267/2001. s.7.

[129]See for example, British Columbia Government, (1992). *Agricultural Waste Control Regulations*, s. 7(1).

[130] *Règlement sur les exploitations agricoles*, R.R.Q., c. Q-2, r. 11.1, s. 6.

[131] *Règlement sur le captage des eaux souterraines* (Regulation respecting Catchment of Underground Water), R.R.Q., c. Q-2, r. 1.3, ss. 29 and 57.

[132] *Standards and Administration Regulation,* A.R. 267/2001. s.8.

[133]*Livestock, Manure and Mortalities Management Regulations*, Man. Reg. 42/98, s. 5(1).

[134] Government of Prince Edward Island, (1988) *Environmental Protection Act*, s. 11.2(10).

A number of provinces address the issue of water table protection: Alberta, Manitoba, New Brunswick and Prince Edward Island, for example, all impose a one metre buffer between ILO facilities and the water table. Quebec requires that the soil on which an animal breeding installation is built or set up be protected from manure by a watertight floor or through any other appropriate means.[135]

Setback requirements for the field storage of solid manure from water courses are generally more stringent than for other manure storage options, but requirements vary across the country, depending somewhat on the age of the guideline or regulation. The most rigorous standards are imposed by Quebec and Prince Edward Island and Quebec, which demand a 300 metre setback for any field storage from water sources used for public water supplies.[136]

Prince Edward island is unique as well in that any field storage of solid manure must also be sited in a manner to avoid runoff into public roads and ditches. Manitoba requires a 100 metre setback from watercourses, which include roadside ditches. Prince Edward Island establishes no specific distance but requires that such runoff be prevented.[137]

In Quebec, MDS requirements for field storage of solid manure are based on six criteria: the pile of manure must be located at more than 150 m from lakes, wetlands, swamps, pounds and, sections of streams whose total discharge area is greater than 2 $m^2$; the pile must be located at more than 15 m from any agricultural ditch; the soil must be covered with vegetation and have a slope of less than 5%; surface runoff must not come in contact with the manure; and, the pile must not remain at the same place for two consecutive years.[138]

Alberta has recently required owners and operators of an ILO or manure storage facility to construct an engineer-designed surface water control system to limit runoff from the project; the system must be certified.[139]

New Brunswick offers an example of the very detailed use of setbacks to protect water quality:

> Manure should not be spread on sloping land adjacent to a water course without immediate incorporation or the provision of an appropriate buffer strip to prevent contamination of the water course. Liquid manure being spread on land within 300 metres of any water course must be spread at rates to ensure that all liquid is absorbed by the soil and no runoff occurs.

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[135] *Regulation Respecting Agricultural Operations*, R.R.Q., c. Q-2, r. 11.1, s. 8.

[136]Prince Edward Island Department of Agriculture and Forestry, Department of Fisheries, Acquaculture and Environment, (2001). ). Quebec *Regulation Respecting Catchment of Underground Water*, R.R.Q., c. Q-2, r. 1.3, ss. 30 and 57.

[137]*Id.*

[138] *Regulation respecting Agricultural Operations,* R.R.Q., c. Q-2, r. 11.1, s. 7.

[139]*Standards and Administration Regulation,* A.R. 267/2001. s.6.

> Manure should not be applied to land within 30 metres of the bank of any water course unless incorporated into the soil within one day. Manure should not be applied to land within 5 metres of the bank of a water course under any circumstances.[140]

Nova Scotia, provides an example of a setback targeted specifically at groundwater protection: "Manure should not be applied within 30 metres of an existing well on a clay loam or loam soil, and not within 60 metres on a sand or gravel soil."[141] Other provinces have very specialized MDSs; British Columbia's guidelines, for example, stress that cattle manure should not be spread "within 30 metres of streams flowing into shellfish growing areas."[142]

In Quebec, two regulations address MDSs from water with respect to the application of manure. The first one relates to farming operations and provides that manure should not be applied in a stream or body of water or to land on their banks, as defined by municipal by-law. Where no by-law has been adopted, the banks are deemed to be 3m wide for most streams and water bodies and 1m wide for agricultural ditches. The regulation also provides that the application of manure should be performed in such a way as to ensure that no runoff reaches the above-mentioned areas.[143]

The second regulation establishing MDSs pertains to the catchment of underground water for human consumption. The regulation prohibits the establishment of an underground water catchment system within 30m from a cultivated parcel of land. It also provides that the owner of a catchment system must delineate around the system a protection area of a radius of a least 30m within which, *inter alia*, the deposit of a substance that could contaminate the water is prohibited. The regulation also sets, for larger catchment systems, bacterial and viral protection areas based on the time bacteria and viruses would take to reach the water table given the rate of migration of water (set at 200 days for bacteria and 550 days for viruses). These protection areas must be determined by an engineer or a geologist who must also determine the vulnerability of the underground water within these protection areas in accordance with the DRASTIC methodology. For smaller catchment systems, the bacterial protection areas are set at 100m and viral protection areas at 200m unless a different area is set by an engineer or geologist. In this last instance, underground water is deemed vulnerable for the purpose of the regulation, unless an engineer or a geologist determines the vulnerability of the water in accordance with the DRASTIC methodology. [144]

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[140]New Brunswick Department of Agriculture, Fisheries and Aquaculture, (1997). Manure Management Guidelines for New Brunswick, s. 5.3(g).

[141]Nova Scotia Department of Agriculture and Fisheries, (2001). Siting and Management of Hog Farms in Nova Scotia, s. D.

[142]British Columbia Ministry of Agriculture and Food, (1998). Environmental Guidelines for Beef Producers.

[143] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r.11.1, s. 30.

[144] *Regulation respecting Catchment of Underground Water*, R.R.Q., c. Q-2, r. 1.3, ss. 8, 24, 25.

The water catchment regulation also contains specific provisions relating to the application of manure. According to the regulation, application of manure is prohibited within a radius of 30 m from the catchment system. In addition, such application is also prohibited within the bacterial protection area if the water table is deemed vulnerable or when the DRASTIC index of vulnerability is of 100 or more. The regulation also provides that the application of manure should be performed in such a way as to ensure that no runoff reaches the above-mentioned areas.[145]

A unique water quality provision in British Columbia should also be noted. As early as 1992, British Columbia made reference to the number of "units in a basin" as a factor relevant to considering setback distances.[146] That is, the greater the number of intensive livestock operations in a particular drainage basin, the higher the setback requirements. To date, British Columbia is the only province to address this question in specific relation to ILOs, but other provinces are considering the benefits of basin management.

### *Hydrology, soils and topography*

When ILOs are proposed, all provinces require information from the proponent about hydrology and soils; some require topographic information. Jurisdictions may demand information on groundwater depth, the source of the water supply, seasonal variations, precipitation, and the quality of the water source. Saskatchewan, for example, requires specific site information on the depth of groundwater, regional drainage patterns for the project area, seasonal flow conditions and characteristics of the general water quality. It also requests that any available information on high water conditions be included.[147] On the basis of this information, the individual decision-maker subjectively weighs all of the information to determine not only whether an approval should be granted, but also what conditions should be included.

Soil parameters that potential operators may be asked to investigate include: depth to bedrock, soil permeability, texture and plasticity. Saskatchewan specifically asks potential operators to provide information regarding soils in the vicinity, to describe and map soil survey data and to provide additional information on soil fertility and its assimilative capacity for manure fertilization. Some provinces demand topographic information on such parameters as slope and drainage patterns.[148] Most jurisdictions leave the decision as to who prepares the site-specific information to the discretion of the proponent; some make reference to the advisability of expert hydrological, geotechnical, and engineering advice.

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[145] *Regulation respecting Catchment of Underground Water*, R.R.Q., c. Q-2, r. 1.3, s. 26. The regulation also allows a municipality to adopt a by-law prohibiting the application of manure in the intake area of a catchment system where nitrate concentrations in the water exceed 5mg/l (s. 27).

[146] *Agricultural Waste Control Regulation*, B.C. Reg. 131/92, Code s. 29.

[147] Saskatchewan Environment and Resource Management, (1997). Draft Interim Guidelines: Information Required for Proposed Intensive Hog Operations, Feeder Barns, Manure Storage and Disposal, s. 3.5.

[148] See for example, New Brunswick Department of Agriculture, Fisheries and Aquaculture, (1997). Manure Management Guidelines for New Brunswick, s. 3.

Alberta, for example, may require that documents prepared for an ILO application be prepared by a professional engineer or land surveyor.[149] Documents that must accompany the application include facility plans, hydro-geological assessments, a site plan, and a manure management plan.[150]

All of the agencies and departments charged with review of applications exercise broad powers based on the information that is forwarded to them. With the exception of Alberta and Manitoba, the actual approval, licence, or permit is issued by the Minister, not a civil servant. As a result, the grounds for judicial review of such decisions are severely constrained by administrative law. In the absence of articulated reasons that may expose the Minister to a judicial challenge to quash the decision, an applicant would have great difficulty establishing a patent injustice on grounds of vexatious, arbitrary or capricious action on the part of the decision-maker. Reasons for an action (or a failure to act) are rarely required when a Minister is exercising a discretionary power. In Alberta, the Natural Resources Conservation Board has the ultimate review and approval authority, and its decisions are subject to limited judicial review.[151] In Manitoba, a permit to construct, modify or expand a manure storage facility is issued by a Regional Director and this decision may be appealed to the Minister.

### *Public participation*

The siting of ILOs raises questions about a community's opportunities for participation in the decision. Environmental departments and local planning authorities have considerable experience with land use conflicts and stakeholder participation models. But the majority of ILOs are licensed and administered by departments of agriculture; historically, their contact with the public has been focused on farmers, and their role has been primarily educative. In many respects, provincial government personnel involved with ILO siting and operation are newcomers to broad-based stakeholder involvement.

Nonetheless, specific requirements for public participation in matters relating to ILOs do exist in some provinces. In Manitoba, intensive livestock operations with over 400 animal units can be classified as a "conditional use" in a "general agricultural zone" within local planning areas. This designation requires public notice and a hearing to consider the impact of the proposal upon neighbouring lands as part of the planning process.[152] Similarly in Saskatchewan, when the council of a rural municipality proposes the adoption or amendment of an ILO-related zoning bylaw under the Planning and Development Act, that municipality is required to give notice of the provisions and to

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[149] *Board Administrative Procedures Regulation.* A.R. 268/2001. ss. 2(2) & 3(2)

[150] *Id.* s. 2(1) and 3(1).

[151] *Agricultural Operations Practices Act* .S.A.2001 c. A-7 Part 2

[152] Regulation and Approval Process: Manitoba Regulations and Guidelines.

offer opportunities for public participation.[153] In both cases, the opportunity to canvas public opinion, disseminate valuable information, and debate the pros and cons of an ILO is mandated prior to irrevocable decision-making.

Environmental impact assessment provisions, which require a systematic review and assessment of projects with potentially negative environmental impacts, could be another vehicle through which to incorporate public consultation. Environmental assessment legislation exists in every province in Canada. However, to date no environmental assessment of an ILO has been completed.

Even where agencies have no mandate for public participation, they frequently offer advice to developers in this regard. The Saskatchewan Department of Agriculture and Food for example, in its Guidelines for Establishing and Managing Livestock Operations, "strongly emphasizes the need for communication and consultation between the developer and local public in order to foster community participation and avoid potential misunderstandings."[154] In the face of growing concern and opposition to existing and new proposals for ILOs, some provinces have gone so far as to recommend on-going public relations activities in order to secure the acceptability of the operation. The rising concern in rural Ontario led to a conference entitled "Living With Your Neighbours" in March 1997. One presenter articulated "good examples of farm efforts to maintain good neighbour relations," listing: notifying neighbours prior to spreading manure, holding a barbeque, holding farm tours, displaying a showcase of agriculture, and organizing an agricultural appreciation dinner, as possible strategies that might be employed by ILO operators.[155]

New provisions in Alberta attempt to open up the application process to public comment, but much discretion remains. Although owner/operators must include a list of "affected parties" with their applications, section 19 of the *Agricultural Operations Practices Act* provides only that an approval officer may require the applicant to actually notify affected parties. On the other hand, subsection 3 of the same section, requires that the approval officer make the application available for "viewing during regular business hours by any member of the public for 15 working days after the application was determined to be complete." An appeals process provides affected parties an opportunity to influence the review conducted by the Natural Resources Conservation Board.[156]

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[153]Centre for Studies in Agriculture, Law and the Environment, (1996). C.C. L. 1996. Expanding Intensive Hog Operations in Saskatchewan: Environmental and Legal Constraints.

[154]*Id.*, p. 26.

[155]Toombs, "The Rising Concern in Rural Ontario Regarding Swine Production", from Living With Your Neighbours, Shakespeare, Ontario, March 26, 1997.
www.gov.on.ca/OMAFRA/english/livestock/swine/facts/concern.htm.

[156]For a complete description of the NRCB review process see *Board Administrative Procedure*s *Regulation.* A.R. 268/2001.

In Quebec, the Ministry of Environment posts on the Internet the list of pending and granted requests for Certificates of Authorization for livestock operations.[157]

## Design Construction

As is the case with many rural building activities in Canada, a construction permit issued by the rural authority (usually a rural municipality) is generally required for an ILO. No exceptions are made for ILOs simply because they may require other permits pursuant to provincial legislation. On the contrary, specific building requirements for ILOs are often incorporated into the building standards of provincial codes of practice, guidelines or even federal codes.

### *Capacity*

Requirements for manure storage capacity in Canada are often related to climate and concerns for the potential environmental hazards associated with spreading manure on frozen ground.

In the colder parts of Canada, storage expectations tend to be longer. Requirements for 210 days of storage capacity are common.[158] According to Saskatchewan Agriculture and Food, "six months storage of manure is the minimum to allow operators enough flexibility to maximize the value of the manure and avoid the need to 'dispose' of manure during the winter months when access to fields is limited." That same agency instructs that 12 months of storage allows for greater flexibility, but notes that multi-year storage is less than ideal due to possible odour problems associated with long-term storage. Some operations within the province are known to have 300-400 days of capacity.[159]

In Quebec, "storage facilities must have the capacity to receive and accumulate without spillage the livestock manure produced in breeding facilities as well as all other products received there for the whole period during which the application of livestock manure cannot take place."[160]

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[157] http://www.menv.gouv.qc.ca/certificats/index.htm

[158] See, e.g., New Brunswick Department of Agriculture, Fisheries and Aquaculture, (1999b). *General Regulation Under the Livestock Operations Act*, O.C. 99-262, s. 13(1).

[159] Saskatchewan Agriculture and Food, (1997). Guidelines for Establishing in Managing Livestock Operations.

[160] Regulation respecting Agricultural Operations, R.R.Q.,c.Q-2, r.11.1,ss.9-10

In British Columbia, with its more moderate maritime climate, regulations provide that "a manure storage facility should be sized to contain six months of manure production;"[161] guidelines suggest ranges from 125-200 days of capacity.

Several provinces also include a general requirement that facilities design, construct and maintain manure storage in a manner that will prevent pollution. The Manitoba regulations stipulate that manure storage facilities shall ensure "sufficient capacity to store all of the livestock manure produced or used in the agricultural operation until such time as the livestock manure can either be applied as fertilizer or otherwise removed from the manure facility."[162] Similarly, the New Brunswick guidelines provide that manure storage facilities should be designed and located in a manner to:

- prevent the escape of materials which could contaminate ground and surface water bodies;
- contain the manure throughout the winter until it can be applied to crops;
- minimize odour; and
- facilitate removal and management of the manure.[163]

Alberta requires that operators of an ILO or manure storage facility employ reasonable measures to control fly infestations; the Natural Resources Conservation Board may require a specific program to control flies (or dust).[164] Alberta also requires a minimum of nine month's storage for liquid manure.

***Field storage***

Some jurisdictions distinguish between field storage facilities and manure storage facilities adjacent to the livestock holding facility. British Columbia provides that solid manure storage may take place in a field for up to 9 months provided that it is located no less than 30 metres from any water source used for domestic purposes or any water course and that the manure is stored in a manner that prevents pollution from escaping.[165] The provision is further tempered by a requirement that berms must be constructed around a field storage area to prevent escape. British Columbia's climate has resulted in another unique provision: in those areas that receive moisioe1.000ther metilmatres fr nira

from October to April, manure must be covered to prevent possible escape and pollution.[166]

The province of Ontario has provided suggestions to ILO proponents for the siting of storage facilities which include the following:

- The storage should not be located to interfere with any future expansion plans.
- The storage should be easily accessible and convenient to the fields receiving manure.
- The storage should be located far enough away from the farmstead home and neighbouring homes so that it does not cause an odour problem.
- Liquid manure storage should be located at least 100 feet from a waterway or drilled well and at least 50 feet from a dug or bored well.
- Visual screening such as fences or tree lines can be used to help reduce the impact of manure storage.[167]

Alberta specifies that field storage can not exceed six months in one location over a three-year period, that storage can not be in a 25-year flood plain, within one metre of the water table, within 100 metres of a spring or water well, or within 30 metres of a common waterbody.

***Liner materials***

Specifications for liners in manure storage facilities vary from province to province. Liner materials are roughly divided into two categories, solid (both above and below ground) and earthen. Solid liners are primarily concrete and steel. When located in the ground, they are expected to weather ground hydrostatic and ice pressures; specific requirements are sometimes articulated. British Columbia, for example, requires that concrete storage facilities shall have a rated strength of 20 Mega pascals (3000 psi) or greater. In those jurisdictions that lack such specificity, proponents would be well advised to consult the National Building Code of Canada and the National Farm Building Code of Canada. New Brunswick makes specific reference to these Codes and requires that non-earthen manure structures shall be designed and constructed in accordance with them.[168]

Prince Edward Island maintains that solid liners shall be 20 inches above the bedrock and 20 inches above the high-water mark (40 inches for earthen liners) unless alternative

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[166] *Id.*, Code s. 9.

[167] Hilborn, (1995). Storage of Liquid Manure, (last reviewed 1997). A.G.D.E.X. 721, order number 94-097.

[168] New Brunswick Department of Agriculture Fisheries and Aquaculture, (1997) Manure Management Guidelines for New Brunswick, s.4.1

means of protection are provided.[169] Quebec provides that manure storage facilities must be water-tight, with no overflow or bottom drains.[170]

Earthen liners may be constructed of concrete, clay, bentonite or plastic. Where the geology permits, clay is by far the most popular substance. Requirements for liner construction are often quite detailed. Manitoba, for example, provides that in the case of clay or clay-type materials:

- topsoil must be stripped;
- soil must be properly compacted using a fully ballasted "sheepsfoot" packer to a density of at least 95% of Standard Proctor density;
- the storage bottom must be one metre above the water table; and
- construction shall be completed under conditions where soil temperatures are above freezing.[171]

Further specifications are often provided for the berm, addressing such issues as slope and width.

In some circumstances, regulators have found it necessary to temper the clay-liner option with further requirements. For example, Manitoba requires a synthetic liner to be installed in a proposed earthen storage facility when it is within an unsaturated portion of an aquifer.[172] Prince Edward Island suggests that, if suitable natural soil is unavailable, earthen storage should be lined with a flexible membrane, concrete or other material.[173] The Department goes on to suggest that a leak detection system is recommended in combination with synthetic liners, a precaution which may also be a licensing condition in New Brunswick.[174] In Alberta, clay-lined liquid manure storage facilities require leak detection systems with at least one monitoring well up-gradient of the facility and 2 down-gradient.[175]

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[169]Government of Prince Edward Island, (1999). Guidelines for Manure Management for Prince Edward Island, s. 4.5.

[170] *Regulation respecting Agricultural Operations*, R.R.Q., c.Q-2, r.11.1, ss. 9-15.

[171]Manitoba Agriculture and Food, (2001). Living With Livestock - Siting Livestock Production Operations. www.gov.mb.ca/agriculture/livestock/publicconcerns/cwa01s07.html.

[172]*Livestock, Manure and Mortalities Management Regulation*, Man. Reg. 42/98, Schedule A, s. 2f. An unsaturated portion of an aquifer would most likely occur in the case of an unconfined (surficial) aquifer.

[173]Prince Edward Island Department of Agriculture and Forestry, Department of Fisheries, Aquaculture and Environment, (2001). Best Management Practices: Agricultural Waste Management.

[174]New Brunswick Department of Agriculture, Fisheries and Aquaculture, (1997). Manure Management Guidelines for New Brunswick.

[175]*Standards and Administration Regulation.* A.R. 267/2001. s. 18

British Columbia requires that enclosed manure storage systems be adequately ventilated to prevent the accumulation of hazardous gases.[176] Alberta requires that liquid storage facilities be secure from unauthorized access and that warning signs about the nature and danger of the facility be posted.[177]

### *Professional accreditation/certification*

In Prince Edward Island, a certificate of inspection must be signed by the designing engineer and submitted to the Department of Technology and Environment after completion of construction and before the facility may begin operation.[178] Some other provinces have similar requirements. Manitoba, for example, requires a professional engineer's certification that a project conforms with regulatory requirements. New Brunswick and Quebec each require that applications for their Certificates of Authorization be accompanied by evidence that the project complies with the *Environmental Quality Act* and all applicable regulations.

For smaller production facilities projects, Quebec requires that, at least 30 days prior to the beginning of operations, a notice of project be sent to the Minister accompanied by a professional agronomist's certificate that the proposed project conforms to regulatory requirements. The agronomist must be hired to supervise the construction of the facility and attest, no later than 60 days after the completion of the work, that the project, as built, meets the regulatory requirements. Where applicable, a professional engineer must also certify that existing manure storage facilities are large enough to stock the additional manure that will be produced by the expansion or new installation.[179]

For new or expanded storage manure storage facilities, the notice of project must be accompanied by a certificate from a professional engineer that the proposed project conforms to regulatory requirements. The engineer must be hired to supervise the construction of the facility and, no later than 60 days after the completion of the work he must attest that the project, as built, conforms to regulatory requirements.[180]

For larger production facilities projects, the promoter must file a request for a Certificate of Authorization accompanied by the construction plans and specifications, which must be signed by an engineer.[181]

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[176]British Columbia Ministry of Agriculture, Food and Fisheries, (1998). Environmental Guidelines for Beef Producers. www.agf.gov.bc.ca/resmgmt/fppa/pubs/environ/beef/beeftoc.htm.

[177]*Standards and Administration Regulation.* A.R. 267/2001. s.12.

[178]Government Prince Edward Island, (1999). Guidelines for Manure Management for Prince Edward Island, s. 4.9, 4.10 and 4.11.

[179] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r.11.1, ss. 39-41.

[180] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r.11.1, ss. 39-41.

[181] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r.11.1, ss. 42-43. *Environmental Quality Act*, L.R.Q., c. Q-2, s. 22. *Engineers Act*, L.R.Q., c. I-9, s. 2.

### *Manure Storage Plans*

Saskatchewan is somewhat unique in that it incorporates all requirements relating to construction, manure storage, land required and liner materials within a requirement for a manure storage plan.[182] A plan is required for any intensive livestock operation that contains an earthen manure storage area, lagoon, or liquid manure storage tank. For earthen manure storage areas or lagoons, for example, proponents must provide the Minister with a plan that, at a minimum:

- specifies total storage days and total storage volume;
- provides for a minimum 60 centimetres of freeboard;
- provides drawings and specifications for all dimensions, including length, depth, interior and exterior side slopes and berm width;
- provides drawings relating to setbacks and distances from surface waters, including water courses;
- provides well records for the area; and
- provides information relating to sub-surface water tables, soils and ground water monitoring programs, as well as any other information required by the Minister.183

## Nutrient Management

All Canadian provinces make specific reference to the desirability of, if not a requirement for, a nutrient/manure management plan (NMP) at ILOs.[184]

Although the requirements for nutrient management plans vary from province to province, there is considerable commonality. Differences can be attributed to a number of factors, including climate, population density, the historical level of public opposition to such projects, and the age of the policy or guideline. Nutrient management planning requirements are increasingly stringent.

The primary focus of these plans is the distribution of manure, post-storage. Typically, nutrient management plans include information as to where the manure is to be applied, the timing and frequency of application, the method of application, the rate of application, and information regarding soils and manure nutrients. In addition, some

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[182] *The Agricultural Operations Regulations*, (1996), c. A-12.1, Reg. 1, s. 5-7.

[183] *Id.*, ss. 5(1) and (2).

[184] Nova Scotia does not promote the development of an Manure Management Plan *per se*, but it does provide guidelines for the management and use of manure. Nova Scotia Department of Agriculture and Marketing, (Revised 1991) Manure Management Task Group. Guidelines for the Management and Use of Animal Manure in Nova Scotia, publication number R-91-2000. See also, "Development of an On-Farm Manure Management Program" (1996). www.gov.ns.ca/nsaf/rs/greenplan/waste/manure/131.htm

jurisdictions demand information regarding topography, location of water courses, water sources and wetlands, maximum manure application, other uses for the manure where it is not to be applied to land, as well as other relevant information which may be required by the reviewing agency. Requirements that are not as common include information on the proposed method of transporting the manure from storage to the application site, any pre-treatment of the manure, and an emergency action plan. New Brunswick and Quebec requires that nutrient management plans be signed by an agrologist registered under the provincial Agrologists Act.[185] To the extent that soil sampling is required in Canada under an NMP, it is solely for determining the level of nutrients in the soil and not the level of contaminants (such as metals, pathogens, antibiotics, etc.).

Several provinces make reference to the necessity for sufficient land upon which to efficiently utilize the manure produced. Saskatchewan, for example, asks that operators specify the land area available for the annual application of manure and provide the written agreements for spreading manure on land other than the land that is controlled by the ILO operator.[186] Quebec also has similar requirements .[187]

Many provinces establish application rates for manure that take into consideration whether "incorporation" (including injection) is to take place. Incorporation reduces the loss of nitrogen, as ammonia gas, as well as nutrient runoff.

Whether required or only recommended, manure management plans are generally prepared only once, for new operations. Manitoba and Quebec are exceptions. Manitoba requires that manure management plans (for operations with more than 400 AUs) be registered annually and submitted no less than 60 days prior to manure application.[188] Quebec provides that an agro-environmental fertilization plan shall be prepared for each parcel of land and each growing season. The plan must be in place before the growing season and may cover a single growing season or two or more successive seasons, but not more than five.[189]

Quebec provides that an agro-environmental fertilization plan shall be prepared for each parcel of land and each growing season (for breeding operations that produce more than 1,600 kg of phosphorus ($P_2O_5$), or operators of application lands of more than 15 ha (5 ha where the land is used to cultivate fruit or vegetables). The plan may cover a single

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[185]N.B. Reg. O.C. 99-262, s. 5(d). ). In Quebec, *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r. 11.1, s. 24. The plan can also be signed by the farm operator himself, one of his partners or a shareholder of the farming operation, if that person holds a certificate of competency delivered by the Minister of Education pursuant to an official study program on the preparation of agro-environmental fertilization plans.

[186]*The Agricultural Operations Regulations*, (1996), c. A-12.1, Reg. 1, cl. 8(1)(g)-(h), ss. 8(1)(g) and (h).

[187]. *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r. 11.1, ss. 20 and following.

[188]*Livestock, Manure and Mortalities Management Regulation*, Man. Reg. 42/98, s. 13(1) and (4).

[189]*Regulations Respecting the Reduction of Pollution from Agriculture Sources*, O.C. 742-97, 1997. G.O.Q.

growing season or two or more successive seasons, but not more than five.[190] The operator of a breeding operation must have, at least once a year, the manure produced through its operations tested for its fertilizing capacity. The operator of a cultivated parcel of land comprised in an agro-environmental fertilization plan must have that parcel analysed for the content and percentage of saturation in phosphorus as well as for all other data required to exploit the parcel.[191] The regulation also requires that farm operators and applicators ask a registered agronomist to determine the annual phosphorus balance of the breeding operation (or of the manure received for application) and the volume that can be applied on available lands in accordance with the regulations.[192] Alberta's new *Standards and Administration Regulation* outlines a number of requirements for nutrient management, including soil testing and laboratory analysis of the manure.[193] The soil sampling focuses on nitrogen, phosphate phosphorous, potassium and sulphur content, as well as salinity and soil texture.[194] The difference between the crop requirement and the present level of soil nutrients is the rate at which nutrients can be supplied by organic fertilizer (manure) or inorganic fertilizer.[195] The calculation is based on "the average soil fertility levels in the four soil zones and manure nutrient from typical production systems."[196] This calculation is further broken down into detailed analyses of the soils, nutrient content of typical livestock manures by species, and manure production volume.[197]

### *Climate considerations*

As with manure storage requirements, climate is a factor in the land-application of manure from ILOs.. All provinces, at a minimum, suggest that the application of manure on frozen or snow-covered soil should be avoided;[198] some prohibit the practice outright. In Quebec, it is prohibited to fertilizing substances between October 1st and April 1st, unless an agronomist specifies otherwise in an agro-environmental fertilization plan and, where the substance to be applied is manure, the substance be incorporated to the soil within the next 2 or 5 days depending on the nature of the soil.[199] Alberta provides a table of minimum setback distances from common water bodies for application of manure on frozen or snow-covered land,[200] while Manitoba uniquely prohibits the

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[190] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r. 11.1, ss. 3, 22 and following.

[191] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r. 11.1, ss. 28 and 29.

[192] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r. 11.1, s. 35.

[193] *Standards and Administration Regulation*. A.R.267/2001 Schedule 3.

[194] Similar analysis is often required of the effluent before it is spread on the fields.

[195] Thus there is no testing for antibiotic or hormone residues nor for other organic contaminants.

[196] *Standards and Administration Regulation.* A.R. 267/2001. Schedule 3

[197] *Id.*

[198] See Nova Scotia Department of Agriculture and Fisheries (2001). Siting and Management of Hog Farms in Nova Scotia, s. D. www.gov.ns.ca/nsaf/rs/envman/onfarm/hogsite.htm.

[199] Regulation respecting Agricultural Operations, R.R.Q., Q-2. r. 11.1,s.31. .

[200] *Standards and Administration Regulation*. A.R.267/2001 Schedule 3. Table 1.

application of livestock manure between November 10 and April 15, for operations larger than 400 animal units.[201]

Other provinces have different concerns about the weather. In Nova Scotia for example, applicators are advised to "apply manure on a sunny, windy day where there is sufficient air mixing high above the ground."[202] According to a Nova Scotia researcher, "ideal conditions are those with sunny, windy days and cloudy nights. It is believed that the unstable air movement during the day will assist in diluting odours, while the sun dries the manure quickly, thus reducing odour." [203] Prince Edward Island also highlights the impact of wind, maintaining that both speed and direction are critical in judging the impact of odours on neighbours. The province further suggests that trees and windbreaks can assist in mixing and diluting odours through the creation of turbulence.[204]

In Quebec, the use of manure spreading equipment designed to spread manure at a distance of more than 25m is prohibited. Low ramps equipment must be used to apply liquid manure.[205]

### *Conflicting land uses*

Prince Edward Island is unique in Canada in that it provides that manure should not be spread, unless it is absolutely necessary, between June 20 and September 8 of each year.[206] Should it prove necessary in that period, manure spreading should be confined to the fertilization of hay, pasture land, summer fallow or established cover crops. There are also specific requirements on incorporation[207] between those dates, and for minimum separation distances from recreational areas, restaurants and motels.[208] Those restrictions are directly attributable to the other mainstay of the Prince Edward Island economy, the tourism industry, which thrives from June through September.

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[201] *Livestock, Manure and Mortalities Management Regulations*, Man. Reg. 42/98, s. 14(1). This provision does not come into effect until November 10, 2003. In spite of this sunrise clause, there is an absolute prohibition between the dates mentioned if the mean slope of the land is 12% or more. *Ibid.*, s. 14(3).

[202] Nova Scotia Department of Agriculture and Fisheries, (2001). Siting and Management of Hog Farms in Nova Scotia, s. D.

[203] Jacobs, (1994). Odour Control Guidelines for Livestock Operators. Final Report 2: Canada/Nova Scotia Agreement on the Agricultural Component of the Green Plan.

[204] Government of Prince Edward Island, (1999). Guidelines for Manure Management for Prince Edward Island, s. 5.2.2.

[205] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r. 11.1, s. 32.

[206] *Id.*

[207] "Incorporation" involves tilling the soil to reduce direct manure runoff and odour. Increasingly, manure is being injected directly into the soil. There is some concern that injection and incorporation, although reducing the threat of runoff into surface waters, may increase the risk of leaching into groundwater.

[208] Prince Edward Island Department of Agriculture and Forestry, Department of Fisheries, Aquaculture and Environment, (2001). Best Management Practices: Agricultural Waste Management.

Saskatchewan has its own unique approach to dealing with an ILO's neighbours. The province provides for minimum recommended setbacks for manure spreading based on a standard to achieve "public comfort,"[209] whether the method is injection, incorporation or direct land application. The public comfort level and corresponding setbacks are contingent upon the population to be impacted by the spreading and the method. For example, should the operator choose not to incorporate the manure, the suggested setback distance is 800 metres from populations of up to 1,000 (200 metres if injected), whereas if the population exceeds 5,000, a setback distance of 1,600 metres is suggested (400 metres if injected). Although these distances are only "suggested," an operator who fails to follow the suggestion might be deemed not in conformance with "normally accepted agricultural practices" and found liable should a problem arise.[210]

Other provinces are less specific yet quite practical in their advice. Nova Scotia for example, suggests that manure be spread at times to avoid periods when neighbourhood activity is most likely to be affected by the odours and, in particular, that it not be spread on weekends or holidays.[211]

Alberta prohibits the use of liquid manure on crops that are intended to be eaten uncooked.[212]

**Legal Liability**

Owners, operators, developers or individual employees of an ILO may find themselves vulnerable to enforcement action should a violation of legal mandates occur. Inspectors are typically given broad authority—and considerable discretion—in enforcing the law. For example, Alberta's *Agricultural Operations Practices Act* provides:

In carrying out an inspection under this section, an inspector may

> (a) require that any equipment used to manage manure be operated, used or set in motion under conditions specified by the inspector
>
> (b) take samples of anything connected with an agricultural operation,
>
> (c) conduct tests or take measurements,

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[209]Saskatchewan Agriculture and Food, (1997). Guidelines for Establishing in Managing Livestock Operations.

[210]See discussion below.

[211]Nova Scotia Department of Agriculture and Fisheries, (2001). Siting and Management of Hog Farms in Nova Scotia, s. D.

[212] *Standards and Administration Regulation*, A.R.267/2001. s.24(4).

(d) demand production of, inspect and make copies of or take extracts from any record, approval, registration or authorization and on giving a receipt for it remove it for not more than 48 hours for the purpose of making copies of it,

(e) record or copy any information by any method,

(f) take photographs or audio-visual records, and

(g) make reasonable inquiries of any person, orally or in writing.[213]

New Brunswick has an inspection provision specific to ILOs: "an inspector may at any reasonable time enter and inspect any site, parcel, place or premises, except a private dwelling, that the inspector has reason to believe is being used for or in connection with a livestock operation."[214]

These powers of inspection are usually coupled with a provision for fines should an inspector be obstructed or hindered in the performance of his or her duties. In Saskatchewan, for example, obstructing the work of inspectors is punishable by a fine of not more than $50,000, plus up to $1,000 a day for each day the offence continues.[215]

In Saskatchewan, the Minister may also, on the recommendation of an inspector, suspend or cancel the approval of a manure management or storage plan where, in the opinion of the Minister, the person has failed to construct the approved operation within three years, or fails to comply with the plan, the Act, regulations or any term imposed by the Minister.[216]

Alberta's new *Agricultural Operations Practices Act* gives the province's Natural Resources Conservation Board broad powers to issue cease-and-desist orders, or to require investigation or even specific construction "if in the opinion of the Board a person is creating a risk to the environment or an inappropriate disturbance."[217] A person who complies with such an order is exempted from prosecution for any offence associated with the facts that gave rise to the order.

Many provinces reinforce their Ministerial Orders with a provision to allow the Minister her/himself to carry out the Order, if the original recipient of the Order fails to do so, and then to charge back the costs associated with such compliance to the individual who caused the adverse environmental impact.[218]

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[213] Alberta, *Agricultural Operations Practices Act*, S.A. 2001, c. A-7, s. 3a(2).

[214] *Livestock Operations Act*, S.N.B. 1998, c. L-11.01, s. 19(1).

[215] *The Agricultural Operations Act*, S.S. 1995, c. A-12.1, s. 26(1).

[216] *Agricultural Operations Act*, S.S. 1995, c.A-12.1. s. 24(1).

[217] *Agricultural Operations Practices Act,* S.A. 2001, A-7, s.39.

[218] Saskatchewan *Environmental Management and Protection Act*, S.S. 1983-84, c.E-10.2, s.8

For the most part, offences under provincial jurisdiction that are quasi-criminal in nature, are strict liability offences, i.e., offences to which "due diligence" (or "reasonable care") is a defence.[219] Adherence to "best management practises" or "industry standards" may be useful in establishing due diligence, but they may not be sufficient. Due diligence involves a broader inquiry into social standards of "reasonable care" in light of all the circumstances of a specific case.[220] It is incumbent upon the accused to show the existence of a proper system of environmental management as well as the effective operation of that system.[221]

Like environmental statutes, regulations specific to ILOs may include a variety of responses to offending conduct. The Manitoba regulations provide for three possibilities: a warning (for a first time offence with minimal environmental consequences), an Order (involving corrective action, commonly used for manure run-off or manure storage problems), or an Offence Notice (generally reserved for repeat offenders who cause serious environmental degradation). In addition, there is always the "back up" of the Environment Act.[222]

It is difficult to determine statistics on the number of enforcement actions against ILOs (i.e., number of warnings, Ministerial Orders or actual prosecutions) because provinces do not generally break down statistics specific to intensive livestock operations. In those provinces where primary control for ILOs rests with the municipalities, yet another level of statistical analysis would be necessary. The most reliable and detailed data on prosecutions comes from Manitoba. In the first year of enforcement under its *Livestock, Manure and Mortalities Regulation* (1998-99), Manitoba reported 12 Offence Notices, 28 Warnings and 9 Orders of Remediation. The statistics for 2000-2001 noted 12 Environment Officer Orders, 9 Directors Orders and 47 warnings.[223] The problems provoking these Orders and Warnings were categorized as:

- manure stored too close to water courses;
- escape of manure from the agricultural operation causing pollution;
- excessive or improper application of manure;

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[219] There are exceptions to the general strict liability approach. For example, in New Brunswick the *Clean Water Act*, S.N.B. 1989, c. C-6.1, specifically provides in section 35, "every person other than an individual who commits an offence under this Act, or the Regulation, commits an absolute liability offence."

[220] *R. v. Gonder.* (1981), 62 C.C.C.(2d) 329 (Y.T.Terr. Ct.).

[221] *R. v. Sault Ste Marie.* (1978), 40 C.C.C.(2d) 353 (S.C.C.).

[222] *Environment Act*, S.M. 1987-88, c. E-125, s. 33, wherein penalties range up to $50,000 for the first offence and up to $100,000 for subsequent offences, in addition to possible imprisonment, and in the case of corporations, up to $500,000 for the first offence and $1,000,000 for subsequent offences.

[223] In 2000 the former term "Remedial Order" was further broken down into Environment Officer Orders and Directors Orders to reflect the level of bureaucracy issuing the directive. In that same year, a number of offence notices (in essence, tickets) were also issued, but because their disposition was not complete at the time of the report, they were not included in the statistics. Conversation with Al Beck, Manager of Environmental Livestock Program, Manitoba Conservation, February 12th, 2002.

- manure storage permit infractions and manure management plan infractions; and /or
- inadequate facilities.[224]

Penalties vary considerably across the country. In those provinces that have updated their environmental regulations in recent years, potential maximum fines for corporate offenders as high as $1,000,000 are common.[225] The most severe penalties for corporate offenders are in Ontario's Environmental Protection Act, where a first time corporate offender may receive penalties of up to $6,000,000, and up to $10,000,000 on each subsequent conviction, provided the offence results in adverse effects.[226] Other provinces demand more modest fines. In Prince Edward Island, for example, corporations that violate any provision of the province's Environmental Protection Act are liable for fines of not less than $1,000 and not more than $50,000 (although they may also be responsible for any restitution a judge may order).[227] In Quebec, corporate fines range from $1,000 to $150,000 for a first offence and from $4,000 to $500,000 for subsequent convictions.[228]

Penalties for individuals are typically less than those prescribed for corporate offenders. At the lower end of the spectrum, Prince Edward Island provides for a minimum fine to a "natural person" of not less than $200 and not more than $10,000, and/or for imprisonment up to 90 days.[229] Restitution may also be required. At the other end of the spectrum, Ontario provides for fines up to $4,000,000 for first time offenders and subsequent penalties of up to $6,000,000 and/or five years in prison, again provided the offence resulted in adverse effects.[230] A few jurisdictions provide for fines based on the amount of "monetary gain" that accrued as a result of the offence, in addition to other penalties.[231]

Evidence of non-compliance may be brought to the attention of the government from a number of different sources. An operator may inform the regulator directly of an accidental spill, for example. Citizens' complaints or government inspections may also provide the evidence necessary for prosecution of an ILO. Several provinces require ILO operators to maintain detailed records of their activities, and those records may be subject

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[224]Manitoba Conservation, (2001). Enforcement Statistics, Actions 2000-2001. Enforcement Summary Under Environmental Protect Legislation.

[225]See the Alberta *Environmental Protection and Enhancement Act*, S.A. 1992, c. E-13.3, s. 214(1), for example. See also, Manitoba's *Environment Act*, s. 33. Penalties under the *Agricultural Operations Practices Act* are significantly lower, however. (See sections 34-36.)

[226]*Environmental Protection Act*, R.S.O. 1990, c. E-19, s. 187(7).

[227]*Environmental Protection Act*, S.P.E.I., c. E-9, s. 33(4).

[228] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r. 11.1, s. 44.

[229]*Environmental Protection Act, S.P.E.I., c. E-9,*. 32(2).

[230]*Environmental Protection Act*, R.S.O. 1990, c. E-19, s. 187(8).

[231]See e.g., Manitoba's *Environment Act*, S.M. 1987-88, c. E-125, s. 36.

to scrutiny for possible violations. In Alberta, records must be kept on the following, at a minimum:

- dates of manure application;
- volume of manure applied;
- location and size of each field;
- results of soil sampling prior to and after application;
- details regarding the transfer or sale of manure.[232]

Quebec requires that a copy of agro-environmental plans be kept by the person who cultivates the parcel for two years after the plan expires and that such plans be provided to the Minister of Environment upon request. The same applies to application registries, a copy of leases passed with land owners to allow for manure application and a copy of agreements for the transfer of manure from one location to another[233]

In the event of an accidental spill from an ILO, provinces provide for the reporting of the event to the appropriate environment ministry. Regulations typically stress the importance of timeliness. Saskatchewan's new Environmental Management and Protection Act (2002) requires any person responsible for a spill to report it "as soon as that person knows or ought to know" of its existence to the department, his or her employer, the owner of the land, the person in charge of the substance, and any other directly impacted parties.[234] But not all spills are necessarily the subject of reporting. In British Columbia, a report is required only if the spill exceeds 200 kilograms.

Prince Edward Island states as a requirement of its guidelines for design and construction of manure storage facilities that an emergency plan should be available should a mishap occur.[235] British Columbia empowers its Minister to order the preparation of contingency plans as he or she deems necessary.[236] Other provinces, including Ontario, recommend that emergency plans be in place that accord with good farming practices.

Enforcement actions may also result as a consequence of citizens' complaints. In many provinces, citizens' complaints are first directed to those bodies charged with the administration of "right-to-farm" legislation, either as an alternative to formal environmental investigation or as a precursor to such investigations. For example, in British Columbia, the Agricultural Environmental Protection Council addresses less

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[232] *Standards and Administration* Regulation, A.R. 267/2001.

[233] Regulation respecting Agricultural Operations, R.R.Q., c.Q-2,r.11.1. ss. 16, 21, 26, 27, 33 and 34.

[234] *Environmental Management and Protection Act*, 2002, S.S. 2002, c.E-10.21.

[235] Government of Prince Edward Island, (1999). Guidelines for Manure Management for Prince Edward Island, s. 4.10.

[236] *Waste Management Act*, R.S.B.C. 1996, c. 482. s.12(2).

severe concerns; if resolution is not possible, other agencies then enforce the regulation.[237]

Some environmental legislation in Canada makes explicit provision for civil liability. Saskatchewan's *Environmental Management Protection Act*, for example, provides that "any person . . . has a right to compensation . . . for loss or damage incurred as a result of the discharge of a substance . . . ." This is a strict liability matter; the claimant need not prove fault or negligence, but the owner can avoid liability by demonstrating that "he took all reasonable steps to prevent the discharge of the pollutant" or that it was the consequence of an exceptional natural phenomenon or an act of war.[238] Right-to-farm legislation also introduces adherence to "normally accepted agricultural practice" as a defence to civil liability in nuisance actions.

## Right To Farm

"Right to farm" legislation[239] was originally introduced in Canada to preserve the integrity of the family farm in the face of encroaching urban development, but large, corporate-owned, intensive livestock operations are also protected.

Although there are variances across the country, a number of common elements can be identified in right to farm legislation. All statutes involve an exemption from liability for nuisance. Generally, an operator will be protected insofar as he or she engaged in "generally accepted" agricultural practices,[240] "normally accepted agricultural practices"[241] or even "normal" farm practices.[242] The standard for what is " normal" or "acceptable" is determined by that which is common in the trade, often incorporating a requirement for attention to innovative practices.[243] In several provinces establishing such practices is the only requirement for the protection; in others, such as Manitoba and Ontario, an operator must also meet requirements under various environmental, public health, and land use control regulations. If there is a violation of any of those ancillary

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[237]British Columbia Ministry of Agriculture and Food, (1998). Environmental Guidelines for Beef Producers, Appendix B.

[238]Environmental Management Protection Act, Chapter E-10.1, section 13.

[239]For a survey of right to farm legislation in Canada, see, Kalmakoff, John "The Right to Farm: A Survey of Farm Practice Protection Legislation in Canada", (1999), 62 *Saskatchewan Law Review*, p. 225.

[240]*Agricultural Operation Practices Act*, S.A. 1987, c. A-7.7, s. 2(1)(c).

[241]*Agricultural Operations Act*, S.S. 1995, c. A-12.1, s. 3(1).

[242]Government of Manitoba, (1992). *The Farm Practices Protection Act*, 1992, S.M. c. F-45, s. 21.

[243] A recent Ontario Court of Appeal case, *Pyke et al., v. TRI GRO Enterprises Ltd et al; Ontario Federation of Agriculture, Intervenor* (2001) O.J. No. 3209, held that "normal" farm practices included consideration of "circumstances" beyond strict industry standards to include the degree of intensity of the disturbance to neighbours and who was first in the neighbourhood. Available at www.gov.on.ca/OMAFRA/english/engineer/nfppb/coa2001-08-03.pdf

provisions, individuals seeking remedy may be able to point to those violations as evidence of a failure to meet acceptable levels of practice.

In all provinces, the onus rests upon the person claiming that there has been a violation of the standard of normally accepted agricultural practice or of the legislation to establish the case. But procedures vary. In some provinces, like New Brunswick, the board hearing the case may not have a judicial role and may engage, instead, in alternative dispute resolution, attempting to find a mediated response between the complainant and the operator. If after 90 days such mediation proves unsuccessful, the complainant may then go to court, and the court may consider the deliberations of the board in reaching its own conclusions.[244] Other provinces have taken a far more aggressive approach and empowered their boards with quasi-judicial authority, empowering them even to shut down ILOs engaged in unacceptable practices.[245] Provinces that have pursued this avenue include Nova Scotia,[246] Saskatchewan,[247] and Manitoba.[248]

The legislation in both Prince Edward Island and Ontario adds an additional wrinkle to the "right to farm" issue. These provinces allow aggrieved farmers to challenge municipal bylaws that attempt to restrict a normal farming practice.[249] This protection was incorporated as a response to attempts by several municipalities to effectively institute a moratorium on ILOs by passing highly restrictive municipal bylaws.[250]

## Comparative Provincial Approaches to Regulation

In considering Canada's ten provinces, it is useful to categorize the regulation of ILOs as either provincially controlled, municipally controlled or a combination of provincial and municipal partnership to regulate the industry. One province, Newfoundland—and Labrador—, has little or no regulation or guidelines specific to intensive livestock operations; such operations are few in number there due to the unsuitability of the area for agriculture in general. Therefore, the following discussions exclude Newfoundland and Labrador.

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[244] *Agricultural Operations Practices Act*, (1999), c. A-5.3 assented to March 12, 1999; yet to be proclaimed.

[245] Though the power exists, no instances of the exercise of the power have been identified.

[246] *Farm Practices Act*, S.N.S. 2000, c. 3.

[247] *Agricultural Operations Act*, S.S. 1995, c. A-12.1.

[248] *The Farm Practices Protection Act*, (1992), c. F-45.

[249] *Farming and Food Production Protection Act* , S.P.E.I. [Prince Edward Island]1999, c. F-14.1, s. 16. *Farming and Food Production Protection Act*, S.O. [Ontario] c. 1 at s. 6.

[250] Recently, however, the court in *Ben Gardiner Farm Inc. v. West Perth Twsp.* (2001) 24 M.P.L.R. (32) 43 (Ont.Div.Ct) upheld the right of a township to severely restrict the size of ILOs within its jurisdiction based on water quality concerns. The decision was further justified through reference to the precautionary principle.

Definitions of regulated livestock operations vary across the provinces, as do definitions of "animal units." Factors that may come into play include manure production,[251] live weight[252] or the number of animals per a defined space. Differences may exist even within provinces when regulation is left to municipalities.

## The local control model: British Columbia, Nova Scotia, and Ontario

### *British Columbia And Nova Scotia*

The provinces of British Columbia and Nova Scotia rely primarily on local governments to approve ILOs through their planning and construction permit processes. Neither province offers much guidance as to what should be expected at the start-up stages, although British Columbia has prepared guidelines for the beef and dairy industries.[253]

Similarly, Nova Scotia treats the control and regulation of intensive livestock operations primarily as a land use issue to be dealt with by municipalities or planning areas. The provincial government provides information in the form of handbooks on such topics as farm waste management; manure storage, handling and use; and livestock production, but the purpose of these documents is only "to provide a guide for agricultural producers of the environmental regulations, standards, code and guidelines which affect or may affect decisions made in the management of their farm."[254] It is left to the municipalities to develop their own bylaws for intensive livestock operations, including such fundamental issues as defining the scope of the regulation. The County of Antigonish, for example, has defined an intensive livestock operation as "an operation consisting of only one type of livestock in which a minimum of 30 animal units are confined to feedlots, structures or poultry facilities for feeding, breeding, milking or holding for eventual sale or egg production."[255] The bylaw also describes "minimum distance separation" (MDS) requirements for the county.

Municipal level regulation can create stark differences within a single province. One county may encourage the establishment of ILOs while a neighbouring jurisdiction

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[251]Alberta Ministry of Agriculture, Food and Rural Development, (2000c). 2000 Code of Practice for Responsible Livestock Development and Manure Management. www.agric.gov.ab.ca/agdex/400/400_27-2.html. Quebec: Regulation respecting Agricultural Operations, R.R.Q., c. Q-2,r 11.1.

[252]*Agricultural Waste Control Regulation*, B.C. Reg. 131/92, OC 557/92. An agricultural unit is defined as a live weight of 455 kg (1000 lbs) of livestock, poultry or farmed game of any combination of them that equals 455 kg.

[253]British Columbia Ministry of Agriculture and Food, (1998). Environmental Guidelines for Dairy Producers.

[254]Nova Scotia Department of Agriculture and Marketing, (1998). Environmental Regulations Handbook for Nova Scotia Agriculture. www.gov.ns.ca/nsaf/rs/envman/educate/handbook.htm. Nova Scotia Department of Agriculture and Marketing, (1998). Siting and Management of Hog Farms in Nova Scotia. www.gov.ns.ca/nsaf/rs/envman/onfarm/hogsite.htm.

[255]County of Antigonish, (1994). The Municipality of the County of Antigonish: Land Use Bylaw, Eastern Antigonish County Planning Area. www. antigonishcounty.ns.ca/lub-east.htm.

attempts an outright ban. Highly populated Yarmouth County, for example, has imposed separation distances for hog and mink ranches that seriously limit opportunities for growth in the industry due to a shortage of land to meet the separation requirements.[256]

*Ontario*

Ontario is the final example in which primary responsibility for regulation of ILOs rests with the local government. The provincial Building Code Act assigns responsibility to the municipalities for construction, alteration, and demolition permits.[257] This, coupled with the authority granted to the municipalities under Ontario Planning and Development legislation, has enabled municipalities to establish standards on minimum distance separation, siting, nutrient management plans and manure storage. The province provides information on industry standards to local governments to assist them in drafting their bylaws. For example, the province makes available a "Guide to Agricultural Land Use and the Minimum Distance Separation I and II" for municipalities to use as they see fit.

As a result, more than 50 local governments have established bylaws on intensive livestock operations,[258] with considerable variation among them. For example, the Township of South Perth has no minimum manure storage requirement nor does it demand manure lease agreements, while the neighbouring Township of Lucan Biddulph has a 365-day storage requirement and demands a formal contract between the livestock farmer and landowners who will accept manure. Similarly, in some municipalities, there has been a cap placed on the size of intensive livestock buildings, while others offer no such restriction. A cap of 600 units per site has been imposed in West Perth County, Ontario. Lampton County's bylaw does not impose a cap on animal units, but instead requires that any operation over 25 units must meet county-developed nutrient management requirements.

In Ontario, the role of the provincial government comes to the fore in the area of manure management. As part of Ontario's "Clean Water Strategy," the province has recently passed the *Nutrient Management Act 2002*.[259] The legislation provides for provincial authority to establish standards for all materials containing nutrients, including manure, commercial fertilizers, and biosolids from municipal sewage treatment facilities. Rather than look at nutrient management on an industry-by-industry basis, the approach is to view the land as a resource and carefully control the nutrient "loading" from outside sources. In so doing, primary responsibility will move from the municipality to the

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[256] Mike Langman, Director, Resource Stewardship, Nova Scotia Department of Agriculture and Fisheries. February 11th 2002.

[257] *Building Code Act, 1992*. S.O. 1992, c. 23, s. 8(1).

[258] George Garland, P. Eng. Manager Engineering and Technology. Ontario Ministry of Agriculture Food and Rural Affairs, Personal Communication, October 2001. There are some 400 local municipalities in Ontario, but many of them would not require such bylaws as there is little or no intensive livestock activity.

[259] S.O. 2002, c.4.

provincial level where universal standards will be set and applied. The intention is to provide a comprehensive approach to all land-applied materials to ensure environmental sustainability. Public consultations (Stages 1 and 2) began in late 2002, seeking input for the supporting regulations specific to the various sectors, including ILOs.[260]

In Ontario, five proposed intensive livestock projects are presently under consideration for environmental impact assessments (EIAs) pursuant to provincial legislation.[261] All of the requests for EIAs have come from the public. Such requests are necessary for the legislation to be applied to private projects, which are otherwise exempt.[262] It has yet to be determined whether the projects will undergo a full EIA; concerns regarding potential pollution risks may be addressed instead by municipal requirements for a nutrient management plan. Should a full EIA be required, it will involve a level of provincial involvement in ILO approval heretofore unprecedented in Ontario.

### *The provincial control model: New Brunswick, Prince Edward Island, Quebec, and Alberta*

#### *New Brunswick*

New Brunswick, through its Livestock Operations Act,[263] requires that a livestock operation licence be obtained prior to commencing operation. As in many provinces, existing facilities are exempt from the requirement unless they increase their size by a factor of ten or construct new facilities more than a kilometre from the original operation.[264]

In lieu of an operating licence, many existing operations have obtained a Certificate of Compliance. This Certificate of Compliance is a voluntary program commenced some 25 years ago to evaluate applicants' capabilities for manure management and their ability to control pollution.[265] Although not a legal requirement, many funding agencies and private lenders have demanded the certificate as a prerequisite to financing ILOs in the province. The program (administered by the New Brunswick Department of Agriculture, Fisheries and Aquaculture) evaluates manure siting, utilization, storage and handling, as well as the disposal of dead animals and milkhouse waste.

The term "intensive livestock operation" is not a term of art in New Brunswick legislation. Any new livestock facility (intensive or otherwise) is prohibited from

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[260] Ontario Ministry of Agriculture and Food, "Eves Government Moves Forward with Nutrient Management Regulations," see www.gov.on.ca/OMAFRA/english/infores/releases/2002/112602.html

[261] *Environmental Assessment Act*, R.S.O., 1999a, c. E-18.

[262] *Id.*

[263] S.N.B. 1998, c. L-11.01, s. 3.

[264] N.B. Reg. O.C. 99-262, s. 4(2)(d).

[265] New Brunswick Department of Agriculture, Fisheries and Aquaculture. Certificate of Compliance. www.gnb.ca/afaa-apa/20/10/201001oe.htm.

operating without a licence.[266] Since the inception of the legislation in 1999, only eight licences have been issued.

A person applying for a livestock operating licence is required to provide the following:

- a site development plan;
- a description of the manure management system;
- a manure nutrient management plan signed by an agrologist registered under the Agrologist Act;
- a copy of any water course alteration permit as required;
- any other information the registrar may require.[267]

Once reviewed by the province, additional terms and considerations may be imposed on the licensee by the regulator including: specific minimum distance separations or setbacks; measures to minimize environmental risk; measures to minimize disease; and restrictions on the method of collection, treatment, transportation, containment, storage, and application of manure and waste water.[268]

According to New Brunswick officials, there have been two proposed projects that, due to the volume of their manure and wastewaters, triggered the province's environmental assessment process. However, in both cases, the projects were withdrawn by the proponent and never constructed. Thus, here too, no full EIA has been completed on an ILO.

*Quebec*

In 2002, Quebec entirely revised its environmental protection regulations pertaining to agricultural operations and to underground water catchment for human consumption.[269] These two regulations are the key components of the environmental regime applicable to intensive livestock operations. Their enforcement rests upon the Minister of the Environment. Very few powers are delegated to municipalities with regard to ILOs.

As mentioned earlier in the text, Quebec requires, for the construction or expansion of smaller production facilities, that prior notice of a project be sent to the Minister accompanied by a professional agronomist's certificate that the proposed project conforms to regulatory requirements. The agronomist must be hired to supervise the construction of the facility and attest, no later than 60 days after the completion of the

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[266] *Livestock Operations Act*, c. L-11.01, s. 3.

[267] New Brunswick Department of Agriculture, Fisheries and Aquaculture, (1999b). *General regulation under the Livestock Operations Act*, O.C. 99-262.

[268] *Livestock Operations Act*, c. L-11.01, s.10(1).

[269] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r.11.1, and *Regulation respecting Catchment of Underground Water*, R.R.Q., c. Q-2, r. 1.3.

work, that the project as built meets the regulatory requirements. Where applicable, a professional engineer must also certify that existing manure storage facilities are large enough to stock the additional manure that will be produced by the expansion or new installation.[270]

For new or expanded storage manure storage facilities, the notice of project must be accompanied by a certificate from a professional engineer that the proposed project conforms to regulatory requirements. The engineer must be hired to supervise the construction of the facility and, no later than 60 days after the completion of the work he must attest that the project as built conforms to regulatory requirements.[271]

For larger production facilities projects, the promoter must file a request for a Certificate of Authorization accompanied by the construction plans and specifications, which must be signed by an engineer.[272] An application for a Certificate of Authorization requires "evidence enough to satisfy the Minister that the proposed project complies in all respects with the Environment Quality Act,[273]

In many respects, Quebec's requirements are the strictest in the country. Quebec, for example, demands leak detection systems as standard practice, bans the spreading of manure on frozen or snow covered ground, and has supported moratoria in specific townships.

*Prince Edward Island*

Unlike its counterparts, the Island province does not have specific legislation regarding ILOs, but relies instead on various pieces of legislation that form a patchwork of regulation. The Guidelines for Manure Management for Prince Edward Island[274] contain a list of permit and approval processes that must be completed by the proponent of a new livestock development. These include a well water permit under the Well Water Regulations within the province's Environmental Protection Act,[275] as well as separate environmental approval for both new livestock operations and significant expansions of existing operations. Approval is also needed for any proposed manure storage plan. The latter, along with a certificate of inspection, must be endorsed by a design engineer and submitted to the Department of Technology and Environment for authorization.

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[270] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r.11.1, ss. 39-41.

[271] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r.11.1, ss. 39-41.

[272] *Regulation respecting Agricultural Operations*, R.R.Q., c. Q-2, r.11.1, ss. 42-43. *Environmental Quality Act*, L.R.Q., c. Q-2, s. 22. *Engineers Act*, L.R.Q., c. I-9, s. 2.

[273] *Environmental Quality Act*, L.R.Q., c. Q-2, ss. 22 and 24.

[274]Government of PEI, (1999). Guidelines for Manure Management for Prince Edward Island. www.gov.pe.ca/af/agweb/library/documents/manoreguide/index.php3.

[275]S.P.E.I. 1988, c. E-9.

*Alberta*

For several years the province of Alberta left primary responsibility for the control of ILOs with rural municipalities. To support local decision-making, the province developed a Code of Practice for Responsible Livestock Development and Manure Management, but left it to the municipalities to determine which of the elements of the Code they wished to incorporate in their own development or construction permits.

With the 2001 amendments to its *Agricultural Operation Practices Act*, the province now retains the responsibility for site determination, monitoring and enforcement of standards for new and expanded ILOs. Specific responsibility rests with the Natural Resources Conservation Board (NRCB).

According to the province, municipalities will "continue to play a key role" in the siting of intensive livestock facilities through the development of "land-use plans to identify where new and expanding [ILOs] would not be incompatible with current or future land uses"[276] Moreover the NRCB will respect conditions imposed by municipalities on existing operations, although the NRCB will assume monitoring tasks. Existing operations will be subject to new regulatory standards for the protection of water bodies from contamination, and to new manure management standards.[277]

Three regulations, the *Standards and Administration Regulation,*[278] the *Board Administrative Procedures Regulation,*[279] and the *Agricultural Operations, Part 2 Matters Regulation*[280] provide the detail on such issues as minimum distance separation, manure storage and nutrient management, application and procedures. Owners of a new or expanded confined feeding operation will require either an approval or registration of their operation, depending on the size of the operation.[281] Authorization will also be required for the construction or expansion of a manure storage facility designed for the containment of manure for six months or more.[282] "Authorization," "approval," and "registration" differ in the degree to which the public is involved in the process. Essentially, the larger the operation, the more complex and participatory the decision-making process. The *Board Administrative Procedures Regulation* outlines the rights of "affected parties" to be notified about operator applications, to make submissions

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[276]Backgrounder. Confined Feeding Operations. Government of Alberta Press Release. November 13, 2001. www.gov.ab.ca/acn/200111/11557.html

[277]*Id.*

[278]*Standards and Administration Regulation.* A.R. 267/2001.

[279]*Board Administrative Procedures Regulation.* A.R. 268/2001.

[280]*Part 2 Matters Regulation.* A.R. 257/2001.

[281]*Id.* ss. 2 & 3. Schedule 2 of the regulation sets out the specific numbers of animals in either the approvals or registration category. For example, 200- 499 beef feeders of less than 900 pounds require only registration, while operations with over 500 feeder require an approval.

[282]*Id*. s.4.

regarding a proposed operation, and to seek a public review. The *Part 2, Matters Regulation* defines "affected party" broadly. Examples include:

> (a) a person or municipality within 10 miles downstream of an ILO that is within 100 metres of the stream, if that person or municipality is entitled to divert water from the stream;
>
> (b) the municipality where a confined feeding operation is located;
>
> (c) a municipality or person who resides within
>
> (i) 1/2 a mile of a confined feeding operation that contains 500 or fewer animal units (AUs);
>
> (ii) one mile of a confined feeding operation with 501 – 1000 AUs;
>
> (iii) 1.5 miles of a confined feeding operation with 1001 – 5000 AUs;
>
> (iv) 2 miles of a confined feeding operation with 5001 – 10,000 AUs;
>
> (v) 3 miles of a confined feeding operation with 10,001 – 20,000 AUs;
>
> (vi) 4 miles of a confined feeding operation with more than 20,000 AUs;
>
> (d) a neighbour to land on which manure from a confined feeding operation is spread.

Alberta has a two-option approach to the regulation of nutrients. On the one hand, the *Standards and Administration Regulation* sets out manure application limits and related matters in great detail, with variations for soil and crop types. On the other hand, the regulation provides for flexibility by allowing individual nutrient management plans, provided the NRCB is satisfied that the plans will be at least as protective of water and soil as the regulations.

### *The cooperative model: Manitoba and Saskatchewan*

#### *Manitoba*

In Manitoba, the approval process generally begins at the local level where land-use bodies control the siting of livestock operations through the issuance of development permits by municipalities or planning districts.[283] Some municipalities have specific land use bylaws; others do not. For municipalities that do not have local land use plans, applications for intensive livestock operations are reviewed at the provincial level within the context of provincial land use policies. The province goes so far as to suggest that

> Municipalities can establish specific "livestock zones" within which all intensive livestock operations over a certain size must be located. These livestock zones would be located in suitable areas with low development

[283]Livestock Stewardship Panel, (2000). Sustainable Livestock Development in Manitoba: www.gov.mb.ca/agriculture/news/stewardship/stewardship.html

density, compatible land uses and appropriate soil, groundwater sensitivity and distance from surface water.[284]

No such zones have been established to date, however.

One additional indicator of the cooperative relationship between levels of government in Manitoba is the establishment of Regional Technical Review Committees to assist municipalities with livestock operation proposals. These Committees, comprised of representatives from the Department of Agriculture and Food, Conservation, and Intergovernmental Affairs, assist local municipalities seeking information as to whether a proposed operation satisfies all provincial guidelines and regulations. Changes to *The Planning Act* in 2000 require Regional Technical Review Committee reports for all proposals for operations with 400 or more animal units. However, this does not preclude municipalities from requesting TRC reports for smaller operations. The locally elected Council of the rural municipality can use the information and recommendations provided by the Technical Review Committee to inform its decision-making process. The report is available to the proponent and, once reviewed by the council, to the public.

At present, in rural municipalities with their own zoning bylaws in Manitoba, the majority of ILOs are granted local permits as a "conditional use" within a "general agricultural zone." The local Council approves the activity based on information from the proponent, the Technical Review Committee, and local public input garnered from a mandatory conditional use hearing.[285] There is no appeal mechanism from the local decision.

Project proponents in Manitoba face a number of additional approval requirements from a variety of legislative and regulatory sources.[286] Through its *Livestock Manure and Mortalities Management Regulation*, issued pursuant to the Environment Act, Manitoba prescribes requirements at the provincial level for the "use, management and storage of livestock manure and mortalities in agricultural operations so that livestock, manure and

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[284] Department of Conservation, Department of Agriculture and Food, Department of Intergovernmental Affairs. "Livestock Stewardship 2000." See www.gov.mb.ca/agriculture/newslsteward/stewardship7.html#Planning%20Act

[285]Manitoba Agriculture and Food, (2001). "Requirements for Setting up Hog Barn Operations". Manitoba Swine Update, vol. 13, No. 1 (Jan. 2001) <http://www.gov.mb.ca/agriculture/livestock/pork /swine/bab02s50.html>. The Technical Review Committee provides information on whether a proposed operation satisfies all provincial guidelines and regulations. The TRC may also highlight concerns, but the final decision on whether to issue a development permit remains with the Council. Petra Loro, Livestock Environment Specialist, Animal Industry Branch, Manitoba Agriculture and Food. Personal communication, October 2001.

[286] For a survey particular to the requirements for hog farmers, see <http://www.gov.mb.ca/agriculture/livestock/pork/swine/bah00s00.html>-- from the Farm Practice Guidelines for Livestock Producers in Manitoba.

mortalities are handled in an environmentally sound manner."[287] Among other requirements, a permit is required for the construction, modification, or expansion of a manure storage facility. That permit will not be issued unless a professional engineer's certificate has been provided certifying that the completed project conforms with siting and construction requirements set out in the regulation. Slightly more than 500 such permits have been issued to date to large, medium and small-scale producers.[288]

In addition, under provincial water rights legislation, proponents of projects will require a water rights licence if the operation uses 5,500 or more gallons of water per day. Finally, proponents must provide an annual manure management plan to the province within 60 days before manure application begins from large-scale operations. Thus, the province maintains an ongoing role in monitoring and enforcement to compliment the activities of the local planning body. Currently, 166 water rights licences have been issued to intensive agricultural operations in Manitoba, with an additional 27 licences currently being processed and another 101 applications outstanding.[289]

*Saskatchewan*

The other province utilizing a cooperative approach is Saskatchewan. Pursuant to Saskatchewan's *Agricultural Operations Act*[290] and regulations, any proponent of a new or expanded ILO must receive approval for both a manure management plan and a manure storage plan. The province specifically defines an intensive livestock operation as one where the space per animal unit is less than 370 square metres. In addition, the province also provides use-related permits pursuant to its Water Corporation Act.[291] At the municipal level, bylaws control the development of ILOs through siting, zoning and building permit phases and also issue permits or approvals for heavy hauling once the operation begins.[292]

In issuing its approvals for manure storage and manure management plans, the Saskatchewan Department of Agriculture and Food refers plans to various other departments, including the Department of Municipal Government and the local rural municipality for their input, though the department is not required to follow the recommendations of other agencies in issuing its approval.

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[287]Livestock Manure and Mortalities Management Regulation, s. 2. Man. Reg. 42/98, s. 2.

[288] Al Beck, Manager, Environmental Livestock Program, Manitoba Conservation, personal communication, December 2002.

[289]Shirley Romano. Database Manager, Water Licensing Section, Manitoba Conservation, personal communication, August, 2001. Applications "being processed" are those for which administrative review has been completed and that are awaiting official approval. "Outstanding" applications are those that are still at some stage of administrative review.

[290]*The Agricultural Operations Act*, S.S. 1995, c. A-12.1.

[291]*Water Corporation Act*, s.s. 1983-84, c. W-4.1.

[292]Centre for Studies in Agriculture, Law and the Environment (1996). Expanding Intensive Hog Operations in Saskatchewan: Environmental and Legal Constraints, p. 24.

To date, no intensive livestock application has required an environmental impact statement pursuant to the province's Environmental Assessment Act.[293] According to provincial officials within the Department of Environment and Resource Management, "extensive project proposals" have been required for screening a number of sites where potential impacts were of concern.[294]

### *The Walkerton Legacy*

Recent events in Walkerton, Ontario, are likely to help retain a focus in livestock issues in Canada. Walkerton's water supply was contaminated by *E.Coli* bacteria in May and June of 2000. Some 2300 residents became ill as a result of the contamination and seven died. The province of Ontario established the Walkerton Inquiry as an independent Commission to examine the contamination. The Commission's findings (two volumes) were presented to the Ontario government and made public in January and May 2002. The findings of the Commissioner indicated a number of problems throughout the administration and operation of the drinking water system at all levels of government. He also confirmed that the original source of the *E. Coli* was manure that entered the system through a source well located downhill from a field occupied by cattle (not an ILO). The operator of the farm was exonerated from blame, however, because the farm operated pursuant to good farming practices and was deemed duly diligent in the management of its manure.[295] The second volume of the report addressed larger issues related to drinking water quality management, including the impact of intensive livestock operations on the resource.

The report included a number of specific recommendations, among them: that no certificate of approval for spreading manure should be issued unless the approval is compatible with source water protection plans, and that the Ministry of Environment should be the lead agency in regulating potential impacts of farm activities, as opposed to the Ministry of Agriculture, Food and Rural Affairs, which should be limited to the task of technical support only.

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[293]*Environmental Assessment Act*, S.S. 1979-80, c. E-10.1. There has, however, been a challenge to the determination that an intensive livestock operation is not a "development" within the meaning of section 2(d) of the Act. The action was dismissed at the Court of Appeal. See *Irvine v. Kelvington Superswine* (1997), 26 C.E.L.R. (N.S.) 1 (Sask. C.A.).

[294]Brent Bittner, Project Manager, Saskatchewan Environmental Assessment Branch, Saskatchewan Environment and Resource Management, personal communication, August 2001.

[295]Hon. Dennis R. O'Connor, *Report of the Walkerton Inquiry: The Events of May 2000 and Related Issues.* Jan. 2000.

# Regulations in Mexico

## Background

According to official statistics, livestock production occupies more than half of Mexico's land area (mostly for cattle grazing) and involves more than 3 million producers, most of them very small-scale. But agriculture, generally, has declined in importance in recent decades as the manufacturing and service sectors have become the axis around which the economy revolves. With the rapid growth of those sectors after the Second World War, all agriculture accounted for only 18% of the GDP by 1950, 11% by 1970, 7% in the 1990s and under 6% by the start of the twenty-first century. Livestock was 5.3% of GDP in the 1950s, 4.5% in 1965, 4.0% in 1970, 3.3% in 1979, and only 1.1% in the 1990s.

Livestock inventories grew very little or not at all over the last decade. Total meat production rose less than 2%. The lively growth of modern livestock operations has barely managed to offset the slowdown and stagnation of more traditional small and medium-sized units.

Half of the nation's milk production and half its pork production are estimated to come from intensive, mechanized operations. Over 90% of its egg production comes from intensive operations. Though beef cattle are still extensively grazed, beef production from feedlots increased 40% between 1980 and 2000.

Specific data on the numbers of intensive livestock operations (ILOs) in Mexico is not available, though some estimates are provided in the Introduction of this Report. Definitions vary. The number of animal operations that the government of one state (Jalisco) considers large enough to track may serve as a useful indicator.

**Jalisco**

| NUMBER OF OPERATIONS | PERMITS |
|---|---|
| PORK | 413 |
| POULTRY | 47 |
| BEEF | 5 |
| DAIRY | 1 |
| COMBINATION | 16 |
| UNSPECIFIED | 9 |
| TOTAL | 491 |

Intensive livestock operations have had an advantage in recent decades because they could more quickly adapt to qualitative and quantitative shifts in demand while offering more homogeneous products. Their integration into international networks provides for access to important inputs and technology (technical consulting, nutritionally balanced feeds, drugs, agrichemicals, machinery, equipment and infrastructure), and their production scale is not subject to restrictions under the agricultural laws, as extensive grazing systems are. (Agrarian Law in Mexico restricts the physical size of agricultural operations, especially if irrigation is involved.)

Mexican environmental law is relatively young. The General Law on Ecological Balance and Environmental Protection (*Ley General del Equilibrio Ecológico y la Protección al Ambiente*—LGEEPA) was enacted in 1988. It has subsequently been amended in light of changes to the Public Administration Law (*Ley de la Administración Pública*), primarily to reflect the decentralization of public administrative functions.

In effect, though environmental law in Mexico is rooted in national legislation, environmental laws—and their enforcement—are increasingly becoming a function of state and local government. In the last administration (1994–2000), the Ministry of the Environment, Natural Resources and Fisheries (*Secretaría de Medio Ambiente, Recursos Naturales y Pesca*—Semarnap), now Semarnat, put much effort into rendering federal powers compatible with state and municipal ones. An understanding of the regulation of ILOs in Mexico requires an appreciation of the law at all three levels (federal, state and municipal) and their interaction.

## National Laws

Six national laws directly or potentially regulate ILOs:

1.- General Law on Ecological Balance and Environmental Protection

2.- National Water Law

3.- General Health Law

4.- Federal Water Duties Law

5.- Federal Animal Health Law

6.- Federal Metrology and Standardization Law

In practice, however, only the National Water Law and two water standards have much impact on the operations of ILOs.

### *General Law on Ecological Balance and Environmental Protection (LGEEPA)*

The LGEEPA has regulations in the following areas:

1) environmental impact;
2) environmental impact assessment;

3) hazardous waste;

4) air pollution prevention and control.

Environmental issues of the agriculture and livestock sector are only marginally addressed by the LGEEPA, however. Its provisions on "solid wastes," for example, refer only to municipal wastes, not agricultural wastes. And odours from agricultural sources are not covered in its odour provisions. The law does provide for an environmental impact assessment process that could be applied to ILOs (it addresses "fishing, aquacultural or farming activities that could cause harm to ecosystems," art. 28) but, in practice, it has not been. In several cases, regulations and standards envisioned by the law have not been formulated or implemented. Water resources are largely the province of the National Water Law (see below), but for all other resources, LGEEPA is the primary environmental law, and its enforcement is the responsibility of the Office of the Federal Attorney for Environmental Protection (*Procuraduría Federal de Protección al Ambiente*—PROFEPA).

### *National Water Law (LAN)*

The National Water Law (*Ley de Aguas Nacionales*—LAN), passed in 1992, provides that "authority over and administration of national bodies of waters and public resources resides with the Federal Executive, which shall exercise its power directly or through the National Water Commission (*Comisión Nacional del Agua*—CNA)."

Water legislation has existed in Mexico for over five decades. The current law repeals that of 1972 which, like its predecessors, was predominately normative and administrative in nature. The current LAN contains substantial changes in the regulation of water, the role of the authorities and the users' responsibility for the resource. The law also has a coercive function, establishing sanctions and penalties for violators.

The Commission (can) is an important public body that has inherited many of the responsibilities of the former Ministry of Agriculture and Water Resources. The agency was subsumed under the Ministry of Agriculture and Livestock Production in the 1980s. With the inception of S in 1994, the CNA came under its auspices, but preserved its singularly influential and important status. A very high percentage of Semarnap's resources (almost 90%) were assigned to the CNA.

Among the important responsibilities of the CNA are to enforce compliance with the LAN, set conditions on wastewater discharges, issue permits and licences for water use and discharge, draft and enforce Mexican Official Standards, and enforce the Federal Water Duties Law (*Ley Federal de Derechos en Materia de Agua*—LFDMA).

The CNA, in coordination with the state and municipal governments, can:

1) establish and enforce requirements concerning wastewater discharges;

2) require a permit to discharge wastewater into public waters;

3) order activities to be suspended where:

a) no discharge permit has been issued,

b) the corresponding Mexican Official Standard or the particular conditions of discharge are violated, or

c) the duties for use of public property are not paid,

4) order any work necessary where there is a threat of harm to the population or the ecosystem, at the expense of whomever is responsible;

5) impose penalties ranging from 50 to 10,000 times the daily minimum wage for 18 different violations, including: discharge of wastewater in violation of the law, use of national waters without title thereto, etc. (Articles 4–5, 7, 85-96, 119-123).

Water laws as they affect ILOs have been considerably strengthened across Mexico in recent years, forcing some reductions in direct discharges of untreated manure and wastewaters from livestock operations into public waters. One consequence is an increase in the quantities of manure applied to land.

### *General Health Law*

The General Health Law (*Ley General de Salud*) was originally enacted in 1984. "Prevention and control of the harmful environmental effects on health" is one of the twenty-eight areas that article 3 of this law includes under its purview of "general sanitary conditions."

Though article 3 includes the concepts of *prevention and control* of "harmful effects," article 111, on the promotion of health, only uses the word *control.* The Ministry of Health interprets that language in such a way that it does not engage actively in *prevention;* it only intervenes when such effects have already manifested themselves, and then endeavours to control them. This interpretation significantly limits the Ministry of Health's ability to exercise any proactive authority over livestock operations.

### *Federal Water Duties Law (LFDMA)*

The LFDMA[296] (*Ley Federal de Derechos en Materia de* Agua), a chapter of the Federal Duties Law (*Ley Federal de Derechos*), may require the payment of a "duty" for use of federal bodies of water. The rate of duties is amended every six months and published in the Revenue Law (*Ley de Ingresos*).

The LFDMA and its related wastewater discharge standard are expressions of an effort to internalize environmental costs. "Fees must be paid when the concentrations of basic pollutants, heavy metals and cyanides, fecal coliform. [etc.] . . . are higher than the maximum limits allowed" (art. 278B). The fees vary according to the types and quantities of pollutants discharged, but the emphasis of the law to date has been on

[296] DOF (Diario Official de la Federacion), July 1991.

revenue collection. Fees can be reduced by the amount spent on measuring equipment. The collected fees go to the Ministry of the Treasury.

### *Federal Animal Health Law*[297]

In the 63 articles of the Federal Animal Health Law (*Ley Federal de Sanidad Animal*—LFSA), there are no references to environmental aspects as risk factors in animal health, nor are there any references to the environmental effects of livestock operations.

The scope of the LFSA is limited to diagnosis, prevention, control and eradication of animal diseases and pests.

### *Federal Metrology and Standardization Law (LFMN)*[298]

The Federal Metrology and Standardization Law (*Ley Federal de Metrología y Normalización*—LFMN) frames the development of mandatory Mexican Official Standards for products and processes that threaten safety, health, or the environment.

The development of Mexican Official Standards involves a process of consensus-building among the different sectors of society—public, private, academic, and civil society.

By 1994, a total of 44 water-related standards had been drafted and published, covering various aspects of economic activity. In 1995, a standard was under development to regulate wastewater discharges from hog operations, but the standard was never adopted. In January 1997 those 44 standards were abrogated. None of the other standards under development specifically address ILOs.

Although article 40, paragraph 13, of the LFMN includes livestock production among the areas for which standards (or regulations) might be developed at the national level, to date that development has not occurred. Instead, the Ministry of Agriculture, Livestock Production, Rural Development, Food and Fisheries *(Secretaría de Agricultura, Ganadería, Desarrollo Rural, Alimentación y Pesca*—SAGARPA) has directed its efforts toward regulation of animal health matters (zoosanitary campaigns in particular) and toxic wastes. The LFMN provides much latitude for the setting of standards, but to date, SAGARPA has not ventured into issues specifically concerning manure from livestock operations. Two general water standards do impact ILOs, however.

- NOM-001-ECOL-1996 ("Standard 001"), Establishing the maximum contaminant limits for wastewater discharges into national bodies of water.

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[297] DOF, June 1993.

[298] DOF, May 1997.

- NOM-002-ECOL-1996 ("Standard 002"), Establishing the maximum contaminant limits for wastewater discharges into urban and municipal sewer systems.

A broad process of participation and consultation must be undertaken, and a cost-benefit study demonstrating the economic viability of a standard must be undertaken before it can be enacted.

*Standard 001*

The standard's stated purpose is to protect the quality of national bodies of water and property, to reverse the contamination of water, and to provide for its subsequent use. Unlike previous standards, Standard 001 regulates the recipient body (*cuerpo receptor*), not the activity producing the discharge. Discharges from various economic activities and municipalities must not exceed the maximum contaminant limits (MCL) established as a function of two characteristics: the type of recipient body and the subsequent use of the water.

The recipient bodies are classified as:

a) rivers,
b) natural and artificial reservoirs,
c) coastal waters,
d) soil, or
e) natural wetlands.

Subsequent water uses include:

f) agricultural irrigation;
g) urban drinking water supplies;
h) fishing, navigation, recreation and other uses, with specific reference to coastal waters.

**Pollutants Covered by Standard 001**

| **Basics** | **Heavy metals and cyanide** | **Pathogens and parasites** |
|---|---|---|
| pH | Arsenic | Fecal coliform |
| Temperature | Cadmium | Helminth eggs |
| Oils and greases | Cyanide | |
| Floating matter | Copper | |
| Settleable solids | Mercury | |
| Total suspended solids | Chromium | |
| Biochemical oxygen demand | Nickel | |
| Total nitrogen | Lead | |
| Total phosphorus | Zinc | |

Three staggered deadlines have been set for compliance with the contaminant loads established by the standard, as measured by biological oxygen demand (BOD) or total suspended solids (TSS). The first is for large polluters (more than 3 tons/day of BOD or TSS), the second for medium-sized polluters, and the last for anyone else who is required to comply with the standards. For municipalities, compliance deadlines are set as a function of population.

**Compliance Deadlines for Non-municipal Discharges**

| COMPLIANCE DEADLINES | CONTAMINANT LOAD | |
|---|---|---|
| | **BOD** | **TSS** |
| | (tons/day) | (tons/day) |
| 1 January 2000 | > 3.0 | > 3.0 |
| 1 January 2005 | 1.2–3.0 | 1.2–3.0 |
| 1 January 2010 | All | All |

Source: NOM-001-ECOL-1996, p. 75.

In an intensive livestock activity like pork production, compliance with the MCL set by Standard 001 for discharges into recipient bodies would entail tertiary treatment systems, since the organic load of ILOs is much higher than that of the industries that were included in the cost-benefit analysis that was performed for the development of the standard. Limited evidence suggests that these costs cause ILOs to dispose of their manure and wastewaters by other means than discharge to water. The table below demonstrates the significant difference between contaminant loads for hog production compared with other industrial activities.

**Characterization of Discharges for Various Industries and Hog Production**

| INDUSTRY | **TSS** mg/l | **BOD** mg/l |
|---|---|---|
| Sugar production | | |
| Raw | 59 | 149 |
| Standard | 335 | 714 |
| Refined | 305 | 1091 |
| Chemical | | |
| Acids, bases and salts | 1452 | 13 |
| Synthetic resins and rubber | 896 | 428 |
| Pharmaceuticals | 463 | 562 |
| Pesticides | 376 | 209 |
| Hog production* | 19,144 | 7238 |

* Raw discharge: assumes the use of 18 litres of water per hog

Source: Rojas *et al.,* 1997. For hog production: Taiganides *et al., 1996.*

*Compliance Reporting (E.G. Annual Self-Monitoring)*

Standard 001 also requires companies to monitor their wastewater discharges to determine the daily and monthly averages of the regulated parameters.

| BOD (t/day) | TSS (t/day) | Sampling and Analysis Frequency | Reporting Frequency |
|---|---|---|---|
| > 3.0 | > 3.0 | monthly | quarterly |
| 1.2–3.0 | 1.2–3.0 | quarterly | half-yearly |
| < 1.2 | < 1.2 | half-yearly | annually |

The Standard provides that the CNA shall conduct sampling and analysis of wastewater discharges periodically or randomly in order to verify compliance with the MCLs.

Inspection visits under the National Water Law are of two types: those arising from a pre-established program and those arising from a complaint. More than 90 percent of inspection visits are of the latter type.

Officials with CNA's Technical Division report that each state has an average of three inspectors. With the incorporation of the staff from the Clean Water Program into the CNA management structure, this number rises to five or six.

The inspectors do not have specific training for the different industries to which they are exposed. Since they are few in number, they are unable to specialize, but must conduct inspection visits to all types of companies. Large industrial establishments are subjected to the closest monitoring.

Since the human resources available to devote to this activity are scarce, compliance cannot be assured. Even in states such as Jalisco, Michoacán and Guanajuato, where livestock is an important industry, the industrial sector has been the priority for environmental compliance and enforcement efforts.

Inspection visits are costly, since they entail water analysis, and the CNA does not have a sufficient budget to cover all users. An added factor is that within the CNA, there is a conflict between the revenue management function, which seeks to maximize the application of penalties, and the technical function, whose goal is to ensure water quality.

Municipal authorities indicated that three animal feeding operations had been closed, two of them for noncompliance, but the nature of the noncompliance was not disclosed. The assistant manager of water administration noted that a negative decision was never issued for technical reasons, only for formal reasons, e.g failure to acquire a permit or deficiencies in the application. The third facility was closed because it was too close to the town; municipal laws in Mexico can require an animal feeding operation to re-locate when urban development nears the farm.

*Assessing Standard 001*

A study[299] of the viability of Standard 001 found it inadequate to regulate wastewater discharges from hog operations, for the following reasons:

- It is a generic standard that does not distinguish the peculiarities of these activities. Discharges from hog operations require tertiary rather than secondary treatment in order to comply with the MCL set by the standard.
- The standard adopts an "end-of-pipe" strategy; it deals with the manifestation of the problem (the discharge) rather than its source.
- Implementation of the standard requires expertise that the authority does not possess and that would be costly for it to acquire.
- Fines and fees collected under the standard do not go to improvement of water quality in the recipient bodies; they go to the general fiscal funds.
- The authority does not possess the human resources and budget to monitor and enforce the standard.
- Standard 001 is regressive, since small producers have to invest proportionately more than large and medium-sized producers to comply with it.

Critics complain that, though some hog producers have built treatment infrastructure and equipment, they have done so without adequate technical support, and the equipment often goes unused. It is expensive to operate and government surveillance is insufficient. Though producers have "internalized" part of the environmental cost, they still cannot comply with the standards. The LFMN provides that standards may be reviewed and amended every five years. Standard 001 could have been reviewed in 2001, but review was not proposed. Various changes to the standard have been urged:

- it should cease to be a generic standard; a specific standard for hog production is needed;
- the staggered compliance provisions should be amended, to avoid waiting another ten years to resolve water pollution problems; and
- the MCL for some parameters, such as fecal coliforms, should be changed.

Though information is not yet available to access the extent to which Standard 001 is being implemented and enforced in relation to ILOs, it should be remembered that until the entry into force of Standard 001, discharges from hog production were entirely unregulated.

[299] R. Pérez: "Aspectos económico ambientales de la ganadería en México: la porcicultura en la región de La Piedad, Mich." Doctoral thesis.

*Standard 002*

Standard 002, like 001, is generic and also subject to staggered enforcement. It regulates wastewater discharges to public sewer systems.

Among its requirements are:

a) pH between 5.5 and 10;

b) maximum temperature of 40°C;

c) floating matter must be absent;

d) BOD and TSS are as in standard 001;

Under the provisions of Standard 002, livestock operations discharging wastewater into public or municipal sewer systems in urban or suburban areas will find it easier to meet their environmental commitments than operations located in rural areas and discharging into public water bodies.

### *Federal Agricultural Assistance Programs*

Mexican agricultural assistance programs are essentially three:

- Direct Rural Support Program (*Programa de Apoyos Directos al Campo*—PROCAMPO)
- Alianza para el Campo, initiated in October 1995, and a
- Marketing Support Program (Programa de Apoyos a la Comercialización)

PROCAMPO provides an income subsidy to producers. When the North American Free Trade Agreement (NAFTA) took effect, PROCAMPO was allowed to offset subsidies paid by the US and Canada to their agricultural sectors during an adjustment period of 15 years. Though the program's coverage is broad, it primarily supports crop producers, not livestock. In fact, the bulk of the subsidy goes to five crops—corn, sorghum, wheat, beans and cotton—mainly in three states (Tamaulipas, Sonora, Sinaloa).[300]

Unlike PROCAMPO, *Alianza para el Campo* (which accounts for some 23% of federal rural support funds) is designed to promote capitalization and raise productivity. The characteristics and operation of *Alianza* differ in each state, but most of its beneficiaries in the livestock sector have been large ILOs. Large dairy farms in the state of Hidalgo, large pork producers in central and northwestern Mexico and the Yucatán Peninsula, and poultry producers in Jalisco, Puebla, Guanajuato, and Querétaro, have received funding under this program.

The program's eligibility criteria include compliance with the relevant environmental regulations and standards, but this requirement has not been enforced in practice.

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[300] Activity Report 1996-1997 and Activity Report 1998-1999. Sagar.

The Marketing Support Program is a small program, originally created to alleviate a problem peculiar to sorghum growers in the state of Tamaulipas. It has been extended to corn purchasing in Sinaloa and wheat purchasing in Sonora, but has no direct impact on ILOs.

**State Environmental Authorities and Laws**

Environmental authorities at the state level have a variety of names and operate at a variety of levels within state governments: ministries, deputy minister's offices, divisions (*direcciones generales*), directorates (*direcciones de área*), institutes and councils.

Of the nineteen states in which significant ILOs are found, only in seven (Durango, Jalisco, México, Nuevo León, Querétaro, San Luis Potosí and Yucatán) is the environmental authority a cabinet-level body. In three states (Aguascalientes, Puebla and Veracruz), it is a second-level body, e.g., a deputy minister's office. In Baja California, the environmental authority is a division, and in three states (Chihuahua, Michoacán and Sinaloa), it is a directorate, i.e., a fourth-level body.

To this assortment of hierarchical levels may be added other entities such as the institutes of ecology of Coahuila, Guanajuato and Sonora and the environment council (*consejo de ecología*) of Hidalgo. There are also local offices of the Federal Attorney for Environmental Protection (PROFEPA) in all states.

All states of the republic have an "environmental" law, but not all of them have amended their laws to reflect the 1996 revision of the LGEEPA; the process of amending and adapting the LGEEPA is ongoing.[301] The 1996 amendments were fundamental. They affected matters as important as the allocation of resources and the delegation of environment-related powers (such as authority to review and evaluate environmental impact statements). Of the 31 states and the Federal District of which the Republic is composed, only seven have amended their environmental laws. Six of these have large-scale ILOs: Aguascalientes, Coahuila, Durango, Guanajuato, Jalisco and San Luis Potosí.

Common features of the state environmental laws include:

- State laws invest neither states nor the municipalities with explicit powers over manure and wastewaters generated by livestock operations.
- State powers are frequently transferred to the municipalities through the signing of coordination agreements.
- Some states have entered into coordination agreements with municipalities to delegate such matters as environmental impact assessment and the licensing of point sources of pollution.

[301] In early October 2001, amendments to 16 articles of the LGEEPA were tabled in the Congress (*Congreso de la Unión*).

- Among the activities potentially requiring environmental impact assessment are waste treatment facilities, sanitary landfills, and wastewater or non-hazardous solid waste disposal. Certain environmental authorities are working toward extending this provision to treatment systems in the pork production sector (e.g. SEMADES in Jalisco).
- State laws typically provide that activities that may cause ecological imbalance or environmental impact, or that may exceed certain limits, are subject to prior authorization (i.e., permitting) by the municipal governments. Wastewater discharges by ILOs generally fall under such provisions, but enforcement of these provisions has often been a low priority for regulators.
- State laws generally provide that the state government and, as applicable, the municipal governments, shall promote the treatment and reuse of wastewater.
- There are no national or state standards governing the gases emitted by ILOs.
- In concordance with the National Water Law, state laws provide that "wastewater of… agricultural or livestock… origin shall be treated before being discharged into rivers, watersheds, reservoirs, marine waters or other bodies of water or watercourses, including groundwater."

***Guanajuato: A Case Study of a state with ILOs and an amended environmental law***

A brief case study of the state of Guanajuato highlights typical issues in the interaction of federal, state and local authorities. The state has its own Guanajuato State Law for Environmental Protection and Preservation (*Ley para la Protección y Preservación del Ambiente del Estado de Guanajuato*). The state-level executive branch, the municipal governments, the State Institute of Ecology (*Instituto Estatal de Ecología*), and the State Attorney General for Environmental Protection (*Procuraduría de Protección al Ambiente del Estado*) all have some level of authority under the statute.

Some disagreement arises as to which agency has what authority over livestock activity, however. The Institute argues that the State Attorney General for Environmental Protection has the responsibility to inspect farms. The Attorney General's Office, however, asserts that the Ministry of Health is responsible for ensuring compliance by livestock operations. The Ministry of Health, on the other hand, says that the law clearly establishes that municipal authorities are those who should intervene. Those disagreements aside, the Ministry of Health has, in fact, closed a swine farm in Guanajuato, relying on the state health law—and in response to pressure from neighbours. The Ecology Department of the municipality of Apaseo el Grande has done the same with another farm, based on its own regulations.

Livestock operations are not mentioned in the state's environmental law. They could be considered "hazardous activities" under the law's expansive definition (those activities "which may cause damage to ecosystems and the population's health," (art. 4)), but they are not. Neither do livestock manure and wastewaters fit the law's definition of "non-

hazardous solid wastes" (a category primarily addressing municipal wastes). Though the statute grants the state broad authority for developing environmental policy, agriculture generally (and ILOs specifically) tend to escape review; attention is focused almost exclusively on industrial sources and municipal wastes. A section of the law authorizes "environmental technical standards" (art. 50) that could address ILOs, but they have not been developed.

Guanajuato also has a Livestock Branch within state government. Its fundamental task consists of carrying out two programs:[302]

1) Rural Development Assistance Program (*Programa de apoyo al desarrollo rural*—PADER) targeting small, low-income producers, and
2) *Alianza para el Campo*, or Rural Alliance, (mentioned under "Federal Agricultural Assistance Programs" above) is a tripartite program for medium and large producers, whose projects are financed with resources from the federal government, state government and the producers themselves. In Guanajuato, *Alianza para el Campo* operates in three areas: genetic (genetic standardization), food (processing of feed pellets), and equipment, infrastructure and manufacturing (e.g., construction of slaughterhouses that meet US import requirements).

As is true at the federal level, *Alianza para el Campo's* operating rules require environmental compliance of beneficiaries of its program, but this requirement is typically not enforced in Guanajuato. In general, the livestock branches of state governments are not given responsibility for environmental matters.

Guanajuato's Law on Livestock includes no environmental parameters. Generally, there is a lack of state legislation concerning the impact of ILOs. Further, state government officials responsible for the livestock sector have limited coordination with state environmental authorities. There is no program that links these areas, nor is there an entity that coordinates their activities.

The only activities conducted by the Livestock Branch that have an environmental component are the programs for composting cattle manure, carried out by the 16 Livestock Groups for Validation of Transfer of Technology (*Grupos Ganaderos de Validación de Transferencia de Tecnología*—GGAVATTs) in Guanajuato.

A Manual of Good Livestock Practices is being drafted, but the initial proposal concerns itself only with issues of productive management, not environmental issues.

The Livestock Branch of the Guanajuato State Government maintains that there are only two intensive livestock units in the state, both poultry, though other sources suggest that the state hosts at least 37 swine operations with more than 500 hogs. (See "Swine Inventory" chart, Introduction of this report.).

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[302] Both are part of the federal program based on agricultural policy and known as *Alianza para el Campo*.

The Ministry of Agriculture, Livestock Production, Rural Development, Food and Fisheries (*Secretaría de Agricultura, Ganadería, Desarrollo Rural, Alimentación y Pesca*—SAGARPA) also has an office in Guanajuato, but there is no formal, institutional coordination between this state office of the national Ministry and the Livestock Branch of the state government. Some informal coordination does take place. Neither does the state-level SAGARPA office coordinate its efforts with the state environmental agencies.

### *Environmental Impact Statements*

Authority to implement state-level environmental laws may be delegated to a municipality through a coordination agreement (*convenio de concertación*), on the theory that municipalities are the most knowledgeable level of government about local problems.

The agreement signed between the Guanajuato Institute of Environment and the Municipality of Celaya, for example, transfers powers invested in the former body by the Guanajuato Environmental Protection Law, in the following areas:

- environmental impact assessment;
- granting of operating licences for point sources under state jurisdiction;
- granting of authorizations to operate quarries.

Though the Agreement is dated May 2001, the transferred powers have not yet been put into practice by the municipality.

Article 27 of the Guanajuato state environmental law would subject ILOs to environmental impact assessment, but an unwritten practice exempts agricultural and livestock operations from environmental impact assessment procedures on grounds that they are a strategic food production sector. An environmental impact study is mandatory where the project entails a conversion of forests to another land use.

### *State Technical Standards*

State environmental laws grant states the prerogative of enacting environmental technical standards that are exempt from the provisions of the national standardization law (LFMN). State technical standards are enforced by the state attorneys for environmental protection. Unlike the Mexican Official Standards, they do not set MCLs.

The state environmental authority (whether an institute, directorate, ministry or other entity) drafts environmental technical standards and submits them to the State Advisory Council for consideration; the input of other state and municipal authorities as well as the general public is solicited.

The development of environmental technical standards by the states is a relatively recent phenomenon. In Guanajuato, for example, four standards have been published regarding

1) agricultural harvest by-products, 2) brick kilns, 3) footwear, and 4) quarries – none related to ILOs.

**Municipal Environmental Regulations**

New facilities (with no size specification) are typically required to obtain the following municipal permits:

1. Building permit
2. Land use permit
3. Land tax registry (*registro catastral*)
4. Animal health certificates for the movement of animals and products

Older operations (the majority) were built without permits of any kind.

The process of "municipalization" delegates various state government responsibilities to the municipalities, at the same time that "federalization" is delegating more functions to the states. As part of this transformation, municipalities have committed to amending their by-laws to reflect these new powers.

Information obtained on the by-laws of 35 municipalities shows the following:

- Seventeen municipalities have an environmental protection by-law, and five of these have ILOs: León and Celaya, Guanajuato; Tepatitlán, Jalisco; Culiacán, Sinaloa; and Mérida, Yucatán.
- Only the environmental regulations of Tlacomulco, Puerto Vallarta and Zapopán in Jalisco are up to date. Other municipalities may still follow the obsolete regulations in finalizing activities already in process, but not for the purpose of initiating new activities.
- Some of the municipal by-laws have specific provisions related to livestock (Celaya, Guanajuato; Tepatitlán, Jalisco; and Culiacán, Sinaloa). Others, such as Mérida, have no such provisions; yet intensive livestock production is a major activity in that municipality. Moreover, the Yucatán Peninsula has serious environmental problems due to soil permeability and the shallowness of groundwater.

The following, from the Environmental Protection Regulation of the Municipality of Culiacán, [303] in Sinaloa, is an example of the kind of laws with some bearing on ILOs that one finds at the municipal level.

ARTICLE 115

[303] 14-10-92 Official Gazette of Sinaloa.

Refuse disposal sites, manure piles, and other sources of physical, chemical or biological contamination shall not be sited near water supplies for human consumption.

ARTICLE 116

It is strictly prohibited to raise any kind of animal, or to site barns, stables or pigsties whose activities generate any type of contaminant such as pathogens, foul odours, or wastes representing a nuisance or a health hazard, in urban or suburban areas. Any such facilities already established shall be removed within a period of 15 days.

ARTICLE 117

Animal manure generated by meat, milk, or egg production facilities or any similar site shall not be disposed of or used without prior treatment. The systems authorized for such purpose are the following:

- Manure piles.
- Digesters.
- Composting.
- Fermentation facilities.
- Any other system authorized by the Department based on a review of its final design.

. . . . The owners of stables, horse farms or any other structure designed for the enclosure or production of animals whose siting is duly authorized, shall transport the manure produced each day to treatment sites authorized by the Department, avoiding at all times soiling public roads; should this occur, the violator shall be immediately sanctioned, and its operating authorizations shall be revoked; where the producer wishes to use the material for agricultural or industrial purposes, it shall provide prior treatment using the aforementioned systems.

Data on the implementation and enforcement of these provisions in Culiacán is lacking. The municipality of Celaya, in Guanajuato, in its Municipal Environmental Control, Protection and Improvement By-Law (1994) [304] provides:

ARTICLE 9: that the Department[305] shall keep an up-to-date inventory of the point sources of air pollution located in the municipality.

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[304] This information may be usefully correlated with the section entitled "Guanajuato: A Case Study" above.

[305] Municipal Environment Department.

ARTICLE 11: that potential generators of air pollution must file an environmental impact statement with the Department before the operating licence is processed.

ARTICLE 61: that establishments engaged in animal raising in rural areas shall install non-polluting systems for final disposal of their manure and wastewaters.

ARTICLE 62: that establishments engaged in animal raising in urban areas shall relocate to semi-urban or rural areas within a period of 60 days from the date so ordered by the Department.

In an interview, the Director of the Environment Department of Celaya made the following comments about the regulation of ILOs in his municipality:

- The Department did not include ILOs among point sources of air pollution, nor does it have a list of the ILOs in the municipality.
- For these reasons, none of these operations was required to file an environmental impact statement, which is a municipal responsibility.
- The Department lacks the resources, whether financial,[306] material or human,[307] to monitor ILOs, and so Articles 61 and 62 of the by-law are not enforced.
- The Environment Department does not have a special ILO program and only acts in response to complaints.
- The fundamental problem for the Environment Department is the management of solid waste (garbage).
- The city of Celaya (population 400,000) does not have a wastewater treatment plant.

Visits to several municipalities with large hog farms (Irapuato, Abasolo, and Pénjamo in Guanajuato; and La Piedad, Numarán, and Yurécuaro in Michoacán) showed that none had air pollution control measures applicable to ILOs.

[306] Its budget represents 0.6% of the total municipal budget. This Department is subordinate to the Urban Development Division.

[307] The Department has 19 employees, six of whom are inspectors and only three of whom are professionals.

**General Provisions—Summary**

***Siting of Facilities***

There are no standards in Mexico on the "setback" distance of facilities from property boundaries, population centers, or other ILOs, except an explicit prohibition in certain municipal by-laws of animal raising in urban areas.

In general, a land registry requirement is the extent of public notice. Inspection by the environmental and municipal authorities is haphazard.

***Design of Facilities***

Municipalities issue building permits, but there are no environmental requirements in the specifications for the construction of livestock facilities. The construction of manure and wastewater treatment facilities also requires a permit, either from a municipality or from another body designated by the state executive branch.

Manure storage capacity is essentially unregulated. For hog production, recommendations on characteristics, size and cost of lagoons for storage and removal of contaminants do exist.[308]

***Required Land Area***

Though Mexico has no regulations on the amount of land required to establish an ILO, the requirements of Standard 001 on wastewater discharges imply the need for enough land to provide for the treatment of wastewater and its application on crops. Without this, the cost of treatment or the payment of duties for exceeding the MCLs set out in the standard would make the operation economically unviable. Enforcement of Standard 001 should force some farmers away from water discharges and toward land application of their manure. Presently, there are no standards applicable to land application and no data on the subject.

***Liner Materials for Lagoons***

There are no specific standards for manure lagoon liners, but the CNA must be assured that the groundwater will not be contaminated. In Jalisco, the Ministry of the Environment for Sustainable Development requires an environmental impact study to be filed by operators building a wastewater treatment lagoon. Some other states have

[308] Manual on Management and Control of Wastewater and Hog Manure in Mexico (1996) Consejo Mexicano de Porcicultura and Instituto de Investigaciones Económicas de la UNAM.

similar provisions. Data on the implementation and enforcement of these requirements is lacking.

### *Approval of Siting Plans*

Review and authorization of the civil engineering plans is the responsibility of the municipal authorities. Wastewater facilities are the responsibility of the CNA.

### *Moratoria on New Facilities or Expansions*

No moratoria on new ILOs exist in Mexico, though there are zones in which the CNA prohibits the siting of new ILOs because groundwater resources are already over-taxed.

### *Manure Management*

Aside from the restrictions on discharges to water bodies, manure management is generally unregulated. Producers use a wide variety of methods. Much of the manure is land-applied as fertilizer, with few restrictions. Some hog producers use the treated solids in ruminant feeds; practically all chicken wastes are used in cattle feeds. Some hog producers in central Mexico sell their manure to avocado producers for fertilizer.

There are no standards on nutrient concentrations in solids.

### *Per-hectare Limits on Manure/Fertilizer*

Among the duties of the Nacional Institute for Forestry, Agricultural and Fisheries Research experiment stations is a mandate to develop and provide recommendations on the appropriate use of fertilizers. No recommendations have been issued so far on the use of manure as a fertilizer. In some experiment stations, the nutrients in cow manure have been analyzed, and the results have been published in specialized journals.

A study performed in Mexico by the Food and Agriculture Organization of the U.N.[309] found that producers using cow or pig manure as fertilizer do not take its economic or agronomic value into account. The organic fertilizers are employed in conjunction with chemical fertilizers, and often over-applied. Producers typically add a percentage to the recommendations of the experimental stations, "for good measure" but with no scientific basis for the practice. The result is over-nutrification of the soil, with the potential for water contamination and the degradation of soils.

### *Water Monitoring*

The National Water Commission has a large National Monitoring Network (*Red Nacional de Monitoreo*—RNM) and a National Water Quality Information System

[309] LEAD-AWI-Mexico Project.

(*Sistema Nacional de Información de Calidad del Agua*), consisting of 744 sampling stations. But data on contributions to water quality problems by ILOs has not been developed.

### *Odour and Air Emission Standards*

Fourteen Mexican Official Standards set MCLs for various gases and particles, but none for methane, ammonia, hydrogen sulphide or carbon dioxide, the gases generated by ILOs.

### *Emergency Plans*

There are no specific recommendations relating to accidental releases from ILOs. Article 149 of the regulation to the LAN provides that a company must report the malfunctioning of a treatment system, and whoever is responsible for the accident shall repair the harm caused.

### *Bonding/Financial guarantees*

Mexico has no bonding or insurance requirements for ILOs.

### *Penalties for Noncompliance*

The LAN (National Water Law) stipulates penalties for violations, ranging from 150 to 10,000 times the daily minimum wage. The LFDMA provides for payment of a duty where the MCLs set by Standard 001 are exceeded.

# Conclusion

Increasingly, livestock are raised in large, intensive operations. The concentration of the industry over recent years has been dramatic. Since 1982, the number of large feeding operations in the United States has increased by 47%, while the number of hog farms decreased by 75% and the overall inventory of animals remained about the same. Similar patterns are evident in Canada, and Mexico is in the early phases of parallel development.

Not only are animals concentrated in large facilities, but the facilities themselves tend to be concentrated around large processing plants (and in proximity to feed sources). These changes are driven by a variety of technical innovations and economic forces, including greater "vertical integration" of the various sectors. Antibiotics and growth hormones facilitate the raising of animals in such concentrated facilities.

Larger production facilities, frequently clustered around processing facilities, have generated a new level of environmental impacts and public concerns; the regulatory regimes of each of the countries has had trouble keeping pace. Manure volumes can exceed local capacities for re-use. Manure spills, surface and groundwater contamination, and odours from large feeding operations have captured headlines. At least one study indicates that a concentration of ILOs in a relatively small region can contribute to the atmospheric deposition of nitrogen in the region. Consumer groups have threatened boycotts for what they see as the excessive use of hormones and antibiotics in the industry. The health of workers in the industry is also a matter of increasing public interest.

Regulatory models in Canada, Mexico and the US vary. In Canada, the regulation of intensive livestock operations (ILOs) is largely a provincial matter; in some cases, authority is further delegated to local municipalities. In British Columbia, Nova Scotia and Ontario, ILO regulation has traditionally been a local matter. Mexico has no environmental regulations specific to ILOs; its general water regulations, which do impact ILOs, are federal, but oversight and enforcement are primarily local matters. The bulk of the regulation of ILOs/CAFOs in the US has historically been at the state level, though new federal regulations will provide a new floor under those state rules. In short, regulations vary among the three countries and from state-to-state and province-to-province within the countries.

Whether these regulatory differences influence the siting of ILOs can not be conclusively determined with currently available evidence. Labour costs and proximity to processors and feed mills appear to be the most influential factors, but there is evidence, for example, that some corporations have proposed facilities in other countries because they found the regulatory climate too restrictive in their native countries (such as the Netherlands, Taiwan and the US). Significant US investment has also gone into ILOs in Mexico and Canada. Local rules can discourage the siting of ILOs (by requiring large separation distances between facilities and their neighbours, for example) or encourage them (by providing financial incentives).

But, despite the differences, similarities are also apparent, especially between Canada and US. Common requirements and trends that define the current state-of-the-art in ILO regulation include (see chart of comparisons below):

1. Permits. In each of the three countries, a permit of some type is required for ILOs above a certain size. Especially in Mexico, the permits may only be construction permits or operating permits with little or no environmental content beyond siting restrictions that limit the proximity of ILOs to developed areas. Where the permits are environmental permits, they focus almost exclusively on issues of water pollution in all three countries. Air pollution from ILOs is dealt with almost entirely by setback requirements that separate the operations from their neighbours. Requirements that address soil contamination per se (whether from excessive nutrients, metals, pathogens, or other contaminants) are very rare.

2. "Nutrient Management Plans" (NMPs) or "manure management plans" (MMPs). These plans seek to control manure at ILOs from its creation through its ultimate disposition, most often on nearby lands as fertilizer. The more comprehensive NMPs specify liners for manure storage facilities, require the testing of manure and the land where it is applied (to prevent excess nutrification), mandate record-keeping (for manure shipped off-site, application schedules, etc.) and insist on certification of the plan by a qualified professional, though requirements for such detailed NMPs are rare. Seldom are even the most stringent NMPs/MMPs concerned with pollutants other than nutrients; the nutrients of concern are typically nitrogen and phosphorous, and often only nitrogen. The implications of antibiotics and hormones in manure are outside the current regulatory purview.

3. Setback or "minimum distance separation" (MDS) requirements. Requirements that ILOs be setback a minimum distance from property lines, other structures or other livestock operations are common in the US and Canada, though the specifics vary greatly. Such separation requirements have largely been in response to odour complaints, but setback requirements from water bodies are also common and contribute to water protection.

Though Mexico does not presently prescribe setback requirements, some municipal laws in Mexico can require a livestock operation to re-locate if urban development encroaches too closely on the farm. "Right to Farm" laws in the US and Canada typically protect farmers from encroaching development.

4. Public information and public notice requirements. A few jurisdictions require notice to adjacent property owners and public meetings before an ILO can be sited, but such requirements are rare. Though the trend is toward greater disclosure of information about the potential environmental impacts of ILOs, requirements in this area are still minimal.

5. Professional certification. A few US states and Canadian provinces require that nutrient management plans be certified by appropriate professionals. Though the certification process lacks standards (or sufficient history for critique), it also offers the prospect of professional support to under-staffed environmental agencies.

6. Financial guarantees. A minority of US and Canadian jurisdictions require the posting of bonds (or other financial guarantees) to ensure the proper closure of manure and wastewater facilities should an ILO cease to operate.

7. Technical assistance. Particularly in the US and Canada, agricultural operations in general have benefited from government programs of technical advice and support. Livestock operations have also benefited from such programs, often in the area of reducing environmental impacts.

**Major points of comparison can be summarized as follows:**

**Country-by-Country Comparisons**

| | **CANADA** | **MEXICO** | **UNITED STATES** |
|---|---|---|---|
| **Definitions of ILO/CAFO** | Defined in 8 of 10 provinces; varies from 50-400 "animal units" (AU). "Unit" definitions vary. Sometimes defined by animal density. | None | At federal level, "large CAFOs" = 700 dairy cows, 2500 swine, 30,000 chickens, etc. (formerly termed "1000 AU"). State definitions vary from 300 to >1000 AU, with a few as low as 10 in sensitive areas (shorelands, MN) |
| **Permits/approvals required?** | Yes in 8 of 10 provinces, conditionally in the other 2. | Some construction and operating permits re-quired. Varies by state and municipality. National water discharge standards must be met for any discharge to public waters. | Federal water pollution control permit required for "all CAFOs." Most states require various state permits, but a few only require the federal water permit. |
| **Public notice**<br><br>**required?** | May be recommended or required by municipalities or provinces. Zoning changes require notice. | Generally, no. Some notice for fiscal matters, the utilization of public utilities, etc. | Yes. |

| | | | |
|---|---|---|---|
| **Separation/Setback Distances** | Yes, in all provinces. Requirements vary widely. For example: 20 metres from watercourse or wetland (Prince Edward Island) to 1 mile from a dwelling in a city, town, village or hamlet (Saskatchewan). | None required. | In federal law, 100 feet between land application and surface waters (less with vegetated buffer or approved "alternative practices.") Yes, in most states, with wide variation based on size, type, new/existing, landscape features. For example: 100 feet from stream (Alabama) to 1 mile from dwelling, school or incorporated municipality (Colorado). |
| **Geophysical Requirements?** | Yes, in 8 of 10 provinces. Some as separation distance from water bodies or water tables; some to avoid flood plains. | ILOs are banned in zones of water scarcity. Some floodplain restrictions. | None in federal law. Yes, in 16 of 20 states, generally to avoid the 100-year floodplain. |
| **Government review of site required?** | Yes, under some circumstances, in 6 of 10 provinces. | Changes from forestry to agriculture require EIA. | Yes, under some circumstances, in 13 of 20 states. |
| **Government approval of plans?** | Yes, under some circumstances in 6 of 10 provinces. | No. | Yes, under some circumstances, in federal law and in all 20 states. |
| **Nutrient Management Plan required?** | Yes, in 6 of 10 provinces, encouraged in others. | No. | Yes, in federal law and in all 20 states (some more stringent than federal requirements). |

## The Future

The environmental impacts of ILOs will likely remain a significant public health and environmental issue in the three countries. Given the decentralized nature of the current regulatory environment, it is unlikely that environmental requirements and incentives will become uniform within a particular country or among the three countries. But technical innovations, driven in part by litigation in the United States, may play a role in helping governments understand the best technologies and practices for managing large concentrations of animal manure and wastewaters.

In North Carolina, for example, a settlement with Smithfield Foods in 2000 has generated a $15 million project to identify "superior technologies" for the management of manure and wastewaters from large animal operations. The project is examining ways to reduce the volume of manure produced, ways to reduce the environmental impact of the manure, and processes for more efficient manure treatment. All farms operated by Smithfield Foods are required to adopt technologies deemed environmentally and economically superior within the context of the agreement; the hope is that any advances made in that project will ripple through the industry. Another settlement, in Missouri, may generate as much as $50 million for research to develop and install wastewater treatment technologies at ILOs; it also requires the companies involved (Premium Standard Farms and Continental Grain Company) to calculate and report on their air emissions for possible air permitting.

The success of these experimental efforts will depend on their efficacy when expanded to full-scale operations and on governments' willingness to incorporate these advanced technologies into enforceable permit conditions or regulatory requirements.

**Conclusions**

1. The livestock industry, particularly the swine industry, has undergone dramatic concentration in the past twenty years.

2. A North American market exists for livestock.

3. Joint ventures are increasingly likely between US, Mexican and Canadian livestock producers.

4. The concentration of manure, as a consequence of those changes in the industry, can be a serious environmental and human health problem; legislation has not always been able to keep pace.

5. Environmental regulation of livestock operations has generally focused on water pollution, but air and soil pollution are also issues at large facilities, as are concerns for worker health and for the industry's extensive use of hormones and antibiotics.

6. Environmental regulation varies significantly across jurisdictions.

7. Though variations in regulations can provide incentives to site new facilities in jurisdictions with the least stringent regulations, evidence that disparities in regulation influence those siting decisions is only anecdotal. Data for tracking foreign investment in livestock operations is difficult, if not impossible, to obtain. The US, for example, requires foreign investors to complete Form FSA 153, but the form aggregates all agricultural investments.

8. Enforcement of environmental regulations at livestock operations varies widely. The agencies responsible for enforcement are frequently under-staffed and/or not trained

specifically in livestock issues. In some cases, jurisdictional issues arise between environmental agencies and agricultural agencies.

9. Mandatory "nutrient management plans" and "setbacks" are primary regulatory tools.

10. Public information requirements for ILO siting and operation are uneven but of increasing importance in several jurisdictions.

11. Professional certification of manure management operations is increasingly a requirement, but there is no standardization of the details of certification.

12. Research is underway that could reduce the impacts of manure and wastewaters from ILOs, though the efficacy and costs of these new technologies are yet to be determined.

**Recommendations**

1. Greater uniformity in the coverage of regulations within (and among) NAFTA countries could minimize incentives to site ILOs in the least-regulated jurisdictions. Though countries, states, provinces or local governments may be justified in having standards different from their neighbours, caution must be exercised to avoid the "race to the bottom effect." Variations from "state of the art" environmental standards should be based on a meaningful assessment of environmental risks in the context of other economic, social and geological concerns.

2. Specifically, greater uniformity in requirements for nutrient management plans, setbacks, public information, public participation, and professional certification could be beneficial. "Public participation" should mean more than an invitation to a public meeting after all important decisions have been made.

3. Where governments have both agricultural and environmental agencies, they should carefully consider the relative responsibilities of those agencies in relation to ILOs. Agricultural agencies have historically functioned as promoters of agriculture and may be ill-equipped to handle an enforcement role. Environmental agencies may need training in agricultural systems, but their traditional role as regulators typically makes them better-suited for the enforcement task. Environmental agencies may also have more expertise with public participation in regulatory matters.

4. Development and implementation of new manure and wastewater treatment and pollution prevention technologies, which consider the lifecycle of these by-products, should be encouraged, especially in areas with excess nutrients.

5. Systems that impose responsibility for environmental impacts on "integrators", as well as livestock producers, where the integrators own the animals, would be more equitable and would likely result in improved environmental performance at the producer level.

6. Improved systems should be developed in each of the three countries to collect information on the environmental conditions associated with ILOs and to periodically survey environmental regulation in each country.

7. Better data collection systems should be implemented for tracking foreign investment in ILOs in each of the three countries in order to help determine whether they are relocating to meet that country's domestic demand or whether they are relocating to export back to the country from which they moved and thereby avoid regulatory costs.

8. The worker health, antibiotic, hormone and specific pathogen issues are beyond the bounds of current environmental regulation and, therefore, of this study. Each deserves improved data collection and significant public attention.

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**Primary Laws Regulating AFOs/CAFOs in US states covered in this report**

| | |
|---|---|
| Federal | Clean Water Act, 33 U.S.C. 1342, and regulations 40 CFR 122.23, Pt. 122 App. B, Pt. 412. |
| Alabama | Water Pollution Control Act, COA 22-22-1 et seq, and regulations AAC 335-6-7. |
| Arkansas | Water & Air Pollution Control Act, ACA 8-4-101 et seq., and Reg. No. 5-Liquid Animal Waste Management Systems |
| California | Porter-Cologne Water Quality Act, Cal. Water Code 13260, and regulations, Cal. Regs tit. 27, 22560-22565. |

| | |
|---|---|
| Colorado | Water Quality Control Act, CRS 25-8-101 et seq., and regulations (Reg.81) 5CCR 1002; and Amendment 14 (Commercial swine feeding permits) CRS 25-8-501.1 |
| Georgia | Water Quality Control Act, OCGA tit. 12, ch.5, and regulations for land application systems, 391-3-6-.11 and .19; regulations for swine feeding operations 391-3-6-.20; regulations for non-swine feeding operations 391-3-6-.21. |
| Illinois | Livestock Management Facilities Act 510 ILCA 77/, and regulations 8 IAC pPart 900; and Environmental Protection Act 415 ILCS 5/ et seq. and Agriculture Related Water Pollution Rules and Regulations 35 IAC Part 501-508. |
| Indiana | Confined Feeding Control Law, IC 13-18-10, and regulations 327 IAC 16. |
| Iowa | Iowa Code water pollution construction and operations permit system, 11 IC 455B; livestock feedlot program, 11 IC 172D, manure storage indemnity fund, 11 IC 455J; and regulations, 567 IAC ch. 65. |
| Kansas | Water Pollution Law, KSA 65-164 et seq; Confined Feeding Law, KSA 65-171d et seq.; and regulations for confined feeding operations KAR, ch. 28, art. 16-18a; and Kansas Livestock Feedlot Law, KSA 47-1501 et seq. |
| Maryland | Md. Code Ann., Envir. 9-319 et seq. and regulations COMAR 26.08.04.09; Water Quality Improvement Act, Md. Code Ann. Agric. 8-801 et seq. and regulations COMAR 15.20.01 et seq.; Md. Code Ann., Envir. 4-413 (soil and sediment). |
| Minnesota | Minn. Pollution Control Law, Minn. Stat. 115; and Minn. Feedlot Program, Mn. Rules ch. 7020. |
| Mississippi | Air & Water Pollution Control Law, Miss. Code Ann. Tit. 49, ch. 17; and regulations WPC-1 and APC-S-2. |
| Nebraska | Livestock Waste Management Act, NRS 54-240- to -2414, and regulations NAC Ch. 130. |
| New York | Environmental Conservation Law, NY ECL 17-0801 and regulations. |
| N. Carolina | Animal Waste Management Systems Act, NCGS 143-215 et seq.; 15 NCAC 02H.0122.; Swine Farm Siting Act, NCGS 106-800 et seq. |
| Ohio | ORC 903.01 et seq. (permitting); Agricultural Pollution Abatement Act, ORC 1511.02. |

| | |
|---|---|
| Oregon | Oregon Rev. Stat. 468B.200-.230 and regulations OAR 603-074, -090, -095 & OAR 340-51; Agricultural Water Quality Act, ORS 568.900 et seq, and 561.190 and .191. |
| Pennsylvania | Clean Streams Law, 35 P.S. 691.1 et seq. and regulations 25 Pa. Code 91.35, .36; Nutrient Management Act, 3 p.S. 1701-1718 and regulations, 25 Pa. Code ch. 83. |
| Texas | Tex. Water Code Ch. 26 and regulations 30 TAC 321; and Water Quality Management Plan Program, 7 Tex. Ag. Code 201.026. |
| Wisconsin | Wis. Stat. Ch. 283, 281, 92 and regulations WAC NR 243, WAC ATCP 50. |

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http://www.sagarpa.gob.mx/

SE: Secretaría de Economía
http://www.economia.gob.mx/

SEMADES: Secretaría de Medio Ambiente y el Desarrollo Sustentable del Estado de Jalisco
http://semades.jalisco.gob.mx/

Semarnat
http://www.semarnat.gob.mx/

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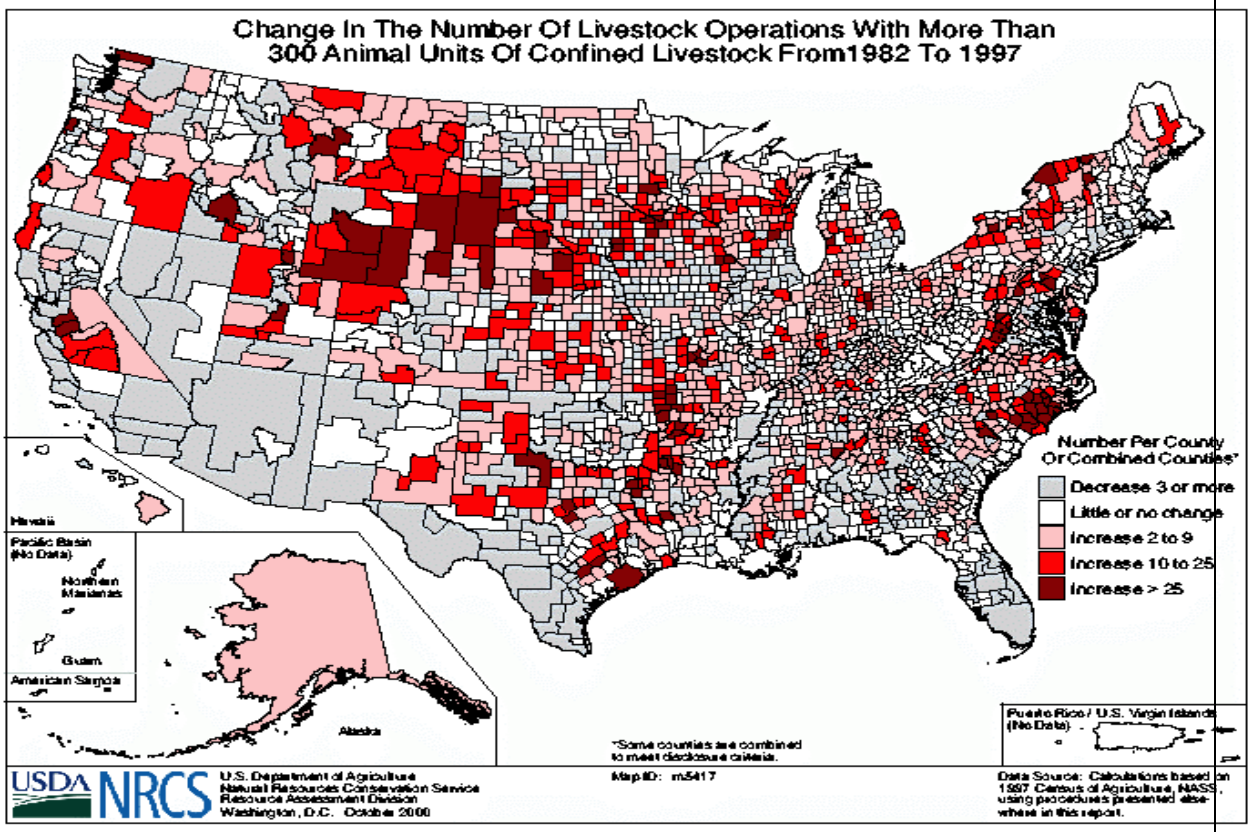
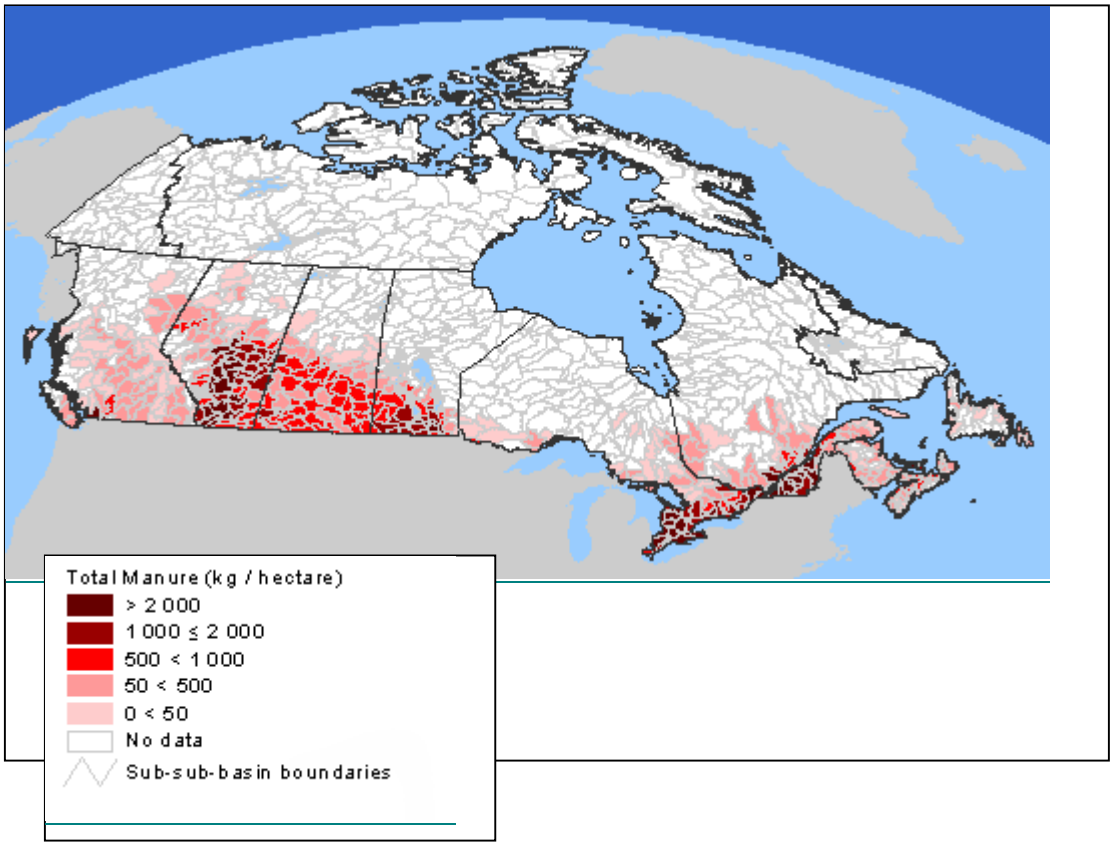
# Appendix

## Map 1: Change in the Number of Large U.S. Confinement Livestock Operations 1982-1997




Source: Kellogg *et al*., 2000.

**Map 2: Estimated Total Livestock Manure Production in Canada 1996**




Source: Statistics Canada, Environment Accounts and Statistics Division