

GAO

Report to the Honorable Tom Harkin,
Ranking Minority Member, Committee
on Agriculture, Nutrition, and Forestry,
U.S. Senate

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**ANIMAL
AGRICULTURE**

**Waste Management
Practices**



**Resources, Community, and
Economic Development Division**

B-282871

July 26, 1999

The Honorable Tom Harkin
Ranking Minority Member
Committee on Agriculture, Nutrition,
and Forestry
United States Senate

Dear Senator Harkin:

The production of livestock and poultry animals, also known as animal agriculture, is important to the economic well-being of the nation, producing \$98.8 billion per year in farm revenue. This production also contributes to the viability of many rural communities and the sustainability of an adequate food supply for the American public. However, concern over pollution resulting from intensive livestock and poultry production—in which large numbers of animals are held in confined production facilities—has increased in recent years. Nationwide, about 130 times more animal waste¹ is produced than human waste—roughly 5 tons for every U.S. citizen—and some operations with hundreds of thousands of animals produce as much waste as a town or a city.² These large volumes of waste threaten surface water and groundwater quality in the event of waste spills, leakage from waste storage facilities, and runoff from fields on which an excessive amount of waste has been applied as fertilizer. Furthermore, as animal production is increasingly concentrated in larger operations and in certain regions of the country, commonly used animal waste management practices may no longer be adequate for preventing water pollution. Consequently, new waste management practices may be needed, including alternative uses for waste, new means of treating waste, and improved methods of moving waste to cropland where it can be used as fertilizer.

Concerned over the adequacy of current animal waste management practices to meet the needs of intensive animal production operations, you asked us to provide information on (1) waste management practices used in the United States; (2) practices used in other countries; (3) potential new practices based on technologies transferred from other industries; (4) federal financial and technical assistance available to producers for

¹Animal waste generally refers to manure but also includes wastewater, urine, bedding, poultry litter, and animal carcasses.

²Animal Waste Pollution in America: An Emerging National Problem. Report compiled by the Minority Staff of the United States Senate Committee on Agriculture, Nutrition, and Forestry (Dec. 1997).

waste management and the processes for obtaining this assistance; and (5) the role of federal agencies in conducting and/or supporting research to develop new waste management practices, including innovative uses of current practices.

Results in Brief

A wide variety of animal waste management practices are currently available to livestock and poultry producers. These practices include techniques to (1) limit waste runoff, such as cementing and curbing animal confinement areas or planting grassed buffers around these areas; (2) collect and store waste, such as scraping or flushing systems and storage tanks or retention ponds; (3) alter or treat waste, such as reformulating feed mixes or composting; and (4) use waste, such as an organic fertilizer, an additive to animal feed, or on-farm energy generation. A farmer's selection of a particular practice or system of practices depends on site-specific factors—the type and volume of waste to be managed and the proximity of the production facility to surface water or groundwater—cost considerations, and state and local regulations.

Generally speaking, animal waste management practices used in other major livestock and poultry production countries are similar to those used by U.S. farmers. However, unlike the United States, some of these countries have government-subsidized companies manage animal waste and related structures, use waste for commercial energy generation, and impose requirements that, in effect, limit the size of herds or flocks. Political and economic circumstances in these countries, which may differ from those in the United States, are factors in choosing these approaches to animal waste management. For example, the use of animal waste for commercial energy generation reflects the relatively high cost of energy inputs, such as oil and natural gas, in some of these countries.

Regarding potential new practices based on technologies used in other industries, some federal officials believe that multistage treatment technologies used to manage municipal wastewater and sewage could be adapted for large animal production operations. However, issues related to the cost of constructing, maintaining, and operating such facilities on farms must be resolved first.

The U.S. Department of Agriculture administers the major federal programs that provide financial and technical assistance to producers to manage their animal wastes. Most of this assistance is provided through the Department's Environmental Quality Incentives Program, which shares

the cost of implementing waste management practices with farmers through direct payments. Several additional assistance programs are administered by the Environmental Protection Agency or the Department of the Interior's Fish and Wildlife Service. Producers generally learn about the availability of this assistance through locally based officials, such as district conservationists and county extension agents, who work with producers to help them select waste management practices and apply for financial assistance. For fiscal years 1996 through 1998, federal agencies provided a total of \$384.7 million in financial and technical assistance to producers for animal waste management; these agencies estimate they will provide about \$114 million for this purpose in fiscal year 1999, although estimates were not available for each program.

The U.S. Department of Agriculture's Agricultural Research Service and Cooperative State Research, Education, and Extension Service are the principal federal agencies conducting or supporting research to develop new or innovative animal waste management practices. For example, in recent years these agencies have conducted or sponsored research to reduce and stabilize the nutrients in animal wastes and to improve waste composting techniques. For fiscal years 1996 through 1998, the Agricultural Research Service spent \$13.5 million for this type of research; it expects to spend an additional \$9.1 million in fiscal year 1999. The Cooperative State Research, Education, and Extension Service spent \$6.9 million for this type of research in fiscal year 1997; data for fiscal years 1996 and 1998, as well as an estimate for fiscal year 1999, were not available.

Background

Animal waste runoff can impair surface water and groundwater by introducing pollutants, such as nutrients (including nitrogen and phosphorous), organic matter, sediments, pathogens (including bacteria and viruses), heavy metals, hormones, antibiotics, and ammonia. These pollutants are transported by rainwater, snowmelt, or irrigation water through or over land surfaces and are eventually deposited in rivers, lakes, and coastal waters or introduced into groundwater. These pollutants can affect water quality and public health in several ways, such as contaminating drinking water supplies and killing fish. Other potential environmental problems associated with animal production include odors, the loss of wildlife habitat, and the depletion of groundwater. According to the Environmental Protection Agency (EPA), agricultural activity,³

³Agricultural activity includes irrigated and nonirrigated crop production and the use of rangeland, pastureland, feedlots (facilities where animals are fattened and confined at high densities), and animal holding areas (facilities where animals are confined briefly before slaughter).

including the production of livestock and poultry animals, is a leading source of impairment to the nation's rivers and lakes, and a significant source of impairment to its coastal waters and groundwater.⁴

As the result of domestic and export market forces, technological changes, and industry restructuring, the past several decades have seen substantial changes in the animal production industry. As we reported in 1995,⁵ the concentration of animal production in large, confined operations has increased since the 1970s for livestock (beef feedlot cattle, dairy cows, and hogs) and poultry (broilers, laying hens, and turkeys) sectors. For example, in the hog industry's top 10 production states,⁶ the inventory controlled by operations with 500 or more hogs increased from about 40 percent of these states' inventory in 1978 to about 77 percent in 1994. Similarly, in the broiler sector, sales attributable to operations with 100,000 or more birds sold increased from about 70 percent of national sales in 1974 to about 97 percent in 1992. According to the U.S. Department of Agriculture (USDA) and other sources, the concentration of production in these livestock and poultry sectors has further increased in recent years.

In light of animal agriculture's contribution to water pollution and the increasing concentration of livestock and poultry production in the United States, the administration recently took actions designed to reduce animal agriculture's contribution to impaired water quality. For example, in February 1998, the administration proposed a plan to address the nation's remaining water quality problems.⁷ Known as the "Clean Water Action Plan," this plan identifies polluted runoff as the most important remaining source of water pollution and provides for a coordinated effort to reduce polluted runoff from a variety of sources, including livestock and poultry production operations. As part of this effort, USDA and EPA developed a

⁴In general, impaired waters are those waters that do not fully support one or more designated uses, such as providing drinking water, allowing swimming, or supporting the existence of edible fish and shellfish.

⁵Animal Agriculture: Information on Waste Management and Water Quality Issues (GAO/RCED-95-200BR, June 28, 1995).

⁶As of 1994, these states were Kansas, Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, North Carolina, Ohio, and South Dakota.

⁷Clean Water Action Plan: Restoring and Protecting America's Waters, U.S. Environmental Protection Agency and the U.S. Department of Agriculture (Feb. 1998).

unified national strategy⁸ to minimize the water quality impacts of confined “animal feeding operations.”

The unified national strategy, issued in March 1999, establishes an expectation that all of the approximately 450,000 animal feeding operations nationwide will develop and implement comprehensive nutrient management plans by 2009. According to the strategy, these plans should include, among other things, provisions to (1) modify animal diets and feed to reduce the amounts of nutrients in manure; (2) improve manure handling and storage to reduce the chances of leaks or spills; (3) apply manure to cropland in a manner that does not introduce an excess of nutrients and minimizes runoff; and/or (4) employ alternative uses of manure, such as the sale of manure to other farmers, composting and the sale of compost to homeowners, and the use of manure for on-farm power generation, especially in situations where the potential for land application is limited.

In addition to the unified strategy, EPA is currently revising its effluent guidelines for large confined animal feeding operations. These guidelines limit the discharge of liquid waste from these operations into the environment and are enforced through permits issued under EPA’s National Pollutant Discharge Elimination System. According to EPA, when completed, the revised guidelines may require an estimated 5,800 to 20,000 of these operations to obtain permits; currently, only about 2,000 permits have been issued to confined animal feeding operations. In general, permits may be required for the largest operations (those with herds or flocks above a certain size); operations with unacceptable conditions, such as direct discharge into waterways; and operations that significantly contribute to water quality impairment within a watershed.⁹ EPA anticipates completing the guidelines for hog and poultry operations in December 2001; it anticipates completing these guidelines for beef and dairy operations in December 2002.

⁸Unified National Strategy for Animal Feeding Operations, U.S. Department of Agriculture and the U.S. Environmental Protection Agency (Mar. 9, 1999).

⁹A watershed is an area of land in which all surface water drains to a common point, such as a stream or river.

Animal Waste Management Practices Currently Available

A wide variety of animal waste management practices are currently available to livestock and poultry producers.¹⁰ A farmer's selection of a particular practice or system of practices depends on (1) site-specific factors, such as the type and volume of waste, the proximity of a production facility to surface water or groundwater, and the availability of farm equipment; (2) cost considerations; and (3) state and local regulations.

Practices Used to Limit Waste Runoff

Waste management practices used to limit or reduce animal waste runoff include a variety of barriers and buffers. Barriers include cementing and curbing animal confinement areas, such as feedlots and barnyards, to capture runoff as well as fencing to restrict livestock's access to rivers, streams, lakes, or ponds to prevent animals from depositing wastes directly into these waters and from breaking down and contributing to the erosion of the banks that line these waters. Figure 1 depicts cemented and curbed barnyards.

Figure 1: Cemented and Curbed Barnyards



¹⁰A more detailed listing and discussion of the various practices livestock and poultry producers may use to manage their animals' wastes may be found in USDA publications such as the National Handbook of Conservation Practices (USDA/NRCS, Apr. 26, 1999), available on the Internet (http://www.ftw.nrcs.usda.gov/nhcp_2.html) and field office technical guides, derived from the handbook, available at NRCS field offices in each state.

Buffers include vegetated filter strips, grassed waterways, and constructed wetlands. These practices are intended to remove nutrients, organic solids, and sediments from animal waste runoff before they can reach surface waters. For example, vegetated filter strips—areas planted with grasses—may be located around animal holding areas, between animal production facilities and surface water bodies, and along the banks of surface water bodies. They may also serve as buffers between these water bodies and rangeland where livestock graze and cropland to which manure has been applied as a fertilizer or soil conditioner.¹¹ Figure 2 depicts a grassed filter strip separating a barnyard from a nearby stream.

Figure 2: Grassed Filter Strip



Practices Used to Collect and Store Animal Wastes

Waste management practices used to collect and store animal wastes include a variety of scraping and flushing systems and storage structures such as tanks, lagoons, ponds, and sheds. The choice of a collection method and storage structure depends, in part, on the volume and moisture content of the waste being handled. For example, wastes with a relatively high moisture content, such as dairy and hog waste, are suitable for a mechanized scraping or water-based flushing system. In contrast,

¹¹As a soil conditioner, animal waste is applied to soil to improve its organic content.

drier wastes, such as beef cattle and poultry waste, are typically moved with a tractor or through manual labor. Figure 3 depicts a mechanized scraping system in which a scraper sled is drawn along by a chain or cable located in a floor groove.

Figure 3: Mechanized Scraping System for Collecting Dairy Cow Waste



Similarly, the choice of a storage structure depends on waste volume and moisture content. Structures such as lagoons, retention ponds, and tanks are suitable for very wet waste, such as waste slurry.¹² Lagoons and retention ponds can be lined with packed clay or a synthetic material to minimize the leaching of liquid waste into groundwater. Structures such as sheds or synthetic covers are used for dry wastes such as poultry litter.¹³ Dry wastes are “stacked” in these structures to shelter them from rain and snow. In general, wastes are held in storage structures until they can be applied to agricultural land as a fertilizer or soil conditioner. Irrigation equipment can be used to pump liquid waste from storage structures onto

¹²Waste slurry is a watery mixture of insoluble matter with a mud-like consistency.

¹³Poultry litter consists of poultry manure and other materials, such as feathers, and bedding materials, such as wood shavings or straw.

fields; dry waste is usually applied with a tractor-drawn manure spreader. Figure 4 depicts a storage lagoon for hog waste and an above-ground storage tank for dairy cow waste.

Figure 4: Storage Lagoon for Hog Waste and Storage Tank for Dairy Cow Waste



Practices Used to Alter or Treat Animal Wastes

Management practices used to alter or treat animal wastes include feed manipulation, composting, and anaerobic digestion. In general, these practices are used to reduce the volume of waste and/or to stabilize nutrients, control odors, and/or eliminate pathogens. Feed manipulation includes changing the composition of an animal's diet or adding enzymes to feed to enable an animal to more efficiently absorb nutrients, thereby reducing the nutrient content of the animal's excrement. Composting, which can be performed in sheds or open-air manure stacks, is the biological decomposition of solid animal waste in the presence of air to form a humus-like material. This material, or compost, can then be applied to agricultural land as a fertilizer or soil conditioner. Figure 5 depicts open-air composting in which manure stacks, or "windrows," are periodically churned to keep them aerated.

Figure 5: Open-Air Manure Composting



Anaerobic digestion, which is generally performed in lagoons or tanks, is the biological treatment of liquid animal waste using bacteria in the absence of air to promote the decomposition of organic solids. The resultant nutrient-rich liquid can be pumped onto fields as fertilizer. Figure 6 depicts an anaerobic digestion tank.

Figure 6: Anaerobic Digestion Tank



Practices for Using Animal Wastes

Practices relating to the use of waste include nutrient management and the use of waste in animal feeds and for on-farm energy generation. Nutrient management includes, among other things, testing the nutrient content of manure and soil to determine appropriate application rates of animal waste as fertilizer to agricultural lands. It may also include practices such as injecting or incorporating animal waste into the soil at the time of application to limit runoff and the volatilization of nitrogen in this waste in the air. Regarding the use of waste in animal feeds, some livestock feed formulations include poultry litter as an additive because of its high nutrient and protein content. The use of animal waste for energy generation is done in conjunction with anaerobic digestion systems. One of the by-products of the digestion process is methane, a colorless, odorless, flammable gas. As discussed, anaerobic digestion is done in either lagoons or tanks. Lagoons must be covered to capture this gas; the methane is already captive in tanks. The methane is then drawn off from these structures to power an electricity-producing generator or to fuel a water heater. The electricity or heat produced can then be used for a

variety of on-farm purposes. Figure 7 depicts a covered lagoon in which methane is drawn off with a vacuum pump as well as an electric generator and water heater powered by this methane.

Figure 7: Covered Lagoon to Capture Methane Gas and Electric Generator and Water Heater Powered by This Methane



Waste Management Practices Used in Other Countries

Generally speaking, animal waste management practices used in other major livestock and poultry production countries are similar to those used by U.S. farmers.¹⁴ However, some differences in the approach to animal waste management exist that are related to political and economic circumstances in these countries.

Practices Are Generally Similar

As in the United States, livestock and poultry producers in other major production countries generally use waste management practices that are based on the eventual application of animal waste to agricultural land as a fertilizer or soil conditioner. According to reports prepared by officials of USDA's Natural Resources Conservation Service (NRCS) who periodically visit these countries, as well as other relevant literature, these foreign practices, including those used to limit runoff and to collect, store, alter, treat, and/or utilize waste, are similar to practices used by U.S. farmers.

¹⁴Other major livestock and poultry production countries include Denmark, Germany, Japan, the Netherlands, Sweden, and the United Kingdom. We selected these countries because they (1) are considered major producers by virtue of their metric tons of production during calendar years 1991 through 1997 in one or more livestock or poultry sectors and/or (2) were recommended by USDA officials and university extension agents as leaders in proactive animal waste management.

However, there are some differences in emphasis on the practices selected. For example, the use of anaerobic digesters to produce methane for on-farm energy generation is more prevalent in European countries, such as Germany, than it is in the United States. According to one expert, there are approximately 400 digesters on farms in Germany compared with 28 on U.S. farms. Officials from EPA, USDA, and the Department of Energy indicated that the relatively high cost of energy inputs in European countries make on-farm energy generation using anaerobic digestion a more economically attractive option in these countries than in the United States.

Furthermore, as in the United States, some European countries encourage nutrient management through incentive payments. For example, a number of countries, including Denmark, Germany, the Netherlands, and the United Kingdom, offer incentive payments to producers to implement conservation practices on their farms to, among other things, better manage animal wastes to protect water quality. In some cases, the availability and amount of these payments is determined on the basis of ratios of cropland acreage to animals. In this connection, several of these countries have published guidelines addressing preferred practices for managing livestock and poultry wastes.

Despite Similar Practices, Some Differences Exist

Although practices are generally similar, some notable differences in waste management exist between other major animal production countries and the United States. For example, in some European countries, such as Denmark, Germany, and the Netherlands, commercial or quasi-governmental companies operate centralized plants that accept animal and other organic waste for anaerobic digestion. In turn, these plants may market the by-products of the digestion process, including methane gas, nutrient-rich liquid fertilizer, and compost made from the residue of organic solids. These plants may also collect user fees from the farms, industrial firms, and municipalities that furnish the organic waste. In addition, some of the plants receive government subsidies to cover their operating expenses. As of 1997, about 40 such plants in Europe accepted animal waste, compared with only 2 in the United States. This discrepancy is explained, in part, by differences in individual national conditions, such as energy prices, the costs of regulatory compliance, and the amount of available land—either for application or landfill—for organic wastes.

In some countries, animal waste is also used for commercial energy generation. For example, in the United Kingdom, an electric power

company has been generating electricity since the early 1990s in two plants that incinerate poultry litter. To date, these plants have required government subsidies to remain competitive with power plants that use fossil fuels such as oil and coal. However, the managing director of the company operating these litter-incineration plants has indicated that many consumers would be willing to pay slightly higher prices for “green power” electricity, that is, power generated from nonfossil fuel sources. The company planned to open a third and much larger poultry litter incineration plant in June 1999.

Some countries have imposed specific nutrient management requirements on farmers. For example, Denmark, Japan, the Netherlands, Sweden, and the United Kingdom have implemented programs that regulate and limit the application of animal wastes to agricultural land. Denmark, for instance, requires its farmers to meet specific cropland acreage-to-animal ratios to ensure that they have ample land to absorb the animal waste nutrients produced on their farms; in effect, this ratio limits the size of a farmer’s livestock herd or poultry flock.

Potential Practices Based on Technologies Used in Other Industries

Regarding potential practices based on technologies transferred from other industries, some EPA officials believe that a multistage treatment technology used to manage municipal wastewater and sewage could be adapted for use in large animal production operations. Another technology, according to one expert, appears to have a more limited potential for transference—reverse osmosis, a technique used for water purification. However, issues related to the cost of constructing, maintaining, and operating this technology on farms must be resolved first.

EPA officials indicated that the treatment technology used for municipal wastewater and sewage could be used for handling large volumes of liquid or slurry waste associated with large dairy or hog production operations. However, they also noted that this technology would require modifications to handle the more concentrated wastes produced by these dairy and hog operations. This technology, which involves several stages of treatment—solids separation, filtration, and chemical purification—represents a considerable capital investment; it is also costly to operate and maintain. According to EPA officials, this technology results in an effluent that is free of organic solids, has been treated for pathogens, and has a greatly reduced nutrient level, but it also produces a residual sludge that must either be placed in landfills, incinerated, or applied to agricultural land as a fertilizer.

According to an EPA official, the construction of an on-farm wastewater treatment facility may require financial assistance, as has often been the case in constructing municipal wastewater facilities. For example, under provisions of the Clean Water Act,¹⁵ as amended, the federal government has assisted communities in meeting these construction costs, first through grants, and then, starting in 1989, through loans made under state revolving funds.¹⁶ Producers may have access to loans under these revolving funds for certain activities, such as constructing animal waste management facilities. In this connection, USDA officials noted that some municipal systems may have excess treatment capacity available that could be used to handle animal wastes from one or more farms, like a municipal wastewater treatment facility in southern California that accepts animal waste from a nearby dairy farm.

Reverse osmosis, a technology in which saltwater or polluted water is forced through a membrane under pressure to produce potable water, may have potential for treating animal waste. Like multistage treatment systems, reverse osmosis could be used to treat large volumes of liquid or slurry waste, filtering out fine solids, pathogens, and much of the nutrient content, according to a former consultant to the Department of Energy's National Renewable Energy Laboratory. However, according to this consultant, this technology is extremely expensive to install, maintain, and operate; it would also result in residual sludge that must be disposed of.

Federal Financial and Technical Assistance for Animal Waste Management

USDA administers the major federal programs that provide financial and technical assistance to producers to manage their animal wastes. Most of this assistance is provided through USDA's Environmental Quality Incentives Program (EQIP), which shares the cost of implementing waste management practices with farmers through direct payments. Several other assistance programs are administered by EPA or the Department of the Interior's Fish and Wildlife Service (FWS). Producers generally learn about the availability of federal financial and technical assistance through locally based officials such as district conservationists, USDA's NRCS and Farm Service Agency (FSA) county office employees, and extension agents; leaflets, pamphlets, and websites describing these assistance programs; advertisements or articles in farm journals or other publications; and

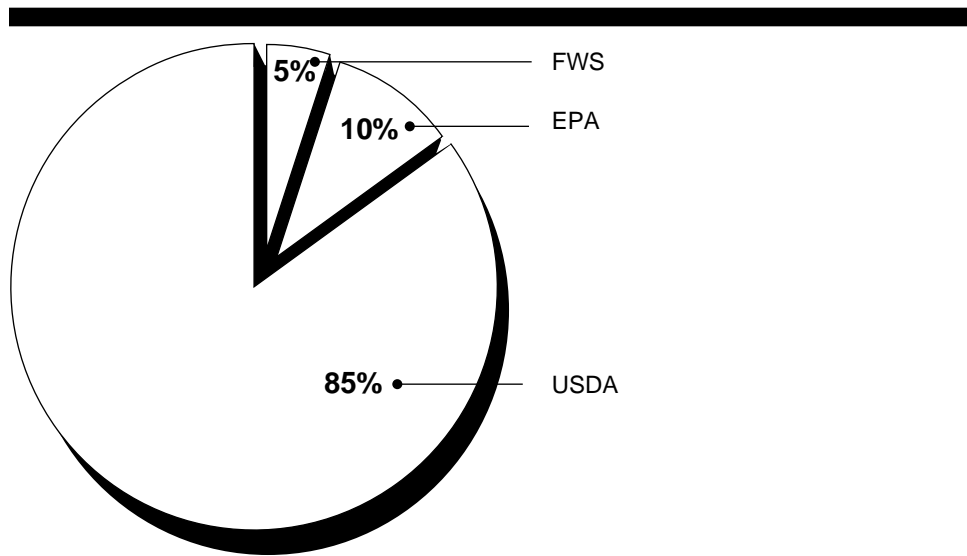
¹⁵The Federal Water Pollution Control Act Amendments of 1972, P.L. 92-500, Oct. 18, 1972.

¹⁶Capital for the state revolving funds is provided by federal funds and a 20-percent state match. The revolving funds are operated by the states and provide loans generally to local governments to finance wastewater treatment and certain other water pollution projects; the repayment of these loans replenishes the funds.

conversations with other farmers. Locally based officials work with producers to assist them in selecting waste management practices and applying for financial assistance.

For fiscal years 1996 through 1998, federal agencies provided a total of \$384.7 million in financial and technical assistance to producers for animal waste management.¹⁷ Furthermore, these agencies estimate they will provide about \$114 million for this purpose in fiscal year 1999, although estimates were not available for all of the programs. USDA provided most of this financial and technical assistance—about 85 percent—to animal producers through its programs, especially EQIP. Figure 8 shows the relative share, by agency, of the financial and technical assistance provided to livestock and poultry producers for animal waste management from fiscal years 1996 through 1998.

Figure 8: Proportions of Financial and Technical Assistance for Animal Waste Management, by Federal Agency, Fiscal Years 1996-98



Note: While not depicted in the figure, the Farm Assessment System, jointly administered by USDA and EPA, provided about \$200,000 in technical assistance for animal waste management during this period. This amount represents less than 1 percent of the total federal assistance provided for animal waste management.

Source: GAO's analysis of USDA, EPA, and FWS' data.

¹⁷No cost-share payments for installing animal waste management practices were made by the Conservation Reserve Program in fiscal year 1996.

USDA's Assistance Programs

USDA provides financial and/or technical assistance to producers for animal waste management through several programs—EQIP, the Small Watershed Program, and the Conservation Reserve Program. In addition to these programs, some animal producers continue to receive financial assistance under long-term agreements related to USDA's Agricultural Conservation Program; although this program was terminated by the 1996 Farm Bill,¹⁸ USDA will continue making payments until these agreements expire in several years.

In general, EQIP and the Small Watershed Program share the cost of implementing animal waste management or other conservation practices with farmers through direct payments. By statute, at least 50 percent of EQIP's funding is used to assist livestock and poultry producers; most of this assistance, according to USDA officials, has been for animal waste management practices. In addition, EQIP assistance is generally targeted to farms in areas or regions of the country that have water quality or other natural resource problems. Similarly, the Small Watershed Program assists farms in watersheds smaller than 250,000 acres with water quality problems.

Under the Conservation Reserve Program, USDA provides annual rental payments to producers who agree to retire highly erodible or other environmentally sensitive land from agricultural production. USDA also provides cost-share assistance to producers to plant a vegetated cover, such as grasses or trees, on this land. In cases where this land is located near animal confinement areas, this cover vegetation acts as a buffer to capture animal waste runoff. Cost-share assistance may also be provided for fencing to keep livestock animals off land enrolled in this program.

Producers must apply for assistance under a specific program. USDA officials review and rank producers' applications using such criteria as (1) whether an applicant's farm is located in a conservation priority or an environmentally sensitive area, (2) what the conservation or environmental benefits of providing the assistance are, (3) what the costs of implementing the proposed practice are, and (4) whether the assistance provided will help the producer comply with federal, state, tribal, or local environmental laws. If a producer's proposal is selected for cost-sharing, the producer must enter into a multiyear agreement with USDA to implement a conservation plan, including specific practices, prior to receiving these cost-share payments.

¹⁸Federal Agriculture Improvement and Reform Act of 1996, P.L. 104-127, Apr. 4, 1996.

In addition to its cost-sharing programs, USDA administers loan programs that producers may use for, among other things, animal waste management practices. These programs, which are administered by FSA, include farm ownership loans and farm operating loans. These loans may either be made directly with FSA or with a private lending institution, in which case FSA guarantees up to 95 percent of the loan principal. In general, loan approval is based on a producer's credit history, ability to repay the loan, and collateral. An official from USDA's Farm Loan Programs office indicated that producers have used these loans to pay for the installation of waste management structures such as lagoons.

For fiscal years 1996 through 1998, USDA provided a total of \$326.4 million in financial and technical assistance under its cost-sharing programs for animal waste management. Most of this assistance—about \$209 million—was provided under EQIP. USDA estimates that it will provide an additional \$104.9 million in assistance for this purpose in fiscal year 1999.¹⁹ USDA did not have information on the level of assistance it provided under its loan programs for animal waste management during these years. According to USDA officials, the Department does not track the number or amount of loans made for specific conservation practices or the type of loan recipient, such as an animal producer.

Appendix I provides additional information on USDA's assistance programs. Appendix II provides information on a variety of animal waste management practices that are eligible for cost-sharing assistance under EQIP.

EPA's Assistance Programs

EPA manages several programs directed at preventing or mitigating soil, water, and air pollution from nonpoint sources, including animal waste runoff,²⁰ that offer financial and/or technical assistance to producers to manage animal wastes. These programs include the National Nonpoint Source Program, the Clean Water State Revolving Fund, and AgSTAR. Unlike USDA's assistance programs, EPA's programs generally do not make direct cost-sharing payments or loans to individual farmers; instead, financial assistance from these programs is channeled through state, local, or tribal governments.

¹⁹An estimate for the Conservation Reserve Program was not available for fiscal year 1999.

²⁰Nonpoint pollution is that pollution that is not traceable to a specific point of origin, such as a pipe or other outlet. Animal agriculture sources of nonpoint pollution include animal waste runoff from animal feeding operations; cropland where manure has been applied as fertilizer; and livestock feeding and watering areas on rangeland or pasture.

Under the National Nonpoint Source Program, EPA makes grants to states to assess water quality problems caused by nonpoint sources and to develop programs to address these problems. In turn, some of these state nonpoint programs provide cost-sharing assistance to livestock and poultry producers to implement animal waste management practices on their farms, including waste storage structures, fencing to limit animals' access to surface waters, and vegetated buffers to capture waste runoff.

The Clean Water State Revolving Fund provides capitalization grants to states so they can provide loans to local governments and communities, primarily to construct new or expanded wastewater treatment facilities. Increasingly, however, some states are using these funds to address nonpoint pollution problems, including those related to animal waste. Specifically, according to an EPA official, six states are using these funds to address nonpoint pollution related to animal agriculture. For example, Minnesota has used state revolving funds to provide loans to farmers for purchasing manure storage, handling, and spreading equipment; installing feedlot improvements to prevent runoff; and implementing stream bank protection efforts.

AgSTAR provides technical assistance to producers interested in installing waste holding tanks or covered lagoons and anaerobic digesters to reduce odors and recover methane gas for on-farm energy generation. A primary focus of this program is to reduce methane emissions, a "greenhouse" gas,²¹ to the atmosphere.

During fiscal years 1996 through 1998, EPA's programs provided a total of \$39.8 million in financial and/or technical assistance for animal waste management. With the exception of AgSTAR, EPA was unable to estimate the level of this assistance for fiscal year 1999 because these programs are generally implemented by state and local governments, which report their spending to EPA at the end of the fiscal year. For AgSTAR, EPA estimates it will provide about \$400,000 in technical assistance in fiscal year 1999.

Appendix III provides further information on EPA's assistance programs.

Other Federal Assistance Programs

Other federal programs providing assistance to livestock and poultry producers for animal waste management include FWS' Partners for Fish and Wildlife Program and a program jointly sponsored by USDA and EPA known as the Farm Assessment System. The partners program provides

²¹"Greenhouse" gases are heat-trapping gases that are believed to contribute to global warming.

cost-sharing and technical assistance to private landowners, including animal producers, who are willing to implement conservation practices that improve wildlife habitat and protect water quality. For example, this program has been used to share the cost of installing vegetated buffers and fencing to limit livestock access to surface waters or to accommodate rotational grazing.²² This program provided a total of \$18.3 million in assistance for animal waste management during fiscal years 1996 through 1998. The Service estimates it will provide another \$8.7 million in assistance in fiscal year 1999.

The Farm Assessment System, usually known as “Farm*A*Syst,” is a national network of state programs that provides technical assistance to producers to implement nutrient management plans that will reduce water pollution and public health risks. Sponsored by USDA and EPA, the program also depends on funding from state and local agencies and others, such as producer organizations. Among other things, program funds are used to produce how-to materials, including booklets and worksheets on manure handling, storage, and application to the land. This program provided a total of about \$200,000 in federally funded assistance for animal waste management from fiscal years 1996 through 1998. According to program officials, the program will provide an additional \$60,000 in federally funded assistance in fiscal year 1999.

Appendix IV provides more information on these programs.

Federal Role in Conducting and Supporting Animal Waste Management Research

USDA’s Agricultural Research Service (ARS) and Cooperative State Research, Education, and Extension Service (CSREES) are the principal federal agencies involved in conducting or supporting research to develop new or innovative animal waste management practices.²³ For example, in recent years, these agencies have conducted or sponsored research to reduce and stabilize nutrients in animal wastes, to reduce emissions of odor-causing compounds and “greenhouse” gases, and to improve waste composting techniques. Generally, these agencies’ research agendas are

²²Rotational grazing is a system in which livestock animals are moved intermittently among several fenced areas or paddocks to prevent overgrazing of the vegetation. Overgrazing can lead to soil erosion, impacting water quality.

²³Neither the U.S. Geological Survey, in the Department of the Interior, nor the National Oceanic and Atmospheric Administration, in the Department of Commerce, has undertaken research related to the development of new or innovative waste management practices in recent years. However, both agencies conduct research addressing the effects of animal waste on the environment. For example, the Survey is engaged in on-site studies and methods development on animal production-related pathogens, pharmaceuticals, and nutrients and works cooperatively with state and local agencies to monitor the effectiveness of on-farm waste management practices.

determined by their customers' needs. These agencies' customers include other federal agencies such as NRCS and EPA, state and local agencies, animal producers and their associations and councils, and environmental groups.

ARS and CSREES use a variety of methods—including formal and informal interagency meetings and workshops—to coordinate their research initiatives on animal waste management practices in order to avoid duplicative projects. For example, ARS sponsored a workshop in April 1998 in which representatives from CSREES, as well as from EPA, NRCS, universities, private organizations, and environmental groups, helped ARS identify its research priorities for animal waste management. Generally speaking, the results of this research are disseminated through agencies' websites and publications; trade journals; public forums, including open houses at federal laboratories; and databases maintained at USDA's National Agricultural Library or at various universities.

In addition to this federally sponsored research, states, producer organizations, and private companies fund research on new and innovative animal waste management practices, often through university departments of agricultural science or environmental studies. For example, the University of Georgia recently completed research financed by the U.S. Poultry and Egg Association on an alternative manure management system for handling the waste of laying hens.

ARS Research

ARS conducts research on animal waste management practices, primarily under the auspices of its National Program for Manure and By-Product Utilization. In recent years, this research has generally focused on nonstructural practices, including adding chemicals, such as aluminum sulfate, to animal waste to stabilize nutrients and control odors; adding enzymes to feed to increase an animal's digestion of nutrients and reduce these nutrients in excrement; breeding crops containing nutrients in forms that are more readily absorbed by the animal; developing methods to reduce emissions of odor-causing compounds, ammonia, and "greenhouse" gases; and developing land-based manure management practices to reduce the movement of nutrients, pathogens, and gases into water and the air.

For fiscal years 1996 through 1998, ARS spent a total of \$13.5 million for research related to animal waste management; it estimates it will spend an additional \$9.1 million for this purpose in fiscal year 1999. The annual

funding for this research has grown from about \$3 million in fiscal year 1996 to an estimated \$9.1 million in fiscal year 1999. According to the co-leader of the Manure and By-Product Utilization national program, this increase reflects the increasing public concern about environmental effects of animal production operations and the need for ARS' customer base, including NRCS, to have scientific information, technologies, and management practices to appropriately deal with manure management issues.

CSREES Research

CSREES provides formula funds and grants to state agricultural experiment stations, universities, and other state institutions that conduct basic and applied research on many agricultural issues, including animal waste management. In its Current Research Information System database, CSREES identified nearly 400 research projects ongoing in fiscal year 1997 that related, at least in part, to animal waste management. According to CSREES' National Leader for Engineering, these projects included research on the biological treatment of waste, combining aerobic and anaerobic methods; the combustion of poultry litter for on-farm energy generation; and the control of animal waste odors, including methods for covering manure storage structures and altering manure with chemical additives.

CSREES spent \$6.9 million for research on animal waste management in fiscal year 1997. Similar data for fiscal years 1996 and 1998, as well as an estimate for fiscal year 1999, were not available.²⁴

Others Conducting Research on Animal Waste Management

States and private organizations are also funding research on new and innovative waste management practices, generally through universities. For example, the North Carolina General Assembly made a special appropriation in 1996 of \$2.3 million to North Carolina State University for research on animal waste management topics such as developing odor-control and waste management technologies. The University also carries out research funded by meat- and egg-processing companies to identify improved methods that livestock and poultry producers can use to treat and dispose of their animals' waste and to identify alternatives to

²⁴According to CSREES, information on the research it funded in fiscal year 1996 has been archived; thus, CSREES was unable to readily analyze these data for research specifically related to animal waste management. Information on research funded in fiscal year 1998 will not be available until the fourth quarter of fiscal year 1999.

applying waste to land.²⁵ In addition, private industry is funding a variety of research projects. For example, some feed manufacturers are funding research on hybrid grains to reduce excess nutrients in animal excrement.

Agency Comments

We provided copies of a draft of this report to USDA, EPA, and the Department of the Interior's FWS for their review and comment. We met with officials from USDA's Natural Resources Conservation Service, including the Associate Deputy Chief for Programs; the Cooperative State Research, Education, and Extension Service; and the Farm Service Agency. We also met with officials from FWS, including the Chief, Branch of Habitat Restoration. We also received comments from officials within EPA's Office of Wastewater Management and Office of Air and Radiation. USDA, EPA, and FWS generally agreed with the information presented in the report.

However, with respect to our discussion of using alternative waste management practices that are based on the technology used in municipal wastewater treatment facilities, USDA and EPA officials noted that these technologies are designed to treat waste that is more diluted than the concentrated wastes typically found in farm operations. They therefore expressed concern about the practicality of using this technology for farm operations. We recognize that this technology would have to be modified to handle animal waste, which is more concentrated than municipal sewage. We modified our report to note this limitation.

USDA, EPA, and FWS also provided a number of technical changes and clarifications to the report, which we incorporated as appropriate.

Scope and Methodology

In developing the information for this report, we interviewed and/or obtained documents from a broad range of officials from federal agencies, such as USDA, EPA, and FWS, as well as from various producer groups, environmental organizations, universities, foreign embassies, and individual producers. We also interviewed officials and/or obtained relevant documentation at various animal waste management conferences and symposia, producer councils and associations, and extension universities, including the University of Maryland-Eastern Shore and North Carolina State University. In addition, we visited a variety of livestock and poultry farms in Maryland, North Carolina, and Pennsylvania to observe

²⁵Meat- and egg-processing companies often enter into contractual agreements with livestock and poultry producers to facilitate economies of size to lower production costs and control for quality and uniformity in response to consumer preferences for quality and convenience-type products.

the waste management practices they employ. See appendix V for more details on our scope and methodology.

We conducted our review from September 1998 through July 1999, in accordance with generally accepted government auditing standards. We did not independently verify the accuracy of expenditure data related to federal financial and technical assistance for animal waste management.

We are sending copies of this report to Senator Richard Lugar, Chairman, Senate Committee on Agriculture, Nutrition, and Forestry; other appropriate congressional committees; and interested Members of Congress; the Honorable Dan Glickman, Secretary of Agriculture, the Honorable Bruce Babbitt, Secretary of the Interior, the Honorable Carol Browner, Administrator of the Environmental Protection Agency; and other interested parties. We will also make copies available upon request.

If you have any questions about this report, please call me at (202) 512-5138. Other GAO contacts and staff acknowledgements are listed in appendix VI.

Sincerely yours,



Lawrence J. Dyckman
Director, Food and
Agriculture Issues

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Abbreviations

ARS	Agricultural Research Service
CSREES	Cooperative State Research, Education, and Extension Service
CTA	Conservation Technical Assistance
EPA	Environmental Protection Agency
EQIP	Environmental Quality Improvement Program
FSA	Farm Service Agency
FWS	U.S. Fish and Wildlife Service
GAO	U.S. General Accounting Office
NRCS	National Resources Conservation Service
USDA	U.S. Department of Agriculture

USDA Programs Providing Financial and Technical Assistance for Animal Waste Management

Dollars in millions

Program	Program description	Amount provided for animal waste management, FY 1996–98	Amount estimated for animal waste management, FY 1999
Environmental Quality Incentives Program (EQIP)	Provides financial and technical assistance to animal and crop producers who agree to enter 5- to 10-year contracts to implement conservation practices. Generally shares up to 75 percent of the costs to install practices, with a maximum of \$10,000 for any fiscal year, or \$50,000 for any multiyear contract; program also provides incentive payments for nutrient management or other land management initiatives. Focuses on priority areas such as watersheds with environmental concerns. At least 50 percent of EQIP funding is reserved to assist livestock and poultry producers; these producers must have fewer than 1,000 animal unit equivalents. ^a	\$208.9 ^b	\$87.0
Small Watershed Program	Provides financial and technical assistance through state and local agencies to producers who usually enter 5- to 10-year contracts to implement management practices. Generally shares from 50 to 75 percent of the actual costs associated with installing management practices, with a maximum of \$100,000 per participant for the life of the program. Focuses on watersheds smaller than 250,000 acres to reduce flooding and soil erosion and improve water quality.	49.6	17.9
Conservation Reserve Program	Provides land rental payments, for 10 to 15 years, to producers who agree to convert highly erodible or other environmentally sensitive land to approved vegetated cover (such as grass or trees). Program also offers cost-share assistance to establish vegetated cover and fencing on enrolled land.	5.9 ^c	Not available
Agricultural Conservation Program	A terminated program that provided financial and technical assistance to producers who entered multiyear contracts to install conservation practices. Generally shared up to 50 percent of costs to implement practices, with a maximum of \$3,500 annually and \$35,000 for a 10-year contract. USDA is still making payment under some of these contracts.	62.0 ^d	Not available
Farm ownership loans	Provides direct loans of up to \$200,000, or guaranteed loans of up to \$300,000, for up to 40 years to, among other things, purchase land, construct buildings or make other structural improvements, and develop farmland to promote soil and water conservation.	e	e
Farm operating loans	Provides direct loans of up to \$200,000, or guaranteed loans of up to \$400,000, for up to 7 years to, among other things, purchase livestock, poultry, equipment, feed, and other farm supplies; develop and implement soil and water conservation practices; and refinance debt.	e	e
Total		\$326.4	\$104.9

(Table notes on next page)

Appendix I
USDA Programs Providing Financial and
Technical Assistance for Animal Waste
Management

Note: In addition to these programs, USDA's Natural Resources Conservation Service provides some technical assistance for animal waste management to livestock and poultry producers out of its Conservation Technical Assistance (CTA) program, which underpins the agency's other conservation programs that provide financial and technical assistance. Essentially, CTA provides funds for salaries and expenses of NRCS field staff who provide technical assistance to producers under programs such as EQIP and CRP. However, USDA was unable to provide us with information on how much of these funds have been directed toward technical assistance for animal waste management. Similarly, USDA's Cooperative State Research, Education, and Extension Service provided about \$2 million for educational and technical assistance to farmers from fiscal years 1996 through 1998. However, USDA was unable to specify how much of this educational and technical assistance was directed toward animal waste management.

^aAnimal unit equivalents are calculated for each livestock and poultry sector according to estimated rates of manure production for each species. Thus, the number of animals representing 1,000 animal unit equivalents varies by sector. For example, the equivalent for hogs is 2,500 animals (hogs over 55 pounds) and the equivalent for broilers and laying hens is 100,000 birds (confinement facilities with continuous watering systems).

^bIncludes assistance provided in fiscal years 1997 through 1998 only. EQIP activities in fiscal year 1996 were funded from the appropriation for the Agricultural Conservation Program.

^cAmount for the Conservation Reserve Program is for fiscal years 1997 and 1998.

^dIncludes an indeterminate but small amount of funds in fiscal year 1996 to fund EQIP activities.

^eFSA does not track the number and amount of loans that are used for specific soil and water conservation practices or whether the loan recipient is an animal producer.

Source: USDA.

Selected Practices Producers Have Installed With EQIP Assistance

Livestock and poultry producers who participate in the Environmental Quality Incentives Program (EQIP) may receive up to 75 percent of the cost to install conservation practices, including animal waste management practices. The Natural Resources Conservation Service (NRCS) maintains a list of practices that are eligible for financial assistance under EQIP, as well as other U.S. Department of Agriculture cost-sharing programs. This list is periodically updated as innovative practices become available and are demonstrated to be efficacious. Table II.1 provides examples of the kinds of practices animal producers have installed with cost-share assistance provided by EQIP, as well as the average per unit cost of installing these practices. The average cost does not include costs associated with the operation and maintenance of these practices.

The average installation costs shown in table II.1 are based on a limited number of cases covering a relatively short time period. They are also based on relatively small animal production operations because (1) the authorizing legislation for EQIP precludes the provision of cost-share assistance to large operations—defined as those with 1,000 or more animal unit equivalents—and (2) in the early months of EQIP’s implementation, NRCS concentrated on smaller operations. According to the NRCS Deputy Chief for Programs, the unit cost for constructing a storage facility or treatment lagoon would be substantially greater for a large facility. In addition, the Deputy Chief noted that farmers usually employ multiple practices that together constitute a waste management system; the cost of this “system” is the sum of the installation costs of constituent practices.

Table II.1: Selected Practices Installed With EQIP Assistance and the Average Installation Cost

Practice	Definition/purpose	Average installation cost per unit
Composting facility	Facility for the biological stabilization of waste organic material.	\$8,409/facility
Cover and green manure crop	Close-growing legumes or small grain to control erosion during periods when the major crops do not furnish adequate cover. Possesses filtering qualities.	\$24.90/acre
Diversion	Channel constructed to divert excess water from one area for use or safe disposal in other areas.	\$3.10/foot
Fence	Constructed barrier to livestock, wildlife, or people.	\$1.54/foot

(continued)

**Appendix II
Selected Practices Producers Have Installed
With EQIP Assistance**

Practice	Definition/purpose	Average installation cost per unit
Filter strip	Area of vegetation for removing sediment, organic matter, and other pollutants from runoff and wastewater. May require a constructed ditch ("settling basin") between a barnyard and the vegetative strip to ensure that solids do not reach surface waters.	\$4,650/acre
Grassed waterway	Natural or constructed channel that is shaped and established in vegetation to convey runoff from water concentrations without causing erosion or flooding and to improve water quality.	\$2,644/acre
Manure transfer ^a	Conveyance system, such as pipelines and concrete-lined ditches, that transfer animal waste (manure, bedding material, spilled feed, process and wash water, and other residues associated with animal production) to (1) a storage or treatment facility, (2) a loading area, and (3) agricultural land for final utilization.	\$10,932/system
Nutrient management	Managing the amount, form, placement, and timing or applications of nutrients, such as from animal waste, for optimum crop yields while minimizing the entry of nutrients to surface water and groundwater.	\$17.10/acre
Roof runoff Management	Gutters, downspouts, and drains for controlling roof runoff water to prevent this runoff from flowing across feedlots, barnyards, or other areas to reduce pollution and erosion; improve water quality; and prevent flooding.	\$3,098/facility
Streambank and shoreline protection	Vegetation or structures used to stabilize and protect banks of streams, lakes, and estuaries to reduce sediment loads—including nutrients from animal waste—causing downstream damage and pollution.	\$27.11/foot
Trough or tank	Provides drinking water for livestock, which can eliminate the need for livestock to be in streams; this, in turn, reduces the amount of livestock waste entering streams.	\$905/trough or tank
Waste management system	Planned system in which all necessary components are installed for managing liquid and solid waste, including runoff from concentrated waste areas, in a manner that does not degrade air, soil, or water resources. A system may consist of a single component, such as a diversion, or of several components.	\$20,477/ system

(continued)

**Appendix II
Selected Practices Producers Have Installed
With EQIP Assistance**

Practice	Definition/purpose	Average installation cost per unit
Waste storage facility	Impoundment made by constructing an embankment and/or excavating a pit or dugout or by fabricating a structure to temporarily store wastes, such as manure, wastewater, and contaminated runoff.	\$19,141/facility
Waste treatment lagoon ^a	Impoundment made by excavation or earthfill for biological treatment of animal or other agricultural waste.	\$20,777/lagoon
Waste utilization	Agricultural waste applied to land in an environmentally acceptable manner while maintaining or improving soil and plant resources.	\$17.10/acre

^aBecause fewer than 30 of these systems or facilities have been completed under EQIP, the average cost may not reflect a statistically valid estimate, according to a USDA official.

Source: USDA.

EPA Programs That Provide Financial and Technical Assistance for Animal Waste Management

Dollars in millions

Program	Program description	Amount provided for animal waste management, FY 1996-98	Amount estimated for animal waste management, FY 1999
National Nonpoint Source Program	Provides grants to states to (1) assess the extent to which nonpoint sources cause water quality problems and (2) develop management programs to address these problems. Several states have used these EPA grants to assist livestock and poultry producers install animal waste management practices to prevent or mitigate waste runoff.	\$17.6	Not available ^a
Clean Water State Revolving Fund	Provides capitalization grants to states, which must provide a matching amount equal to 20 percent of the total grant and agree to use the money first to ensure that wastewater treatment facilities are in compliance with the deadlines, goals, and requirements of the Clean Water Act. However, all states have met their priority wastewater infrastructure needs, and some have begun using this revolving fund to support programs to deal with nonpoint source pollution, including animal waste runoff. Some states use this funding to make low-interest loans to producers for implementing animal waste management practices.	20.3 ^b	Not available ^a
AgSTAR	Provides technical assistance to producers interested in installing waste management systems, such as covered lagoons and anaerobic digesters, that reduce odors and recover methane gas for use as an on-farm power source. The program has established several projects on farms in at least five states.	1.9	0.4
Total		\$39.8	\$0.4

^aThese program funds are distributed by state and local governments according to local priority needs. As a result, EPA is unable to estimate the portion of these funds that will be used to assist producers in managing their animal wastes.

^bStates have only reported to EPA the aggregate amount of loans made for animal agricultural runoff since they began using these funds for nonpoint source pollution-related activities. Hence, some states may have been providing loans for this purpose since 1988. However, EPA officials said that most states began using these funds for nonpoint source projects in the mid-1990s.

Source: EPA.

Other Federal Financial and Technical Assistance Programs for Animal Waste Management

Dollars in millions

Program	Responsible agency	Program description	Amount provided for animal waste management, FY 1996-98	Amount estimated for animal waste management, FY 1999
Partners for Fish and Wildlife	Fish and Wildlife Service, Department of the Interior	Provides cost-share and technical assistance to private landowners, including livestock and poultry producers, who are interested in implementing practices that improve habitat for federal trust species, ^a decrease overland runoff, reduce stream degradation, and improve forage production and management. Cost-share assistance under the partners program generally requires a 50-percent match from the landowner. However, the program has the flexibility to share costs of more or less than 50 percent, on a case-by-case basis.	\$18.3	\$8.7
Farm Assessment System (Farm*A*Syst)	USDA and EPA	Supports a network of 45 state programs. The program provides producers with state-specific worksheets to help them identify and assess the causes of nonpoint source pollution, pinpoint pollution risks on their property, and identify site-specific actions to reduce the causes of nonpoint source pollution, such as nitrogen and phosphorous nutrients, pesticides, and pathogens. With this assessment, the program can assist producers in developing feasible plans to prevent pollution and in locating sources of financial assistance through other programs, such as EQIP, to implement practices such as those for managing animal wastes.	0.2 ^b	0.06 ^b
Total			\$18.5	\$8.8

^aFederal trust species include migratory birds, threatened and endangered species, anadromous fish (fish that migrate between fresh and salt waters, such as salmon), and marine mammals.

^bAccording to Farm*A*Syst officials, no EPA funds have been directed toward animal waste management activities.

Source: U.S. Fish and Wildlife Service and Farm Assessment System.

Scope and Methodology

In developing the information for this report, we interviewed and obtained documents from a broad range of officials from federal agencies, such as the U.S. Department of Agriculture (USDA), the Environmental Protection Agency (EPA), and the the Department of the Interior's Fish and Wildlife Service (FWS), as well as from various producer groups, environmental organizations, universities, foreign embassies, and individual producers. Specifically, to obtain information on waste management practices used in the United States, we interviewed USDA and EPA officials, and we reviewed USDA's National Handbook of Conservation Practices and EPA's Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. We also interviewed officials and/or obtained relevant documentation at various animal waste management conferences and symposia, producer councils and associations, and extension universities, including the University of Maryland-Eastern Shore and North Carolina State University. In addition, we visited a variety of livestock and poultry farms in Maryland, North Carolina, and Pennsylvania to observe the waste management practices they employ. These farms included hog, broiler, and laying hen production operations.

To determine the animal waste management practices being used in other major livestock and poultry production countries, we conducted a literature search at USDA's National Agricultural Library and reviewed several years of trip reports prepared by Natural Resources Conservation Service employees visiting other countries to observe their conservation practices. We also obtained documentation from the Washington, D. C., embassies of Germany, Japan, the Netherlands, Sweden, and the United Kingdom. We selected these countries because they (1) are considered major producers by virtue of their metric tons of production during calendar years 1991 through 1997 in one or more livestock or poultry sectors and/or (2) were recommended to us by USDA officials and university extension agents as leaders in proactive animal waste management. To determine potential new practices based on technologies transferred from other industries, we interviewed USDA, EPA, and Department of Energy officials and reviewed the documentation they provided.

To obtain information on federal financial and technical assistance available to livestock and poultry producers for waste management, including the processes for obtaining this assistance, we interviewed and obtained documentation from USDA, EPA, and FWS. We also obtained information from the Catalog of Federal Domestic Assistance. In addition,

we met with the American Farm Bureau Federation, which represents, among others, livestock and poultry producers.

To determine the role of federal agencies in conducting and supporting research to develop new or innovative animal waste management practices, we interviewed and obtained documentation from officials at USDA, EPA, the Department of Energy, the National Oceanic and Atmospheric Administration, and the U.S. Geological Survey. We also interviewed and obtained documentation from officials at North Carolina State University, including its Cooperative Extension Service and its Animal and Poultry Waste Management Center.

GAO Contacts and Staff Acknowledgements

GAO Contacts

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Acknowledgements

In addition to those named above, Shannon B. Bondi, Katherine Carey, and Melissa M. Francis made key contributions to this report.

Related GAO Products

Water Quality: Federal Role in Addressing—and Contributing to—Nonpoint Source Pollution (GAO/RCED-99-45, Feb. 26, 1999).

Water Quality: A Catalog of Related Federal Programs (GAO/RCED-96-173, June 19, 1996).

Agriculture and the Environment: Information on and Characteristics of Selected Watershed Projects (GAO/RCED-95-218, June 29, 1995).

Animal Agriculture: Information on Waste Management and Water Quality Issues (GAO/RCED-95-200BR, June 28, 1995).

Agricultural Conservation: Status of Programs That Provide Financial Incentives (GAO/RCED-95-169, Apr. 28, 1995).

Conservation Reserve Program: Alternatives Are Available for Managing Environmentally Sensitive Cropland (GAO/RCED-95-42, Feb. 21, 1995)

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