Introduction

Animal waste products (manures and composts) have been used for a long time as a source of plant nutrients, especially nitrogen (N) and phosphorus (P). These waste products can also increase the organic fraction of soil, thereby resulting in improved plant growth and yield. Since most crop production is limited by levels of N and P, especially in the acid, highly weathered soils of the Southeastern U.S., animal manure, litter, and compost have found increasing use as a plant nutrient source. These waste products are readily available due to increased growth of confinement livestock and poultry operations.

Land application of these waste products of animal feeding operations (manure, litter, compost, wastewater, etc.) is a cost-effective and beneficial way to manage the large volume of materials generated from confined livestock and poultry operations. However, efficient and environmentally safe use of animal waste products as a source of plant nutrients requires planning. Recommended practices should be followed in storage, handling, and land application to prevent pollution of surface and groundwater.

The same nutrients that benefit plant production can also result in pollution of groundwater or produce uncontrolled phytoplankton and algae growth, which can clog and damage surface water and harm aquatic life. Using best management practices (BMPs) for implementing a systematic nutrient management plan can minimize these adverse impacts. Alabama’s 1999 AFO/CAFO rules require that all animal feeding operations (AFOs) follow BMPs that may include a comprehensive nutrient management plan.

Areas of Concern Related to Land Application of Animal Waste Products

Nitrogen in the nitrate form is a threat to both surface and groundwater. Most fertilizer and manure nitrogen are eventually converted to nitrate by soil microorganisms. Because nitrate is mobile, it can easily move off fields where manure has been spread and wash from unprotected manure stockpiles and feedlots during rainfall runoff, polluting nearby streams and ponds. When applied to fields at rates exceeding plant use or on shallow, very permeable soils, the nitrate form of nitrogen may pollute groundwater. Especially vulnerable to nitrogen pollution are fields with sandy soils or fields where the soil is shallow to fractured bedrock or lies over cavernous bedrock. While nitrate is not toxic in humans, in babies less than 6 months old, it often changes to nitrite, which is harmful. Nitrite pathogenic microorganisms, and organic matter; the contamination of soil by copper and zinc; and air quality problems associated with odors. However, the potential harm from the mismanagement of manure and dead animals can be eliminated, turning the waste products into a valuable source of plant nutrients, soil amendments, and livestock feed.

Each year in the United States, animals in confined feeding operations produce approximately 61 million tons of manure, according to estimates by the Council for Agricultural Science and Technology. The estimated fertilizer value equates to $3.4 billion annually. On a nationwide basis, an average of 15 percent of nitrogen and 42 percent of crop phosphorus could be supplied by animal manure. In Alabama, the broiler industry alone produces an estimated 1.5 million tons of litter annually, enough to fertilize all of the state’s row crops and some of its pastures. Along with supplying necessary nutrients and protecting the environment, proper land application of manure solids can also improve the chemical and physical condition of the soil.
interacts with hemoglobin in the blood and reduces its capacity to carry oxygen, and nitrates can combine with other nitrogenous compounds to form cancer-causing agents. Drinking well water that is high in nitrates has been shown to cause health problems, and even death in some cases, in livestock and humans (especially infants).

**Phosphorus** is also a major concern in regard to surface water pollution. Higher than normal concentrations of phosphorus in surface water stimulate growth of aquatic plants, which contribute to eutrophication (the process by which water becomes enriched with nutrients) of streams and lakes. When large populations of aquatic plants die, their decomposition uses up dissolved oxygen in water and releases certain toxins, thus increasing the potential for fish and other aquatic organisms to die-offs. Excessive aquatic plant growth makes bodies of water less desirable for swimming, fishing, and boating; in extreme cases, eutrophication causes a water body to become a shallow-water wetland with aquatic plants.

Since phosphorus is often the limiting nutrient for accelerated eutrophication, it is becoming very important to plan carefully and monitor regularly the application of manure to crop and pastureland to reduce phosphorus losses in runoff. Improper or untimely application of manure will increase the opportunity for phosphorus to leave a site either attached to sediment in runoff or in dissolved form. In addition to potential adverse environmental impacts, movement of both nitrogen and phosphorus off fields and pastures represents an enormous loss of nutrients that could have been used for the production of crops and forages.

**Pathogens** such as bacteria, viruses, and other microorganisms can infect both people and animals, causing outbreaks of disease. The spreading of animal manure and improperly composted animal mortalities can carry these pathogens to cropland and pastures. Special care must be taken to avoid contamination of water resources, especially in areas where there exists a high density of animal feeding operations and a relatively small amount of cropland for spreading.

**Organic matter** associated with manure can also pose a problem. Oxygen is required for organic matter to decompose. When oxidation occurs in water, it reduces the amount of dissolved oxygen, causing problems for aquatic life. This oxidation process adds to the problems associated with excess phosphorus in surface waters and excessive growth of aquatic plants; it can also create a high demand for oxygen as aquatic plants die.

**Heavy metals** including zinc, copper, and occasionally arsenic, are present in many animal rations. The level of heavy metals, mainly copper and zinc, can build up in agricultural lands where animal waste is being applied. Most of these metals are immobile in soils and rarely appear to have adverse effects on crop production. Also, they probably will not accumulate in crops at levels that are dangerous to people or animals consuming these crops.

**Odors** associated with livestock and poultry production are the result of natural decomposition of organic material (feed, manure, mortalities). Anaerobic (without oxygen) storage and treatment facilities used for liquid systems accommodate the decomposition of complex biological wastes to gases such as methane, hydrogen sulfide, carbon dioxide, and ammonia, which can produce offensive odors. Composting and dry stacking systems decompose organic material into less volatile forms than those produced in the anaerobic systems. Properly designed and operated waste storage and treatment systems minimize the generation of offensive odors. Unavoidable problems sometimes occur during the decomposition period, when volatile organic compounds are released into the atmosphere as a result of equipment deficiencies or adverse climatic conditions.

**Regulations Related to Animal Feeding Operations and Land Application of Animal Waste Products**

Increased emphasis on nonpoint source (NPS) contributions to water pollution throughout the nation, and particularly in Alabama, has caused the Environmental Protection Agency (EPA) and the Alabama Department of Environmental Management (ADEM) to strengthen enforcement of the Clean Water Act under the provisions of National Pollutant Discharge Elimination System (NPDES) Rules.

The ADEM NPDES Rules for Animal Feeding Operations (AFO/CAFO rules), which took effect April 1, 1999, require adoption of appropriate BMPs, including nutrient management planning, for all operations where animals are confined for a total of 45 days or more in any 12-month period and the confinement area does not sustain growing crops in a normal growing season. Essentially all animal feeding operations are affected. Larger operations, concentrated animal feeding operations (CAFOs), must register a “comprehensive animal waste management plan” with ADEM. (See listing under ADEM in For More Information http://www.adem.state.al.us/RegsPermit/ADEMRegs/Div6Vol1/rdiv6v1.html).

Operators with animal feeding units that may not be subject to registration based on the number of animals on site within the specified time period must also meet the same standards for nonpolluting waste management, including having a waste management system plan. The plan, which does not have to be approved by a qualified credentialed professional, must include practices protective of water quality. Adequate records must also be kept to document that management practices...
and measures “meet or exceed” NRCS standards and ensure their status related to registration requirements.

While the rules are specific for farms with animal feeding operations, they also have implications for other operators who use animal waste products in their crop and forage production systems. As a minimum, these operators must follow BMPs in handling land application of animal waste products, and they must maintain sufficient records to prove (if challenged) that they are in compliance with established standards for environmental protection.

**How to Use This Information**

The information presented here can help you better understand the risks and economic benefits of using animal waste products in agricultural crop and forage production systems. The self-assessment section presents a series of statements concerning how well you are managing the land application of animal waste products while protecting the environment from potentially harmful pollutants. Responses to these statements will provide a useful assessment of your overall management practices and highlight those areas you should modify to further reduce your risks. The last section focuses on developing an action plan to fit your specific situation and needs, as determined by the self-assessment. The Alabama Farm*A*Syst program is strictly voluntary and confidential. It is intended solely to help provide you with useful information and helpful resources.

**Managing Waste From Animal Feeding Operations**

**A Self-Assessment**

Managing animal waste products for their nutrient value in crop and forage production involves more than just the proper application to land. It involves collection, storage, treatment, and transport, usually to a designated field for spreading or incorporation into the soil. Depending on the animal source and collection choice, the consistency of the waste-product material will be solid, semi-solid, or slurry. Knowing how to manage waste products of a particular consistency is critical to safeguarding the environment from harmful contaminants, while realizing maximum benefits from the material.

The actions and practices listed in the following self-assessment exercise can serve as indicators of how well you are doing to properly manage and utilize waste products from your animal feeding operation and to safeguard water and environmental quality. The assessment is purely confidential and solely for your benefit and use. So be hard on yourself. If you are performing a recommended practice, check **Yes**. But if you only perform the practice part of the time, check **No**; this might indicate that it is a practice and risk area that needs more attention. You are encouraged to complete all parts of the assessment and go to the last section, which provides suggestions on how to use your responses to develop a better self-help plan to best manage animal waste products.

### Handling, Storage, and Treatment

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure, litter, and compost are stockpiled on impervious clay or concrete pads and are kept covered with plastic sheeting or a roof structure to protect material from weather and to prevent seepage.</td>
<td></td>
</tr>
<tr>
<td>Stockpiles are kept as dry as possible to minimize odors and flies.</td>
<td></td>
</tr>
<tr>
<td>All manure/litter stockpiled or retained on site prior to land application or transporting is located with adequate separation from adjacent property, wells, and other water sources.</td>
<td></td>
</tr>
<tr>
<td>Diversions, roof water collection, and vegetative filters are used to prevent stormwater from flowing over the feedlot into a storage pond or dry stack area and to keep polluted runoff from reaching streams and impoundments.</td>
<td></td>
</tr>
<tr>
<td>A settling basin has been installed to remove solids before water from confined animal operations reaches vegetative filters.</td>
<td></td>
</tr>
<tr>
<td>Liquid manure storage facilities are maintained in good condition to prevent overflow and accidental discharges.</td>
<td></td>
</tr>
</tbody>
</table>

### Transporting and Land Application

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil tests are done at least every three years on fields regularly used for spreading manure, litter, compost, or liquid material.</td>
<td></td>
</tr>
<tr>
<td>I only apply manure (dry or liquid) and dead bird compost on actively growing crops at times consistent with a nutrient management schedule.</td>
<td></td>
</tr>
<tr>
<td>No land applications are made when soil is frozen, saturated, or when rainfall is predicted within the next three days.</td>
<td></td>
</tr>
<tr>
<td>Hauling and spreading is done by an Alabama certified animal waste vendor (CAWV).</td>
<td></td>
</tr>
<tr>
<td>Land application/spreading is done in the morning when the air is warming and rising to reduce odor nuisance and not when wind is high in the direction of neighbors.</td>
<td></td>
</tr>
</tbody>
</table>
Compliance With Regulatory Rules and Regulations

Yes No

❑ ❑ Contact has been made with the local Soil and Water Conservation District (SWCD) office, and I understand the status of my animal feeding operations and my responsibilities under ADEM’s AFO compliance program and CAFO registration process.

❑ ❑ My operation qualifies as a “Concentrated Animal Feeding Operation” (CAFO), and I have complied with or am in process of complying with registration requirements: filing Notice of Registration (NOR) form, developing a comprehensive waste management system plan certified by a qualified credentialed professional, and keeping required records. Plans are under way to meet annual requirements for continuing education credits in waste management or other approved topics.

❑ ❑ My operation does not qualify for registration under the ADEM AFO rules, but I have met or am taking steps to comply with rules affecting my operation: developing a waste management plan, implementing BMPs protective of water quality, and maintaining records to document practices and the status of my operation under the rules.

How Am I Doing?
A Self-Help Action Plan

At this point, you are aware of the actions and practices that you are correctly performing and those that should be done to maximize the value of waste products from your animal feeding operation and to protect surface and groundwater. You have a system in place for collecting, stockpiling, and treatment of waste products (solid or liquid) that will minimize nutrient pollution risks from runoff, seepage, or overflow of storage ponds prior to land application or transporting to other sites.

The next step is to follow a systematic plan for using the material on site as a plant nutrient source and/or arrange to move all or part of the material from the site of origin to other locations. Effective use of animal manure, litter, and compost (solid or liquid) in crop and forage production involves both nutrient management planning and environmental safeguards. These are key planning considerations:

✓ Residual soil nutrients—Nutrient application rates should be based on the results of soil tests and Auburn University Soil Test Laboratory recommendations for Alabama.

✓ Nutrient needs of the crop(s)—A realistic optimum yield goal should be determined for the crop and nutrients applied to satisfy, but not exceed, that goal.

✓ Available nutrients—Nutrients available to crops include those identified by the soil test plus any residual nitrogen provided by animal manure applied in prior years and also that provided by legumes and green manure crops. Prior to its application, manure, litter, compost, or wastewater should be analyzed for available nutrients.
✓ **Controlling nutrients**—Nutrient analysis of animal manure is not balanced like commercial fertilizers, so one of the nutrients is selected to control the volume of manure applied, and commercial fertilizer is used to balance the application of other essential nutrients to crop needs.

✓ **Water quality protection**—The type of fertilizer, timing, method of application, and placement should all be adjusted to conform to seasonal variations in the uptake of nutrients by specific crops.

✓ **Farm map**—A farm map is used to identify fields that receive applications of animal by-product material. Soil tests are taken and dates recorded.

✓ **Records**—For each field, records are kept of the dates crops are grown and the amount of waste products and other nutrients applied.

✓ **Analysis**—Animal manure, litter or liquid material, nitrogen, phosphorus, etc., must be analyzed by a qualified laboratory and should be used in determining application rates.

✓ **Environmental protection**—Other factors, such as nearby wells, residences, roads, water bodies, soils, climate, and topography are considered in preparing plans that are specific for land application sites.

The nutrient management plan is an essential part of a comprehensive plan for handling and using animal waste products in crop and forage production systems. Land application of animal waste products requires careful planning to ensure that all nutrients in the system are accounted for and that those being applied are adequate to meet plant production objectives. In addition, animal waste must be applied in such a way that the environment is not degraded. Environmental risks increase when animal manure, litter, etc., are applied at excessive rates just to dispose of the materials instead of rates designed to meet plant requirements.

**For More Information**

**Alabama Cooperative Extension System**
http://www.aces.edu
(334) 844-4444

For more information on specific topics, call your county Extension office. Look in your telephone directory under your county's name to find the number, or go to the Extension Web site and click on County Offices to find your county.

**Small Farmers Outreach & Technical Assistance Program**

http://saes.aamu.edu/Agb/Farmers.htm
The Small Farm Research Center
P.O. Box 356
Normal, AL 35762
(256) 858-4970

The Small Farm Program at the Cooperative State Research, Education, and Extension Service (CSREES), an agency within the U.S. Department of Agriculture (USDA), is committed to meeting the needs of the small farm community.

**Farm*A*Syst National Office**
http://www.uwex.edu/farmasyst/
(608) 262-0024

Alabama Farm*A*Syst is a partner with the national Farm*A*Syst/Home*A*Syst program, an environmental package designed to help farmers and homeowners evaluate pollution and health risks around their property.

**Alabama Department of Environmental Management (ADEM)**
http://www.adem.state.al.us/
(800) 533-ADEM

ADEM administers all major federal environmental laws, including the Clean Air, Clean Water, and Safe Drinking Water Acts and federal solid and hazardous waste laws.

**U.S. Environmental Protection Agency (EPA)**
The National Agriculture Compliance Assistance Center
http://www.epa.gov/agriculture
(888) 663-2155

The Web site has easy-to-understand information about CAFO regulations with commonsense, flexible approaches that are both environmentally protective and agriculturally sound.

**USDA Cooperative State Research, Education, and Extension Service (USDA/CSREES)**
http://www.reeusda.gov/
(202) 720-7441

CSREES is a program under the U.S. Department of Agriculture (USDA) that helps link research and scientific information at land-grant colleges to families and communities. Areas covered include agriculture, nutrition and health, youth and families, environmental stewardship, and community economic development.

**USDA-Natural Resources Conservation Service (NRCS)—Alabama**
http://www.al.nrcs.usda.gov
(334) 887-4539

NRCS is the USDA agency that works at the local level to provide technical assistance to farmers and ranchers to develop conservation systems to reduce erosion, conserve and protect water, and solve other resource problems.

Look in your telephone directory for your county NRCS office.
Soil and Water Conservation Districts

http://www.nacdnet.org (National Association)
(334) 745-2511 (Lee County Office)

Soil and Water Conservation Districts work closely with the NRCS. The NRCS actually plans out projects, and the Soil and Water Conservation Districts help put those projects on the ground. Soil and Water Conservation districts are located in all of Alabama’s 67 counties. Each year county landowners are offered grant money to help install conservation practices. Offices are co-located with NRCS offices. Look in your telephone directory under your county’s name to find the number.

Publications

Alabama Cooperative Extension System (ACES)

http://www.aces.edu/pubs/

ACES has many publications that can be downloaded from the Extension Web site. The following publications also may be ordered by calling (334) 844-1592 or by e-mailing publications@aces.edu for information on availability and cost.

In addition to written publications, an excellent colorful slide show with narration by Dr. Charles Mitchell with the Alabama Cooperative Extension System may be downloaded from the Web site. Dr. Mitchell explains how better management of nutrients and soil testing improves productivity on the farm and helps protect the environment. It especially emphasizes Alabama and Southern soils. Access the Web site at http://www.aces.edu/extcomm/satellite/nutrient01.htm.

On the Extension Web site, look under Publications, and enter the publication number in the “search our site” window for the following publications that may be particularly useful:

- ANR-244 The Value and Use of Poultry Manures as Fertilizer
- ANR-839 Broiler Litter Storage
- ANR-889 Calibrating Poultry Litter Spreaders
- ANR-918 Animal Waste Management Planning
- ANR-925 Calibrating Traveling Guns for Slurry Irrigation
- ANR-926 Nutrient Management Planning for Small AFOs: Broiler Operations
- ANR-954 Selecting, Planning, and Managing Dairy Waste Storage Ponds
- ANR-963 Planning and Managing Lagoons for Dairy Waste Treatment
- ANR-965 Constructed Wetlands for Animal Waste Treatment
- ANR-970 BMPs to Handle Dairy Wastes
- ANR-971 Planning and Managing Lagoons for Poultry Layer Waste Treatment
- ANR-973 Planning and Managing Lagoons for Swine Waste Treatment
- ANR-996 Solid Set Wastewater Irrigation System for Controlled Grazing
- ANR-1025 Advantages of Manure Solid-Liquid Separation
- ANR-1090 Sizing Swine Lagoons for Odor Control
- ANR-1102 Sampling Animal Waste for Nutrient Management: Nitrate Field Testing
- ANR-1175 AFO / CAFO Registration Requirements: Your Questions Answered
- ANR-1176 Alabama’s Certified Animal Waste Vendor Program: What You Need to Know
- ANR-1188 BMPs for Animal Feeding Operations (AFOs and CAFOs)
- ANR-1205 Continuing Education Requirements for AFO & CAFO Operators
- ANR-1206 The Role of Qualified Credentialed Professionals Under Alabama’s AFO/CAFO Rules

On the Extension Web site Alabama Water Quality Program (http://www.aces.edu/waterquality), enter “Publications” and search for the following articles:

- “Animal Waste Management to Protect Water Quality”
- “Animal Waste and How It Affects Water Quality”
- “Regulating Animal Wastes”
- “Animal Waste Management Systems”
- “Land Application of Animal Wastes”
- “Analyzing Nutrient Value of Animal Wastes”
- “Calculating Rates of Application Based on Nitrogen Needs”
- “Calibrating Manure Spreaders”
- “Managing Open Lots and Pasture Systems to Minimize NPS Pollution”

Alabama Department of Environmental Management

http://www.adem.state.al.us/RegsPermit/ADEMRegs/Div6Vol1/rdiv6v1.html

ADEM water quality rules and regulations can be accessed at the Web site. Chapter 7 refers to Animal Feeding Operations (CAFOs).

Alabama Agricultural Experiment Station

http://www.ag.auburn.edu/aaes/

Look under Research Information and then Publications to locate various publications.

You can order printed publications online, by mail, phone, or fax. When placing your order, please include
the publication number, title, and quantity along with your name and mailing address.

Alabama Agricultural Experiment Station
Office of Communications
2 Comer Hall
Auburn University, AL 36849
Telephone: (334) 844-4877
Fax: (334) 844-5892

USDA-Natural Resources Conservation Service (NRCS)—Alabama Office

http://www.al.nrcs.usda.gov/TECH/ags.html

The following conservation practice guide sheets are available online.

AL 312 Odor Control for Animal Feeding Operations
AL 313A Waste Storage Pond
AL 313B Dry Stack Building for Poultry Litter
AL 317 Composting Poultry Mortality
AL 317A Composting Swine Mortality
AL 329A Residue Management, No-Till and Strip-Till
AL 329B Residue Management, Mulch-Till
AL 329C Residue Management, Ridge-Till
AL 344 Residue Management, Seasonal
AL 359 Waste Treatment Lagoon
AL 590 Application Distances for Applying Animal Manure and Organic By-Products
AL 634 Wastewater Irrigation
AL 656 Constructed Wetlands for Animal Waste Treatment
AL 749 Waste Field Storage

Acknowledgments

This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement Nos. 99-EWQI-1-0552 and 00-51130-9820. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

This project was reviewed and funded by the Alabama Department of Environmental Management through a Clean Water Act Section 319(h) nonpoint source grant provided by the U.S. Environmental Protection Agency-Region IV.

We would like to acknowledge the staff of the National Farm*A*Syst/Home*A*Syst Program who developed the original materials at the University of Wisconsin-Extension. This national program has been supported by the USDA Cooperative State Research, Education, and Extension Service (CSREES), the USDA Natural Resources Conservation Service (NRCS), and the U.S. Environmental Protection Agency (EPA). The national office provides guidelines and educational support to each state for the development of Farm*A*Syst/Home*A*Syst programs. We would also like to acknowledge Tennessee, Georgia, and Mississippi Farm*A*Syst materials used for reference in the preparation of this document.

Special thanks to all who helped with the technical review of the materials and who provided editorial assistance.

The Farmer’s Guide to the Internet

http://www.rural.org/Farmers_Guide/

Contains links to useful sites for farmers on the Internet.