Best Management Practices for Swine Operations

Extension Division

Virginia Polytechnic Institute and State University

Publication 4 WCB 5 **November 1980**

BEST MANAGEMENT PRACTICES FOR SWINE OPERATIONS

Prepared for and under a grant from
the State Water Control Board
Commonwealth of Virginia
(State Water Control Board Information Bulletin 535)

by

Rolland Z. Wheaton
Visiting Professor

and

Edward B. Hale
former Extension Specialist

Department of Agricultural Engineering
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, and September 30, 1977, in cooperation with the U.S. Department of Agriculture. W. R. Van Dresser, Dean, Extension Division, Cooperative Extension Service, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061; M. C. Harding, Sr., Administrator, 1890 Extension Program, Virginia State University, Petersburg, Virginia 23803.

Best Management Practices For Swine Operations

Introduction

Swine producers are concerned with waste management. Increasing public concern about water quality along with passage of the Clean Water Amendments of 1972 have placed additional emphasis on improving the management of animal wastes. (The 1972 Act and resulting programs are discussed more fully in "Best Management Practices in Agriculture and Forestry", Extension Publication 4WCB1, January 1980.)

Water pollution resulting from most swine operations is classified as nonpoint source pollution. This pollution, unlike point source pollution, is usually the result of storm runoff or seepage into waterways.

This publication outlines potential nonpoint source problems associated with swine production and describes methods, called Best Management Practices (BMPs), recommended to control or abate nonpoint source pollution. These practices are voluntary, common sense measures which many producers are already employing. They deserve a closer look by those unfamiliar with the methods suggested for conserving land and water resources.

How Swine Affect Water Quality

Livestock operations may produce pollution through percolation to groundwater, surface runoff, dust, or odors. Only the possible impact of swine operations on surface or subsurface water quality is considered here.

Surface runoff from swine operations or from the fields where wastes have been spread can carry sediment, organic matter, nutrients, and bacteria. If swine have denuded an area, it will be subject to severe erosion which could result in sediment and waste being carried into the stream. Runoff from feeding areas can transport large volumes of waste.

Erosion of land on which wastes have been spread is especially likely to transport pollution to the stream. Surface runoff from these lands, even without erosion, may transport wastes if they have not been worked or injected into the soil. Heavy applications of waste to land increase the potential for pollution of surface and groundwater.

Figure 1. Lot has been totally denuded by swine.

Overflow from waste holding facilities or lagoons is another potential pollution source. Seepage from these facilities can also contaminate groundwater.

When organic matter enters a stream, it begins to decompose. This uses oxygen from the water and reduces the dissolved oxygen to a very low level. Under these low-oxygen conditions, fish may suffocate.

Nutrients in wastes, mainly nitrogen and phosphorus, "enrich" the water resulting in rapid growth of algae. Phosphorus is thought to be the element most responsible for this growth and the rapid aging of lakes. High nitrogen levels could impair water quality for human or animal consumption.

Wastes are a source of pathogenic organisms. Polluted water may spread diseases to humans or animals. Pollution of water by swine wastes could result in closing of the water to fishing or shellfish harvest.

Percolation to the groundwater is most likely to contain nutrients, especially nitrogen, and possibly disease producing organisms. This seepage may occur from the waste holding area, from the pen areas, or from land on which wastes have been applied. Prevention of groundwater pollution is more difficult in areas of high watertable, sandy soils, or limestone areas where the fractured rock is near the surface.

Benefits of Waste Management

For the public, it will result in improved water quality in lakes, rivers and streams, increased recreational use of water resources, and propagation of a greater diversity of fish species.

For the swine producer, better use of waste may result in decreased purchases of commercial fertilizer. The organic matter in the waste will improve the physical conditions of the soil. Improvements in waste handling and utilization will generally require a higher level of management and additional capital investment. But, good waste management will reduce the likelihood of lawsuits or fines which may result from pollution of water by waste.

Types of Operations

For purpose of discussing the problems and possible solutions, swine production systems will be separated into three types: 1) open feedlot or pasture area, 2) open shelter and concrete lot, and 3) the total confinement operation. It is recognized that any individual operation may combine parts of all three types.

The open lot or pasture may contain only a few hogs per acre in the vegetated area, but more commonly, has a high density of hogs. The major problem here is the tendency for the vegetation to be removed, resulting in a bare compacted soil area (Figure 1). This makes the area highly vulnerable to soil erosion and waste runoff.

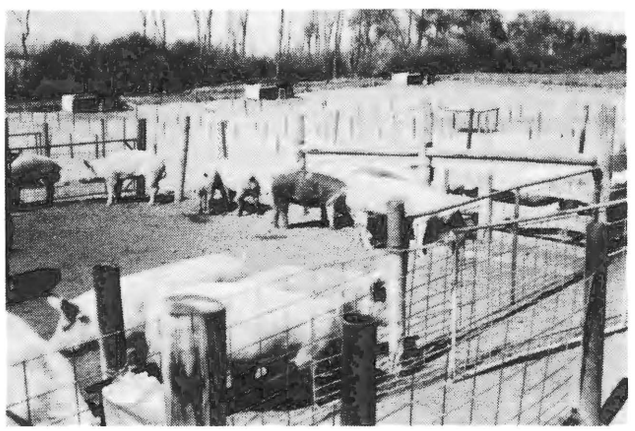

Figure 2. Swine lot drains to stream near trees.

Frequently, swine lots are near a stream so that the runoff goes directly into it (Figure 2). When hogs have access to the stream, the bank vegetation is removed, resulting in unstable stream banks. With the open lot system, there is little waste handling other than possibly the cleanout of the shelters.

The open shelter concrete lot should be operated so that wastes are scraped or flushed into liquid manure storage or a lagoon (Figure 3). Surface runoff from these facilities is the major concern. Water from the building roofs or water

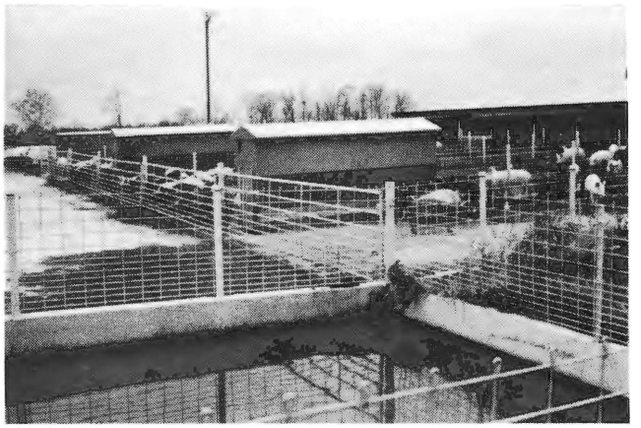

Figure 3. Pens and concrete lot drain to collection basin in foreground.

from outside the area may add to the runoff problem. Seepage from the manure storage area or seepage and runoff from the land disposal areas are other potential pollution sources.

In the total confinement buildings, slotted floors with manure storage pits are common (Figure 4). Flushing or scraping may be used to move wastes into a storage area or lagoon. The wastes may be hauled directly to the field from the storage pit. Lagoons are often used for treatment of the wastes from the storage pits before field disposal. Since outside water is excluded, the major concerns are adequate waste storage and prevention of seepage. Runoff and seepage from the land disposal area are other potential pollution sources.

BMPs for Swine Operations

Swine production must be thought of as a total system. BMPs (Best Management Practices) should be a part of that system. They include management, collection, storage, treatment, and utilization of the wastes and are intended to reduce the potential for pollution of surface or groundwater. The BMPs must be adaptable to the

Figure 4. Slotted floor in swine confinement building.

production system, be feasible, and provide for an accepted level of water quality.

A few of the principles of Best Management Practices and their application are discussed to help the operator decide which are best for him. The specific details of design, construction, and operation of the practices are found in other publications (see list at the end). THE BASIC CONCEPT IS TO KEEP CLEAN WATER CLEAN AND TO COLLECT AND ADEQUATELY DISPOSE OF WASTES AND CONTAMINATED RUN-OFF.

In the ideal open lot system, the soil is protected by vegetation. With a good vegetative cover, erosion is greatly reduced and potential for waste runoff is low. To accomplish this ideal situation would require a very low density of hogs and probably rotation between fields to maintain the vegetation.

The more typical open feedlot will have bare soil, a condition subject to high rates of runoff and erosion. There are several approaches that may be used to reduce the amount of runoff. Water from the higher elevations should be intercepted by a diversion dike or ditch and carried safely away (Figure 5). Good surface drainage is needed but the minimum slope that will provide adequate drainage should be used. Lots should be laid out with the shortest dimension in the direction of the greatest land slope. Collection ditches, alleys, or roadways across the slope can collect and transport runoff away from the lots. The lot should be located well away from any stream or lake. Systems for collection, treatment, or filtration of the runoff should be provided.

For the open shelter concrete lot system, surface runoff is the greatest problem. The facility should be located near the top of the slope and as far from streams as possible. A diversion can be used to intercept and carry away water from higher lands. Roof water should be conducted away from the site but provision should be made to add it to the manure storage area if needed. Adequate storage for runoff from the lot should be provided. There is the potential for seepage from the storage facility which may contaminate groundwater. This, and the application of liquid waste to land, will be described following the discussion of the total confinement operation.

In total confinement housing with adequate manure storage, waste runoff from the facility is eliminated. Locate buildings away from streams or lands subject to flooding. Divert water from higher lands away from the site. Conduct roofwater away but make provisions to add it to the manure storage pit or lagoon as needed.

Many operators use lagoons for treatment of waste from storage pits. Lagoons must be properly designed and constructed. Some soils will require sealing with clay or other material to prevent seepage. When seals are used in areas of high groundwater, care must be taken not to pump the liquid waste level below the groundwater level thus preventing the seal being broken by water pressure from the outside.

Land application is the most common method used in disposing of animal waste. Liquid wastes may be spread on the surface or tilled into the soil to reduce odors and runoff potential. Wastes also may be injected into the soil, a practice which requires additional power but virtually eliminates odors and runoff (Figure 6). Irrigation is an effective method of spreading liquid wastes but can cause odor problems.

Regardless of the method of applying wastes to the land, good management is needed to prevent pollution of ground or surface waters. Proper timing, location, and quantity of materials applied are methods of reaching this objective. Commercial fertilizer may be added to provide the correct balance of nutrients. Spreading wastes on snow, frozen ground, wet soils, steep slopes or near streams or in large amounts will each increase the potential for water pollution.

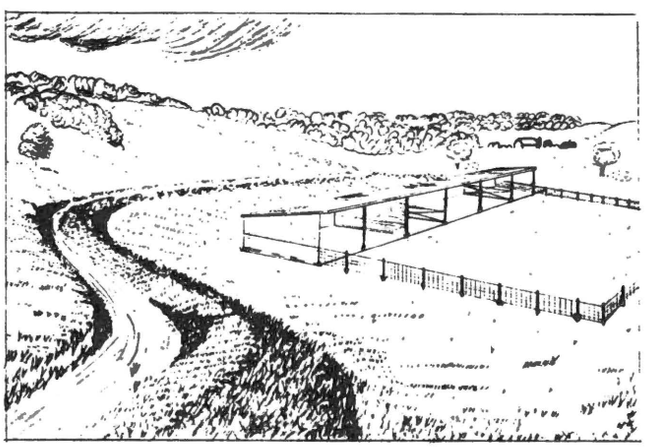

Figure 5. Diversion around a swine facility.

Figure 6. Injecting liquid wastes into the soil.

Nutrients in the material should not exceed the amount which will be removed by the crop or held by the soil. On sands and soils with low water and nutrient holding capacity, two or more smaller waste applications will be better than applying the total volume at one time.

The Water Quality Management Planning Program (208 planning) is a non-regulatory program. However, there are some instances where certificates are required by the State Water Control Board. A certificate is required for the construction of waste storage facilities. Also, if there is an actual or potential discharge of treated or untreated wastes from an operation, conditions must be improved to qualify for a no discharge permit. In addition to the state requirements, there may be local regulations or zoning which apply.

TABLE 1

A list of some BMPs which the swine producer may use.

Diversion
Filter Strips

Controlled Feed and Water Access
Fencing
Salt, Minerals and Feed Supplement Site Locations
Shade Areas
Planned Travelways

Waste Management System
Elimination of Excess Runoff Water

Waste Storage Pond
Waste Storage Structure
Waste Treatment Lagoon
Piles, Open Stack Storage and Composting

Waste Utilization and Disposal
Land Absorption Areas
Waste Application Site Selection
Timing and Methods of Application of Animal Wastes

Transportation of Wastes
Disposal of Dead Animals and Poultry

The Producer is the Key

The purpose of a Water Quality Management Plan for animal wastes and fertilizer control is to utilize the resource while reducing the potential for water pollution. The swine producer is the key to reaching this goal. Voluntary acceptance and use of BMPs will contribute to the collective effort of all farm operators to get the most benefit from animal wastes and the land while preserving water quality.

How BMPs Are Selected

The selection of a system of BMPs for water quality improvement is specific to the individual operation. Other than to solve a specific problem such as inadequate storage, most waste management plans will combine several BMPs into the most practical system. Working with the owner or operator, the planner will review the problems, the present system, future plans, location, topography, soils, and land area available for waste disposal. From this, he will help the producer develop a waste management plan which will be suitable to the operation and meet the water quality objectives. Alternative plans may be developed for review.

Where Assistance Can Be Obtained

Many local, state, and federal agencies are providing assistance for the development and implementation of water quality management plans. The State Water Control Board has the overall responsibility for water quality improvement, planning, and implementation. The management of the agricultural portion of this plan has been delegated to the Virginia Soil and Water Conservation Commission with the Soil and Water Conservation District assuming leadership at the local level.

Information about water quality planning and techniques is available at the local office of the Cooperative Extension Service, the Soil and Water Conservation District, and the Soil Conservation Service (SCS). Many Extension, USDA and other publications may be obtained from these offices.

Technical assistance for planning and implementation is available from SCS through the local Soil and Water Conservation District.

Financial assistance to aid in the implementation of BMPs may be available through the County Agricultural Stabilization and Conservation Service Office (ASCS).

Other Publications of Interest

Best Management Practices for Beef and Dairy Production, Extension Publication 4WCB4, July 1980.

Best Management Practices for Row Crop Agriculture, Extension Publication 4WCB3, June 1980.

Best Management Practices in Agriculture and Forestry, Extension Publication 4WCB1, January 1980.

Earthen Storage Basins for Manure, Extension Publication #805, September 1979.

Anaerobic Lagoons for Livestock and Poultry Wastes, Extension Publication #729, September 1979.

Use of Manures in Crop Production, MA-208, January 1977.

Solid and Semi-Solid Manure Handling Systems, ME-101, January 1977.

Methane Production from Livestock Wastes, Extension Publication #718, October 1976.

Environmental Quality Legal Guidelines for Virginia Livestock Producers, Extension Publication #707, June 1976.

Disposal of Dead Poultry and Other Farm Animals, Extension Publication #638, December 1974.

Liquid Manure Handling, Extension Publication #598, March 1974.

Some Questions and Answers Concerning Livestock and Poultry Waste Disposal, Extension Publication #521, September 1972.

In addition to the above publications, the Swine Industry Handbook has many articles of interest. Some of these may be available through the Extension Office.