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Animal Waste and Water Quality

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Types of Animal Wastes

There are three types of animal wastes that can cause water quality problems, **manure, dead carcasses, and food processing wastes.** At the farm level, manure and dead carcasses are the concerns. Both are primarily organic and will degrade in nature, but they can lead to a variety of problems in water.

What is Water Quality?

A stream or lake has physical, chemical and biological properties that relate to its quality. Most surface waters have a thriving **ecosystem,** a community of interaction among animals, plants, microorganisms, and the environment in which they live. Any activity within a watershed which affects the flow of sediment, nutrients, organic wastes, or toxic substances into this water can have serious impacts on its quality.

How Does Animal Waste Affect Water Quality?

Animal wastes may cause the following effects on water:

* **oxygen depletion,**
* **bacterial contamination,**
* **nutrient enrichment, and**
* **nitrate contamination.**

oxygen depletion. Through oxygen depletion of water, organic wastes can **kill fish** and other air breathing organisms, and can **interrupt the photosynthesis-respiration cycle.**

Organic matter, one of the most common surface water pollutants, degrades water by depleting it of dissolved oxygen. All organisms living in water, including a score of microorganisms as well as

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fish and other invertebrates that need oxygen for survival, die when dissolved oxygen gets below certain levels. Most fish cannot live in water once the oxygen level gets below 0.004 grams per liter (4 parts per million by weight). When living organisms die in water they simply turn into lifeless organic matter, and further aggravate the oxygen deficiency and subsequent putrefaction or souring that results.

Oxidation of organic materials in water is **a natural purification process,** and all surface waters have a certain capacity to degrade organic materials. The many microorganisms in water utilize organic material as food, and in doing so, convert it to water and oxide gases of carbon, nitrogen and sulfur. The amount of oxygen required by such organisms to oxidize a given amount of organic material is called the biological oxygen demand or BOD. Any organic material added to water increases the DOD. The primary method of determining organic pollution in water is to determine its DOD, or oxygen required to degrade all the organic material in a given sample.

The wastewaters of modern society often have high levels of organic material, giving them very large biological oxygen demands. Human sewage and animal wastes are high in organic matter, and thus, have high BODs. **Permits are now required as to the level of organic materials that can be discharged into various Alabama streams.**

Bacterial contamination. The primary concern with bacterial contamination of water is disease transmission. Organisms from the intestinal track of all warm blooded animals, including humans, **can make us sick,** if ingested in water. Many contagious diseases have originated from a single human or animal, and then spread to many others through waste contamination of water.

Surface water is much easier to contaminate with bacteria than groundwater, but much easier to clean up. For many years now, community water systems which use surface supplies, have disinfected their water with chlorine, because of the high incidence of bacterial contamination. Groundwater, on the other hand, was, until just recently, considered free of bacteria and not disinfected in many cases.

Individuals that get their drinking water from **private wells are at a greater risk** of ingesting bacteria contaminated water. If these same individuals have an on-site septic system or have high concentrations of animals nearby, they have an even greater risk of bacterial contamination of their drinking water supply.

Recreational uses of some Alabama lakes and streams have been restricted because of high bacteria counts, and the incidence is becoming more common. In some cases, these bacteria came from human sewage, but in other cases, the source was animal waste.

Nutrient enrichment. The primary water quality problem associated with nutrient enrichment is **eutrophication,** or accelerated growth of algae and aquatic weeds, especially in lakes. **This flush of plant growth can shorten the life of a lake, cause nuisance problems due to looks and aesthetic appeal, limit recreational boating and skiing, and can cause odor and taste problems in drinking water. When massive growths of algae die, oxygen depletion and fish kills may follow.**

Although some water plants are essential for fishes and other animal species, too much and too rapid a growth cycle can lead to major problems in lakes and some streams. Nutrients such as nitrogen, phosphorus and potassium continuously wash into lakes in surface runoff or attached to eroded sediment, and thereby, fertilize lakes, allowing algae and weeds to grow. Most aquatic plants are digested by other organisms or die and decompose with some remains going to the bottom as muck. Under natural conditions the lake turns into a marsh or bog. This normally takes hundreds or thousands of years. Accelerated nutrient enrichment from human activities or animal wastes can rapidly accelerate this eutrophication, thus making a lake "old" before its time.

The growth of certain types of algae, which thrive in nutrient-rich water, can lead to taste and odor problems if this water is used for drinking. The taste and odor comes from chemical break-down products that are released during decomposition of these algae. Granular activated carbon filtration systems are needed to remove most of these chemicals.

Accelerated aquatic weed growth, especially in shallow zones of lakes, has also led to beaches and other recreational areas being closed to boating and water contact sports. Some weeds are very efficient in clogging boat propellers.

Nitrate contamination. High levels of nitrate nitrogen may occur in surface and groundwater, but it is primarily a **health concern in drinking water** from groundwater supplies. A primary drinking water standard of 10 milligrams per liter has been set for community drinking water systems.

Nitrate is not a problem for adults, but can be a problem for babies, especially those less than six months of age. Babies are also more susceptible because of their small size and an exclusively liquid diet. It takes a few months for a baby's digestive system to fully develop. During the first few months of life a certain bacteria can live in an infant's digestive system that can convert nitrate, which is not poisonous, to something that is, called nitrite.

If nitrite is absorbed into the blood it combines with the chemical that carries oxygen, called hemoglobin to form a chemical called

methemoglobin, which cannot carry oxygen. This condition called **Methemoglobinemia,** causes a baby to turn blue due to oxygen starvation, and may result in death if not treated.
Young animals are affected by nitrates in the same manner as babies, and nitrate is a problem for ruminant animals of all ages. Some livestock have been known to abort fetuses because of drinking high nitrate water. A recommended safe level for animals is 100 milligrams per liter.

Nitrate from animal wastes. Nitrate and other forms of nitrogen are present in the soil, and it is essential for plant growth. Nitrate from mineral or organic sources can, however, become a problem if too much moves from the soil into drinking water supplies. Organic nitrogen is everywhere around us because it is common in plant residues and animal wastes, including human wastes. Much organic matter is inadvertently or purposely applied to the land. This organic nitrogen is then converted by bacteria in the soil to ammonia, and other bacteria convert the ammonia to nitrate. Nitrate, however, is very soluble in water. If more nitrate is present in the soil than plants can use, it can be leached to groundwater. Wise management of animal wastes is one of the primary aspects of groundwater protection from nitrate contamination.

Animal Waste - A Resource or Disposal Problem

Livestock wastes, including that from poultry, is agriculture's biggest disposal problem. Water quality degradation from animal waste has grown into a major issue, and has already limited further development of animal production in some areas of the country. We may suffer that same fate in Alabama if we are not careful. If treated and handled properly, much of our animal waste can be a resource instead of a nuisance.

Advantages and disadvantages of manure fertilizers. There are definite advantages from the use of manure as fertilizer. Other than supplying nutrients, manures have soil conditioning benefits that include improved soil structure, improved infiltration and drainage on fine textured soils, and increased water holding capacity on most soils. These beneficial effects are due primarily to increased soil organic matter content. Incorporated manures are also very effective in reclaiming the productivity of drastically disturbed and severely eroded soils.

Manures, however, have several disadvantages for large-scale farming operations. In general, they are not as convenient nor as economical to handle as commercial fertilizers because of their bulk and low percentage of nutrients; their nutrient value is also inconsistent which makes calibration difficult; manures may not supply the exact nutrient mixes to meet specific soil and crop needs as can commercial fertilizers; timely release of some nutrients is hard to predict; and transportation is a problem unless planned sites for land application are nearby.

Production levels. The amount of livestock waste produced in this country is equivalent to that of a human population of 2.5 billion people. A feedlot with 50,000 cattle has a disposal problem comparable to that of a city of 600,000 persons. One highly productive dairy cow may produce more manure than 25 adults.

Alabama is a leading state in animal production, and therefore, a leading state in animal waste production. Animal production accounted for 66.3 percent of the total cash receipts from agriculture and timber production in Alabama in 1990 (Source: Alabama Agricultural Statistics, Bul. 33, 1990). Some of this production occurs where the wastes can not be conveniently applied to pastureland or cropland as a source of nutrients.

Figure 1 shows the distribution of cropland in Alabama and Figure 2 shows animal waste production (manure and litter) in reference to available cropland and pastureland. Those counties which have high animal waste production, but do not have the land resources available for disposal, are most likely to suffer animal waste-related water quality problems. Based on official complaints from ADEM, this appears to be the case.

If land application is to remain the major method of animal waste disposal in Alabama, available land resources will be a must. Long term application of high animal waste levels to small land bases will most likely create water quality problems and could lead to restrictions on animal production.

The Environmental Movement and Animal Waste Management

Like many other farm-related activities, animal waste management decisions at the farmstead level were once left primarily to the discretion of individual producers. Environmental concerns appear to be changing this. People are now very concerned about environmental and health issues, and predisposed to hear lots of information on these topics--so make no mistake--the public will decide how to handle these issues.

The public is just now relating to the environmental concerns of animal waste management. Agricultural producers are a small minority and can not expect to be left alone in making decisions on how they handle animal waste to prevent water quality problems in the future. The USDA, State water quality agencies, and even your next door neighbor, may have an impact on how you manage your animal waste, or whether you stay in business in the future.

Persuasion vs. enticement vs. enforcement. People generally respond to things in a certain way for one of three reasons, because of personal satisfaction, because they receive some reward for doing so, or because they are forced to do so. This same philosophy could apply to animal waste management on the farm.

Most voluntary actions of producers to protect soil and water resources come under the category of good **stewardship.** A good steward practices soil and water conservation because of personal convictions, and sincerely cares about protecting the environment. Extension will continue to support the philosophy of good stewardship through education and persuasion. Since some folks don't respond to friendly persuasion, other methods of persuasion have been adopted.

The **incentive (carrot) approach** has been used for many years to entice producers into adopting practices that reduce environmental degradation. Cost-share programs and other financial assistance from USDA qualify as incentives. Special incentives for animal waste management have increased during recent years. These dollars help offset the initial costs of soil and water conservation measures. Some states have cost-share dollars available through their state conservation agency or state agricultural agency. These dollars are very limited in Alabama.

The environmental movement, is forcing agricultural producers to deal more with the **enforcement (stick) approach** to environmental compliance. Even the Soil Conservation Service (SCS) is being forced into a regulatory role of monitoring compliance standards mandated in conservation provisions of the 1985 and 1990 farm bills. Farm management plans could very well include mandated animal waste management provisions in the future.

The stick carried by the Alabama Department of Environmental Management (ADEM), is big and swift, should they decide to use it. They can put you out of business real fast if you have an animal operation that is causing water quality problems. If someone registers an official complaint and ADEM officials show up on your farm and find that you are indeed contaminating state waters, they are mandated by state law to prevent it.

Waste management permits. Animal waste management permits may be coming in the future. Some states have already initiated such programs. In Texas, for example, dairies with more than 250 milking cows are required to obtain waste management permits from the Texas Water Commission. The Texas Water Commission also adopted a new enforcement policy in 1990 that allows dairy farms smaller than 250 cows to operate without state waste management permits only as long as the farms have registered with the commission and apply best management practices (BMPs) to prevent water pollution. Other state agencies are looking at adopting similar programs.

Violators have been fined over $50,000 each in Texas for violating state water quality laws by discharging wastewater into nearby streams and for operating without a permit. Although Alabama does not have any such permit program, animal operations have been heavily fined in Alabama and some forced out of business due to water pollution problems.

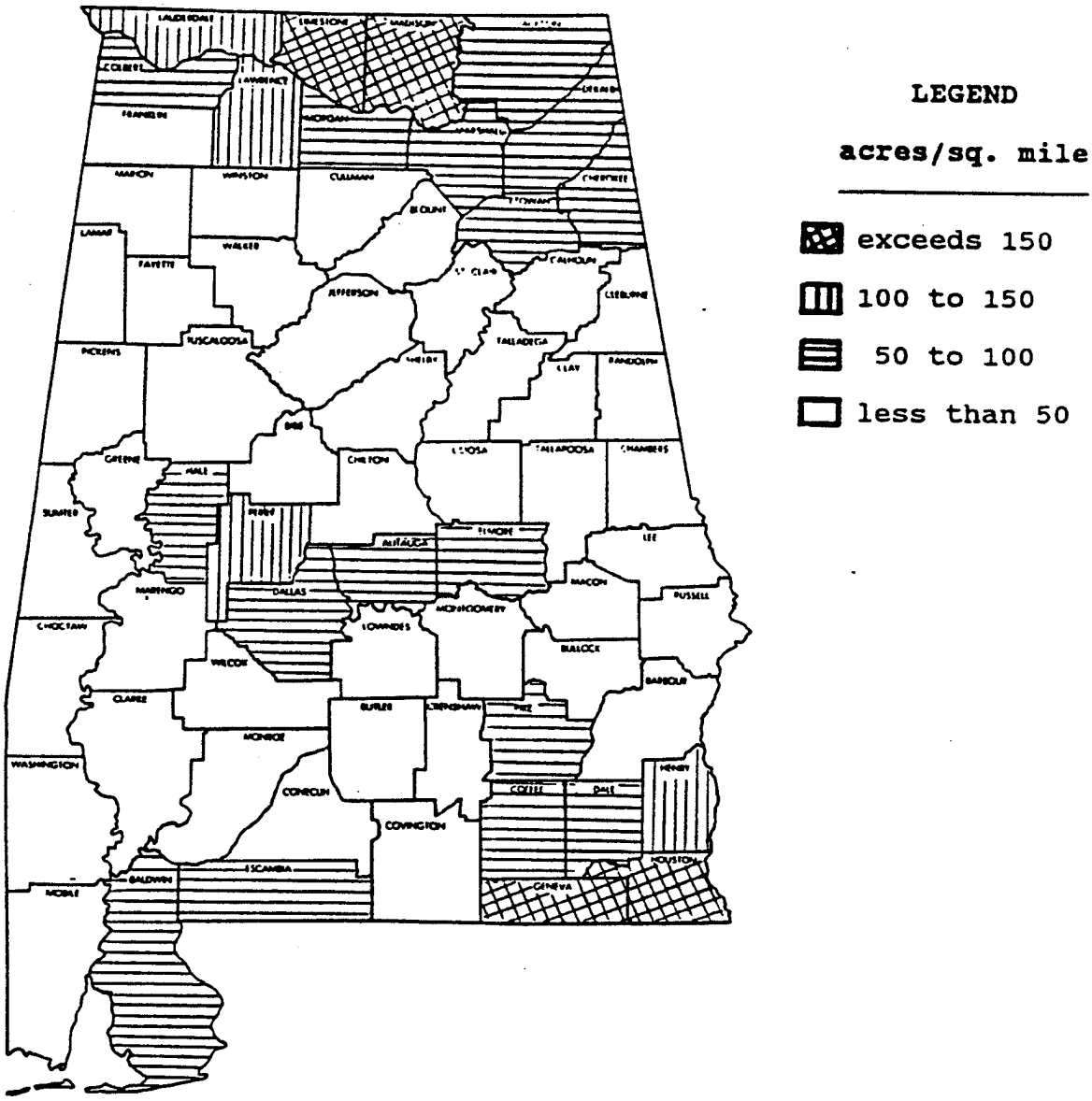

FIGURE 1
Source: ADEM Nonpoint Source Management Program, 1989)

DENSITY OF CROPLAND IN ALABAMA

ACRES OF CROPS PER SQUARE MILE

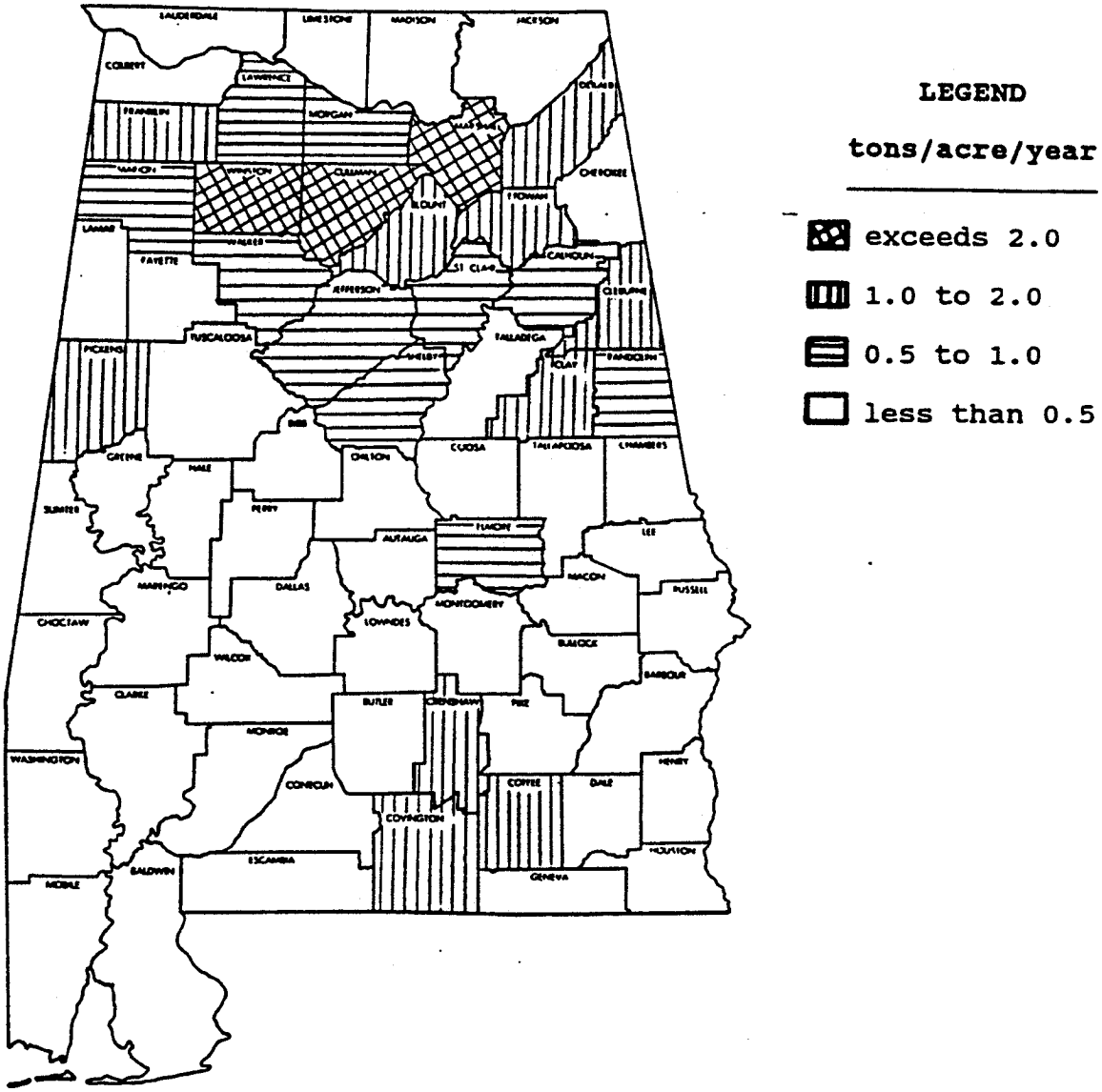

FIGURE 2
(Source: ADEM Nonpoint Source Management Program, 1989)

ANIMAL WASTE PRODUCTION IN ALABAMA

TONS PER ACRE PER YEAR
OF CROPLAND AND PASTURELAND