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Livestock Development and Water Quality

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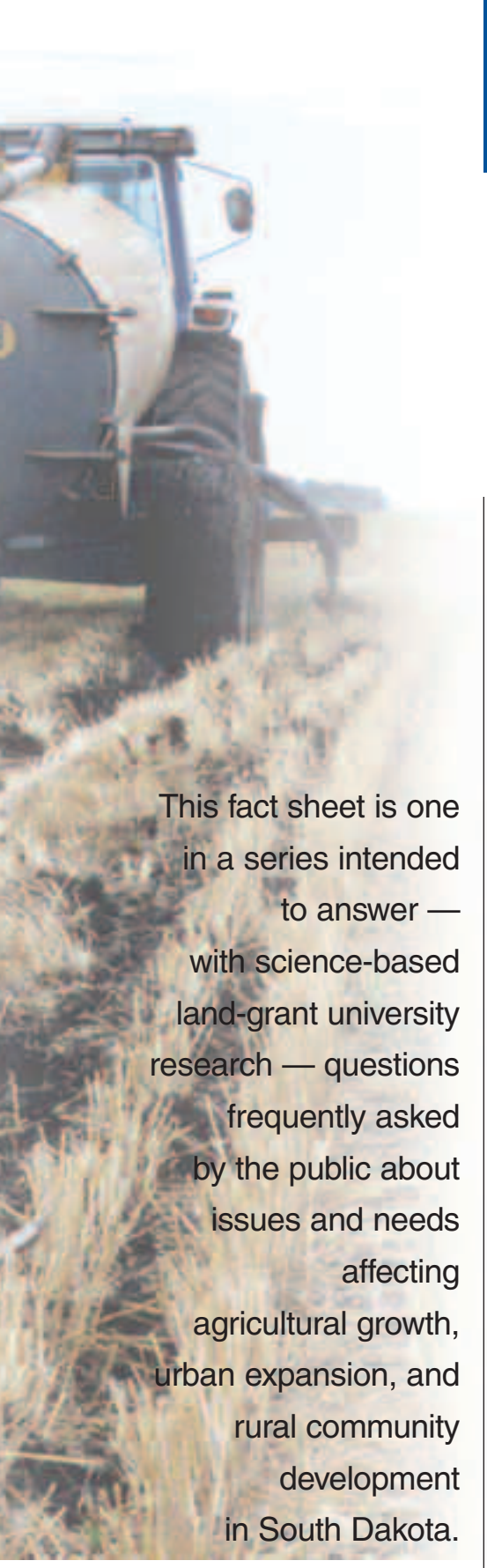

This fact sheet is one in a series intended to answer — with science-based land-grant university research — questions frequently asked by the public about issues and needs affecting agricultural growth, urban expansion, and rural community development in South Dakota.

Livestock Development and Water Quality

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Are there state regulations that farmers must follow when building or operating a large livestock confinement facility and applying manure?

Large livestock confinement facilities in South Dakota must have a state water pollution control permit to operate. This permit establishes the minimum environmental standards for livestock operations defined as concentrated animal feeding operations (CAFO) to ensure protection of the state's surface and ground waters.

An operation is considered large if it has a capacity of at least 700 dairy cows, 1,000 feeder cattle, 2,500 feeder pigs, or equivalent numbers of other animals. Smaller operations may also be regulated if they are posing a pollution hazard to waters of the state. The South Dakota Department of Environment and Natural Resources is responsible for developing and enforcing the state permit for livestock operations.

To obtain a state permit, livestock operations must present engineering plans for the building site that show how manure will be collected and stored to prevent environmental degradation. In addition, they must have an initial nutrient management plan showing they have adequate land under their control to properly spread manure according to typical nitrogen and phosphorous soil tests, estimated soil erosion from each field, expected manure analysis, and nitrogen and phosphorous recommendations for their crop rotations.

Before operations can be permitted, the operator must attend an approved training workshop that clarifies the regulations and gives details that need to be in a nutrient management plan. Once an operation is permitted, it must test manure intended for land application each year. In addition every field must be soil tested each year prior to manure application to determine the correct rate of application for the crop to be grown.

The South Dakota Department of Environment and Natural Resources regularly inspects permitted facilities to ensure manure is being properly stored and land-applied to prevent environmental degradation.

The water pollution control permit for livestock operations allows local governments and planning and zoning commissions to concentrate on land-use and zoning issues instead of water pollution control issues. The permit does not regulate odors or local land use

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planning. A copy of the permit for large livestock operations can be obtained from the South Dakota Department of Environment and Natural Resources and from their web site at www.state.sd.us/cafo.

The state also administers the following permits that may be required for a livestock operation: water right, storm water construction, dewatering, and ground water discharge.

Are county governments in South Dakota involved in regulating livestock operations and manure applications?

Counties in South Dakota often make local regulations concerning livestock operations that must be followed in addition to the state regulations. For example, counties may require a state permit for operations with fewer livestock than are required under the state permit.

A county may have rules restricting the location of livestock operations or where manure can be applied, such as within certain distances of occupied buildings or over shallow aquifers. Since county regulations are specific for each county, residents must check with their local county officials for local rules that pertain to them.

Does anyone make sure that producers follow the rules once a CAFO is established?

Complaints can be filed with the South Dakota Department of Environment and Natural Resources (DENR), which is responsible for investigating and monitoring compliance.

What is the status of our water quality?

Water quality is defined based upon the intended uses for water, and most of the water resources in South Dakota are managed simultaneously for multiple uses. Drinking, swimming, fishing, irrigation, livestock watering, and other uses each have different water quality standards.

Water quality criteria have been defined to support each of these uses and all of the criteria for all uses assigned to a water body provide a set of standards. Water bodies that do not meet these standards fail to support one or more of their designated uses.

The State of South Dakota is required by federal legislative mandate to monitor water quality within the state and report the status of the state's waters every two years. In the most recent report, 44% of monitored stream miles did not support all of their uses. High total suspended solids, high fecal coliform bacteria counts, high specific conductance, high sodium adsorption ratios, high total dissolved solids, high water temperatures, and low dissolved oxygen concentrations were the most frequently observed water quality problems. Sixty-six percent of monitored lake basins (excluding the Missouri River reservoirs) did not support one or more of their designated uses and most of the observed impairments were attributed to nonpoint sources of dissolved salts, nutrients, and organic matter from associated watersheds.

What is a TMDL?

The total maximum daily load (TMDL) is the maximum amount of a pollutant that a water body can receive and still meet water quality standards. Assessment projects are conducted to evaluate the quality of a water body and define the loads of pollutants entering. An assessment uses field data and computer modeling to estimate the load contributions from many sources. This is called load allocation.

Once the load has been estimated and allocated to different sources, a total maximum daily load is defined. This TMDL is the maximum quantity of that pollutant that the water body can receive and still stay within the water quality standards (support all of its uses).

TMDL studies are required through Section 303 of the Clean Water Act. The results of a TMDL study are used by water resource managers to identify critical areas within a watershed in need of best management practices.

Once a TMDL has been defined for a water body, state and local agencies can work with landowners to implement best management practices designed to bring the average daily load within the TMDL limit.

Partnerships generated between landowners and state and federal agencies include cost-sharing and monitoring to evaluate the success of implementation projects.

Livestock makes manure. Can manure pollute surface waters?

Aquatic life depends on oxygen dissolved in the water just as we depend on oxygen in the air. Manure contains high levels of organic matter (20-30% by weight). This organic matter is decomposed by bacteria within streams and lakes, using available oxygen in the process. The amount of oxygen required for this decomposition is called the biochemical oxygen demand (BOD).

The Nebraska Extension Service states that BOD levels in livestock manure average 20,000 mg/L or 50 times that found in municipal sewage. Fish kills resulting from depressed dissolved oxygen in lakes and streams resulting from manure entry have been reported in neighboring states. These problems can be prevented by fencing livestock away from lakes and streams and through construction of waste containment facilities. Cost sharing may be provided for the construction of these systems.

Many streams within South Dakota suffer from high suspended solids concentrations. In fact, high suspended solids concentrations are the most frequently observed cause of water quality standards

violations. Suspended solids are the small particles within a water sample that are not able to pass through a filter. Some streams within South Dakota have naturally high levels of suspended solids (e.g., Badlands streams). Others have elevated levels resulting from inputs of suspended materials from erosion within the watershed and locally along stream banks. Eroding and sloughing stream banks can be prevented through grazing rotations and eliminated by fencing off the stream channel. Many landowners use pasture pumps to provide water to livestock that are fenced away from the channel.

How can nutrients in manure cause water problems?

Manure contains many different nutrients but nitrogen and phosphorus have the greatest potential to cause water quality problems. After manure is applied to the soil, nitrogen in it is converted by soil microbes to the nitrate form. Nitrate is the dominant form of nitrogen used by plants.

The key issues here are that nitrate does not attach to soil particles and is completely soluble in water. Therefore the nitrate is not in the soil itself but rather in the water that is in soil. If water in soil moves below the root zone of crops, nitrate in the water also moves below the root zone and likely will continue its downward movement until it reaches the ground water. The movement of water and nutrients through soil is called leaching.

Although water can move through any soil, it moves much more rapidly through coarse textured sandy soils and gravels than through heavy clay soils. Therefore the likelihood of moving water and nitrate below the root zone and into the ground water is much greater on the coarse textured soils. These coarse textured soils are often above the aquifers that supply drinking water. Because nitrate moves into soil so easily, it normally doesn't run off the soil surface into surface water.

High nitrate levels in drinking water can cause health problems, especially in infants. The drinking water standard is 10 parts per million nitrate nitrogen.

Phosphorus in manure acts differently than nitrogen when applied to soil. It attaches tightly to soil and is not very soluble in soil water. Because of these properties it does not move through soil like nitrate and does not readily end up in ground water.

However, because phosphorus stays on or near the soil surface, it is subject to runoff into surface waters with sediment that is eroded off fields or dissolved in the runoff water.

Unlike nitrogen, phosphorus itself is not a major health hazard in water. However, it promotes algal growth in surface waters. Algal growth makes recreational activities less desirable and can cause fish kills.

Does livestock manure in water constitute a human health concern?

The jury is still out on this question. Several pathogens found in livestock manure are known to cause disease in people. However, it is not clear how important livestock wastes are in transmitting these pathogens.

Wastes entering a water body may come from many sources (e.g., people, livestock, wildlife). State water quality agencies use fecal coliform bacteria as an indicator of animal waste contamination in water resources. These bacteria are found within the digestive tract of all warm-blooded animals. They are simply indicators, not disease causing organisms, but the probability of contracting a water-borne disease is higher if the water is contaminated by fecal material.

High fecal coliform counts are found in streams, lakes, and groundwater sources throughout the nation. These bacteria may have originated from any warm-blooded animal.

Traditional monitoring techniques only tell us that the indicator is present and how abundant it is in the water sample. New bacterial source tracking techniques are currently under development which would help water managers identify the source animals contributing this fecal material.

Is manure more likely to cause environmental problems than other sources of nutrients such as commercial fertilizer?

Nutrients in manure are converted in soil into the same compounds as nutrients in fertilizers, legumes, and crop residues. Therefore, when applied at equal rates of nutrients, manure is generally not any more likely to cause nutrient losses to the environment than other sources of nutrients. The key issue here is "applied at equal nutrient rates."

In the past, manure was sometimes applied at rates that supplied much more nitrogen and phosphorus per acre than was normally applied as commercial fertilizer. Because high rates of manure were being applied, regulations were put in place to ensure farmers used application rates that are closer to the nutrient needs of the crop to be grown. The price of commercial fertilizer is the incentive for farmers to apply only the amount needed by the crop, minimizing the need for commercial fertilizer application rate regulations.

Can manure be applied to soil without significant risk of nitrogen leaching or phosphorus runoff?

The major cause of leaching losses of nitrogen is applying more nitrogen than the crop can use. The excess nitrogen remains in soil after crop harvest and is subject to leaching before the next crop uses it. South Dakota State University, through research in soil

fertility, has calibrated a two-foot deep nitrogen soil test that determines the amount of nitrogen that needs to be added to soils to meet crop needs.

In addition to soil testing to determine the amount of nitrogen needed, manure testing determines the amount of nitrogen in manure that is available to the crop. When the two-foot nitrate test is used in combination with manure analysis, manure rates can be applied such that little nitrogen is left in soils after harvest, minimizing the risk of nitrogen leaching losses before the next cropping season.

The major cause of phosphorus runoff is soil and manure losses by erosion. Reducing erosion by implementing good soil conservation practices minimizes losses of soil and the phosphorus attached to it. Knifing in liquid manure and incorporating solid manure dramatically reduce manure runoff losses.

When manure is applied to meet the nitrogen needs of the crop, often more phosphorus is applied than removed by the crop. The additional phosphorus raises the phosphorous content of soil. Soil testing is needed to measure the phosphorous levels in soil. Increased phosphorous soil test levels have been shown to increase phosphorous losses in runoff water. Regulations, however, have been implemented to restrict phosphorous applications to rates no greater than crop removal once phosphorous soil tests rise to critical levels, therefore minimizing runoff potential.

Resources:

Environment and Natural Resources Surface Water Quality Program / Joe Foss Building / 523 East Capitol / Pierre SD 57501-3182
Telephone: (605) 773-6707
Website: www.state.sd.us/cafo or www.state.sd.us/denr/DES/Surfacewater/feedlot.htm
Contacts: Kent Woodmansey (kent.woodmansey@state.sd.us) and Jeanie Votava (jeanie.votava@state.sd.us)

2004 South Dakota Integrated Report. Surface Water Quality Assessment, South Dakota water quality water years 1998-2003 (streams) and water years 1993-2003 (lakes). South Dakota Department of Environment and Natural Resources.

Fertilizer, manure, feed and pesticide residue testing: SDSU Analytical Services / Oscar E. Olson Biochemistry Lab / Box 2170 / South Dakota State University / Brookings, SD 57007-1217
Telephone: (605) 688-6171
Website: http://anserv.sdstate.edu
Contact: Nancy Thiex (nancy.thiex@sdstate.edu)

Minnesota Environmental Quality Board. 1999. Generic environmental impact statement (GEIS) on animal agriculture: summary of the literature related to the effects of animal agriculture on water resources. http://www.eqb.state.mn.us/geis

Nicolai, R., J. Gerwing, C. Ullery. 2004 update. Environmental training for South Dakota livestock producers. SDSU Agricultural & Biosystems Engineering Department.

Nutrient recommendations for crops: SDSU Soil Testing Laboratory / Box 2207A / South Dakota State University / Brookings SD 57007-1096
Telephone: (605) 688-4766
Fax: (605) 688-4667
Website: http://plantsci.sdstate.edu/soiltest
Contacts: Jim Gerwing (james.gerwing@sdstate.edu) and Ron Gelderman (ronald.gelderman@sdstate.edu)

South Dakota water quality standards and TMDL project status. http://www.state.sd.us/denr/denr.html

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Fact sheets in the 925 livestock development series:

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