An Environmental Look at American Feedlots

PEGGY GREB (K10520-1)

This experimental feedlot in Bushland, Texas, was built for study of the environmental effects of feedlots. Agricultural engineer Nolan Clark programs automatic runoff samplers at the feed pens.

In the heart of America's beef cattle feedlots, in Bushland, Texas, sits an unusual experimental feedlot. It is one of a very few built to study the environmental effects of feedlots—as well as animal performance.

Feedlots concentrate large numbers of cattle in relatively small areas, and that means lots of manure. Manure is normally removed and transported to farmland for use as fertilizer. During this process, some nitrogen can leave manure and enter the atmosphere as ammonia gas. Ammonia washed from the atmosphere in rain can harm natural ecosystems by overfertilizing them with nitrogen. Also, ammonia can combine with other gases or particles in the air and still be small enough to be inhaled. This can potentially cause human health problems.

Nolan Clark, an agricultural engineer with the Agricultural Research Service in Bushland, together with animal scientist Andy Cole and other colleagues, are working with the Texas Agricultural Experiment Station (Texas A&M University) to study these and other environmental effects of feedlots.

The experimental feedlot has 18 pens that hold 10 to 15 head of beef cattle each. The pens slope uniformly from the feed bunks to the back. Runoff can be easily measured with flumes and runoff samplers installed at each pen.

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Animal scientist Andy Cole (left) and agricultural engineer Nolan Clark examine runoff samples from a pen in the experimental feedlot.

"Runoff monitoring is rarely done in feedlot studies," Cole says. The research team checks nitrogen, phosphorus, and pathogen levels before storing the runoff in holding ponds that prevent it from contaminating waterways.

"We've stepped up our efforts over the past 6 years to get a handle on how much ammonia and other forms of nitrogen are escaping from feedlots," Clark says. He is director of the ARS Conservation and Production Research Laboratory.

Cole says, "When a cow urinates in a wide open pasture, there's a good chance that most ammonia gas escaping from the urine will just land nearby and fertilize some grass. But when animals are close together in a feedlot, there is enough concentration of ammonia emissions that some of it can travel farther afield. We are working closely with Texas A&M scientists on the ammonia emissions."

At the experimental feedlot, scientists can monitor how much an animal eats and excretes, then determine how much of the consumed nutrients later end up in the atmosphere and in runoff and manure collected from the pens.

The problem is that cattle, like people, need nutrients like nitrogen or phosphorus in their food. But the animals don't use all the nutrients in the diet. For every 10 pounds of nutrients consumed, 8 to 9 pounds are excreted in the feces and urine. "So the trick is finding out how to put the same amount of beef on cattle with less loss of nutrients," he says.

One outcome of these studies might be recommendations for diets with lower protein/nitrogen content. Current feed diets typically contain about 13.5 percent protein. Grain and hay usually contribute about 70 percent of the protein, and a supplement contributes the rest.

The scientists hope to find out what level of nitrogen is optimal and which source of nitrogen is best to supplement diets with—urea or other additives. Feeding urea has the disadvantage of raising the nitrogen content of urine. But other

sources, like cottonseed meal, have the disadvantage of raising the levels of phosphorus in the diet. Finding the right nitrogen/phosphorus balance is what the Bushland feedlot work is all about.

The feeding of cattle, versus pigs and chickens, is further complicated by cattles' greater genetic diversity. For example, one steer may perform best on a diet with 14 percent protein and another on a diet with 10 percent. "We're looking for the balance point that will benefit the feedlot overall, while minimizing losses of nutrients," Cole says.

The team recently began tracking disease-causing microbes from feedlots. Two ARS microbiologists—Bill Rice and Bill Purdy—working with Cole on the project are interested in the possibility that dust and runoff might carry pathogens and could contaminate nearby crops. They are also interested in whether manure spreads pathogens the same way.

Cole sees the experimental feedlot as one of many methods scientists are using to study these problems.

For example, Cole's colleague, soil scientist Richard Todd, studies ammonia emissions from manure under outdoor conditions. He built simulated feedlot surfaces by placing packed manure in 8-inch-deep, 33-foot-diameter circles. A 10-foot-tall tower above each circle collects ammonia in the air at various heights. After wind speed is accounted for, ammonia emissions are then calculated via a micrometeorological method.

Initial results show that decreasing dietary protein from 13 to 11.5 percent might decrease daily ammonia emissions by about 20 percent. However, simultaneous cattle performance trials indicate that daily weight gain and feed efficiency might go down if protein is lowered that much for the entire feeding period. Preliminary data indicate that performance problems can be avoided if protein is reduced only near the end of the period.

"We recognize that it's difficult for commercial feedyards to feed cattle two different levels of protein," Cole says."We want to attack the problem from several different angles. Each has part of the answer. Each has strengths and weaknesses, and we want to put all the pieces together for an accurate picture of what's happening on feedlots."

The researchers plan to study other feedlots emissions, such as methane, as well. Their goal is to make recommendations that will help feedlots environmentally—without sacrificing animal performance—in areas such as diet, feed additives, and pen surface management.—By **Don Comis,** ARS.

This research is part of Manure and Byproduct Utilization, an ARS National Program (#206) described on the World Wide Web at www.nps.ars.usda.gov.

R. Nolan Clark and N. Andy Cole are with the USDA-ARS Conservation and Production Research Laboratory, P.O. Drawer 10, Bushland, TX 79012-0010; phone (806) 356-5724 [Clark], (806) 356-5748 [Cole], fax (806) 356-5750, e-mail rnclark@cprl.ars.usda.gov, nacole@cprl.ars.usda.gov. ★

PEGGY GREB (K10525-1)

As part of ammonia emission studies, soil scientist Richard Todd (left) and biological science technician Larry Fulton measure air flow rate through ammonia collectors installed on a simulated feedlot surface.

PEGGY GREB (K10532-1)

Physical science technician Jeanette Herring uses a flow-injection analyzer to determine nitrogen and phosphorus concentrations in manure and runoff.