A BAMN Publication

INTRODUCTION TO NUTRIENT MANAGEMENT FOR CATTLE

Bovine Alliance on Management & Nutrition

This guide is published by the Bovine Alliance on Management and Nutrition (BAMN), which is comprised of representatives from the American Association of Bovine Practitioners (AABP), American Dairy Science Association (ADSA), American Feed Industry Association (AFIA) and the U.S. Department of Agriculture (USDA). The BAMN group is charged with developing timely information for cattle producers regarding management and nutritional practices.

In the past few years, nutrient management has taken on a new meaning for cattle and milk producers. Increased scrutiny of animal feeding operations has resulted from intensification of animal agricultural operations. The ability to balance production and economic viability goals with environmental safeguards may determine the future of many farms.

What is nutrient management?

Previously, nutrient management simply meant feeding cattle a balanced diet for desired growth and production. Today, nutrient management also encompasses providing crops a "balanced diet" for desired production while minimizing adverse environmental effects. Nutrients should be applied to crops at rates needed to optimize crop growth and to maintain soil productivity. To avoid contamination of air or water, excessive nutrients should not be applied to fields.

Why is everyone talking about nutrient management?

All livestock producers are potentially subject to regulations from the Federal Clean Water Act, administered by the U.S. Environmental Protection Agency (EPA). Farms designated as Concentrated Animal Feeding Operations (CAFO) have specific requirements under these regulations. Operations may be required to obtain a National Pollutant Discharge Elimination System (NPDES) CAFO-specific permit, but you need to check with your own state regulations or one of the ten regional EPA offices to find out what you must do to be in compliance with the law. These rules stipulate requirements about how you may apply fertilizer, manure and waste water to your land.

Should I have a nutrient management plan?

Though not required for all operations, it is strongly recommended that all facilities develop a nutrient management plan (NMP) documenting when and how much manure will be applied to their crop lands, and the actual nutrient contents of the applications. This is the best way to prevent surface water discharge and minimize effects on underlying groundwater. The law, as currently interpreted, states that an NPDES permit is required only if you discharge manure or feed nutrients to surface waters. All NPDES-permitted facilities must have a nutrient management plan.

Facilities obligated to obtain NPDES permits will need to follow the timeline established by EPA. Other facilities may need to follow a timeline established through their state regulatory process. All producers need to understand their nutrient balance and the importance of nutrient balance on long term viability for the operation. Continued nutrient accumulation on production units is not sustainable for agriculture.

Who has access to my nutrient management plan?

A court decision determined that a nutrient management plan (NMP) is in fact a critical component needed for the NPDES permit and is therefore an official part of the permit (subject to citizen review). The NMP must be reviewed before a permit can be issued. If this decision holds, it is the best incentive for never over-applying or allowing release of manure or feed nutrients to surface waters.

A NMP is not necessarily available for public review if it is not required as a permit component. Farm information is available upon request by regulatory agencies during a routine farm inspection. In some states, specific information may be submitted to the regulatory authority and therefore available for public review even in the absence of a mandatory plan.

Are records of dietary nutrients required by law?

The final rule of the Clean Water Act does not mandate that dietary information be recorded. However, dietary modifications can reduce excretion of environmentally damaging nutrients.

Is dietary manipulation a useful tool for my facility?

Diets for cattle operations are typically based on least-cost-ration formulation and meeting nutrient requirements of animals. Overfeeding of nutrients beyond production requirements or feeding an imbalance of carbohydrate and proteins decreases the efficiency of conversion of nutrients to animal products and results in increased excretion of the nutrients in manure. Reducing nutrient intake has been shown to decreases nutrient excretion. Most facilities can benefit from dietary manipulation that results in reduced nutrient output. If your facility is in an area where surface-water contamination is a concern, it is important to evaluate dietary nutrients. In most of the United States, regulatory authorities are concerned about phosphorus pollution of surface waters as a result of soil erosion, contamination from tile drains, or other sources. Animal manure is included in other sources. Regulatory authorities are also concerned about nitrate and salt contamination of groundwater.

Phosphorus

Over application of manure nutrients occurs when manure nutrients are applied to land in excess of what plants actually utilize. In some parts of the country, soils are already at or near phosphorus saturation levels. Runoff of phosphorus occurs when phosphorus builds up in soils or through soil erosion. In these areas, additional applications of manure nutrients will need to closely match crop uptake. If land application of phosphorus exceeds specific soil phosphorus threshold concentrations based on the NMP, then steps need to be taken to reduce phosphorus accumulation at the facility (reduce intake and excretion and/or utilize off-site removal).

Fewer acres will be needed for land application of manure if phosphorus content of manure is lowered based on dietary phosphorus restriction. Erickson et al. (1999) evaluated phosphorus requirements and excretion in feedlot diets. They reported that yearling finisher diets have a phosphorus requirement as low as 0.14% of the diet dry matter and that the phosphorus requirement for calves was as low as 0.16%. Cattle fed corn-based finishing diets typically consume a diet greater than 0.3% phosphorus, a two-fold excess of the requirement. In other work, Erickson et al., (2000) compared 0.40% phosphorus diets with 0.22% or 0.28% phosphorus diets. Phosphorus excretion was reduced from 11 to 5.3 lb phosphorus/yearling steer (132 day trial) and 12.5 to 7.5 lb phosphorus/steer calf (183 day trial) for the control and low phosphorus diets respectively; this decrease in phosphorus level in the diet reduced phosphorus intake by 33 to 45% and phosphorus excretion by 40 to 50%. Phosphorus efficiency was improved and there was no effect on animal performance. At present, the only logical way of formulating lower phosphorus diets for cattle fed in the nation's feedyards is by selecting feed ingredients containing low phosphorus; and using non-protein nitrogen if additional nitrogen is needed in lieu of high phosphorus protein supplement. Feedlot cattle fed high-grain diets never need mineral phosphorus supplementation. If byproducts high in phosphorus are fed for economical purposes, then access to more acres is required to distribute the excess phosphorus. As an example, Vander Pol et al. (2006) suggested that feedlots may make $10 to $20 more per finished animal by feeding wet distillers grains and Kissinger et al. (2006) suggested that spreading costs are only increased by $1 to $3 to spread manure over more acres.

Nitrogen

Feeding cattle according to their expected production can minimize excretion of nutrients. Phased or group feeding, where different concentrations of nutrients on a dry matter basis are fed to animals with similar expected gain, is an effective method to reduce nutrient intake and subsequent excretion. Erickson et al. (2000) and Klopfenstein and Erickson (2002) reported that use of lower crude protein diets (13.4% vs. 10.2 to 12.0%) and phase feeding can reduce nitrogen excretion in yearling and fattening beef cattle from 389 to 339 lb of nitrogen/yearling steer (132 day trial; Figure 1) and 491 to 389 lb nitrogen/steer calf (183 day trial), respectively. Feed-nitrogen intake was reduced by 10 to 20% when using phase feeding and the National Research Council model to meet the animals' metabolizable protein requirements. When intake was reduced, it resulted in a reduction of nitrogen excretion ranging from 13 to 21%. This also reduced the runoff of nitrogen from the feedlots and reduced the amount of estimated nitrogen volatilization losses from the feedlot surface by 15 to 33%. Current recommendation is to minimize feeding excess protein whenever possible.

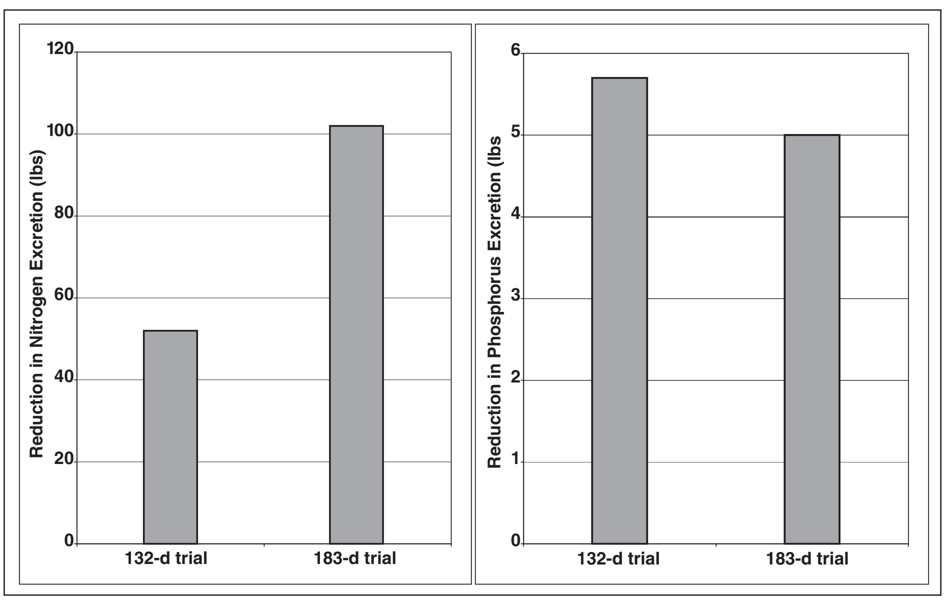

Figure 1. Total reduction in excretion of nitrogen and phosphorus (pounds) with dietary manipulation. Nitrogen excretion was reduced 50 and 102 lbs over 132 and 183 days, respectively, when feedlot steers were phase fed. Phosphorus excretion was reduced 5.7 and 5 lbs when phosphorus inclusion in the diet was reduced from 0.40 to 0.22% over 132 days and from 0.40 to 0.28% over 183 days, respectively. This represents a much greater reduction in phosphorus than nitrogen as a proportion of the amount fed.

Recent studies on nitrogen requirements of dairy cattle have focused on reducing the total nitrogen fed. Although dairy cattle dietary protein requirements are not as well defined as those for pigs and poultry – which are fed specific amino acids to reduce total protein needs – advances have been made in altering nitrogen excretion in ruminants. A study of replacement heifers was conducted to determine the environmental benefit of reducing nitrogen intake. James et al. (1999) reduced the crude protein from 11.0% to 9.6% in oatlage and concentrate diets (77:23 dry matter basis) with soybean meal serving as the protein source fed to heifers . The reduction of nitrogen intake by 14% (dry matter basis) resulted in a 28.1% reduction in ammonia emissions and decreased urea nitrogen, total nitrogen, percentage nitrogen excreted in the urine by 29.6, 19.8, and 7.4%, respectively.

Historically, reproductive problems in cattle were associated with insufficient phosphorus intake. Previous studies of phosphorus supplementation did not account for the energy content of rations. Thus, the reduced reproductive response attributed to phosphorus was likely because of inadequate energy levels in the rations. Wisconsin researchers (Wu and Satter, 2000) analyzed records of 95 cows fed either 0.48 or 0.38% phosphorus on a dry matter basis. These researchers reported no differences in milk production or reproductive performance based on phosphorus content of the diet. Yet, an additional 14 lbs of phosphorus was consumed and excreted each year per cow in the high phosphorus group. This is roughly equivalent to 32 lbs of P2O5. The additional P2O5 summed over a herd of animals would require additional acreage for proper nutrient management, depending on the crops grown and yield potential. There should be no adverse effects on reproduction when animals are fed at National Research Council recommendations. Work with phosphorus excretion in Florida showed that as dietary concentration decreased from 0.56% to 0.40% of dry matter (44 lb total dry matter intake/day), phosphorus excretion decreased from 0.22 lbs/day to 0.15 lbs/day (Morse et al., 1992). Additional decreases in excretion would be expected through additional dietary reduction as phosphorus was still fed at amounts greater than National Research Council recommendations.

One must consider nutrient excretion when formulating rations with nutrient concentrations above National Research Council recommendations or when adding mineral supplements. The daily feeding of nutrients or supplements above requirements for part or all of a herd can result in the need for many more acres of farm land for manure application.

How do I document compliance with regulations?

Each state may have different requirements for documenting compliance. Farm records that include nutrient applications, crop yields, and soil residues will allow regulatory authorities to determine if manure nutrients were properly applied. The penalty for over application has not been determined. However, if over application of nutrients are documented, it is highly likely that subsequent applications of manure will need to be adjusted to reduce or eliminate over application.

Producers should test their soils to determine nutrient levels, emphasizing phosphorus. If phosphorus levels are above legal levels, immediate access to additional land will be needed for manure application. Nutrient requirements specifically for nitrogen and phosphorus of crops should always be considered when determining manure application rates.

Summary

Producers, nutritionists and veterinarians should understand the ramifications of feeding excessive nutrients to animals.

Key points to consider:

- Be informed of state regulations.
- Identify competent, unbiased sources of information.
- Regularly evaluate your progress toward compliance.
- Compare excreted nutrients with nutrient uptake from crops grown on land where manure is applied (consider fertilizer applications).
- Analyze manure nutrient content to compare nutrients in manure with estimated nutrients excreted.
- Modify nutrient intake/excretion and/or manure application if application exceeds crop nutrient uptake.
- Formulate environmentally responsible diets.
- Keep diligent records.
- Develop a farm nutrient management plan.

This publication was initially drafted by Deanne Meyer, Livestock Waste Management Specialist, University of California, Davis and Galen Erickson, Beef Feedlot Extension Specialist, University of Nebraska, Lincoln and then revised by BAMN.

Additional information and References:

EPA-CAFO handouts (Web available) http://cfpub.epa.gov/npdes/afo/cafofinalrule.cfm

Contacts for each state permitting agency related to CAFO rule http://cfpub.epa.gov/npdes/contacts.cfm?program_id=7&type=STATE

Livestock and Poultry Environmental Stewardship Curriculum available from http://www.mwpshq.org

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Other BAMN Publications

1. A Guide to Modern Calf Milk Replacers, Revised 2002.
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