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Integrating Animal Feeding Decisions into CNMP Processes: Part 1

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Introduction
Environmental planning in animal production systems often requires an estimate of nutrient excretion. Standard values published by the Natural Resources Conservation Service (NRCS) (SCS 1992), American Society of Agricultural Engineers (ASAE 1999), and MidWest Plan Service (MWPS 2000) commonly have been used for this purpose. However, these current procedures do not reflect the impact of producers' animal dietary decisions on nutrient excretion. The increasing variety of feed ingredient options, changes in nutritional programs to match improving genetic potential, and feeding strategies designed to reduce nutrient excretion are influencing the amount of nutrient excretion. Standard methods for estimating nutrient excretion need to reflect animal feed strategies and integrate feeding decisions into a Comprehensive Nutrient Management Plan (CNMP).

Variation in the nutrient excretion of animal diets is critical to CNMP processes. Erickson et al. (1998) reported a 44% reduction in phosphorus (P) excretion by beef cattle for a reduction in dietary P concentration from 0.35% to 0.22%. Van Horn (1991) estimated nitrogen (N) and P excretion to be 16% higher and 48% less than ASAE estimates for feeding programs based upon recommendations by the National Research Council (NRC 1989). Morse et al. (1994) attributed these observed differences in dairy cattle to improved genetic potential, increased feed intake, and intensive management practices. The use of phytase and crystalline amino acids is well documented to cause significant reductions in N and P excretion in swine. Similar relationships between dietary intake of nutrients and nutrient excretion have been reported for poultry.

Alternative Model for Nutrient Excretion Estimates
Powers and Van Horn (2001) and other authors have proposed an alternative model that estimates nutrient excretion by subtracting nutrient retention from feed nutrient intake (see Figure 1). Estimates of feed nutrient intake are commonly available from animal producers by calculating the product of feed intake and feed nutrient concentration and then cross checking these values with feed

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inventories. Nutrient retention in the animal or animal products may be estimated by a simplified approach proposed by Powers and Van Horn (2001). This method, included as an alternative in a recent MWPS-18 publication on Manure Characteristics, is illustrated in Table 1 (see attachment). The table provides a simple calculator to relate changes in feed nutrient concentration to the associated value or cost to the CNMP program. National Research Council methods for estimating nutrient retention. NRC procedures provide a more complex and possibly more accurate method of estimating retention for species such as beef and swine. This estimate of retention is a peer-reviewed, industry-accepted methodology.

Future CNMP programs must integrate animal feed programs into CNMP processes. That integration is critical to recognizing the impact of feeding decisions on land requirements for managing nutrients. Crediting producer efforts to achieve regulatory water quality standards through modified dietary strategies designed to reduce nutrient excretion. The livestock and poultry industry can potentially practice source reduction similar to any other industry. Convincing producers and feed consultants that decisions made at the feed bunk affect water quality in their rural community.

Below, we present an example of a 1,000-head beef cattle feedlot where cattle are fed a typical industry diet (13.3% protein and 0.31% P) and a range of diets representing the current industry low (12.5% protein and 0.25% P) and high (14.0% protein and 0.50% P) levels. A dietary-based estimate of N excretion is reasonably comparable with currently accepted references. The typically observed range of dietary protein levels results in only modest changes in land requirements (Table 2). However, currently accepted references overestimate P excretion by about twice the predicted estimate based upon dietary P level. In fact, current standards estimate that excretion exceeds feed intake of P, an obvious indicator of the inaccuracy of current standards. In addition, the current range of dietary P levels produces a maximum of a 240% difference in land requirement.

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Table 2. Comparison of nutrient excretion and land requirement estimates based upon standard references and a proposed nutrient balance method for beef cattle.

	Nitrogen Excretion & Land Requirement			Phosphorus Excretion & Land Requirement		
	Lbs per day per 1,000 lbs	Lbs per finished animal	Land required for 1,000-head feedlot[1]	Lbs per day per 1,000 lbs	Lbs per finished animal	Land required for 1,000-head feedlot[1]
Excretion estimates by standard references						
ASAE	0.34	51.0	390 ac	0.092	13.8	1,450 ac
NRCS	0.30	45.0	350 ac	0.094	14.1	1,480 ac
MWPS	0.49	73.5	570 ac	0.083	12.5	1,310 ac
Nutrient balance excretion estimate. Dietary nutrient concentration at an industry						
Average	0.37	54.7	420 ac	0.047	7.1	750 ac
High	0.39	58.2	450 ac	0.084	12.6	1.320 ac
Low	0.34	50.9	390 ac	0.035	5.2	550 ac

[1] Assumes nutrient requirement of 150 lbs of N and 22 lbs of P per acre and an availability of manure N and P of 50% and 100%, respectively.

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