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## Nutrient balance of a commercial feedlot

### Abstract

The ability to develop nutrient balance for a livestock operation is important for maintaining a long-term sustainable production system and for compliance with current and future environmental regulations. Producers invest considerable financial resources in farm inputs, primarily feed and livestock. When animals leave the farm, they retain a portion of the feed nutrients they consumed, but the majority of consumed nutrients are excreted. Once excreted, certain compounds in the manure volatilize, which lowers the manure nutrient content and diminishes economic value of the manure as fertilizer. In addition, these volatile compounds can create air quality concerns. Operations designated as concentrated animal feeding operations must develop nutrient management plans to provide documentation that the manure produced will be applied at agronomic rates for environmental protection. Understanding the nutrient balance of a livestock operation is critical in developing whole-farm manure management plans. Objectives of this experiment were to determine the nutrient balance of a commercial feedlot and measure amounts of recoverable nitrogen and phosphorus from the feedlot pen surface.

### Keywords

Cattlemen's Day, 2008; Kansas Agricultural Experiment Station contribution; no. 08-212-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 995; Beef; Cattle; Nutrient balance; Nitrogen; Phosphorus

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## NUTRIENT BALANCE OF A COMMERCIAL FEEDLOT

*J. M. DeRouchey, S. Q. Jones, and J. M. Ham<sup>1</sup>*

### Introduction

The ability to develop nutrient balance for a livestock operation is important for maintaining a long-term sustainable production system and for compliance with current and future environmental regulations. Producers invest considerable financial resources in farm inputs, primarily feed and livestock. When animals leave the farm, they retain a portion of the feed nutrients they consumed, but the majority of consumed nutrients are excreted. Once excreted, certain compounds in the manure volatilize, which lowers the manure nutrient content and diminishes economic value of the manure as fertilizer. In addition, these volatile compounds can create air quality concerns. Operations designated as concentrated animal feeding operations must develop nutrient management plans to provide documentation that the manure produced will be applied at agronomic rates for environmental protection. Understanding the nutrient balance of a livestock operation is critical in developing whole-farm manure management plans.

Objectives of this experiment were to determine the nutrient balance of a commercial feedlot and measure amounts of recoverable nitrogen and phosphorus from the feedlot pen surface.

### Experimental Procedures

A commercial feedlot in south-central Kansas with a capacity of approximately 35,000 cattle was used for this experiment from November 2005 to May 2006. Within the feedlot, eight adjoining pens were used for data collection. Both heifers and steers, as well as cattle at different weights and feeding durations, were used in the experiment. Average number of head and body weight per pen were 66 and 958 lbs, respectively. Each pen had a total area of 20,664 ft<sup>2</sup>, which equated to an average of 313.5 ft<sup>2</sup> per head.

Daily logs were kept for each pen. Data included head count, ration, and amount of feed delivered. Data also were provided on starting and ending weight for each group of cattle housed in the pens. Data were used to determine occupancy of pens during the entire experiment.

Samples of all rations fed during the experiment were taken at the bunk for analyses of daily calculations of nitrogen and phosphorus intake. Diets were based on steam-flaked corn, corn silage, alfalfa hay, and wet distiller's grains, and the proportions of each varied with feeding stage.

Prior to the experiment, all pens were cleaned uniformly following the standard pro-

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TOCOL of the feedlot. At the conclusion of the experiment, pens were individually cleaned and weights of removed manure were recorded by pen. All manure removed from the eight pens was hauled to a common storage area and piled. A total of 15 manure samples (approximately 30 lbs total) were then taken from the manure pile representing all eight pens. This composite sample was mixed thoroughly and sub-sampled. Four sub-samples were collected and analyzed at a commercial laboratory for Kjeldahl nitrogen and phosphorus. The four sub-sample analyses were averaged to determine the mean concentration of nutrients in the collected manure.

All calculations were completed on a per animal basis within pen. Results are presented as grams/animal per day (Tables 1 and 2). Intakes of nitrogen and phosphorus were calculated based on daily feed deliveries and analyzed nutrient levels of the diets. Values of nitrogen and phosphorus retention are referenced from values obtained from Kissinger et al. (2007) in a large scale nutrient balance study representing six feedlots in Nebraska (nitrogen = 28.0 grams per animal per day; phosphorus = 6.5 grams per animal per day). Excretion of nitrogen and phosphorus was determined by subtraction of retained nutrients from nutrient intake. Nitrogen and phosphorus in manure were determined from the actual manure analysis and volume of manure collected by pen. Amounts of nitrogen and phosphorus lost were determined by subtracting the amount excreted from the amount in the collected manure. Also, the standard deviation for each calculated value was determined.

### Results and Discussion

Nitrogen intake for cattle in the experiment was 210.7 grams/animal per day. Based on the assumed nitrogen retention of 28 grams/animal per day, 13.3% of nitrogen fed was retained by the animal. In addition, 135.6 grams/animal per day of nitrogen was lost or

non-recovered, which represents 74.2% of the amount of nitrogen excreted.

**Table 1. Nitrogen Balance of a Commercial Feedlot<sup>a</sup>**

| Item,                      | Mean              | SD   |
|----------------------------|-------------------|------|
| N intake, g/animal daily   | 210.7             | 29.8 |
| N retained, g/animal daily | 28.0 <sup>b</sup> |      |
| N excreted, g/animal daily | 182.7             | 29.8 |
| N manure, g/animal daily   | 47.1              | 14.4 |
| N lost, g/animal daily     | 135.6             | 26.6 |
| N lost, % of excreted      | 74.2              | 7.6  |

<sup>a</sup>Represents eight pens in a 35,000 cattle capacity feedlot from November 2005 through May 2006.

<sup>b</sup>Referenced value from Kissinger et al. (2007).

**Table 2. Phosphorus Balance of a Commercial Feedlot<sup>a</sup>**

| Item,                      | Mean             | SD   |
|----------------------------|------------------|------|
| P intake, g/animal daily   | 33.0             | 4.3  |
| P retained, g/animal daily | 6.5 <sup>b</sup> |      |
| P excreted, g/animal daily | 26.5             | 4.3  |
| P manure, g/animal daily   | 17.6             | 5.4  |
| P lost, g/animal daily     | 8.8              | 4.7  |
| P lost, % of excreted      | 33.3             | 18.5 |

<sup>a</sup>Represents eight pens in a 35,000 cattle capacity feedlot from November 2005 through May 2006.

<sup>b</sup>Referenced value from Kissinger et al. (2007).

Phosphorus intake for cattle in the experiment was 33.0 grams/animal per day. Based on the assumed phosphorus retention of 6.5 grams/animal per day, 19.7% of phosphorus fed was retained by the animal. Also, 8.8 grams/animal per day phosphorus was lost or

non-recovered, which represents 33.3% of the amount of phosphorus excreted. This level of phosphorus loss was higher than previously published values and was not expected to be this high because phosphorus is not volatile.

The percentage loss of nitrogen recovery can be explained mainly by volatilization of nitrogen from the feedlot surface and secondarily from runoff during rain events or not recovering all nitrogen in the manure from the pen surface. Nitrogen in the form of ammonia can volatilize and contribute to decreased air quality, increased odor, and reduced economic value of the manure for fertilizer. Discrepancy in phosphorus recovery is likely due to unaccounted runoff losses, mixing manure with soil after precipitation events, inconsistent scraping depths at the start or at the conclu-

sion of the experiment, or a combination of these factors.

During the entire experiment, 8.4 inches of rainfall were recorded. However, 4.05 inches were received during the last 45 days of the experiment. With wet conditions present during the last portion of the study, challenges in obtaining complete manure removal at the end of the study might have occurred, which could have resulted in underestimation of recovery of total manure, especially phosphorus.

### **Implications**

Significant amounts of nutrient excretion relative to nutrient intake levels occur in feedlot cattle. This, coupled with subsequent losses of excreted nutrients, particularly nitrogen, from the pen surface needs to be addressed further.