

## Developing Whole-Farm Nutrient Plans for Feedlots

Iowa is a state with many farmer/feeders. Manure from feedlot cattle is a valuable source of fertilizer nutrients. However, as agriculture, as a whole, continues to move toward becoming a more environmentally aware industry, management of excreted nutrients will receive more attention in feedlot operations. Producers will need to be more aware of nutrient production and nutrient use within their own operation and how best to maintain a balance between the two.



A cattlefeedlot in Iowa.

Development of a site-specific nutrient management plan is essential in order to prevent the over-application of fertilizer nutrients, potentially threatening environmental quality. Feedlot owners and operators must be able to accurately estimate the amount of nutrients generated on-farm and the quantity of each nutrient that the farm is capable of using. A feedlot must keep accurate records of rations and the amounts of nutrients being fed in each diet throughout a year. An accurate method of estimating nutrient flows, including nutrient excretions, is needed. Feedlots also must consider nutrient losses that occur as a result of decomposition and volatilization during storage and application of manure. Ensuring equality between the quantities of nutrients applied to the crops and the quantity used by the crops completes the cycle.

Following is a brief step-by-step guide for development of a feedlot whole-farm nutrient management plan. By addressing each step and

### For Open Feedlot Operators

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making reasonable estimates of the nutrients at each stage, producers can identify where opportunities exist, within their own operation, to optimize nutrient flows. Figure 1 refers to two example feedlot plans, on a per-space basis, where the average animal in the feedlot is a 1,000 lb. steer gaining 3.37 lbs per day with a finish weight of 1,300 lb. The plan is developed for a one-year period of time and assumes that the feedlot is occupied during the entire year.

### Step I - Feed Management

By knowing nutrient quantities fed in rations and level of production one can estimate quantity of nutrients excreted. A mass balance approach considers nutrient intake, via diet, and subtracts from this nutrients retained in the product, growth or gain as a means of estimating the difference which represents nutrient excretion. Estimates of nutrient digestibility of common feeds are currently available, from which dietary nutrient absorption can be calculated. The indigestible portion of nutrient intake is excreted contributing to total excretion.

One option to maintain a whole-farm nutrient balance or reduce the number of acres required to spread manure is to decrease dietary nutrients (i.e., N and/or P) such that animal performance needs are still met with as little dietary N or P excess as possible. This is the case with the examples illustrated in Figure 1. Because protein and P are relatively expensive nutrients, often times, reducing dietary N and/or P to just meet animal needs also reduces ration cost in addition to reducing nutrient excretions. As a feedlot animal matures nutrient needs decreases. Nutrient density in grains, in particular, often exceeds the nutrient needs of a finishing animal.

Referring back to the examples provided, the effect of feed selection on nutrient excretion is illustrated. In Feedlot A the average animal is fed a diet containing alfalfa-brome hay, corn, a calcium supplement, and wet corn gluten feed. In Feedlot B, the average animal is fed a diet containing alfalfa-brome hay, corn, a 40 percent liquid energy and protein supplement and limestone. Both diets provide similar quantities of protein and energy.

Many of the co-product feeds included in feedlot rations are higher in P than the primary feed (Table 1). While, in many cases, these feeds are less expensive than corn and soybeans, making diet cost cheaper (Feedlot A with co-products = \$74/ton, Feedlot B without co-products = \$92/ton), cost of manure application to more acres should be considered when determining the economics of feed sources. Co-products serve as an important feed source for the animal industry. Producers just need to be aware of their nutrient content and the availability of nutrients in order to manage excreted nutrients appropriately.

### Step II - Nutrient Excretion and Retention

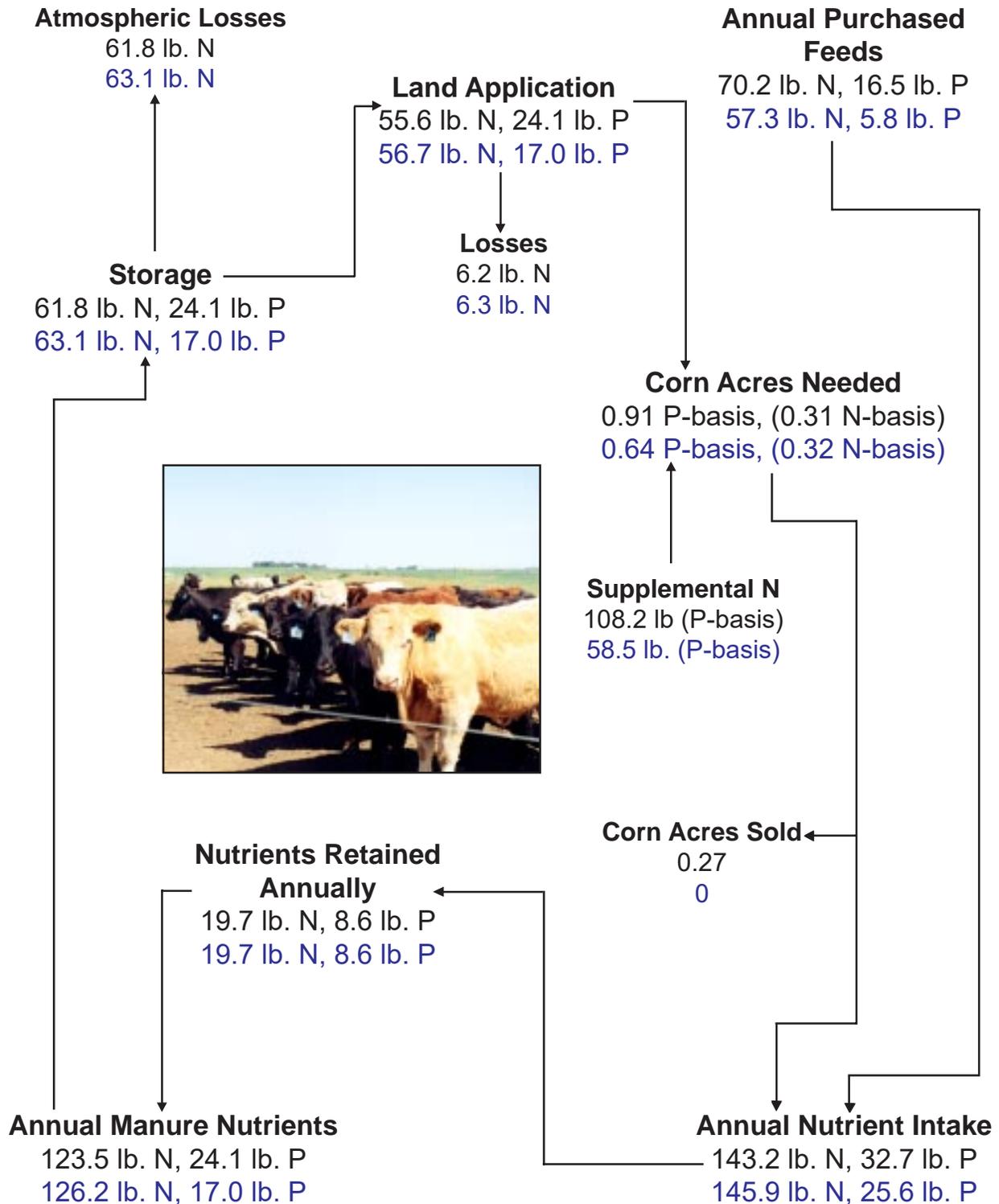
Nutrients are essential for growth and weight gain in feedlot cattle. First we must reasonably estimate the nutrient intake. Nutrient composition of gain, multiplied by weight gained, is subtracted from nutrient intake to provide a difference that represents nutrient excretion.

Weight gain is similar between the two illustrations because we formulated diets with similar protein and energy

**Table 1.** P content of typical feedlot feed ingredients

Feed	P content (% DM)
Soybean meal	0.70
Corn	0.35
Corn gluten feed	0.90
Distillers grains with solubles	0.70
Condensed corn distillers solubles	1.00

# Feedlot A vs. Feedlot B



content. However, because Feedlot A feeds a diet with greater P, more P is excreted. N excretions are more similar between the two examples because diets were formulated to contain similar N content.

It is important to note that table values commonly used to prepare manure management plans for a confined beef operation in Iowa use 0.07 lb. P (0.16 lb  $P_2O_5$ ) per day for a finishing animal. In cases where the producer is feeding as close to the animal P requirement as possible, the state forms may be overestimating excreted P, which then has to be managed. However, it is equally important to note that many operations are overfeeding P and other nutrients, including N. Producers should work closely with their feed managers to ensure that this practice is minimized, if not ceased.



**Manure solid settling basin at a feedlot in northwest Iowa.**

### **Step III - Storage**

Long-term open lot manure storage, anaerobic lagoons, and surface spreading contribute to ammonia loss to the atmosphere. Typically 30 percent of excreted N can be lost as ammonia due to volatilization in open feedlots. During storage in lagoons or settling ponds up to 70 percent of excreted N can be lost. As a result of ammonia volatilization following excretion, manure P becomes more concentrated, relative to N, than when the manure was first excreted, prior to any N losses.

Systems that conserve N result in a product with a N:P ratio more closely aligned with crop needs. Conservation of N also increases the fertilizer value of manure. Assuming a corn yield of 150 bushels per acre, recommended application rates of N and  $P_2O_5$  in Iowa are 180 lb. per acre and 60 lb. per acre, respectively. Ideally, manure nutrients would be excreted in this ratio. As excreted, feedlot manure contains a N:P ratio of approximately 3.7:1 (equivalent to 8.4 N:1  $P_2O_5$ ), actually greater than needed by the corn crop. However, as N is lost to the atmosphere the ratio decreases substantially. In a system where 70 percent N loss is typical, the resulting manure that is land applied has a N: $P_2O_5$  ratio less than that needed by corn (2.5:1 compared to 3:1 needed). When this manure is applied to fields based on P application rates, N is deficient, requiring supplemental inorganic N to meet crop needs. In this case, it is to the producer's advantage to retain as much of the N in the manure as possible to reduce costs for supplemental fertilizer. As we look down the road, environmental regulations may restrict N losses to the atmosphere, providing further incentive to retain as much of the excreted N in the manure.

In our example feedlots, we have assumed similar storage and handling of manure between the feedlots with a 50 percent N loss due to volatilization from storage.

#### **Step IV - Land Application**

Manure N has typically been used to determine manure application rates because of nitrate concerns and potential leaching of nitrates into ground water. As a result, producers have been over-applying P. Feeding diets containing P greater than that needed by the animal only serve to exacerbate the problem. In the future, priority will be on reducing excretion of P, as a means of decreasing needed land base, and retention of a higher proportion of excreted N in the excreted manure.

Retaining more manure N can be accomplished by incorporating manure into the soil immediately after application. By broadcasting manure, 15 to 30 percent of N can be lost. However broadcasting, followed by immediate cultivation can reduce N loss to 1 to 5 percent for solid manure. Most losses occur within 24 hours of application to the field. N loss, during land application, is usually greatest during dry, warm, windy days, and during the summer and spring months.

In our example feedlots, we have assumed similar manure application methods between feedlots with a 10 percent N loss due to volatilization.

#### **Step V - Crop Uptake**

To complete the nutrient cycle, manure excreted by the feedlot animals is applied to crops that can be used as a feed nutrient source for the feedlot animals. Manure nutrients available for crop uptake are the nutrients remaining from excretion after losses to the soil and air are subtracted.

In a typical Iowa cornfield, recommended manure application rates suggest 1.2 pounds of N per bushel of corn produced and 60 lb. of  $P_2O_5$  (26.4 lb P). The nutrient management plan helps to create a balance between the nutrients consumed, the manure nutrients that are land applied, and the nutrients harvested by crops grown. In the examples provided, the budgets were developed for manure application based on corn P needs. In Feedlot B, because dietary excess of P was minimized, manure provided P to grow 0.64 acres of corn. The Feedlot B diet fed this same amount of corn on an annual basis. The diet in Feedlot A was slightly higher in P content. Therefore, manure supplied sufficient P to grow more corn than the animal would consume in one year. As a result, corn from 0.27 acres per space would be exported. An alternative would be to export the equivalent quantity of manure. Manure P content estimates used by the Iowa Department of Natural Resources are higher than those shown here, reflecting the fact that many producers feed above the animal requirements for N and P. However, Feedlots A and B illustrate budgets that are feasible when careful consideration is given to diet.

#### **Conclusions**

## **SOLUTIONS**

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Nutrient management has become necessary for all livestock producers. It is important to keep a balance between nutrients produced and nutrients needed. The steps outlined above can help a producer become more actively involved in the nutrients his farm produces and how to manage them. To achieve environmentally acceptable nutrient balances, many animal production facilities will have to export manure or manure products in the future or change nutrient production to match nutrient needs.

## References

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## SOLUTIONS

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