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Inventory Management

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Introduction:

Feed is approximately 40 to 60% of the value of milk. Because of this large concentration of input cost, inventory management of feed is an important area for economic control. An inventory policy should be developed for each feed ingredient on the farm. The purpose of this paper is to evaluate the current efficiency in which feed inventories are maintained on dairy farms.

Inventory cost:

The basic problem facing the producer is to maintain a sufficient inventory to meet the daily demand of the dairy operation and yet minimize total inventory and product cost . How much should be ordered and how often are the major management decision that determine inventory policy for a given feed ingredient. Large purchase volumes offer a cheaper price/unit (ton) yet often incur greater storage cost. Furthermore, inventory cost must be considered in determining the value of home grown feeds. Inventory associated cost start to accumulate from the day of harvest.

If a feed ingredient is purchased and used at a constant daily rate, the standing inventory can be represented by a sawtoothed pattern as shown in Figure 1. The height of each tooth is a function of the quantity size (Q) ordered while the number of tooths is a function of the frequency orders. The total amount of an ingredient purchased/year (demand) can be calculated by multiplying the number of orders/year time the quantity size ordered. These are two cost associated with an inventory policy: holding cost and order cost. The optimal inventory policy will minimize both of these cost.

Inventory holding cost is dependent on the amount of feed stored in inventory. A common method of expressing this inventory cost is as a percent of value of the feed being stored. This represents the "lost opportunity" associated with having money tied up in inventories. The average amount of the feed being stored is approximately one half the order quantity (Figure 1). Hence the annual inventory holding cost can be calculated by multiplying the average inventory times the holding cost:

$$Annual\ Inventory\ Holding\ Cost = \frac{1}{2} Q C_{Holding} \quad [1]$$

Q = order quantity
(Note 1/2 Q is the average inventory maintained when the ingredient is used at a constant rate.),

$C_{holding}$ = holding cost/unit.

The second component of inventory cost is that associated with reordering feed, including the time spent determining the needed inventory. This cost is independent of the order size.

$$Annual\ Ordering\ Cost = \frac{D}{Q} C_{order} \quad [2]$$

D = total annual demand,
Q = order quantity,
C_{order} = cost/order.
(Note that D/Q equals the number of orders/year.)

Trucking fees can be included in the order cost when they are independent of the order size. Total inventory cost is the sum of holding cost and order cost.

$$Total\ Inventory\ Cost = \frac{1}{2} Q C_{holding} + \frac{D}{Q} C_{order} \quad [3]$$

A basic assumption for the above calculations is that demand can be estimated and that the usage rate is constant. Herds without a seasonal calving pattern will have a relatively constant demand and usage rate for most feed ingredients. To calculate the order quantity (Q) that results in the lowest inventory cost (optimal reorder quantity) one can take the derivative of the total inventory cost equation (3), resulting in:

$$Q_{optimal} = \sqrt{2D \frac{C_{order}}{C_{holding}}} \quad [4]$$

Figure 2) shows the order and holding cost associated with various order quantities. The minimum cost, determined by equation 4 is also shown graphically on figure 2. Note that this is the point where the annual order cost is equal to the annual holding cost and the sum of the two cost is minimum.

The reorder volume can be determined for each ingredient to ensure that a stockout does not occur. The reorder volume is the inventory volume when a new order should be placed. It is a function of the daily use rate multiplied times the lag time associated with the ingredient.

$$Reorder\ Point = Daily\ Use\ Rate \cdot Lag\ Time \qquad [5]$$

The optimal number of orders per year can be calculated by dividing the total demand by the optimal order quantity.

$$Number\ of\ orders\ /year = \frac{D}{Q_{optimal}} \qquad [6]$$

The optimal cycle time in terms of days between orders can be calculated from by multiplying the reciprocal of orders/year time 365 d.

$$Cycle\ Time = \frac{365}{orders/year} \qquad [7]$$

In many situations, the producer does not have the opportunity to dictate the optimal order quantity but has to accept set order levels. For example often feed ingredients are offered at various order volumes along with a varying unit prices. When evaluating volume feed discounts one should compare the total inventory cost along with the cost of the product for a given demand level. Usually a year's demand is used. Table 1 shows a feed ingredient offered at three order volumes and prices for a yearly demand of 19 tons. The total unit cost is calculated along with the associated inventory cost to yield a total cost. The policy with the minimum cost should be selected (#2 in the example in table 1).

References:

D Anderson, D Sweeney, T Williams. Quantitative Methods for Business. West Publishing Com. NY, 1989.

Table 1) Evaluation of Quantity Discounts

	Price 1	Price 2	Price 3
Total Demand Tons:	19	19	19
$ per ton:	$700.00	$690.00	$685.00
Transportation Cost:	$0	$0	$0
Cost per order:	$30	$30	$30
Time value of $:	10%	10%	10%
Holding $ /ton/yr	$70.00	$69.00	$68.50
Order Quantity:	2.0	5.0	10.0
Annual Inventory Cost:	$70	$173	$343
Annual Order Cost:	$285	$114	$57
Total Inventory Cost:	$355	$287	$400
Reorder Volume Point:	1	1	1
Demand/d:	0.05	0.05	0.05
m lead time d's:	10	10	10
Cycle days between Orders:	38.4	96.1	192.1
Number of Orders/year	10	4	2
Total cost of feed and storage:	$13,655	$13,397	$13,415