Feeding To Make Money: Managing Nutrients In The Total Herd

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Feeding to make money takes on many shapes. We can spend a lot of time talking about least cost or maximum profit ration formulation, feed purchasing and growing strategies. We can discuss the strategies in feeding the various groups of animals on the farm. We can make quantitative points about the importance of analyzing feeds. We can discuss the optimum strategies for manure management. Outlines can be made of the daily feeding management strategies. Each of these are important and a significant amount could be written about each of them. The goal is to make a good return on investment. In order to accomplish this it is necessary that we integrate each of these areas into a system. It is the system approach that we will use in our discussion in this paper.

Too frequently on farms we spend excessive time on the area that we feel most comfortable with or like most. Some of us would rather spend time with the milking cows, others with the replacements and still others with the crops. The truth is we need to spend enough time on each of the areas in order to make the area profitable.

I think that it is important that you divide your feeding system into profit areas. I would suggest some of the following divisions; you may have more:

- Feed Procurement
- Manure management
- Animal grouping and flow
- Ration formulation
- Feeding management

These divisions represent areas that can have a significant impact on cash flow and profitability. This list does not include labor management; it is implicit and the costs are real. It is essential that you understand that each of these areas are not isolated, but are interdependent. It is this last point that many times is not considered when making management decisions. This can become exceedingly painful when capitol expenditures are involved.

Feed Procurement

When we discuss feed procurement we need to now consider nutrient flow on the farm and nutrient balance on the farm. It is this latter point that prompted me to place manure management in second position. We need to carefully integrate our nutrient input on the farm with the nutrients leaving the farm. A price needs to be placed on the removal of N, P and K from the farm in a form other than milk and animal.

Growing crops needs to be considered as a feed procurement activity. If this is a part of the feed operation you need to ask whether it is making you money. Can you buy the quality forages/grains for less money than it costs you to grow them? If you can, will the quality be as consistent as that which you can produce? If you are to purchase forages what will this do to your farm nutrient balance? If the decision is to produce forages/feeds on your farm then how can you produce them most profitably? You should know exactly what your per-acre costs are, including costs such as taxes, machinery depreciation, storage costs and depreciation, inventory shrinkage, and nutrient variability from year to year. Finally, it is important to know what your real yields are per acre. This means weighing the crops as they come off the fields, and it is suggested that scales be installed. This means knowing the exact acreage that you are growing your crops on. Many of us do not have exact measurement of the acreages that are being cropped.

I can't overemphasize the importance of quality forage for optimum performance in your herd. Quality has may facets. The most obvious one is the nutrient content of the forage. It is critical that the appropriate forage with the correct nutrient content be available for all cattle at all times. This means routine analysis of the feeds. The most important routine analysis is the moisture level of the ensiled or wet feeds, if they are to be used in a TMR. In Finland and the U.K. they also measure the digestible dry matter, using enzymes. This practice is also used in Japan. This allows them to feed more forage than we do. We have not adopted the approach yet, partly because we are using legumes and have found that using enzymes to predict the energy values of forages is not accurate enough. We need to

put much emphasis on this in the future if we are going to increase profitability. It is important that we measure the protein and carbohydrate fractions. Equally important are the macro and trace elements. We need to know more about the availability of the minerals in the feeds to the rumen and to the cow.

The feed storage system needs to be designed so that it will be possible to access quality forages at all times. The system needs to be arranged so that the time to feed is minimized and accuracy will be assured. Quality also means that the particle size is correct, the acid or NH_3 levels are not excessive in the silages. If the milk is to be used primarily for manufacture of soft cheeses then clostridial spore contamination of the silage becomes a concern. Feeds need to be free from molds and yeasts. Aerobic stability is of great importance for silages and the amount fed out each day needs to be adequate to ensure fresh feed.

The purchase of feeds takes on several dimensions. First, the feeds should be purchased based on economic considerations. These economic considerations are the following:

Price
Variability of price
Availability of feedstuff
Variability of nutrients

The other considerations are quantities that you need to purchase to get a good price and the inventory turnover. It may not be wise to buy a quantity of an ingredient that will turn over slowly, especially if that ingredient has a poor shelf life. Remember, this is money that is tied up for a period of time that may be uneconomical when compared to buying it as a percent of a supplement that will turn over more frequently.

It has been my personal observation on many farms that there are inventories of minerals/vitamins and other feed additives on the farm that do not meet the needs of the herd and out of date. Careful planning is needed to control these inventories.

Manure Management

Nutrient balance is becoming an important consideration in the purchase of feeds. If you are purchasing excess amounts of N, P and K from feeds that cause nutrient balance problems on your farm then you need to reconsider the purchase of that feed. For example, the latest problem is with K. We are finding that high-K rations is the primary cause of milk fever. We are, with manure lagoons being highly efficient at recovering the K excreted by the cow in the urine. This is being spread on the fields and the forage plants are taking up the K in luxury consumption. It is becoming a challenge to balance against high K forages. Anionic salts have helped. However, the long term solution is to reduce the amount of K that we bring on the farm.

Feeding excess N is not only wasteful, but it will also have a negative effect on animal performance, particularly reproductive performance. In hot areas, especially where humidity is a problem, excess N intake can increase the animal's heat production and also water intake. This will cause a change in the animal's intake behavior and lead to metabolic upset. This problem can be compounded if water intake is restricted in any way. It will not be long before there will be an additional cost that will need to be input into our ration programs to economically assess the cost of manure disposal.

Grouping

The concept in the grouping of animals is to create groups that are as uniform as possible in size, age, productivity and stage of lactation and/or gestation. This is advantageous from a nutritional point of view. It is also will reduce the feed costs per animal per day. For example, if we are feeding one lactation group we will feed for the high producing animals in the group, i.e. the cows between freshening and peak. We are overfeeding the cows in mid to late lactation. Another advantage to grouping is being able to feed special supplements that are high cost for short periods of time. This is especially important during the last 3 weeks before calving and the first 4 weeks after calving.

Grouping should be a dynamic process. The system should be designed to minimize labor and to maximize taking advantage of the physiological state of the animal. For example, we need to espe-

cially focus on the replacement between weaning and puberty, the late gestation cow in the last 3 weeks before calving, and the fresh cow. There is an optimum blend, depending on things such as herd size, holding area and parlor size, calvings per week, distribution of lactation numbers for the weekly calvings, and season of the year.

Animal numbers in a pen/string need to be governed by feed/water bunk space and resting space. The rations that are formulated for the group will depend on the lactation number or age, body weight, days in milk, milk volume and composition and daily gain. Factors such as temperature in the pen need to be considered when formulating the diet. It is important to realize that the ration for a designated pen can change frequently depending on the composition of the pen.

The herd, contrary to popular belief, also has replacements and dry cows. Further, the replacements are not a homogeneous group but at least 6 groups with distinct differences in nutrient requirements. The dry cows, defined here as those animals that have gone through one lactation or more, have at least 2 groups and some would argue 3 or 4. If we think of the different groups of animals on the farm not as physical groups in the sense of pens or strings, but as physiological groups with unique nutrient, behavioral and management requirements, then we can better physically group the animals and formulate rations for them that will maximize performance, at high efficiency and at maximum returns. We need to first define the physiological groups on the farm and then provide some guidelines for the management of the groups so that we can better feed the herd. Below are defined the different physiological groups on the farm.

Please understand that physiological and physical groups do necessarily equate. You will, in all probability, have less groups. However you need to, for ration formulation purposes, adjust your rations to accommodate the differences in intake and requirements for the different groups physiological groups that you put together. The obvious one being putting springing heifers in with the dry cow groups. They have a growth requirement and eat less.

Ration Formulation

Most nutritional consultants today are using a least cost ration program. If you are buying supplements from a feed manufacturer they usually will be using a least cost program to formulate rations. There are a number of least cost programs available to producers that are good programs. There is only one maximum profit program that is available on the market. This is based on the original program developed at the University of California and is now available through Tri Logic.

I am most familiar with Spartan, a program developed at Michigan State University, and the University of Pennsylvania version of the Cornell Net Carbohydrate Amino Acid model, both of which have LPs in them. I will restrict my comments about formulation to those two programs.

I like to use a LP in the formulation of rations for farms. It forces me to be more logical. We need to ask many questions about the herd, groups of cattle, feed inventory, the environmental restrictions and the any labor restrictions that may be imposed (i.e. feeding another time each day). Kalter and

Table 1

Preweaned:
- 0-2 weeks
- 2 weeks to weaned

Weaned:
- weaned to 4 weeks post-weaned
- 4 weeks to puberty
- puberty to breeding
- breeding

Bred:
- early gestation
- mid-gestation

Late Gestation (heifers):
- 60-21 days pre-calving
- 21-0 days pre-calving

Late Gestation (1+ lactations):
- 60-14 days pre-calving
- 14-0 days pre-calving

Lactating:
- fresh (0-28 DIM)
- reproductive (28-100 DIM)
- mid (100-200 DIM)
- late (200 DIM to dry)
- first calf

Skidmore developed, with support from Elanco, a Expert System model called DAIRYPERT. This model was discussed in a Cornell Agricultural Economics publication in 1991. The model was to have been released by Elanco for use in the field in relation to the management of herds receiving bST. It never was released. I was disappointed because it represented a significant step forward in identifying problems on the farm. The model asked the producer many questions about the farm system. Much emphasis is placed on the physical facilities. Cow comfort and bunk space for feed and water are emphasized. If these are inadequate the program will warn the user of a problem. For example, if the feed bunk space is restricted to less than 2' per cow, it is warm, there is secondary fermentation in the forages, the facilities are poorly ventilated and the producer feeds once per day, there will be a warning given. The program will provide guidelines for change. The change could involve feeding management, change in ingredients (the Cornell model is built into the model to assess the interaction of the environment and the ration) fed and/or facilities. This is a systems approach to ration management. This is the approach that we need to take in the future. For now the LP allows me to make these type of decisions in an organized manner.

Will Hoover, West Virginia, has placed much emphasis on carbohydrate nutrition. This emphasis is correct. The dairy animal is a ruminant. We must formulate rations to maximize rumen function. This makes sense from an economic viewpoint and in terms of nutrient management. Hoover's group has developed a fermentable carbohydrate system. He has conducted research that demonstrates the value of highly fermentable fiber in feeds. He calls this the fill system. Rapidly digested fiber will reduce the fill effect of the fiber more quickly allowing the cow to eat more. This concept is supported by the work of Allen of Michigan State University who has determined that there can be large differences in the digestibility of fiber of different corn silage varieties.

The second component of the carbohydrate system is the non fiber carbohydrate(NFC). This is a calculated number that represents the sugars, starches VFA, pectins and glucans. The sugars and starches are the major components that have the greatest impact on rumen function. Hoover has developed a large data base on the sugar/starch content of feedstuffs. He has also measured the fermentability of the sugars/starches in the rumen. From this he has developed some preliminary recommendations for feeding the early lactation cow. He does not use the net energy system. He feels that the cattle will perform if we balance the carbohydrate and protein fractions. I would go one step further in the formulation. I think that many times because of feed inventory and environmental considerations we do not have the right combination of fermentable ingredients. We can include fat as a energy source. This is a good management tool.

I have been using Spartan to do routine balancing of these components. Spartan has a column for starch and fermentable starch. There are 4 columns

Table 2. Nutrient constraints

NUTRIENT	CONSTANT	MINIMUM	MAXIMUM
Dry Matter			
eNDF			
Fermentable Fiber			
Starch			
Fermentable Starch			
NEl			
Total Protein			
Soluble			
Degradable			
Undegradable			
Bypass Lysine			
Bypass Methionine			

that can be added and I have added fermentable fiber as one of them. In Tables 2 and 3 can be found examples of the approach used in formulating with an LP. In Table 2 we define the nutrient requirements with modifications for the environment that surrounds the group.

In Table 3 we can constrain the feeds as defined by feed inventory or quality constraints. Placing a price on the feed, either what it costs delivered or what it costs to produce it.

There have been many consultants who have adopted this concept on carbohydrates and proteins and I believe are well satisfied. There are many people now using the Net Carbohydrate model. The above concepts are in the model in a more sophisticated form. I have found that I can use the concepts that are in DAIRYPERT on environment and management analysis to help me set the minimum and maximums on starch and fiber fermentability to formulate rations that perform. We need much more work on this. At this point I would be working closely with your nutritionist to evaluate the rations for these carbohydrate and protein fractions.

Table 3. Feed constraints

FEED	CONSTANT	MINIMUM	MAXIMUM
Alfalfa hay			
Corn silage			
Barley			
Corn			
Soy 48			
Bypass Prot. Suppl			
Min/Vit			

The use of lipids in rations has now become an excellent management tool. For high producing herds it is recognized, given the variable environment that surrounds the cows and the variability of our forage quality (fiber digestibility being the major one) and grain quality, that we often need a high energy source that is consistent. Lipids provide that source of energy. We need to be careful in the type of lipids that we feed to dairy cows. Too much unsaturated fat from vegetable sources has a negative effect on rumen function. This is especially true if the cow eats a significant amount of the unsaturated fat at once. A mixture of saturated and unsaturated fats is best. If rumen bypass fats are being fed it is important to know the digestibility of the fat. It appears that some fats that are high in Stearic fatty acid have a lower digestibility in the small intestine.

Since the publication of the dairy NRC, formulating for protein fractions has become pretty well accepted. The major flaw in the system is still a lack of a good laboratory analysis system that is acceptable to everyone. In the Northeast we have been measuring protein solubility and acid detergent insoluble protein for many years. We feel that this gives us an estimate of the rapidly rumen degraded protein and the unavailable protein. We have been using the S. Griseus enzyme to measure degradability or measuring the protein insoluble in neutral detergent combined with rates of digestion to measure the bypass(Cornell Model). We need to reach agreement on methods. We have been reasonably satisfied with the above methods.

Ration formulation for the degradable and soluble protein is extremely important for all groups of animals on the farm. If these are balanced properly the carbohydrate fermentability will be enhanced. The work of Hoover and field experience strongly argues for providing part of the degradable protein from solvent extracted soy. This provides the peptides and rumen degradable amino acids needed to enhance starch and fiber digestion.

Once the rumen is optimized then it is necessary to provide a quality bypass protein. It is suggested that a combination of corn gluten meal, blood meal and a little fish meal makes an excellent supplement.

This will provide the right amount of methionine, lysine, isoleucine and possibly arginine needed for optimum production. Our recent research has emphasized the importance of amino acid nutrition for the dry cow and fresh cow. Research is suggesting that we need to pay attention to the protein quality for the replacement from birth through at least puberty. After this the replacement should be able to obtain enough amino acid from microbial flow to the small intestine.

Mineral and vitamin nutrition of the dairy animal can be the most important part of the nutrition program. It is often forgotten or we make sure that the Ca and P are adequate and do not look much further. In fact we need to constantly monitor the mineral and vitamin nutrition of the total herd. The requirements are significantly different among the different groups of dairy animals on the farm. We need to pay particular attention to the trace minerals and vitamins. It is easy to assume that the balances are correct but frequently the balances change with changes in the forages.

Water is frequently overlooked. The water needs to be moderate in its mineral content. Data would suggest that the pH of the water should be near 7.0. If the water is over 8.0 or below 6.0, there can be an intake problem. Bacterial contamination, especially coliform, should be minimal or non existent. The water should be free of organic matter contamination. This means that the water tanks need to be cleaned frequently. We use tip-type waterers that are on a pivot. These are very easy to dump and clean. Waterers are an excellent place for stray voltage. This needs to be checked carefully by someone skilled in the area. The available space for cattle to drink is a function of productivity level and environmental temperature. In too many barns there is inadequate "bunk" space for cows to drink. I saw at a farm in Alberta, Canada where there was a flowing water trough for each side of the parlor. I was in a parallel parlor in Japan where there was a water trough on the front of the stalls in the parlor. Both of these producers were very satisfied with the results.

Feeding Management

We can balance the most sophisticated rations in the world with the most sophisticated grouping system and the animals will not perform. How we feed what we have formulated is the difference between success and failure in making money form feeding your herd. You need to have some monitoring tools in place. Historically, the use of DHI has been a tremendous tool for management. Today it still is an excellent tool. However, due to herd size and the dollars involved we need more frequent measurements. The use of electronic milk measurement, cow ID and microcomputers have provided us with some excellent additional tools. In addition we need to use keen observation on dry matter intake amounts and change, body condition score and change, manure condition score and change, and change in milk volume and composition over the lactation. With this management information you will be able to make intelligent changes in rations and daily feeding strategies.

There are some additional measurements that might be helpful in the future. In Sweden and Finland they have been using milk urea and milk acetone as a routine management tool. The combination of these two measurements provide information on the cow's efficiency in the use of protein and energy status. The concept of measuring "signature" metabolites in milk is not new. We discussed this several years ago with people from Kodak. If unique metabolic products of metabolism can be identified in milk and measured cowside and/or through DHI, it can help in making management decisions. To date in addition to milk fat and protein we have available the potential of acetone, progesterone, urea, non protein nitrogen (urea is a part of) and citric acid. We do not know much about citric acid. This information is available when the milk ureas are run on the latest instrumentation from Foss Electric. Research needs to be done in his area.

We need to apply the principles discussed above to the whole herd. We need to start with the replacements. We need to plan on replacements calving at 21-23 months of age at 80-85% of mature frame size. This will result in a significant percentage of the first calf heifers peaking over 100 lbs. of milk if

they are Holsteins. This, in reality, becomes the most important part of your nutrition program in the herd. This will result in you also able to feed a higher proportion of forage to the total herd, which increase your profitability. In that you will be able to assess the quality of the animals in the first lactation you will be able to cull more intelligently on production. The late gestation animal or dry cow nutrition needs intensive management. All of the feeds need to be analyzed for these groups. You will need high quality bypass protein supplements and you will need to balance the minerals and vitamins carefully. The key is to make absolutely sure that what you are balancing for they are eating. Feeding hay on the side will not work. Chop it and incorporate it into the ration. We are also finding that we need to balance the ration protein for 13-15% C.P. with 25-28% of the protein being soluble for the close-up dry group. The first 4 weeks post partum is critical. The cows are not eating at capacity so there is a need for a high ration density with a carefully balanced carbohydrate mix.

Good feeding and environmental management is a must during this period. If the cows are sharp and aggressive after the first 4 weeks then the rest of the lactation will fall in place.

Summary

Feeding the high producing herd needs a total integrated approach. If you do not want to do this yourself then identify a nutritionist that is willing to look at the total picture. Have the nutritionist sit down with your veterinarian, crops specialist (If you are growing forages) and key herd people to discuss the total herd. nutrition program. Identify the weak links and prioritize the short term and long term goals for the herd. You will find that the return over feed costs will begin to improve.

notes