Using Feedstuff Inventory Management and Feeding Management Software on the Dairy: Concepts and Tasks

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Introduction

The intent of this paper is to introduce and discuss concepts and tasks which are involved in the processes of procurement and management of feedstuff inventory, and the preparation and presentation of rations in today's high producing dairy herds. The aforementioned processes can be, in many cases, managed more efficiently and effectively by utilization of available software and hardware tools. In this paper, I will discuss some of the concepts and tasks related to the acquisition and management of feedstuff inventory, and ration preparation and delivery, which need to be understood to effectively utilize software and hardware tools. I will also relate experiences with the tools and attempt to highlight areas where appearance might not reflect reality. This paper is divided into several sections, the first exploring some broad generalities and definitions, the second exploring acquisition and measurement of inventories, and the third exploring the processes involved with mixing and delivery. The final section of the paper will discuss on-farm experiences and the potential strengths and challenges inherent in utilizing these tools.

General Concepts

The expense of providing a balanced, healthy, safe, and high performance diet to today's dairy herd is one of the larger, if not the largest, single line item in the expense budget of a dairy. Feed related expenses are truly the "800 pound gorilla" in the cubicle where expenses live. The aforementioned is true whether the majority of feedstuffs are raised and harvested as part of an integrated operation, or whether the feedstuffs are largely purchased from outside the dairy operation. Effectively managing the feed expense to maximize the space between the cost of the ration and the revenue generated by the cow (milk sales) on a daily basis is a key component of operating a profitable dairy enterprise.

Integral to maximizing the return on the feed investment is the ability to deliver a consistent and high quality diet on a regular basis, and to effectively and efficiently manage inventory. The consistency and quality of the diet is dependent on both the consistency and nutritional quality of ingredients utilized in the diet, and the ability to reduce, as much as practical, variability in the mixing and delivery (presentation) process. Managing inventory, mixing, and feed delivery are processes which can be improved and monitored for quality control by utilizing software and hardware tools which are designed and integrated to automate data capture, make measurements with appropriate precision, and turn data into information (reporting).

Feedstuff Inventory Management

When considering inventory management and the individual tasks which could be involved, we need to ask ourselves what the goals are and

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what level of precision will achieve the goals. Some inventory items will be tracked at the ton level, others may require tracking at the pound level. We also need to consider how we want to utilize the information. Will the system be utilized just for farm accounting purposes, or will the system be required to support further uses, such as ordering, managing deliveries, tracking disappearance, and calculating losses due to shrink.

Common tasks associated with inventory management of feedstuffs are the ability to gather accurate weights of feedstuffs, and also the ability to gather reasonable measurement of dry matter **(DM)** content, particularly when working with wet forages and wet industrial co-products. The feedstuffs are measured, mixed, delivered, and consumed on an as-fed basis; however, the DM nutrient basis is frequently how cost will be measured and value determined.

The following examples are to demonstrate the magnitude of errors in either of these processes when working with wet feeds. The examples clearly demonstrate that to have good information, we need to have the ability for good data capture for weights and DM content, and we need to execute well.

Assumptions used in the following examples:

9,000	Tons of as fed forage
33%	Percent DM
$25.00	Price per ton as-fed
$75.76	Price per ton DM

Example 1: Scale error – as-fed tons of forage actually 8700, DM accurate

8,700	Tons of as-fed forage
33%	Percent DM
$25.86	Price per ton as-fed - Increase
$78.37	Price per ton DM

($2.61 increase in price per ton DM)
(99 tons short vs. calculated)
($7,500 more needed to purchase additional)
($0.02 per cow per day at 50 lb inclusion)

Example 2: Dry matter error – DM 1% lower, as-fed tons accurate

9,000	Tons of as-fed forage
32%	Percent DM
$25.00	Price per ton as-fed
$78.37	Price per ton DM

($4.89 increase in price per ton DM)
(99 tons short vs. calculated)
($7,500 more needed)
($0.02 per cow per day at 50 lb inclusion)

Example 3: Scales & Dry matter error – DM 1% lower, as-fed tons 8700

8700	Tons of as-fed forage
32%	Percent DM
$25.86	Price per ton as-fed - Increase
$81.07	Price per ton DM

($5.31 increase in price per ton DM)
(195 tons short vs. calculated)
($14,750 more needed)
($0.05 per cow per day at 50 lb inclusion)

The variability of the impact of inaccuracy, both in weight and DM content measurement, is clearly illustrated in Figure 1. The X axis of this graph represents percentage of DM of the feed. The Y axis represents total pounds of as-fed feed needed for one pound of DM.

The graph illustrates the curvilinear relationship between as-fed and DM as DM content of a feed change. At the left end of the graph, errors in DM measurement (and weight measurement) can result in significant error in estimation of total DM amount and can have significant diet effects. Towards the right end of the graph, errors in measurement of DM are much less significant to actual DM amounts. Moving towards the right end of the graph, accuracy of weight as-fed more closely approximates DM delivered.

The examples are to illustrate the significance of data veracity. Considerations beyond the measurement of weight and DM content also must include how the data is captured into the software. Automated capture of data eliminates the potential human error of reading and manual entry into a system. Other decisions involve such items as frequency of empty transport vehicle weights, etc. How these decisions are made and how the data are captured will all have an influence on the value of the information which will be retrieved from the system.

Feeding Management

The goal of feeding is to deliver the correct rations at the correct times to the correct locations. Because these tasks are ongoing and repetitive and rations change on a regular basis on many dairy farms due to ingredient/nutrient opportunities, reducing variation in the delivered ration is a challenge. Add to this situation the use of less than precise measuring instruments, and the challenge grows even larger. Software tools can be a useful assistant in managing these processes. Marriage of the software tools with correct hardware and communications capabilities to automate data capture and transfer can increase the value.

Many of the same considerations involved with inventory management are also important when discussing feeding management. Accuracy and precision of measurement, particularly of weights and DM content, are good examples. Other considerations include the equipment involved in the process, and the ability and motivation of the labor force involved. Equipment capability involves issues such as how consistently and evenly ingredients can be combined and delivered, what are the constraints on precision, and the complexicity of the process. "Keeping it Simple Studied" **(KISS)** remains king of the feeding pad. My own bias is that mixes should not exceed 3 or 4 ingredients.

The following examples in Figures 2 and 3 demonstrate some of the challenges involved in mixing and delivering rations, as well as challenges involved in making monitoring decisions. Ration nutrients are on the horizontal axis of the figures. The vertical axis represents deviation from target nutrient values, with 0 being the horizontal line which intersects the Y axis halfway from top to bottom. The nutrients represented are DM lb., as-fed **(AF)** lb., CP, NE_L, NDF, fat, ash, forage, cost, non-fiber carbohydrate (NFC), and NDF_forage. Figure 2 is representative of a situation in which the correct ration was mixed, DM was correct, and the correct number of cows were fed – the pen was fed at 100% of actual population. There is zero deviation in either direction for any nutrient.

Note in Figure 3 that the delivered nutrients are all 3% above target, with no deviations beyond that in individual nutrients at target DM intake. This would equate to feeding for 3% weigh back.

Figure 4 is the same as the previous, all ingredients added at correct weights, cow target is 3% over actual population, but the corn silage DM has changed unnoticed from 33 to 31%.

The dark bars in Figure 4 represent what happens to nutrient intake if the cow eats the 1.9% more (as fed) ration she should to meet her DM requirements.

Figure 5 is similar, but the DM have not changed, rather several weight errors occur during the preparation of the ration. The pen is still being fed at 103%, corn silage was long 3%, haylage was short 4%, grain mix was long 4%, and protein oil seed was short 10%.

Figure 6 combines all the potential errors we have discussed. The pen is fed at 97% instead of 103% because of innacuracies in pen population data. The same weight errors during preparation occur. And corn silage DM has changed 1% and haylage DM has changed 2%.

What is the likely picture we find at the bunk when read for the next feeding? And how do we interpret what we see? Has the forage DM decreased? Actually, it increased in the diet from 47.5 to 48.5%. If we increase the target number of cows the next feeding, and in the interim, the lost cows get returned to the correct pen, what happens?

Use on Dairy Farms – Consultant View

Available commercial systems for managing both feedstuff inventory and feed mixing and delivery on dairy farms have tremendous potential for use by the dairy consultant. The conceptual and example material in the first sections of this paper were to establish a framework for a discussion about using the systems in a dairy environment. Understanding what data we are perusing and how the data were acquired and manipulated is critical to effective use of these systems. I believe it is also critical that we understand and have realistic expectations for our ability to reach conclusions and establish causality with these data.

These software/hardware systems allow consultants and management to monitor the tasks involved in feed delivery. Reasonable knowledge of feed delivery and intake by pen is now easily available. With these numbers, we can progress through to reasonable estimates of ration performance and efficiency. Just have an awareness of how the data are collected, the accuracy and precision of the equipment involved, and how the reports are generated. All of the aforementioned factors will influence the reported numbers, some to a larger degree than others. We live in a world of 4 decimal places, and these are oftentimes not 4 decimal place situations. That being said, having an idea of what amount of what feeds are delivered when is incredibly valuable, perhaps even at the hundreds or tens level, depending on the pen or corral size. Also keep in mind the source of the denominator of the items reported. It may or may not bear any relation to reality. Pen populations come to mind, particularly in high movement pens, such as pre-fresh and post-fresh pens.

Monitoring of the task of physically mixing rations, from ingredient weights, mixing times, and delivery times, is another key piece of controlling and reducing variability in the world of the dairy cow. Most dairy farms that I visit which are using feeding software regularly review these data. Deviation report use is a good example. Reviewing actual composition of mixes created on the dairy for inclusion in diets is another example.

Managing ingredient inventories, planning purchases and shipments, managing forage inventories and calculating shrink are tasks which are also possible, but do not seem to be utilized as frequently. With the advent of the ability to automate the process of vehicle identification and weights upon ingress and egress from a dairy, I think these uses will rapidly gain wider acceptance.

In closing, I want to extend an acknowledgement and thank you to Dr. Steve Stewart for his valuable assistance in preparing this presentation.

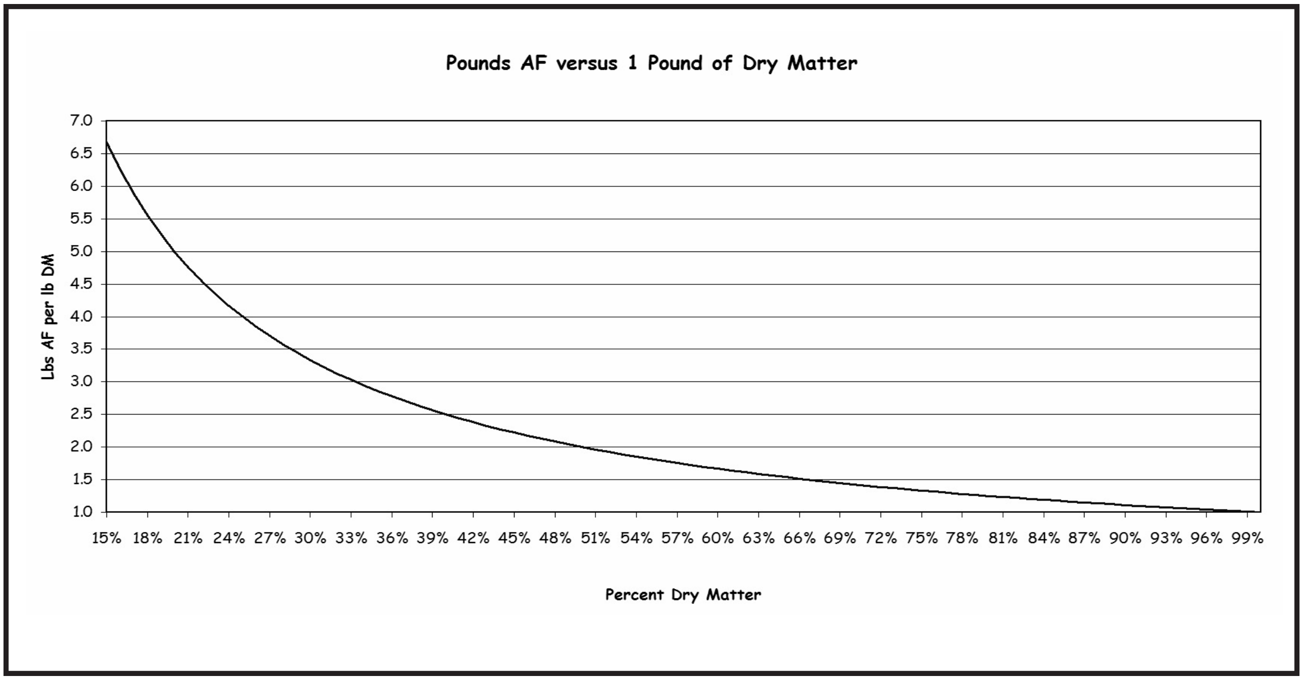

Figure 1. Pounds as-fed (AF) versus 1 lb of DM.

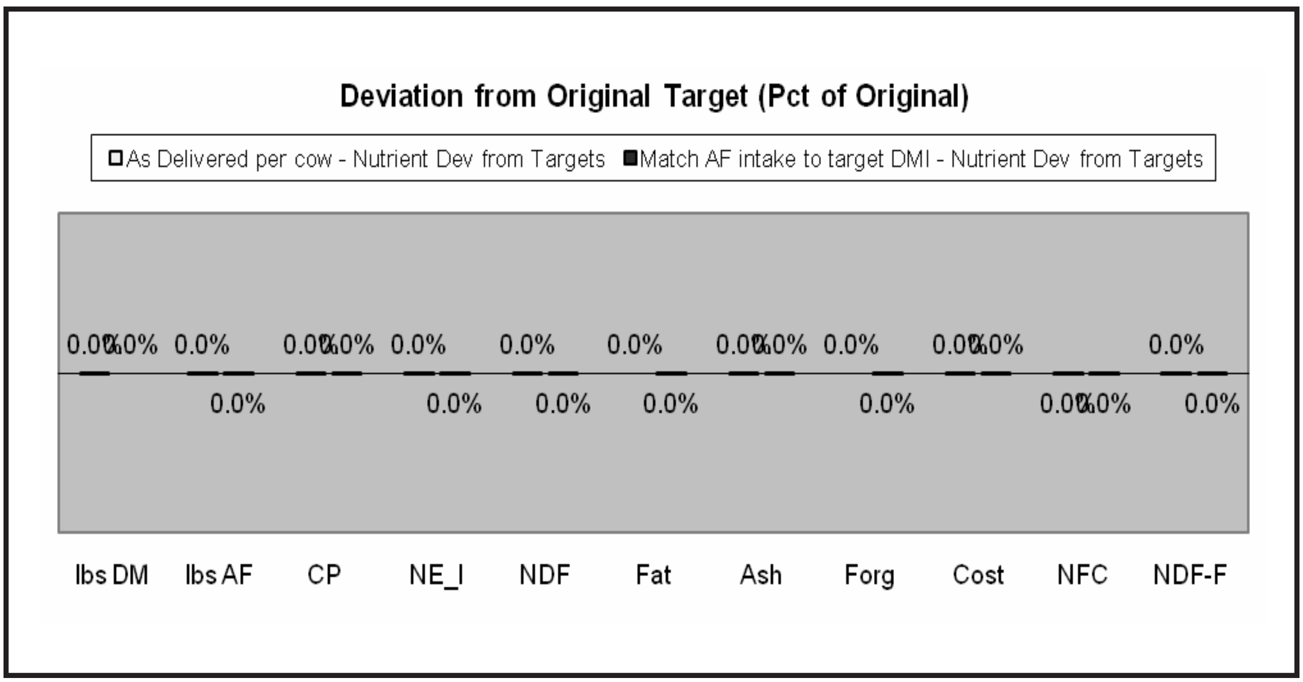

Figure 2. Deviations from original target in which DM was correct and the pen was fed at 100% of actual population (DM = dry matter, AF = as-fed, CP = crude protein, NE_l = net energy for lactation, NDF = neutral detergent fiber, Forg = forage, NFC = non-fiber carbohydrates, and NDF-F = NDF from forage).

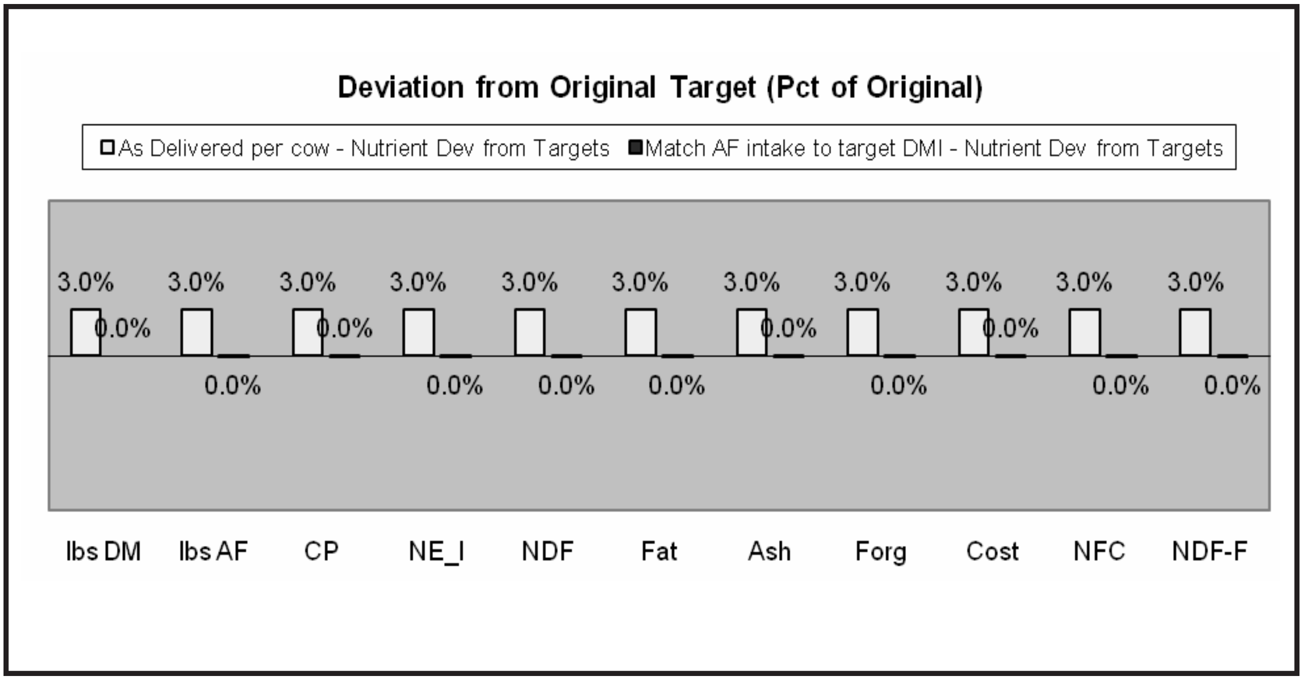

Figure 3. Deviations from original target in which the DM was correct and the pen was fed at 103% of actual population (DM = dry matter, AF = as-fed, CP = crude protein, NE_l = net energy for lactation, NDF = neutral detergent fiber, Forg = forage, NFC = non-fiber carbohydrates, and NDF-F = NDF from forage).

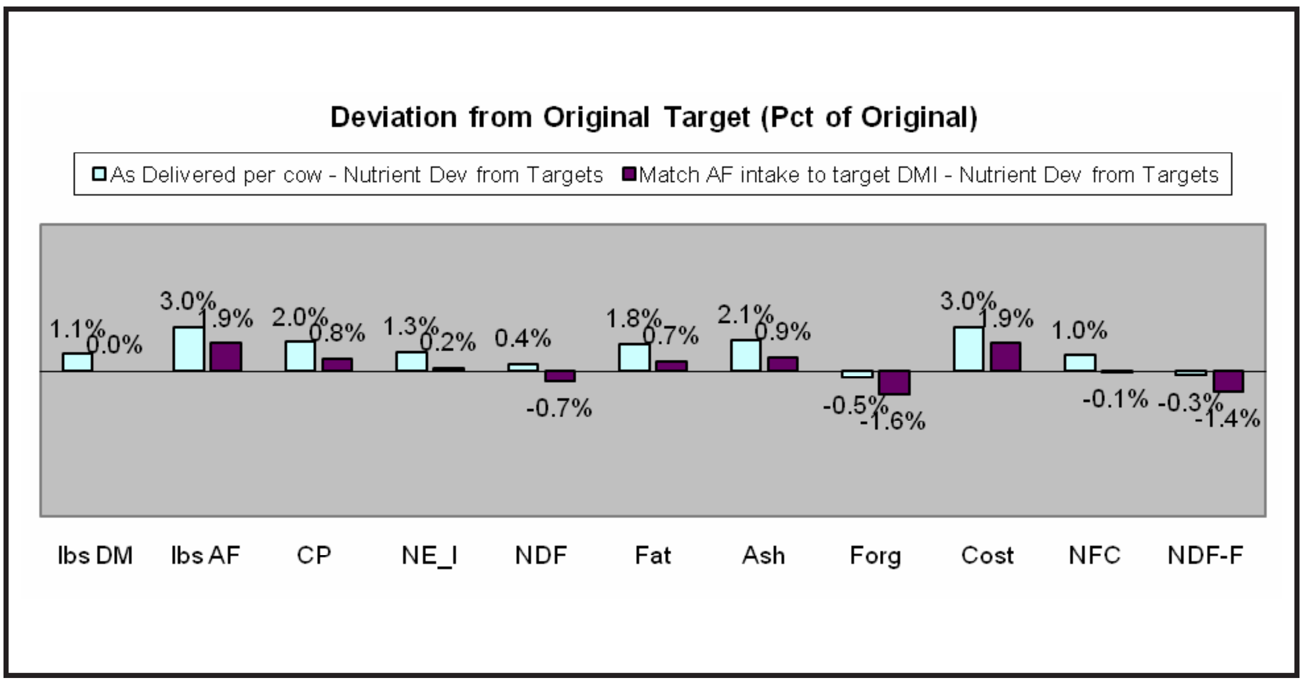

Figure 4. Deviations from original target with correct weights, cow target 3% over target population, and corn silage DM changed unnoticed from 33 to 31% (DM = dry matter, AF = as-fed, CP = crude protein, NE_l = net energy for lactation, NDF = neutral detergent fiber, Forg = forage, NFC = non-fiber carbohydrates, and NDF-F = NDF from forage).

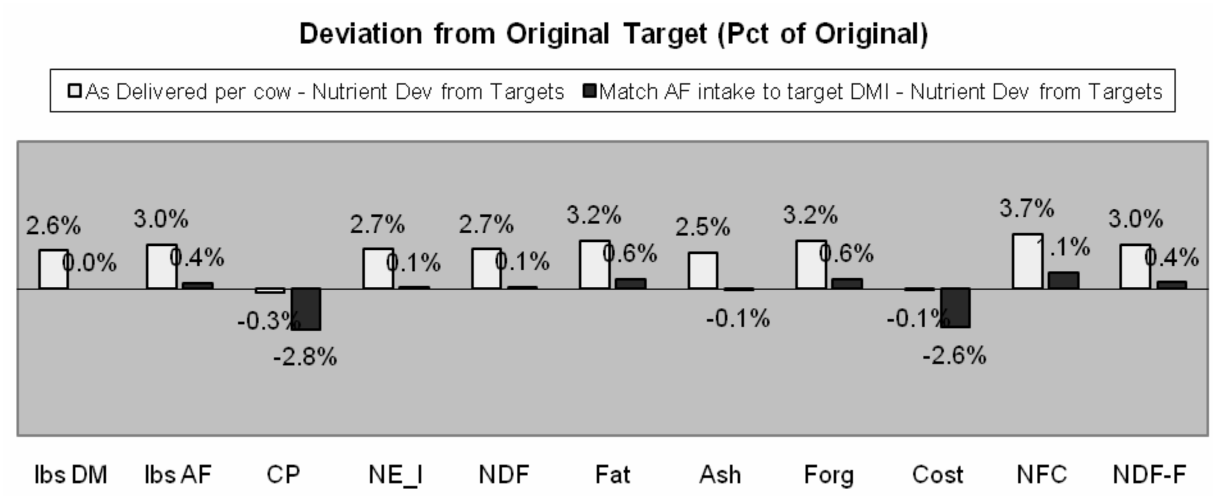

Figure 5. Deviations from original target with the pen being fed at 103%, corn silage overage at 3%, haylage short 4%, grain mix average at 4%, and protein oil seed short at 10% (DM = dry matter, AF = as-fed, CP = crude protein, NE_l = net energy for lactation, NDF = neutral detergent fiber, Forg = forage, NFC = non-fiber carbohydrates, and NDF-F = NDF from forage).

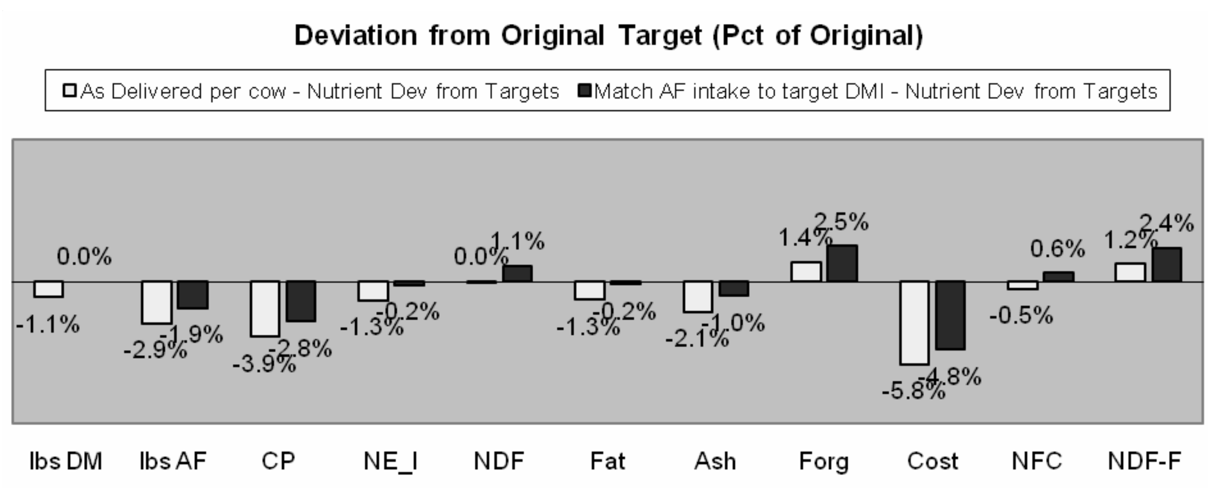

Figure 6. Deviations from original target with the pen fed at 97 intead of 103%, corn silage DM has changed 1%, and haylage DM has changed 2% (DM = dry matter, AF = as-fed, CP = crude protein, NE_l = net energy for lactation, NDF = neutral detergent fiber, Forg = forage, NFC = non-fiber carbohydrates, and NDF-F = NDF from forage).