Is Shrink Robbing Your Operation of Profits?

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INTRODUCTION

Shrink can be one of the top expenses on a dairy operation. This expense often goes unnoticed because operations do not have systems and protocols in place to measure or monitor shrink. Dairies today need to closely monitor every aspect of their operation in order to maintain a profitable business.

Some losses are typically considered as a cost of doing business. Frequently, what starts out as being an abnormal occurrence becomes commonplace and is easily overlooked. This seems to be a common occurrence on farms without shrink management. However, this cost of doing business can result in extreme losses for the farm. For example, for a farm with a herd size of 1000 cows, where feed cost is $7.00/ cow/d and shrink is 8 %, the total yearly cost of shrink for the herd is $204,400 or $25,550 for every 1 % shrink. This degree of loss can greatly impact profitability.

Producers go to great lengths to purchase ingredients at the best price possible in order to save money. However, when ingredients arrive on the farm and go unmanaged, the losses due to shrink are far greater than the initial savings when inputs are purchased. Table 1 illustrates the cost of shrink on different ingredients and increasing shrink levels. In order to truly be profitable, both a lower purchase price of ingredients and a decrease in shrink loss are required to help the operation maximize profitability.

WHAT IS SHRINK?

Shrink can be defined as the loss of resources that never have the potential for economic return. It is believed that shrink only occurs in feed ingredients. However, this is not the case. Shrink can occur in

Table 1. The cost per ton of feed ingredients when shrink occurs compared to the current cost of feed ingredients.[1,2]

Ingredient[3]	Current	1%	5%	7%	9%	11%	13%
SBM 48 %	$482	$486.82	$506.10	$515.74	$525.38	$535.02	$544.66
Ground corn	$195	$196.95	$204.75	$208.65	$212.55	$216.45	$220.35
DDG	$255	$257.55	$267.75	$272.85	$277.95	$283.05	$288.15
WCS	$299	$301.99	$313.95	$319.93	$325.91	$331.89	$337.87
Citrus	$280	$282.80	$294.00	$299.60	$305.20	$310.80	$316.40
SH	$234	$236.34	$245.70	$250.38	$255.06	$259.74	$264.42

[1]Current price of feed ingredients with no shrink included (Current) and price of feed ingredients with 1, 5, 7, 9, 11, or 13 % shrink included.
[2]SBM 48 % = Soybean meal at 48 % crude protein; DDG = dried distillers grains; WCS = whole cottonseed; Citrus = Citrus Pulp; SH = Soyhulls

many areas of the dairy operation. Some resources where shrink can be prevalent are:

1. Ingredients
2. Labor
3. Time
4. Accuracy

Because shrink occurs in these resource areas, optimum economic return may never be realized for the inputs that have been purchased. The areas of economic return loss can be as follows:

1. Ingredient disappearance
2. Quality loss/ingredient integrity
3. Formulation errors
4. Contamination of ingredients
5. Ration consistency
6. Use of labor/time efficiently
7. Loading accuracy

Shrink does not only occur on items that are *visible* (i.e. feed ingredient losses from spillage from loader buckets or loose silage at the bunker face). The most costly part of shrink is often *invisible*. Some examples of invisible shrink include: loading errors (adding too much of an ingredient into the mixer) and errors in ration formulation. Some operations are better at managing the visual shrink, while other operations do a better job of managing the invisible shrink. Managing both types of shrink helps improve profitability.

MAIN AREAS WHERE SHRINK OCCURS

There are four main areas on dairy operations where shrink can occur. These areas include:

1. Forage
2. Feed center
3. Loading and mixing
4. Barns and delivery

Table 2 shows the commonly observed shrink values on dairy operations that Diamond V works closely with managing their feeding operation. There is a wide variation in shrink values on these dairy operations. Some of these farms do a really good job of managing shrink compared to others. However, all of these farms still have room for improvement.

Table 2. Common observed shrink values on dairy operations (Greene, 2013).[1,2]

Ingredient	Range, %		
Corn silage	9	-	16
Haylage	12	-	18
Flat storage dry ingredients	2.5	-	11
Bulky dry ingredients (whole cottonseed)	3.5	-	13
Upright/overhead storage	1.5	-	7
Wet by-products	12	-	20
Average observed (all ingredients)	*8*	-	*10*

[1]Shrink loss for each ingredient was observed on 16 dairy farms.
[2]Values were collected over the course of a year on farms by D. Greene.

Forage

As Table 2 illustrates, forage, such as corn silage and haylage, is commonly the largest area of shrink on most operations. Many people only think about shrink occurring during storage and use of forage on farm. However, shrink can also occur in the field before harvest and during harvest. The remainder of this section describes how and when shrink occurs before, during, and after harvest of forage for silage or haylage.

In the Field before Harvest

Planting and maintaining a crop requires resources. Resources are spent on seed, time, and labor for planting and maintaining the crop (water, fertilizer, weed control, etc.). When maximum yields of the crop are not harvested, optimum return on the initial investment will not be realized.

There are multiple opportunities for shrink to occur in the field before the crop can be harvested. Some of these areas include:

1. Improper fertilization of the forage
2. Inadequate weed control
3. Inadequate germination
4. Insect damage
5. Animal or bird damage
6. Harvesting at the wrong stage of maturity
7. Weather damage

Applying fertilizer to crops and managing weeds are two important areas for maximizing crop yield. If fertilizer was not applied at the proper ratios of nutrients or at the correct time, the quality of the crop and the amount of crop produced will be lower than expected. Weeds can also diminish crop yield because weeds will utilize nutrients in the soil that would typically be used by the crop. These two areas result in shrink because they have the potential to decrease crop yield.

Inadequate germination of the seeds can also decrease crop yield. Many factors can reduce germination of the crop such as seed quality, soil quality, and moisture availability. If this occurs, it is considered shrink. Insects can cause a reduction in quality and quantity of the crop as well. It is very common for birds and animals to have a negative effect on crop yields by damaging or destroying the crop before it can be harvested. This seems to be more prevalent when the crop is almost ready to harvest because the grain content is mature. Birds can actually prevent adequate pollination and can damage the grain of the crop. Animals such as wild hogs can completely destroy acres of crops preventing anything from being harvested by knocking over the crop and eating the mature grain.

If the crop is not harvested at the proper stage of maturity, there are opportunities for loss. Harvesting a crop too soon can decrease yield by not allowing the full potential of the grain to mature and reach its nutrient potential for the animal being fed. Harvesting a crop too late can affect yield because the plant may fall over and not be picked up by the harvester. Also, harvesting a crop too wet or too dry can affect yield. Harvesting a crop at too high a moisture level can cause run-off at the storage site, which is shrink. Harvesting a crop at too low a moisture level, can result in brittle forage. The plant material can break apart and be lost by being left behind in the field or being carried off by the wind.

Weather can also result in loss of crop output. Lack of moisture can result in shrink, because adequate moisture levels are needed to reach maximum yield of the forage. Storms can result in damage to the

crop with more potential for damage when crops are closer to maturity. Heavy rains, wind, and hail can result in reduction of crops because the plant becomes damaged or falls off and cannot be harvested. For example, some corn varieties have less resistance to wind or lower standability. These factors should be considered in a management plan if the area in which the crop is being grown is susceptible to these challenges.

During Harvest

Shrink can also occur during the harvesting process. Areas where shrink can occur during harvest are:

1. Over-filling or missing the trucks when loading the crop into the trucks.
2. Harvester knocking down crop before it can be harvested.
3. Spilling forage from the trucks during travel to the storage facility.
4. Chopping the forage at the wrong length.
5. Harvesting the forage at excessive moisture levels.
6. Processing the forage inadequately.

Over-filling and missing the trucks when loading the crop, spillage from trucks during travel to the storage facility, and the harvester knocking down the crop before it can be harvested are all common occurrences on many operations. These are commonly seen as normal occurrences during harvest of crops. However, any forage that is not loaded into the trucks and that does not make it to the storage facility is a loss of potential revenue, whether the crop is being sold to another farm or feed mill or being used on the farm (i.e. less feed for cows to produce milk).

If the forage is not chopped at the proper length, there is an increased opportunity for shrink as well. For example, if the moisture level of the crop is drier than expected, the chop length may need to be shortened. This is necessary to help the forage pack better to prevent heating and loss.

Harvesting at the correct moisture level is key, especially for silage and haylage. If the crop is harvested at too high a moisture content, there will be a considerable amount of *run-off*. Run-off is a term used to describe the water and nutrient loss from forages (i.e. water draining from a silage pit). This loss of water and nutrients is considered shrink; because the overall volume of the forage is decreased, along with a potential decrease in quality (i.e. nutrient loss). This can also cause complications in nutrient containment and disposal.

One of the more important considerations when harvesting a crop is processing of the crop during/after harvest. It is very important to make sure the processor is at the correct setting. All too commonly corn silage that contains whole unblemished kernels is seen. Whole kernels are more difficult for the cow to digest and are often passed through the cow and found whole in the manure. Undigested corn results in a loss of energy for the cow and could result in a decrease in milk yield.

Storage

The storage area for forage is the most common area where shrink occurs. Proper management of feed storage can allow the dairy operation to reap the benefits of growing and harvesting a good crop. Every task has to be done properly to assure that shrink is minimized. However, problems that seem minor are often overlooked or are done incorrectly and can result in shrink. The more prevalent areas for shrink to occur during storage are as follows:

1. Poor or uneven foundation pads for piles, bags, or trenches.
2. Forage is not packed well.
3. Piles or trenches are not covered properly.
4. Holes in bags or covers are not repaired quickly.
5. The feeder does not deface the silage/haylage smoothly.
6. Silage is not pre-blended before loading.
7. Spillage and loose silage is not cleaned up regularly.
8. Covers on piles and trenches are not strategically cut back at feed out.
9. Sampling errors occur when monitoring dry matter.
10. Dry matter is not adjusted when heavy rains occur.
11. Not enough silage is removed from the face of the silage pit or the top of the tower silo.

Preparation for storage should be completed prior to harvest. Often, the foundation pads for piles, trenches, and bags are uneven and rough; which promotes waste because the storage area cannot be properly maintained. If the pad is smooth, it is easier to clean the spillage as the forage is fed. The storage area has to be smooth and even to allow for shrink to be managed efficiently.

Silage and haylage have to be packed well in order for proper fermentation of the silage/haylage. Often during harvest, forage is harvested quicker than it can be adequately packed into the trench or bag. Inadequate packing of the forage will result in lower quality forage because the forage will not ferment properly.

Once the forage is harvested and packed, the forage has to be covered immediately. This will prevent rain or oxygen from entering the pit and prevent spoilage from occurring. Preventing oxygen from entering the pit will also provide a proper environment for fermentation of the forage and result in better quality forage.

Holes in the covers or in bags must be repaired as soon as possible to prevent oxygen from entering and allowing the start of heating and deterioration of the crop.

Shrink can occur if the pile or trench is not defaced smoothly. If the pile or trench is not defaced smoothly, this will allow for more surface area to be exposed, which results in heating of the forage and energy loss. It is a good practice to deface the forage with either a mechanical or rake type defacer as these defacers are designed to create a smooth surface. Also, when a defacing machine is used, pressure is applied in a downward motion and keeps the integrity of the packing in place. Defacing with the bucket of a loader is usually done in an upward manner and loosens the silage. This allows areas where oxygen can enter the pile and results in heating of the forage.

Once the forage has been defaced, it should be pre-blended into a central pile to create a more consistent silage to prevent variation in the total mixed ration (**TMR**). If variation occurs, refusals may be more than expected. Feed refusals, in that situation, have the opportunity to be considered shrink.

Pits and trenches are typically covered with plastic to prevent spoilage, as mentioned previously. It is ideal to remove only the plastic covering over the silage that will be used in a day. This will maintain the integrity of the remaining silage and minimize spoilage. However, on large operations, this can be difficult. It is common to remove plastic every other day

to prevent having to do this task daily; but this creates the challenge of keeping the dry matter consistent and allows heating to start to occur.

When feeding silage or haylage, the correct dry matter content must be determined. Frequently, the silage is not sampled properly. This results in the wrong dry matter values being used to formulate the ration. If this number is not precise, it can cause the ration nutrient analysis to be inaccurate or the total pounds of TMR on an as-fed basis to be wrong. Feed refusals can increase as a result. This is very common when rainfall occurs and dry matter content is not adjusted accordingly. An efficient way to monitor dry matter content of forage is using a food dehydrator to dry all forages overnight. Once, dry, the proper dry matter content can be recorded and rations can be adjusted accurately every day.

It is very important that enough forage is removed from the face (bag, trench, or pile) or the top (tower) of the silage each day to prevent dry matter loss. The average dry matter loss for different storage systems according to the amount of forage removed from the face of the pit or trench is in Table 3. In a bunker, bag, or tower system, dry matter loss can be greatly reduced by removing more silage and maintaining a smooth face.

Feed Center

Feed center design, layout, and maintenance is critical in helping employees minimize shrink. If the design of the feed center is not conducive to efficient movements and smooth travel, shrink is a challenge to keep under control. Also, if the feed center is not well maintained, shrink can be hard to manage. It is common for holes and rough areas to develop in the concrete where the loader travels. When the loader travels over these holes and rough areas, spills will occur. Time can also be wasted because the loader may travel slower over these areas to minimize spills. In this situation, spillage and wasted time are both considered shrink.

Here are several factors to consider when designing a feed center.

1. Travel distances for the loader should be minimized. This can be accomplished by centrally locating the mixer in the loading area.
2. Lower inclusion, higher priced ingredients should be kept in storage bins.
3. It is ideal to have the feed center totally enclosed.
4. The use of a micro-blender can minimize bags or hand added ingredients.
5. The highest volume ingredients need to be placed closest to the mixer.

Table 3. Percent dry matter (DM) loss by silage storage system (Clark, 2008).

Silage storage system	DM loss, %
Bunker/silage bag (less than 5”/d)	11
Bunker/silage bag (more than 5”/d)	5
Tower silo (haylage)	11
Tower silo (corn silage, whole plant)	4

6. Bin/bunk space must be allowed for ingredient rotation. Older ingredients should be used before new ingredients (first in, first out).
7. Sharp or long sweeping turns should be minimized to prevent spills.
8. Travel and loading areas must be level.
9. The operation should be prepared to handle unloading capabilities of all delivery types.
10. All ingredients should be added without moving the mixer.
11. Be sure dividers in bays prevent cross contamination of ingredients.
12. Design to minimize animal, rodent, and bird challenges
13. Bag or hand-add areas need to be big enough to maneuver large loaders to prevent damage.
14. Proper liquid application is important to assure a quality mix.
15. Label the bays with measurements, so ingredient inventories can be estimated.

Enclosing the feed center can help minimize shrink by protecting the feed ingredients from wind, rain, snow, and other weather related issues as well as animals and birds. Some lighter weight, bulkier ingredients can blow away in the wind. If the feed center cannot be enclosed, the loading area should be under a roof that has at least two sides to reduce the wind blowing the feed ingredients out of the loader or mixer during loading. Examples of amounts of loss that can occur with varying types of feed centers are in Table 4. Observed shrink levels for feed centers that are under a roof or in enclosed areas or bins are 2.5 to 3 % less than open feed centers. It is critical to get as many feed ingredients as possible under a roof or in a bin out of the weather to minimize loss to the elements.

Another big issue with open feed centers is the amount of ingredients that wildlife can consume (Table 5). Deer and raccoons can consume a larger amount of feed per animal. However, birds can consume a larger amount of total feed because thousands of birds may be in the feed center at one time. A flock of birds can consume a very significant amount of feed, especially if it is a daily occurrence. Based on data presented in Table 5, 1000 starlings can consume up to 60 lb of feed/d. Also, birds, animals, and rodents can transmit

Table 4. Percent loss of different ingredients based on type of storage facility (Kertz, 1998).

Ingredient	Uncovered Open Piles, %	Covered 3-Sided Bay, %	Closed Bin, %
Whole cottonseed	10 – 20	5 – 15	--
Dry meal	5 – 10	3 – 8	2 – 4
Soybean hulls	12 – 20	5 – 10	2 – 5
Dry distillers	15 – 22	7 – 10	3 – 5
Wet distillers	15 – 40	15 – 40	--

Table 5. Wildlife grain consumption (Jaderborg and DiCostanzo, 2012).

Wildlife type	As fed, lb/d
Norway rat	0.06
Deer	0.50
Raccoons	0.41
Pigeon	0.06
Starlings	0.06
Redwing blackbird	0.02

disease; which can be another reason to minimize their presence in the feed center.

A common issue that is observed is contamination of ingredients at the feed center. Often times older operations that have outgrown their feed centers install temporary walls in their current feed bins to be able to store more ingredients. However, these walls are often not very stable or are not tall or long enough to prevent spills from bay-to-bay. In some instances, walls are not utilized and two ingredients are placed within the same bay. This will cause variation in the diet because the correct amount of each ingredient is not added to the ration and the diet may contain ingredients that were not formulated for that ration. This can lead to challenges for the management team as they strive to minimize refusals and attain production goals.

Bag or hand-add areas should be kept clean, neat, and rodent free. It is easy to have waste in these areas as bags can often be torn on these expensive items or can have holes caused by rodents. Spilled feed from these bags usually are a more expensive loss, as hand-add items are often some of the more expensive ingredients. Also, it is imperative that a properly working scale be utilized for measuring these ingredients. Many of these ingredients have to be fed at an exact amount or negative results can happen.

Liquids should be added to the TMR using an appropriate application system. A single pipe is not the best way to add liquids to the mixer; as this could result in a considerable amount of variation in the TMR. A liquid dispersion bar applies the liquid from multiple holes in a pipe that is two-thirds the length of the mixer and is the best way to achieve proper mixing. If a vertical mixer is used, this allows the liquid to be applied over each screw. For a horizontal mixer, this length allows the liquid to be distributed evenly over a larger area to ensure proper mixing.

In order to estimate inventory of ingredients, the walls of the feed center bays should be labeled with measurements. This is not completely accurate, but allows the operation to compare these amounts with the computer inventory to determine how much of each feed ingredient is remaining. This will also ensure that the feeders keep the bays in neat order so the measurements can be taken. Figure 1 explains how to calculate the estimated inventory in the ingredient bays. By having the feeders measure the ingredients on a regular basis, it helps keep the feeders attentive to the value of ingredients and the cost that is associated with the shrink that commonly occurs.

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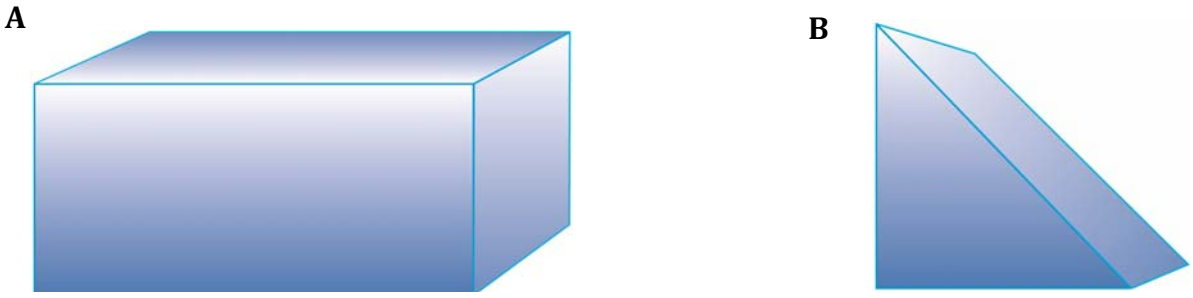
Figure 1. Method to calculate the amount of ingredients in the feed ingredient bay.



(A) Cubic ft = L x W x H

(B) Cubic ft = ½ x L x W x H

Once the cubic ft volume has been determined use the following equation to calculate total weight of the ingredient inventory of that bay.
A + B x (weight of ingredient/cubic ft) = total ingredient inventory

Example: Ingredient - Dried Distillers Grains (18 lb/ ft^3)
Ingredient in the commodity bay: (A) 32 x 18 x 10 = 5760 ft^3
(B) ½ x 12 x 18 x 10 = 1080 ft^3
5760 + 1080 = 6840 ft^3
6840 x 18 = 123,120 lb or 61.56 t of DDG

Loading and Mixing

During, loading and mixing of feed ingredients, correct operational procedures must be followed; as there is a large potential for loss of feed ingredients here. The feeder should constantly monitor what he is doing in order to try to minimize shrink. There are several things that have to be managed when trying to minimize shrink in the loading and mixing area.

1. Loader buckets should not be over filled to minimize spillage.
2. Loading weight deviations must be kept to a minimum.
3. Scales need to be checked and calibrated on a regular basis.
4. The size of each batch of TMR is important. Loads that are too small do not mix well. Loads that are too big cause feed to spill out of the top of the mixer during mixing of ingredients or will lack uniformity.
5. Numerous small batches of TMR are a bigger risk for shrink, because the number of loader buckets of ingredients added to the mixer is increased. This leads to more opportunities to spill feed from the loader.
6. Numerous ingredients that require small inclusion rates increase the chance of weighing and mixing errors.
7. The feeder must travel at slower speed to prevent spills from the bucket.
8. The mixer must be empty after each load before a new batch of feed is mixed.
9. Pen head counts must be communicated so the correct delivery amounts are provided to each pen.

Communication is a big part of making the loading and mixing area more efficient. The size of each batch of TMR has to be communicated to the nutritionists and feed department manager that is entering the information into the feeding software or calculating the amount of feed to provide to each pen on feeding sheets. The correct number of cows needs to be recorded for each pen to ensure that the correct amount of feed is provided to each pen. If this is not communicated to the nutritionist or feed department manager, too little or too much feed could be provided to each pen. Also appropriate batch sizes for mixers should be determined. Batch sizes that are too small will not mix well in certain types of mixers causing variation in the TMR. If a feeding software program is used, minimum and maximum load size can be entered for every mixer. This will ensure that proper mixing of the TMR takes place.

Shrink is increased every time an ingredient is added to the mixer. It is more efficient if all small inclusion ingredients are included in a premix. The feeder will only have one ingredient, the premix, to add to the mixer when mixing the TMR. This will minimize loss and minimize shrink.

Variation in rations can result in shrink. Ration inconsistency causes intakes to vary and production to be lower than expected. Reduced production can be seen as shrink because of the time and labor spent to achieve higher production levels. Also, ration inconsistency can lead to higher feed refusals, which can also be considered shrink. One of the most common causes of ration inconsistency is worn mixing equipment. Worn mixer augers and knives can decrease the ability of the mixer to mix the ingredients thoroughly and to chop hay, for example, to the correct length. Often as mixers are worn they do not empty out well. This can cause feed delivery issues, ration inconsistency, and contamination of subsequent diets. The feeder has to be certain the mixer is empty before loading the next load, which increases feeding time. The equipment, especially the mixers, has to be kept on a regular maintenance schedule to prevent inconsistencies and major breakdowns. It is a good practice to have the feeders look inside the mixer at least one time per day to monitor for visual problems or foreign objects that may have gotten inside.

Delivery and Barns

This is a critical area to manage. Issues with feed delivery and management of feed in the barn can be costly. Several things can take place while delivering the TMR or in the barn that can cause increased shrink.

1. TMR can be thrown in the cow alley instead of in the feed bunk area.
2. Cows can throw the feed out of reach or into the cow alley.
3. Bunks are not read properly for feed refusals to allow correct amounts to be delivered to each pen.
4. Pen delivery amounts are not correct.
5. Feed is not pushed up closer to the cows regularly.
6. Feed refusals are wasted instead of being fed to another group of cows (if possible).
7. Drive through alleys are not smooth and cannot be cleaned thoroughly.
8. Delivery of the feed is not evenly distributed from end-to-end in the bunk.
9. Birds, rodents, and animals can be a major cause of shrink in the barn.

The feeder has to be aware of each of these challenges so they can be managed. If the TMR is being thrown in the cow alley, the feeder should move further away from

the bunk edge or a deflector should be added to the discharge of the mixer to prevent this from occurring. The feeder also needs to better manage the refusals by keeping them separated and out of the drive lanes to prevent contamination or wasting after they have been pushed to the end of the bunk or barn.

One major area that needs constant attention is the pushing up of the TMR in the bunk closer to the cows. If the TMR is pushed up regularly, this can minimize ration inconsistency and sorting while increasing intake. The TMR should be pushed at least every 2 hr and just before delivery of new feed. This will allow the cows to have better access to the feed and to prevent the mixer wagon from running over the TMR. This will also prevent changes in dry matter of the feed that has not been pushed up. The ridge of feed that is left by the cow will decrease in moisture if the new TMR is delivered. This can cause increased feed refusals. It is preferable to roll the feed rather than just pushing it up closer to the cows. This will reblend the TMR and prevent additional sorting.

CONCLUSIONS

There are many areas on an operation where shrink can occur. The four main areas are with forage (before, during and after harvest), in the feed center, during loading and mixing of the TMR, and in the barn during and after feed delivery. Determining where shrink is occurring on your operation is key in order to be able to manage it. A total shrink management program should be implemented so that the resources spent can express optimum return. Goals and written protocols need to be in place to minimize shrink. Everyone from the management team to the feeders needs to follow these protocols and be committed to reach the set goals. A checklist system is a good tool to help monitor and manage the four major areas of shrink.

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