Improving Beef Cattle Handling
for Increased Profitability and Safety

Improving beef cattle handling can increase your farm’s profitability and safety. Good beef cattle handling entails

- proper cattle handling practices (for example, knowing how to move cattle on the farm safely and efficiently and how to load and unload cattle from trailers)
- adequately designed cattle handling facilities (for example, properly arranged and constructed pens, alleys, and chutes).

There are many options that enable you to improve your cattle handling. The changes you make can be tailored to meet your needs, concerns, and resources. You can invest a lot of time and money or just a little. However, the bottom line will show that improvements you make can be a wise investment that produces benefits that far outweigh the costs.

This publication will show you how improving beef cattle handling can benefit your cattle operation, no matter how large or small it may be. It will also provide information about beef cattle psychology, handling methods, and facility design for small and large operations.

Benefits

This section discusses the following benefits that will make your cattle operation not only more profitable and safe, but more enjoyable through

- increased performance
- reduced shrinkage during transit
- reduced labor expenses
- improved safety
- better animal welfare and an enhanced public image.

Increased Performance

Beef cattle are less stressed when they are handled and managed properly, and animals that experience less stress perform better. For example, in a cow-calf operation, brood cows that are handled correctly have higher conception rates than cows that are not. Likewise, calves and yearlings that are properly handled are healthier, better able to resist infectious diseases, and gain more weight.

Cattle that are handled using proper handling practices and adequate handling facilities are also less likely to be injured. A poorly handled calf can receive a serious injury such as a broken leg or less severe injuries such as bruises and cuts that cause pain and discomfort and can reduce the animal’s feed intake.
Since bruising costs the cattle industry more than 22 million dollars each year, packers are beginning to bill back for bruising and scarring that reduce the quantity of marketable beef. As cattle ownership continues to become more reliably documented, it will become more common for packers or feedlot operators to take action directly against the farm of origin. Such action may include a request for a partial refund either for their losses or for the cost of purchasing their cattle elsewhere. Ultimately, farmers will pay the bill for poor cattle handling.

Improved handling and adequate handling facilities enable you to have an effective herd health program and in return increase your farm's profitability. The lack of proper facilities makes it difficult, if not impossible, to administer dewormer implants, or insecticidal ear tags, for example. Often producers who do not invest even a little time and money toward improving their handling facilities do not fully understand the benefits of doing so. With this in mind, we will show how adequate facilities can benefit each of the following components of your herd health program: growth implants, internal and external parasite control, dehorning and castration, and vaccination.

**Growth Implants.** If you provide your calves with a growth implant, you can expect each animal to gain an extra .2 pound per day. Each implant costs about $1.00 and must be replaced every 100 days. Table 1 shows how using growth implants can increase your profit if you have a two-day-old calf that you are planning to sell at nine months of age.

<p>| Table 1. Sales Price for Calves Given Growth Implants Versus Those That Are Not |</p>
<table>
<thead>
<tr>
<th>Without a Growth Implant Program</th>
<th>With a Growth Implant Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>No additional investment is made.</td>
<td>The calf is given growth implants on day 2, 100, and 200. The implants cost $3.00, and the calf gains an extra 0.2 pound per day.</td>
</tr>
<tr>
<td></td>
<td>Now, calculate the weight of the calf at nine months.</td>
</tr>
<tr>
<td></td>
<td>500 + (280 days x 0.2 lb/day) = 556 lb</td>
</tr>
<tr>
<td>The calf weighs 500 lb and is sold for $0.70 per pound.</td>
<td>The calf weighs 556 pounds and is sold for $0.67 per pound. (Calves that weigh more generally sell for less per pound.)</td>
</tr>
<tr>
<td>Calculate the auction price as follows:</td>
<td>Calculate the auction price as follows:</td>
</tr>
<tr>
<td>500 lb x $0.70/lb = $350.00</td>
<td>556 x $0.67/lb = $372.50</td>
</tr>
<tr>
<td>No additional profit is realized.</td>
<td>Calculate the return on your growth implant program:</td>
</tr>
<tr>
<td></td>
<td>$372.50 - $350.00 - $3.00 = $19.50</td>
</tr>
</tbody>
</table>
**Internal and External Parasite Control.** The economic impact of internal and external parasitism is estimated by the USDA to be $2.5 billion annually in the United States. The cost of external parasites alone exceeds $80 million in the Southern Region of the United States (Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Kentucky, Mississippi, Louisiana, Arkansas, Oklahoma, and Texas) and studies show that internal parasites can cause losses of $20 to $200 per head per grazing season. Parasitism can result in one or more of the following:

- reduced weight gains
- anemia due to blood loss
- lower resistance to infectious diseases
- ruined hides
- transmission of beef cattle diseases
- irritated and stressed animals
- reduced milk production in brood cows
- reduced reproductive efficiency.

Looking at reduced weight gain specifically, studies conducted throughout the United States show that deworming cow-calf herds for internal parasites increases the weaning weights of calves by 30 to 60 pounds and that a return of $5.00 to $10.00 usually can be realized for each dollar spent to control external parasites.

Generally, parasite control costs from $1.00 to $7.00 per head and improves weaning weights from 5 to 15 percent. For example, assume that your parasite control program costs $3.00 per head and increases the weaning weights by 10 percent. At weaning, a calf that has not been part of your parasite control program would weigh approximately 500 pounds and fetch $0.70 per pound. Table 2 shows how to calculate your return on investment.

**Table 2. Sales Price for Calves Treated for Parasites Versus Those That Are Not**

<table>
<thead>
<tr>
<th>Without a Parasite Control Program</th>
<th>With a Parasite Control Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>No additional investment is made.</td>
<td>The calf is treated for parasites. The program costs $3.00, and the calf gains an extra 10% in weight over nine months.</td>
</tr>
<tr>
<td></td>
<td>Now, calculate the weight of the calf at nine months.</td>
</tr>
<tr>
<td></td>
<td>500 + (500 lb x 10%) = 550 lb</td>
</tr>
<tr>
<td>The calf weighs 500 lbs and is sold for $0.70 per pound.</td>
<td>The calf weighs 550 pounds and is sold for $0.67 per pound. (Calves that weigh more generally sell for less per pound.)</td>
</tr>
<tr>
<td>Calculate the auction price as follows:</td>
<td>Calculate the auction price as follows:</td>
</tr>
<tr>
<td>500 lb x $0.70/lb = $350.00</td>
<td>550 x $0.67/lb = $368.50</td>
</tr>
<tr>
<td>No additional profit is realized.</td>
<td>Calculate the return on your parasite control program:</td>
</tr>
<tr>
<td></td>
<td>$368.50 - $350.00 - $3.00 = $15.50</td>
</tr>
</tbody>
</table>
**Dehorning and Castration.** If you have the facilities to restrain your cattle properly, dehorning and castration are procedures that can be performed easily and safely and you will find your investment handsomely rewarded at the auction barn. Castrated and dehorned cattle can be sold at graded auctions where they command from 5 to 8 cents more per pound than a horned bull calf sold at a weekly auction; at weekly auctions, they sell for a premium over horned bulls on the same sale, especially if their weight is greater than 400 pounds. The premium is usually $2.00 to $8.00 per hundredweight.

**Vaccination.** A good vaccination program helps prevent many infectious diseases, including clostridial diseases such as blackleg, bovine viral diarrhea, infectious bovine rhinotracheitis, parainfluenza, and bovine respiratory syncytial virus. Preventing these diseases through immunization is far less costly than the death of one or more animals or the cost of treating these diseases. For those producers raising only a few cattle, the loss of one animal to a disease like clostridial infection can cost more than the total cost of vaccinating all the cattle the producer raises during a lifetime.

**Reduced Shrinkage**

Whether your cow-calf or stocker operation is large or small, it takes several months to raise the cattle for sale. Therefore, you want to maximize the rate of return on your investment. During transit from farm to market, cattle shrinkage is always going to occur. Because shrinkage can be 2 to 5 percent or more of live weight, the amount of shrinkage affects the money you will make.

Approximately two-thirds of shrinkage is due to water vapor loss from the lungs and one-third from urination and defecation. As a result, cattle that become excited and agitated and breath harder shrink more. You can reduce the amount of shrinkage by ensuring that, from time of loading at your farm to unloading at market, your cattle are handled gently and with as little excitement as possible.

Cattle that are accustomed to being around people and that have been handled properly in the past will shrink less during transit. While you may have little control over how your cattle are handled once they leave your farm, observe how the hauling company treats them during loading. If your animals are mistreated, consider finding another company to transport them in the future because a company that mistreats your animals ultimately will cost you money.

![Figure 2. Poor handling during transport increases shrinkage.](image)
Reduced Labor Expenses

Using proper handling practices is one way you can reduce your labor expenses. If you have hired help before, you know the difference between an experienced handler who works the cattle smoothly and efficiently and an inexperienced handler who is ineffective and often dangerous to the animals and himself or herself. Over time, the amount you save on labor expenses will pay for any time spent learning correct cattle handling practices and ensuring all your handlers abide by these practices.

In addition, if you have a small or medium-sized herd and a well-designed handling facility, you can perform most herd management operations without hiring any additional help. For example, one producer related his experience handling approximately 20 to 30 yearling calves each year. With his old facility, it required an hour and a half for him to apply a pour-on dewormer to 20 head of cattle with the help of one additional handler. After he improved the facility, he was able to administer the same pour-on dewormer to 17 head of cattle in 35 minutes without any assistance.

Less Aggravation and Stress

While reducing labor costs does not apply if you currently do not need to hire any workers, proper handling and improved handling facilities will reduce the stress and aggravation of handling cattle. Many producers probably do not implement important herd health practices because working their cattle is so taxing. Making even small facility improvements can go a long way in making your farm more profitable and reducing the stress involved with working your cattle.

For example, the farmer mentioned earlier claims his operation is not only more profitable, but he finds the job of raising cattle significantly more enjoyable. He is also able to observe his cattle more closely and identify and treat minor ailments before they become major problems.

Improved Safety

Injuries caused by beef cattle are a serious problem and contribute to agriculture’s ominous title as one of the most dangerous occupations in the United States. Surveys, such as those completed by the National Safety Council, show that farm animals are a close second to farm machinery in causing nonfatal injuries on farms (17 versus 18 percent). In 1988, interviews with farmers from Iowa, New York, South Carolina, and Washington revealed that 21 percent had been injured by a farm animal sometime during the year.

Both beef and dairy cattle are responsible for a large portion of these farm-related injuries. In North Dakota, for example, the State Department of Health set up a surveillance program to measure farm-related injuries. They found cattle were responsible for 61 percent of all injuries caused by farm animals. A study conducted by a large Wisconsin trauma center revealed that cattle caused 40 percent of all farm-animal-inflicted injuries that received treatment in their emergency room over a six-year period.
 Though injury data are not available for North Carolina and none of the studies compared injuries caused by dairy cattle with those caused by beef cattle, the fact remains that cattle can injure people of any age. Injuries can be relatively slight (for example, broken arms and legs, cuts and bruises) or severe (for example, broken backs and internal injuries such as damage to lungs, spleen, and kidneys). Some can result in lengthy hospitalization.

Severe injuries can also lead to permanent health problems. In Wisconsin, for example, one farmer who was severely injured by a bull needed to be maintained on mechanical ventilation in an intensive care unit for 15 days. One and a half years later, he still experienced trouble breathing and was unable to resume normal farm duties.

While cattle primarily cause nonfatal injuries, they can kill. Over a four-year period in Wisconsin, cattle were responsible for killing 25 people, and over a six-year period in Kentucky, cattle caused 4 percent of all farming deaths. To provide a better understanding of the types of injuries that occur and their causes, Table 3 lists 18 of the 57 cattle-inflicted injuries reported in North Dakota over a one-year period.

<table>
<thead>
<tr>
<th>Table 3. Some Serious Cattle-Inflicted Injuries Reported in North Dakota in a One-Year Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Broken back (knocked down by cow and squashed to the ground)</td>
</tr>
<tr>
<td>2. Arm broken in many places (bull attacked all-terrain vehicle and flipped it)</td>
</tr>
<tr>
<td>3. Severely bruised leg (kicked by cow)</td>
</tr>
<tr>
<td>4. Broken ribs (gate not closed tight and cow pushed it open and ran over person)</td>
</tr>
<tr>
<td>5. Sprained and bruised foot (steer charged person and stepped on his foot)</td>
</tr>
<tr>
<td>6. Broken nose (kicked by cow)</td>
</tr>
<tr>
<td>7. Separated shoulder (caught between two gates by a cow)</td>
</tr>
<tr>
<td>8. Broken leg (run over by a cow from behind when chasing cows out of a pen)</td>
</tr>
<tr>
<td>9. Concussion and injured face (twice kicked by cow)</td>
</tr>
<tr>
<td>10. Severe internal injuries (kicked by calf in trailer)</td>
</tr>
<tr>
<td>11. Bruised neck and face (knocked down by cow and stepped on)</td>
</tr>
<tr>
<td>12. Broken jaw and loss of consciousness (kicked by cow)</td>
</tr>
<tr>
<td>13. Fractured hand (cow attacked person so he punched her)</td>
</tr>
<tr>
<td>14. Ruptured disks in back (“butted” in the back by a bull)</td>
</tr>
<tr>
<td>15. Bruised thigh and ribs (cow pushed person against a barn wall)</td>
</tr>
<tr>
<td>16. Fractured hip (knocked over by cows coming in different barn door)</td>
</tr>
<tr>
<td>17. Fractured collarbone (mauled by cow after delivery of her calf)</td>
</tr>
<tr>
<td>18. Internal injuries (kicked by cow)</td>
</tr>
</tbody>
</table>

These are probably just the tip of the iceberg since hundreds of injuries go unreported, making injury prevention one of the most significant benefits of improving beef cattle handling practices and working facilities, it is also good business. The cost of an injury can be devastating and includes not only medical costs for treatment and lost productivity, but also the potential of a law suit by an injured worker and the emotional and physical suffering of the injured person and their family.
Animal Welfare and Public Image

Whether it is your primary source of income or something you do on the side, the intent of raising beef cattle is to make money. Consequently, like any other industry, the beef cattle industry is consumer driven. Listening and taking positive steps toward responding to the consumer's concern about animal welfare is essential to the beef cattle industry's success.

Besides the moral issues that surround the subject, animal welfare is a legitimate concern for everyone who raises or handles beef cattle. Even though inhumane treatment decreases cattle performance and therefore profits, those who mistreat cattle not only lose their return on investment but discredit the livestock industry as a whole.

Understanding Beef Cattle Psychology

Beef cattle psychology is the study of how cattle sense and react to the world around them. The way cattle behave is influenced by their herd instincts and their ability to see, smell, and hear. Understanding cattle perception and behavior will help you learn and perform proper cattle handling techniques and determine improvements you can make to your existing handling facility.

Cattle handling practices are influenced by the animal's psychology, including such things as how to move cattle from one area of the farm to another and how to work cattle in pens and chutes. Similarly, cattle psychology directly affects how you should design and install pens, alleys, and chutes. Knowing basic cattle psychology will ultimately enable you to increase your farm's safety, productivity, and profitability. Some of the basics you need to know include:

- how cattle see, hear, and smell the world around them
- how knowledge of herd behavior, “follow the leader” instincts, and the presence of dominant and subordinate cattle enables you to predict their movements
- how the influence of their maternal instinct, their ability to remember, and their breed affects their behavior

How Cattle See

Since their eyes are on the sides of their heads, cattle have a wide angle view of the world around them with only a narrow blind spot directly behind them. Yet they have some problems seeing because their view of their surroundings is like looking through a “fish-eye” lens; everything appears bent and distorted, especially at the periphery. For example, a fence post that looks straight to us appears curved to cattle. They are also hindered by their inability to see color.
Because their view is distorted, cattle react strongly to movement and contrast. They will balk or turn when they approach bright sunlight or come across a shadow on the ground. To them, the shadow looks like a deep hole in the ground that they need to have a closer look at before crossing.

♦ **Reduce Shadows.** Keeping alley and handling areas as free of shadows as possible improves your ability to move cattle. Look around for shadows cast on the ground by fences, farm equipment, or anything else. Wherever possible, rearrange the environment to reduce the number of shadows cast in places where cattle will be moving. Since even a bright ray of light coming through a hole in the roof can cause balking, you need to identify problems like these and correct them.

♦ **Avoid Approaching Cattle from Behind.** Cattle cannot see directly behind themselves, so avoid approaching them from the rear. If you must come up from behind, let them know you are coming. An animal that is startled from behind will kick. If the animal is in a squeeze chute or head gate, you should get behind it only if there is a gate to protect you from being kicked.

Keep in mind that not only are you at risk of injury when an animal kicks, but so is the animal and any other animal that is nearby.

Quick movements, like the flapping of jackets or plastic tarps in the wind, will spook your cattle, causing them to balk or become agitated. You can easily prevent this from happening by securely tying tarps down and not leaving jackets or other things lying around or hanging on fences.

Cattle are so sensitive to movement that simply flapping your arms around when working cattle can upset them. By keeping your movements smooth and consistent you will be more effective and not provoke the cattle.

Since cattle have a tendency to move toward light (not bright light) use frosted lamps to light up the inside of trailers when you load cattle at night. Similarly, cattle like to move to areas where they sense a means of escape. If you want to get cattle into a headgate, open the gate before the cattle even see it. Cattle will balk if they sense they are heading into a dead end.

### How Cattle Hear

Noise is very stressful to cattle. Like any animal, cattle are disturbed by loud, abrupt noises or sounds that are new to them, especially high-pitched noises. For example, sudden noises such as a gate slamming, a telephone ringing, or the crack of a whip bothers these animals.

Every farm has unique sounds that can bother cattle, lower their food intake and performance, and cause them to balk. Reducing noise around your farm as much as is reasonably possible will help make your cattle easier to handle. Some common sense (and inexpensive) practices like using rubber stops on gates to prevent them from banging shut and lubricating hinges to prevent squeaking can make a lot of difference in the anxiety levels of your animals.
Agricultural Health Promotion System

When you work cattle, you should not go around whooping, hollering, or screaming at them. Cowboying is for the movies, not for farmers who want to maximize their profits and prevent animals and people from getting hurt. Cattle need to be handled deliberately, confidently, and calmly. Getting them excited makes your job more difficult. Only small amounts of noise are needed to move cattle. For example, rustling a stick (such as a mop handle) with plastic strips attached is often enough to get an animal moving in the right direction.

How Cattle Smell

Cattle have an excellent sense of smell, and this sense often dominates how they behave. For example, a cow’s sense of smell can tell her if she is being separated from her calf. To prevent cows from becoming stressed and dangerous, keep them upwind as you separate them from their offspring. This will reduce their ability to smell their calves and make the separation easier.

Odors are also the primary means of sexual communication between cows and bulls. A bull fenced in a pen can smell a cow in heat from a significant distance and will begin acting aggressively.

Herd Instinct

Another characteristic of cattle that contributes to their behavior is their herd instinct. Cattle are social animals that are more comfortable and feel safer in a group. Their herd instinct evolved as a means of protection against their predators. Even though cattle were domesticated thousands of years ago, their herd instinct remains strong. When isolated from the rest of the herd, a single animal will become very stressed and easy to upset. Cattle gain weight and produce better when they are managed in groups rather than individually. Table 4 identifies the two primary characteristics of the cattle herd instinct.

Table 4. Characteristics of Cattle Herds or Groups

<table>
<thead>
<tr>
<th>Their desire to follow the leader: Among members of a herd there are followers and leaders. The “leader” is the animal that is almost always the first member of the group to move in a particular direction. When this animal heads off to go somewhere, the rest of the group will follow.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The herd social order: This is similar to the pecking order among a flock of chickens. One animal asserts dominance over a weaker member but is in turn dominated by a stronger animal. Normally, dominant cattle are not the herd leaders, nor are subordinate cattle necessarily followers. By observing the herd, you can identify the dominant and subordinate cattle. When they are grazing, dominant cattle are usually in the middle of the group where they can get the most protection, and the subordinate cattle are on the periphery. Also, when they are at a feeder, the dominant cattle will push subordinate cattle out of their way to get at the food.</td>
</tr>
</tbody>
</table>
Agricultural Health Promotion System

Handling can be easier and more efficient if you take advantage of your understanding of cattle herd instinct. For example, it is easier to work with them in groups rather than managing them alone. If you have a single animal who is a straggler and does not want to come out of the pen and go into the chute, release a couple of animals from the chute into the pen. Then move all three animals out of the pen and into the chute as a group. Managing the single animal in any other way can cause problems. If you try to drive it into the chute, it will become agitated and may attempt to join the rest of the group by jumping over the fence rather than going through the chute.

In general, when you move a group or herd of cattle, focus on getting a few animals heading off in the right direction and the rest of the group will tag along.

Maternal Instinct

The maternal instinct in cattle is very strong. Normally, a cow will be wary of people, especially strangers, and will be protective of her young. Her protective nature is strongest during the first two weeks after her calf is born and can remain strong for as long as she is taking care of the calf. As a result, you risk injury whenever you try to do anything to a calf when the mother is nearby and is not restrained. This includes assisting in delivery, examining the newborn, castrating, and ear tagging.

The best way to protect yourself from being hurt is to separate the cow from her calf. If you are near a handling facility, allow the cow to walk into a pen and then cut the calf off from behind with the gate. If you are out in the field, get the calf into the bed of a pick-up truck while someone else diverts the mother's attention. Do the work that needs to be done on the calf in the bed of the truck or drive the truck out of the pasture and return the calf to its mother after you are done.

Cattle's Ability to Remember

You have heard the saying that elephants never forget. Well, beef cattle also have long memories, especially of painful events. Handling your cattle all the time with a minimum amount of excitement is extremely important because cattle that were treated poorly in the past will be more difficult to handle in the future. Animals that are always handled with care will be less stressed and easier to manage in the long run.

Keep your use of nose-tongs and electric cattle prods to an absolute minimum. These devices rarely need to be used and cause too much pain. Use halters instead of nose-tongs to hold the cattle's heads and use long sticks or sticks with plastic streamers instead of electric prods to move cattle along.
Agricultural Health Promotion System

Often if you fail to restrain cattle on the first attempt, it is more difficult to restrain them the next time around. You can increase your chance for success by simply planning ahead. Know what you want to do before you start working the cattle.

- Scout the work area ahead of time and make sure it is ready to receive cattle.
- Check the equipment you are planning to use to ensure that it is in good working order and that you know how to use it.
- Make sure alleys, chutes, and pens are clear of obstacles and that the gates open and close properly.
- Do not rush. Take your time. Speed will come with some practice.

Breed Behavior

The breed of cattle also shapes their behavior. As most people who handle cattle know, Brahman and Brahman-cross cattle are easily excited. While all cattle are herd animals, Brahman and their crosses form extremely tight groups. They are easily stressed when they are alone. A unique characteristic of Brahman and Brahman crosses is their tendency to lie down when they become overly excited or disturbed. In general, the behavior of these animals makes them more difficult to handle than English or Continental breeds.

There are a few tips for handling Brahman cattle and their crosses. They need to be handled calmly and gently and, whenever possible, in groups. If a Brahman or Brahman-cross lies down because it is stressed, leave it alone for at least five minutes. If you immediately try to force the animal to get up, you can cause it to go into shock and die.

Aggressive Animals

With any breed of cattle you are going to come across a few now and then that are overly aggressive or nervous. These animals have no place on your farm because they may hurt you and the other cattle that are around them. Not only are they dangerous, but they will also stress the other cattle and reduce their performance as well. If you have any highly aggressive or skittish animals, it is strongly recommended that you cull them.
Improving Beef Cattle Handling Practices

Proper cattle handling is important whether you are moving cattle on a pasture or working them through handling facilities. This section builds on the information discussed in the previous section, “Beef Cattle Psychology.” It discusses the concepts of flight zone and point of balance and how they affect the way you handle your cattle.

**Beef Cattle Handling Practices**

*Flight zone* is a term used to describe the animal’s personal space (see Figure 4). It is an imaginary circle around the animal. When you enter its flight zone, the animal will move away from you; when you step out of the flight zone, it will stop. If you penetrate the flight zone too deeply, the animal will often panic. The shaded area in Figure 4 labeled “blind spot” is the area where you cannot be seen as you approach. If you enter an animal’s flight zone in its blindspot, it may immediately become agitated and kick.

Having a flight zone is not unique to cattle; we have our own flight zones too. For example, when someone comes up too close to you, you back away. Cattle behave the same way; they do not want you too close and will physically defend their flight zone from intruders.

Each animal has a different size flight zone. The size depends on several different conditions—for example, how wild or tame the animal is. The tamer the animal, the smaller its flight zone. Cattle that have been on the range can have flight zones approaching 300 feet, while the flight zone of feedlot cattle may be as little as 5 to 25 feet. In some cases, if cattle are extremely tame, they may not have a flight zone at all. Animals without a flight zone or with very small flight zones can be more difficult to drive. Often the best way to move a tame animal is to lead it with a feed bucket or use a halter.

Similarly, if cattle are treated gently and carefully by people with whom they are familiar, they will let these individuals get closer to them. Some producers only let people work their cattle after the animals become familiar with them. For instance, if a veterinarian or Extension agent arrives at a farm, the farmer may keep him or her away from the cattle until they have been moved into the working facility. Very often the movement of animals from pasture to the handling facility proceeds more smoothly when strangers are kept at a distance.

The breed of cattle or line within the breed influences the size of the flight zone. Breeds that are easily excited, such as those with Brahman blood, tend to have larger flight zones. The size of the flight zone also varies according to the direction from which an animal is approached. In most instances, the flight zone will be larger when the handler approaches head on. When cattle are confined in a single-file chute their flight zone becomes smaller.
The second concept, point of balance, is the place where there is a balance between moving forward and moving backward. In Figure 5, it is an imaginary line that starts from the animal’s shoulder and goes out at a 90 degree angle until it intersects the edge of the flight zone. You use the point of balance and flight zone of cattle to move them backward and forward. If you place yourself to the left of the imaginary line at position A, the animal will move backward, and if you place yourself to the right of the imaginary line at position B, the animal will move forward.

![Diagram](image)

Figure 5. The animal’s point of balance begins at its shoulder and intersects its flight zone.

**Things to Keep in Mind When Handling Cattle**

It takes practice to feel comfortable using the concepts of flight zone and point of balance to handle your cattle easily, efficiently, and safely. However, before you can improve your cattle handling practices, you may need to break some old habits. Many people work their cattle by whooping and hollering at them and even chasing, beating, and poking them with electric cattle prods. Not only does this place undue stress on your animals, it is an ineffective way to move them. Move your cattle patiently and quietly and you will be rewarded with less frustration and have an easier time getting the job done.

Another habit to break is getting in the animal’s blind spot. Cattle are difficult to handle when you get behind them. They will zig-zag back and forth, trying to keep an eye on you instead of moving forward. If you remain within the animal’s field of vision, you will have fewer problems.

**Handling Cattle in Confined Areas**

When working cattle in confined areas, you must be especially careful since it is very easy for you to invade the animal’s flight zone too deeply or get in its blind spot. Avoiding sudden movements that may startle the animal will help. If you get too far inside an animal’s flight zone, it will panic and try to flee. When this happens in a working chute, pen, or alley, the animal may try to jump the fence or turn back on you, increasing the risk of either you or the animal getting hurt.

When an animal turns back on an inexperienced handler, you will often see the handler try to get the animal heading in the right direction by jumping out in front of it and waving his or her arms or by striking the animal with a stick, cattle prod, or fist. These actions are not only ineffective but dangerous for both the handler and the animal. Instead, if you act quickly and back out of the animal’s flight zone, you may prevent the animal from actually bolting. If the animal still turns back on you, just get out of its way. The animal will settle down once you are outside of its flight zone.

**Handling Cattle in a Working Chute**

With a properly designed working chute, you remain outside of the chute while moving the cattle toward the headgate, squeeze chute, or trailer. Sometimes cattle start moving too quickly and ride up on one another. When this happens, do not step up to the fence and try to push the cattle down with a stick or cattle prod. This will only upset them more since it requires that you enter deeply into their flight zone. Instead of forcing the animals off of each other, step back and leave them alone. They will eventually settle down again on their own.
Using Flight Zone and Point of Balance Concepts

The concepts of flight zone and point of balance apply to all handlers and to any size of operation. If you hire handlers, make sure they also know how to handle cattle correctly or it will cost you money.

The best place to be before you start moving an animal is within the shaded triangle and just outside the flight zone (see Figure 6). To determine the edge of the animal’s flight zone, approach it confidently and deliberately from slightly behind the shoulder. As you approach, its first reaction is to look at you. When you have entered its flight zone, it will begin to move away.

Moving from position A to position B represents the point of entering the animal’s flight zone. Remember not to penetrate this area too deeply or the animal will panic and flee or turn back and possibly run over you. Always be alert to how the animal is reacting to you. Once it begins to move away, you can keep it moving straight ahead by moving back and forth between positions A and B. By placing yourself at position B you press the animal forward, and then by moving back to position A you relieve the pressure and prevent it from panicking. As you move along, repeat the pattern of entering the flight zone and backing away.

To stop the animal’s forward progress, move to position A and remain there. After taking a few more steps it will realize that you are not entering its personal space and will stop.

Changing the Animal’s Direction of Movement

Steering beef cattle is like steering a car. First, you need to get the animal moving by entering its flight zone. Once it is moving, shift your position from B to C (see Figure 7). While position C is not any closer to the animal than position B, it is closer to the animal’s point of balance.

When you place yourself in position C, the animal will circle ahead in the direction shown. Animals circle around you because they want to keep you in sight at all times and they do not want you to cut them off. If the animal does not circle around you and heads off in a different direction, it will not be able to see you. You are taking advantage of the animal’s natural circling behavior.
Moving Cattle Backward

Depending on the situation, there are times when you may want to move an animal backward. If you have been moving it forward by entering and retreating from its flight zone, you can get the animal to back up by placing yourself in front of its point of balance (see Figure 8).

You would move from position B to position C, making sure that you do not cut across its flight zone as you move. If you do, you may invade its personal space too deeply and cause the animal to spook or turn back on you. Instead, follow along the imaginary edge of the flight zone from B to C. Do not rush the animal. Let it move backward at its own pace.

Moving a Herd of Cattle with One Handler

The concepts of flight zone and point of balance apply to a herd just as they apply to individual animals. When combined with the natural tendency of cattle to follow one another, these concepts will help you handle cattle more easily. As shown in Figure 9, you initiate cattle movement by approaching the group until you are in position 1, just inside the group’s flight zone. The herd will proceed in the direction shown. Even though you are near the rear of the group, you want to avoid the animals’ blind spot. If you enter their blind spot, they will begin zig-zagging back and forth as they try to keep an eye on you.

Once the cattle are moving, walk forward at an angle until you reach position 2. The distance between positions 1, 2, 3, and 4 will depend on what works best for you. Since you are walking at an angle between position 1 and 2, the amount of pressure on the group’s collective flight zone will decrease as you approach position 2. Consequently, as the cattle begin to slow down, you again increase pressure on the flight zone by walking straight toward the cattle until you reach position 3. By placing yourself at position 3, you put pressure on the group’s leaders to move forward. The rest of the group will follow right along.

As the group speeds up, turn and head up in the opposite direction that they are going until you reach position 4. While it may seem that this will halt the group’s progress, you are actually motivating them forward as you cross their point of balance.

As you proceed from position 3 to 4, walk at a slight angle towards the group to increase the pressure on their flight zone. To keep the group moving along, repeat the pattern. The length and angle of the movements in the pattern will vary according to the characteristics of the herd. Only with practice will you discover the length and angle of each movement that works best for the herd you are handling.
Moving a Herd of Cattle with Two Handlers

If you have a second handler to directly control the group leader, controlling and moving the group is easier. The rear handler moves in and out of the group's collective flight zone, following the same pattern used when one handler is moving the herd. The lead handler should be just behind the lead animal's point of balance and move in and out of the leader's flight zone in the same pattern as the rear handler (see Figure 10).

The lead and rear handlers should remain as close together as possible to prevent any animals from escaping between them. You do not need to worry too much about the cattle in the rear—they will have a strong desire to follow the rest of the herd even when the rear handler is in front of them.

Moving Stragglers Back into the Group

Occasionally, cattle break away from the herd and become stragglers. These animals can be handled fairly easily if you do not get directly behind them and chase them. This will only upset and excite the stragglers. Instead use their follow-the-leader instinct to do most of the work for you. With just a little help, stragglers can be drawn back into the rest of the group (see Figure 11).

From position 1, approach the stragglers at an angle until you cross over both their flight zone and point of balance. Walking toward these animals gradually increases the pressure on their flight zone. After you cross the point of balance, the stragglers will speed up to regroup with the cattle in front of them. Just past the point of balance, at position 2, turn around and head back at an angle toward position 3. From position 3, return to position 1 and resume your normal pattern of movement.
Agricultural Health Promotion System

Moving Cattle into a Pen

Before the cattle arrive, open and secure the pen’s gate. You do not want to stop them to open the gate once they are moving. Do not hold the gate open while another handler drives the cattle in from the rear. The cattle will be more hesitant to enter the pen since they do not want to get too close to that person.

On the other extreme, you do not want the cattle to rush into the pen. They will enter the pen in controlled manner if they walk past you at a distance that does not upset them. The correct position of the handler is in position 1 just outside the cattle’s flight zone (see Figure 12). While cattle are entering the pen, the handler alternately increases and decreases pressure on the flight zone by moving back and forth between positions 1 and 2.

Do not make any side-to-side movements and be careful not to enter the cattle’s flight zone too deeply or you will cause them to balk, turn back, or panic. You want to place just enough pressure on them to keep them against the fence and under control as they enter the pen. Once the leaders enter the pen, the rest of the group will follow. If you do not handle the leaders as we just discussed, they will balk and the rest of the group will follow suit.

Emptying a Pen and Sorting at the Gate

Cattle should leave a pen in a controlled manner as well and not be allowed to run wildly out. The proper method of emptying a pen is to move back and forth between positions 1 and 2 (see Figure 13). By moving between these two positions, you alternately increase and decrease pressure on the cattle as they leave the pen. This ensures that they move steadily and in an orderly manner. If they race out, they can hurt themselves or the handlers who are working them.

Sometimes you may want to sort cattle as they are leaving the pen. In order to allow some cattle out of the pen while leaving others in, you move forward and backward between positions 3 and 4. Do not move side-to-side or they may slip past you. When you are at position 3, you are decreasing pressure on the animal’s flight zone, allowing it to leave the pen. When you move to position 4, you are increasing pressure and the animal is held back. By paying attention to each animal’s flight zone, you can increase pressure on those animals you want to hold back and decrease pressure on those animals you want to let out.
Improving Beef Cattle Handling Facilities

Installing efficient cattle handling facilities or improving existing facilities can increase your farm’s profitability and safety. However, it is important to realize that the type of improvements appropriate for one producer may not be appropriate for another. Each cattle operation is unique, with different needs and different resources. Not every producer has the money or even the need for a complete handling facility that includes a holding pen, crowding pen, working chute, squeeze chute, and headgate. For example, since very few North Carolina producers need a facility large enough to handle 500 cow-calf pairs, purchasing hydraulic squeeze chutes will not have as great a return as other facility options.

When you have completed this last section you should be able to begin to determine those options for improving existing facilities and designing and installing new facilities that are practical for you. The extensive facilities required for larger herds can cost several thousand dollars. For some producers, an investment of $1,000 to $1,500 is reasonable; for others, a couple hundred dollars is tops. The Cooperative Extension Service can work with you to tailor facility improvements that will meet your needs, goals, and resources.

Importance of Adequate Cattle Handling

It is very dangerous to restrain or move cattle when all you have is a rope and a tree. Many North Carolina producers, unfortunately, have only these rudimentary tools available to handle their cattle. Some producers may have better facilities, but they are often grossly inadequate for safe and efficient cattle handling. As a result, deworming, vaccinating, dehorning, castrating, ear tagging, and other herd health practices that can increase farm profitability are neglected.

Adequate facilities not only enable you to perform modern production practices, but they also reduce labor expenses, decrease stress, and prevent injury of both cattle and handlers. There are many excuses for not building new facilities or improving an existing facility. Some think it just too expensive. Others, who are raising cattle as a hobby or for supplemental income, believe they raise so few head of cattle that improvements will not justify the cost. Still others may not be aware of the benefits of making facility improvements or of the variety of choices available. However, the range of facility options available enable all producers to improve their handling facilities and still be rewarded with benefits that far exceed the initial cost.
Installing, Evaluating, and Improving Your Facilities

Whether you are building a new facility or improving an existing one, you need to verify that the changes you are planning have been tested and proven to work. Many producers install or upgrade their facilities without consulting anyone knowledgeable about facility design and installation. Yet a flawed design can seriously damage a facility’s usefulness. Even when a facility is properly designed, it will function as intended only if it is built correctly. Furthermore, the amount of money spent on a facility does not necessarily determine how well it will function.

A well-designed facility takes into account how cattle sense their environment. If you have a basic understanding of beef cattle psychology, you will have a greater appreciation of the importance of designing a handling facility from your cattle’s perspective.

♦ Selecting a Site. The first step of facility design is determining its location. If you are installing a new facility, you can be more flexible than if you are improving an existing structure.

- To make loading and unloading cattle at your farm more convenient, the facility should be located in an area that is served by an all-weather road and is in proximity to your pastures.
- Moving cattle into the facility is easier if it is located at the corner of a pasture or along a fence where two pastures join.
- The facility should also be near shade and water.
- In order to move cattle easily, the facility should be built on level ground with good drainage. Note that with extended use, cattle will work the soil out of the facility, creating a dam effect around the perimeter. This causes rain water to “pool” in the facility. To minimize this problem, mound the soil in the area where the facility will be built to raise it slightly above its surroundings.

♦ Building on a Slope. If the facility must be located on a slope, make sure that the cattle will be worked in a direction that requires them to move uphill. This is important for two reasons: first, cattle move downhill with great difficulty, and second, if the area where cattle will be handled is at the bottom of the hill, you will be working in an area that is wet and muddy.

♦ Select Materials for Durability. Always make sure to use strong materials. Inferior products save a few dollars in the beginning but in the long run cost more in repairs. Using heavy, permanent construction ensures that the facility is durable and will last for many years. When building a new facility, it is important to use a flexible design that can be enlarged to accommodate more cattle. As your operation grows, your facility should be able to grow along with it.
Balking Caused by Shadows and Drainage Grates

Cattle balk when they see a shadow or anything else that creates strong contrasts between light and dark. A fence is one of many types of objects that can cast a shadow across an alley, loading chute or any other area where cattle are being handled (see Figure 14). Solid fencing helps reduce shadows that cause balking. Similarly, drainage grates located in alleys and working chutes produce contrasts that bother cattle. An animal walking down an alley with a grate (see Figure 14) would balk when it came to the grate. Instead of using drainage grates, slope the floor so water runs into a ditch outside the fence.

Figure 14. Reducing shadows and removing drainage grates will help prevent balking.

Balking When Entering Rooled, Working Chutes

Cattle also balk when they move from a bright, sunny area into a dark area— for example, when a handling facility has a roof over the single-file working chute (see Figure 15). In this situation, cattle are forced to move simultaneously from a crowding pen into a working chute and from bright sunlight into the dark. Balking can be reduced if the first 10 to 15 feet of the working chute are in sunlight (see Figure 15). As a result, cattle are lined up in the chute before they enter the roofed working area. Another alternative is to leave the facility completely unroofed; however, this makes it more difficult to work cattle in poor weather. You can also roof the entire facility, but this can be quite expensive. When designing a chute or alley, it should be laid out in a north-south rather than east-west orientation. While cattle do not balk when walking directly into the sunlight, it does make them uncomfortable.

Figure 15. To prevent balking, have cattle line up in a chute before entering the roofed
Chutes with Solid Sides Reduce Distractions

In addition, since cattle have wide-angle vision, they are easily distracted by people, tractors, and other things found on the farm. Distracted cattle are more difficult to handle. You can reduce distractions by making the sides of the working chute, loading chute, and crowding pen solid (see Figure 16). Solid chutes reduce shadows and distractions and force the cattle to see only one means of escape—that which is in front of them. Cattle will also proceed more smoothly through a facility when they are forced to concentrate on those animals who are moving down the chute in front of them.

Dead Ends

In the previous figures, the gate at the end of the alley was solid. In Figure 16, you can see through the gate. One-way gates in alleys and chutes should not be solid. Being able to see through the gate contributes to the animal’s perception that the view in front of them is a means of escape. Cattle are more likely to balk if the chute or alley appears to be a dead end.

Figure 16. Replacing solid gates will help prevent balking.

Advantages of a Curved Working Chute

A curved chute works better than a straight chute because it prevents the animal from seeing the trailer, squeeze chute, or headgate at the end (see Figure 17). Balk ing is reduced, because the animal does not realize it has approached a dead end until it is already there. However, the curved chute itself can appear as a dead end if it is not properly designed. As the cattle view the chute from the crowding pen, they should be able to see at least two body lengths up the chute. If they cannot see this far ahead, they will balk.

A second advantage of a curved chute is that it uses the cattle’s natural tendency to circle around their handler in order to keep the handler a comfortable distance away and within sight at all times. When you are working cattle in a curved chute, position yourself along the inner radius of the chute. If you are installing an elevated catwalk, it should be along the inner radius of the curved chute. Avoid working cattle from the outer radius. Finally, whether it is curved or straight, orient the chute so that it directs cattle back to the area where they entered the facility. This takes advantage of the tendency of cattle to return to their starting point.
Chutes for loading and unloading cattle also need to be designed and constructed properly. Position the loading chute in an area that enables the vehicle driver to view and approach the chute from the driver side of the vehicle. When a loading chute is in place, make sure that there are no gaps between the trailer and the chute. Gaps can cause foot and leg injuries as the animals walk over them. Injuries can also occur when the incline of the loading chute is too steep. Portable or adjustable chutes should be no steeper than 25°, and the slope of a permanently installed chute should not exceed 20° (see Figure 18).

A chute that can be adjusted to different heights is more flexible and functional than a chute that is fixed at one height. Chutes should also have solid sides and a floor that is stair-stepped or cleated for sure footing. Last, the location of the chute is important. Since cattle will be more likely to balk if they associate loading with the discomfort of being restrained, the loading chute should not be located near the squeeze chute or headgate.

Designing or Upgrading a Facility

In order to ensure that the investment in upgraded or new facilities are both functional and cost effective, it is important to consider the following design parameters.

Table 5. Major Points to Remember When Designing or Upgrading Your Facility

1. The facilities should be designed with a minimum of square corners and sharp turns. When they are laid out with smooth curves and fewer corners, cattle are less likely to get bunched up, enabling handlers to work cattle easily and safely.
2. The facilities should have nonslip flooring, especially in areas where floors are made of concrete. Concrete floors need to be deeply grooved with a diamond pattern to prevent slipping.
3. The facilities need to be inspected periodically, especially just before you use them. Your inspection should include each of the following:
   a. Thoroughly check the facility to make sure the alley, chutes, and pens are free of obstacles that may cause cattle to balk.
   b. Keep headgates, chutes, and gates must also be kept in good working order. Specifically, inspect gates to ensure that they do not squeak and that they close and latch properly.
   c. Since many individuals have been injured when a cow has kicked a gate against them, equip gates with tiebacks that prevent them from swinging open inadvertently.
   d. Check posts and fences for splintering and protruding bolts or nails. A protruding bolt, piece of metal or splinter of wood can easily cut and bruise an animal when they brush up against it.
The Tobacco Barn Situation

The first type of facility layout which uses a tobacco barn (see Figure 19), is better than a rope and a tree but is not very good for handling cattle. Often this type of facility is used when a producer decides to raise a few head of cattle as a hobby or as a small source of supplemental income and has an old tobacco barn in which equipment is stored and minerals are fed to the cattle. Usually the only time the cattle are handled is to load them up for market. To do this, the animals are enticed into the barn where a borrowed portable headgate or trailer is placed against the doorway.

Typically, the producer and worker enter the barn and get behind the cattle, then whoop and holler to try to force cattle toward the doorway, hoping that one of the animals will decide to enter the headgate or squeeze chute. What usually happens, however, is that the cattle turn back and circle around over and over, not leaving an easy means of escape for the handlers. Often handlers will end up getting kicked or run over.

Eventually, the job will get done, but not until both the cattle and the handlers are completely stressed out. What should have taken 15 to 30 minutes to do ends up taking two or three hours. With a little bit of time and money, this facility can be improved a lot. Rather than facing the difficulties described, you can use an improved facility that allows you to work cattle more easily and safely.

Inexpensive Facility Improvement

Figure 20 shows how the tobacco barn can be modified to make it more efficient and safe. It has a short working chute and a 12 foot gate. At the end of the chute, you can position a portable headgate, squeeze chute, or trailer.

The most important feature of this facility layout is the 12-foot gate that has the freedom to swing over 180°. A single handler can move cattle into the middle of the pen and then slowly and methodically crowd them into the working chute. Once the gate is swung around, it is latched in a closed position. After the gate is closed, the handler can stand outside the chute and work cattle toward the headgate or trailer.
With a facility such as this one, once the cattle are in the pen, there is always a gate or fence between the handler and the animals that are being processed, decreasing the risk of injury. Since the pen and working chute are relatively small, it is possible to work about three head of cattle at a time. This facility is recommended for someone who is raising fewer than 20 head of cattle. The materials to make these improvements should cost around $250 to $300. Many producers who do not need an expensive facility find that this inexpensive facility does just fine.

**Intermediate Design**

While the previous layout can handle only 3 cows at a time, the intermediate facility design can handle as many as 15. It is a sound, basic facility (see Figure 21). In addition to being larger, this facility also has a number of improvements that further simplify cattle handling.

First, you can move a group of up to 25 cattle into the holding pen before moving them into the crowding pen. Second, the facility has fewer corners in which the cattle can get bunched. As a result, they can be handled more easily and more quickly. Third, the gate of the crowding pen, which is also 12 feet wide, can be latched in different positions as cattle are moved into the working chute.

Being able to latch the gate in different positions reduces the number of handlers needed since no one needs to hold the gate. In most cases, only one handler is needed to operate this facility. This facility has a strong, basic design that can be modified according to your needs and the amount of money you are willing to spend. For example, you can easily add additional pens to handle larger groups of cattle.

The first step in using the intermediate facility is to move a group of no more than 20 cattle into the holding pen. As you move the group, some of the cattle will move into the crowding pen. Next, swing the 12-foot gate around and move up to 15 head of cattle toward the working chute. As cattle work down the chute and are processed, move the gate forward in steps to apply pressure on the cattle and keep them moving forward.

Once the first group of cattle has been worked, a second group can be processed and the cycle continues as before. This facility is appropriate for producers raising between 20 and 40 head of cattle and costs around $900 to $1,000 without a headgate or squeeze chute. Depending on what you are doing, a borrowed portable headgate, squeeze chute, or trailer can be mounted at the end of the working chute.
Figure 22 shows modifications to the intermediate facility that make it capable of accommodating more animals. The most notable addition is a second holding pen, which doubles the facility's capacity from a maximum of 25 head of cattle to a maximum of 50 head. Another change is the addition of a permanent headgate and loading ramp.

By leaving the middle exit open, you can still borrow a squeeze chute or scale. However, working your cattle will be more convenient if you own restraining and loading equipment since you do not need to spend time rounding up the equipment from someone else. Although a complete facility such as this one may cost $3,000 to $4,000, it is an investment that will pay for itself if you are raising at least 40 to 50 head of cattle and are using the facility to implement a thorough herd health program.

Remember, you do not need make all the modifications described. Just increasing the facility's capacity is an important modification that does not cost a lot of money. Another point to keep in mind is that once you have invested in a good, basic facility, it can be modified to meet your expanding needs for many years to come.

Figure 22. Intermediate facility modifications to accommodate up to 50 cattle.
Summary

Improving the way you handle your beef cattle is a wise investment that provides handsome returns. The benefits include increased cattle performance, reduced shrinkage, lower labor expenses, less aggravation and stress, improved safety, and a better animal welfare program and public image. Making improvements does not need to be difficult, and the Cooperative Extension Service can help you determine what changes are appropriate for your farm.

How cattle sense and react to the world around them affects the way they need to be handled and the types of facility improvements you should consider. By using the concepts of flight zone and point of balance you can handle and move your cattle safely, efficiently, with fewer workers, and with less stress on both you and the animals. Learning proper handling techniques alone, however, is just the beginning. You can do a lot with a little to improve the efficiency and safety of your handling facilities.

While improving your ability to handle cattle efficiently and safely does cost both time and money, it is an investment that can provide an excellent and often immediate return. A number of options are available if you want to install a new facility or improve an old one, enabling you to improve your facility so that it meets your needs without exceeding your resources.

While some design principles apply to all types of facilities, others apply to specific facility designs. The Cooperative Extension Service is ready to help ensure that your facility is appropriate for your needs and properly installed. Since an informed decision must be made during each step of facility improvement, the Extension Service can provide valuable advice and information that will help ensure the profitability of your investment.
References and Additional Materials


Grandin, T.: "Handling Facility" Fitness, Department of Animal Science, University of Illinois.


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