BEEF CATTLE MANAGEMENT

for Water Quality Protection in Arkansas

MP375

UofA UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE

University of Arkansas, United States Department of Agriculture, and County Governments Cooperating

BEEF CATTLE MANAGEMENT

for Water Quality Protection in Arkansas

Table of Contents

Authors

Dirk Philipp, Assistant Professor – Forages, University of Arkansas Division of Agriculture, Fayetteville

Katherine Teague, County Extension Agent – Agriculture/Water Quality, Washington County, University of Arkansas Division of Agriculture, Fayetteville

Karl VanDevender, Professor – Agricultural Engineering, University of Arkansas Division of Agriculture, Little Rock

Introduction

The beef industry is a major part of Arkansas' economy. Cattle are produced on approximately 30,000 farms, of which over 90 percent are family owned and operated. The total economic impact of our state's beef industry is over $1.4 billion; the cash value of the 1.8 million cows and calves alone is over $432 million.

Arkansas is also rich in water resources that provide drinking water for communities, irrigation for agriculture, transportation and recreational benefits, including swimming and fishing. The state's rivers and stream tributaries typically originate in rural, forested areas and drain large watersheds encompassing both urban and rural areas, including livestock operations. Therefore, it is crucial to minimize environmental disturbances in all parts of the watershed as water resources are shared by a growing population.

FIGURE 1. A major concern in beef cattle management is to protect the quality of our state's water resources. ***This photograph courtesy of Arkansas Parks and Tourism.***

The main objective of livestock management for water quality is to avoid the entry of manure-contaminated runoff into waterways. Through environmentally sound management of animals and manure, the quality of our state's water resources can be protected. Conversely, improper livestock and pasture management can result in manure accumulation, soil compaction and loss of desirable vegetative cover, all of which may lead to serious water quality impairments. Prevention is a more cost-effective approach than remediation to protecting water quality.

The goal of pollution prevention in livestock agriculture is to avoid the contamination of ground and surface waters with undesirable bacteria and excess nutrients from excretions. The two primary nutrients of concern are phosphorus and nitrogen. While both elements are essential nutrients for living organisms, excessive amounts in waterbodies can cause eutrophication, a process in which aquatic plant growth is accelerated. The resulting microbial decomposition causes the depletion of dissolved oxygen, essentially depriving other organisms of this crucial element. In turn, populations of desirable fish such as crappie and bass may decline while more low oxygen-tolerant species such as carp may increase. Furthermore, livestock manure can be a source of disease-causing organisms. These pathogens can infect humans and animals alike through contact with a contaminated water source.

The objective of this publication is to help beef producers recognize management practices that protect water quality while enhancing their operations economically. If these practices are implemented voluntarily, environmental concerns can be addressed on the farm with the freedom and flexibility not available through regulation.

Grazing Management

Soil Resources

Soil compaction from overstocking is a common problem that results in reduced infiltration rates and increased runoff risk. This is particularly the case in fields that are designated for hay feeding during the colder and wetter periods of the year. There is rarely only one soil type found on any property; therefore, different areas of the farm should be managed accordingly to minimize environmental impacts while maximizing utilization for the production goals that the producer wants to achieve. In general, loamy and clayey soils are more susceptible to compaction than soils with gravelly or sandy textures. Moreover, soils around riparian zones can easily be compacted due to the higher amount of organic matter and moisture content found there in comparison to upland pastures. Producers should recognize the location of particularly wet areas that might be excluded from grazing or protected with special measures.

Soil compaction is primarily caused by cattle hoof action, and several factors can influence the magnitude of compaction. Among these are:

1. **Stocking Density** – This has been shown to affect infiltration rates and vegetative growth, but depending on the grazing method used, high stocking densities can be afforded if animals graze through an area quickly and at times with low soil moisture present.

2. **Grazing Management** – Continuous stocking should not be favored in areas where cattle have the opportunity to loaf or socialize in areas such as riparian zones or streams. With rotational grazing or strip grazing, producers have control over how long animals will remain in a particular paddock, thus reducing the risk of soil compaction and over-, under- or spot grazing.

3. **Vegetative Growth** – Pastures should be in good condition – that is, maintaining ground cover, sufficient forage growth and avoiding overgrazing. The pasture canopy helps reduce the impact of rain and, therefore, helps retain soil particles in place to minimize erosion.

FIGURE 2. Beef production is a vital contributor to Arkansas agriculture. The total impact of the state's beef industry is over $1.4 billion.

Grazing Methods

As previously indicated, the main concern in maintaining water quality standards is the potential addition of N, P, sediment and pathogens to surface waters. These additions may occur from direct deposits or when those elements are subject to leaching or runoff from pastures. The concentration of nutrients and microorganisms in manure deposits is very high; therefore, the challenge is to keep manure on pastures and away from waterways through suitable grazing management and/or appropriate placement of filter strips. Manure distribution

on good pastures is usually not a problem; however, uneven distribution of manure is more likely to contribute to water quality impairments. Regardless of grazing method, the major problem is overgrazing, which occurs when too many animals are kept on too few acres for prolonged periods of time. This can result in reduced production of desirable forage species in a pasture, increased potential for internal parasite infestations, decreased animal performance and pasture damage due to compaction, especially on wet soils.

Grazing animals can have either a positive or negative effect on water quality, depending on the way their grazing patterns are controlled. Proper grazing management favors pasture productivity and reduces the potential for soil erosion and manure runoff. Healthy and vigorous canopy cover protects and enhances water quality by lessening the impact of precipitation which dislodges soil particles, thereby reducing the amount of sediment in surface runoff.

FIGURE 3. The challenge for beef producers is to utilize manure without impacting water quality. This is achieved through appropriate management strategies, particularly maintaining pasture canopy height and applying suitable grazing methods.

Possible stocking rates depend upon the land's carrying capacity. Factors affecting the carrying capacity include soil productivity, forage yield potential, species composition, animal age, soil type and the physical characteristics of the pasture. When implementing a forage plan, the advantages and disadvantages of possible grazing methods should be considered.

A grazing method is a defined procedure or technique of grazing management designed to achieve a specific objective. These methods can impact environmental quality to a larger or smaller extent based on their specific nature. Some of the more common grazing methods are as follows:

Continuous Stocking

This grazing method allows livestock unrestricted and uninterrupted access to a specific area for a specific time. No subdivision fences are used during this period. To respond to changes in forage supply, producers can add or remove livestock, increase the total size of the area being grazed or provide supplemental feed. In northwest Arkansas, many producers utilize this grazing method due to relatively low input requirements such as labor and fencing material. Because farms in the region are relatively small and most producers or their spouses are required to seek off-farm income, this is the preferred grazing method. However, one single method of grazing – particularly continuous stocking – rarely fits an overall forage plan. Moreover, given the topography, weather patterns and soil conditions, this method may be disadvantageous from the viewpoint of environmental stewardship. Some studies have shown that continuous stocking increases the runoff potential, simply because of greater soil compaction through cattle hoof action compared with other grazing methods or hay-making. Overgrazing can frequently occur and results in poor groundcover and low infiltration rates.

Rotational Stocking

Rotational stocking implies recurring periods of grazing among two or more paddocks with periods of rest and regrowth of forage between grazing events. During periods with high forage production, some paddocks can be used for hay before the forage becomes too mature. Under normal circumstances, a paddock or cell is grazed until 70 to 80 percent of the available forage has been utilized. Alternately, with continuous stocking, forage utilization is lower at about 55 to 65 percent. Grazing pressure under these circumstances is lower, and thus cattle may avoid certain pastures areas. Rotational stocking is particularly important for pastures that contain species which benefit from rest periods. Legumes such as clovers and alfalfa should be grazed rotationally to provide times for

replenishment of root and shoot carbohydrates. A grazing system comprised of rotational stocking as a grazing method is more labor intensive, but there are advantages in terms of environmental sustainability. There is evidence that nutrient concentration in runoff may be reduced under rotational stocking compared with continuous stocking. Additionally, a rotational stocking scheme gives the producer the flexibility to react to changes in forage production and to take advantage of differences in pasture species maturity of warm- and cool-season forages.

Strip Grazing

Strip grazing confines animals to an area that is grazed during a relatively short period of time. Utilization is high with this grazing method, up to 80 to 90 percent, because grazing takes place quickly on a small area, thereby reducing waste due to trampling. Stocking density is set high enough to remove available forage as complete and quickly as possible.

Creep Grazing

This practice allows juvenile animals to graze areas that their dams cannot access at the same time. Therefore, the impact on environmentally sensitive areas can be reduced by avoiding trampling of heavier animals yet giving access to forage for smaller animals with a requirement for higher-quality forage.

Buffer Grazing

In a grazing system using continuous stocking, buffer grazing is an approach to adjust forage supply by using temporary fencing to exclude livestock from certain areas that can be harvested either as hay or grazed during a time when environmental impacts are minimized. This grazing method is well-suited to make use of sensitive riparian areas by providing only infrequent access for grazing livestock yet allowing extra forage when needed.

Riparian Zone Protection

The stability of streambanks is of utmost importance for maintaining a high degree of on-farm water quality protection. Numerous studies have shown that livestock can damage streambanks in the process of seeking access to water and shade. This is especially critical with widespread use of toxic endophyte-infected tall fescue forage that may induce elevated body temperatures that lead cattle to seek water cooling, particularly during spring and summer. Besides trampling of streambank vegetation resulting in sediment loss, water quality may be impaired through defecation in streams, both of which can result in a transfer of nutrients from pasture to waterway.

Definition of Riparian Zones

Riparian zones are vegetated corridors adjacent to streams that provide a transition zone between aquatic and upland ecosystems. For many livestock producers, riparian zones are also economically important as forage quantity and quality tend to be greater in these areas than on upland pastures. If managed properly, riparian zones can protect waterways while simultaneously enhancing forage supplies.

Riparian areas serve a variety of functions which help protect water quality:

- Riparian vegetation including trees and understory species help maintain streambank structure by holding soil in place and slowing the erosive power of water flow. Through reduced erosion, less sediment is transported away, keeping fish habitat intact while minimizing nutrient loss.
- Riparian vegetation can filter runoff and hence reduce the amount of sediments and nutrients reaching the stream. Nutrients that are transported from higher upland areas can be taken up by riparian plants.
- Riparian vegetation provides shade to maintain cooler water temperatures. Algae growth is limited in shaded waterbodies due to reduced solar radiation. Woody debris can help create spawning areas for fish. Smaller organic debris such as twigs and leaves provide a food source for many aquatic organisms.
- Riparian vegetation helps reduce stream velocity that, in turn, helps reduce bank erosion and sediment loss.

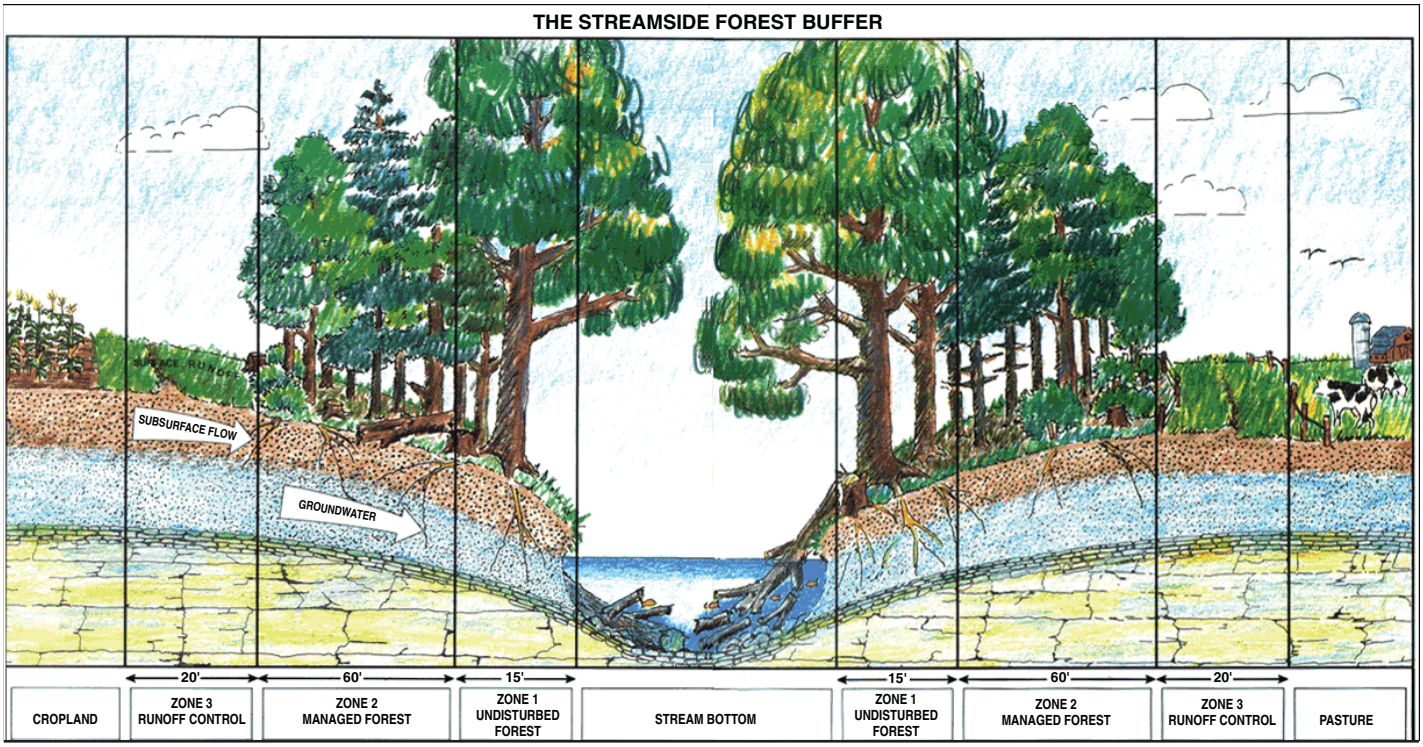

FIGURE 4. Schematic design of a stream buffer. There are usually several zones between the stream and the crop or pasture land. ***Illustration courtesy of Arkansas Water Resources Center, University of Arkansas. Original source USDA Forest Service.***

Livestock Management

There are many management options to improve the functionality of riparian zones through proper livestock management. Even in cases where riparian zones have been degraded to a high degree, vegetation will re-establish soon after stress factors which diminished vegetation in the first place have been removed. Complete livestock exclusion is an effective way to let bank vegetation recover; however, adoption has been limited due to various reasons, and there are other opportunities to achieve desired results.

Stream Crossings and Partial Livestock Exclusion

In many instances, intermittent streams cross farmers' land or serve as property boundaries. These streams drain pastures and serve as tributaries for larger rivers or lakes further downstream. Therefore, any kind of water quality impairment occurring at that level should be avoided. Good grazing management is especially important whenever paddocks are intersected by a larger drainage channel. Often, cattle are given the opportunity to cross wherever, but establishment of defined stream crossings is preferred in the long run. One of the simpler solutions is to cover the stream bottoms with coarse gravel at specific crossing sites to prevent further channel erosion and exclude cattle from sites along the stream that are already heavily eroded. In doing so, temporary fences made of poly- or high-tensile wires can be set up relatively inexpensively to allow for flexibility when they have to be moved. Another type of livestock crossing is comprised of an approximately 8-foot-wide concrete slab that is lined with large rocks on either side. These rocks prevent cattle from walking into the stream while catching debris and sediments during runoff events. More expensive designs of crossings consist of plastic webbing structures that line the stream bottom and are filled with gravel. Many NRCS financial-incentive programs include stream crossings as an approved practice.

FIGURE 5. Damage to an intermittent stream caused by uncontrolled access of cattle. The streambanks recovered rapidly after access for livestock was limited.

FIGURE 6. Healthy banks surrounding an intermittent stream in a pasture setting. ***Photograph courtesy of John Pennington, University of Arkansas Division of Agriculture.***

Fencing of streams is recommended whenever degradation reaches a point where temporary, or for some stream sections permanent, livestock exclusion is warranted. One management strategy is one-sided exclusion of a stream with a temporary fence. This will allow cattle access on one side, but animals are discouraged from crossing the entire stream. Therefore, the fence should be placed close to the edge of the streambank. To make this option workable, livestock need to be rotated frequently to avoid overuse of one or the other side of the streambank. Fencing along both sides of the stream is recommended when bank damage has progressed to an extent that complete exclusion is the only option for sufficient soil protection and vegetation recovery. In this case, cattle can still be given infrequent access to graze forage inside the fenced area.

FIGURE 7. Example of a well-constructed cattle crossing. These structures help maintain streambank stability by allowing cattle to cross the water at certain locations only. Stream crossings vary in design and costs. ***Photograph courtesy of NRCS.***

Off-Stream Watering

Providing watering devices off-stream has been shown to be an effective alternative to stream access. Examples such as nose water pumps can provide clean water to animals while minimizing trampling of streambanks. When given the choice, cattle drank from an off-stream water trough 92 percent of the time versus the time spent in the creek, as shown in an experiment conducted in Virginia (Sheffield et al., 1997). During this study, streambank erosion was reduced by 77 percent, and in-stream total suspended solids were reduced by 90 percent, total nitrogen by 54 percent and total phosphorus by 81 percent. During typical, hot Arkansas summers, cattle may still prefer the cooler stream areas, but nutrient transport into streams from feces should be avoided. Time spent by cattle in

FIGURE 8. Off-stream watering devices can reduce cattle damage to pond banks and ensure the availability of water in a safe manner. In the picture above, the soil surrounding the water access point is protected with coarse gravel to prevent the development of muddy conditions. ***Photograph courtesy of NRCS.***

streams can be minimized by providing shade that is located away from streams. If no other option is available than watering cattle from streams, livestock access points should be protected with gravel similar to a stream crossing so that animals do not linger, trample banks or otherwise damage the channel structure. For additional information, refer to Extension fact sheets FSA3021, *Water for Beef Cattle*, and FSA3128, *Watering Systems for Cattle Ponds*.

Grazing Management in Riparian Zones

Total livestock exclusion may provide the quickest results in terms of vegetation recovery in eroded riparian zones, but appropriate grazing management can greatly reduce negative impacts in riparian zones. In general, grazing practices that have negative effects on soil stability and plant vigor should be avoided. Grasses and forbs can be grazed in riparian areas as long as an approximate minimum canopy height of 4 inches is maintained. While most producers focus on grazing practices for cattle, an increasing number of farmers own goats and sheep, which have different grazing habits than large ruminants. Goats are browsers and can select individual leaves and strip bark of woody plants. Sheep graze close to the ground but tend to do less damage in riparian areas since these animals do not congregate in low-lying areas as they feel vulnerable to predation.

Riparian zones should be grazed whenever conditions allow for minimal environmental impact. The following recommendations should be considered whenever livestock is utilized to graze riparian vegetation:

- Monitor soil moisture content close to streams. If moisture content is high, soil is more sensitive to compaction, resulting in increased runoff during following precipitation events.

- Graze pastures to a height of no less than 4 inches.

- Avoid moving cattle to riparian zones during hot summer days. Cattle will linger in streams and may damage streambanks.

- Avoid cattle grazing during periods of flowering of native grass species.

- Avoid excessive grazing of woody species that build the underbrush in a riparian ecosystem.

Grazing methods utilized depend on the situation, but rotational stocking will likely be more beneficial from an environmental standpoint than continuous stocking. Furthermore, other methods such as strip grazing can be used to move cattle through sensitive areas quickly. Creep grazing can be used to give calves access to lush vegetation that usually develops in riparian zones due to generally higher soil moisture in these areas.

Management of Heavy Use Areas

Heavy use areas are those areas where livestock tend to congregate. Apart from watering devices and stream crossings that were previously covered, examples emphasized here include feeding areas, shade loafing areas, travel lanes, working facilities and holding pens. The typical site for these areas has little or no vegetative cover and substantial manure accumulation. Emphasizing soil, vegetation and animal management in these areas can reduce the potential for water impairment.

General Principles

Size

Heavy use areas are generally characterized by a lack of vegetative cover, compacted soil and a concentration of manure. Cattle cannot graze these areas because little if any forage is produced there. Heavy use areas cannot be completely avoided, but the size can be minimized. Travel lanes should be no wider than necessary to provide movement of cattle and equipment from one part of the farm to another. Holding pens and working facilities should be designed to make maximum use of a minimum of space.

Location

The location of a heavy use area can impact management efficiency and water quality. Select sites with higher elevation and slight to moderate slope to promote drainage and reduce the amount of standing water. Uniform slopes are less likely to puddle. Avoid steep slopes that increase the chance of nutrient runoff and erosion. Studies of settling channels for unpaved drylot runoff showed an accumulation of about 2 yd^3 of solids/head-year from a 340-foot-long lot with a 15-percent slope. From a shorter 7-percent slope, the settled solids were only 0.6 yd^3/head-year. Berms or grassed waterways may be necessary to direct water away from heavy use areas.

When determining the location of heavy use areas, avoid environmentally sensitive areas. These areas include creeks, ponds, wells, sinkholes or any access to surface or ground water. Constant action and movement of cattle can cause erosion problems and premature destruction of pond and creek banks. Water quality can be lowered by the increase in sediments due to erosion and the addition of bacteria and nutrients from manure. Fencing is the most effective management tool for limiting access to these areas. If fencing is not economically feasible, other options include:

- Providing shade in an environmentally safe area.
- Reviewing the external parasite control program used on the farm. Perhaps fly pressure is driving cattle to the pond for relief.
- Refer to grazing management practices that limit adverse health effects in cattle, such as replacing endophyte-infected tall fescue with an alternative.

FIGURE 9. Cattle should be managed in ways that limit access to ponds and creeks. Fencing is the most effective option, but other options exist. ***Photograph courtesy of NRCS.***

Management

The advantages of a well-maintained heavy use area are reduced amount of mud and standing water, and increased animal comfort, health and safety.

Beef producers usually find that heavy use areas require little routine management or maintenance. Filling in low spots and maintaining a uniform grade help minimize areas of standing and mud. Concrete, gravel or gravel over a geotextile mat may be needed to prevent excessively muddy conditions.

In most cases, scraping the area to remove excess manure is not needed. If scraping becomes necessary, excess manure collected from these sites can be used as an excellent fertilizer. The nutrient value will vary with the production phase and the ration being fed. It is estimated that one ton of manure from beef cattle would provide about the equivalent of 100 pounds of 11-7-10 fertilizer. Manure analysis is available through your local Cooperative Extension Service Office. To avoid stockpiling or manure storage problems, be sure to land-apply excess manure as it is collected. Apply in accordance with a nutrient management plan or at a proper agronomic rate when no rain is in the forecast.

Filter Strips

Filter strips are an important tool in nutrient management and are maintained to reduce the nutrient and bacterial content of runoff from the entire farm. Locating vegetative filter strips downslope from heavy use areas helps protect water resources. Quite often, pasture forage found downslope of the heavy use area serves as an effective filter strip.

Research at the University of Arkansas demonstrates that, with adequate vegetative cover, a filter strip's effectiveness is determined by the width and slope of the filter (Table 1). The wider the filter strip, the better the filtering action. A filter strip on a flatter slope will be more effective than on a steeper slope. As the slope increases, so should the width of the filter strip. Assistance is available from the University of Arkansas Cooperative Extension Service and the Natural Resources Conservation Service (NRCS) for the proper design of filter strips in accordance to a specific land type.

TABLE 1. Vegetative Filter Strips	
% Slope	Length of Flow
0% - 3% Slope	30 ft
3% - 8% Slope	50 ft
Over 8% Slope	100 ft
Critical Landscape Feature (e.g., well, sinkholes)	100 ft

Managing Specific Heavy Use Areas

Feeding Areas

Cattle tend to defecate near where they are fed; therefore, management of the feeding area is a major portion of the manure management aspects of a beef program. The point has already been made that the feeding site should be located away from any environmentally sensitive areas. When feeding grain or a mixed ration, use feed bunks or troughs. Permanent bunks or feeding sites may need to be on a concrete or geotextile mat. Move portable feeders as needed to allow these areas to recover.

Beef producers should also rotate hay-feeding areas throughout the feeding season. Portable hay rings can be used to help reduce waste, but they do not totally eliminate it as cattle tend to pull hay out of the ring and tromp it into the ground. Waste can be reduced by limiting the number of cows fed at one time. Two feet of space is needed for each mature cow to access hay in a ring. This limits the number of cattle that one hay ring can efficiently feed to approximately 15 head. Moving the portable rings on a regular basis to reduce excessively muddy conditions, spreading the manure over a large area and minimizing long-term damage to the pasture are important.

Unrolling round bales is another hay-feeding option. This enables more cattle to feed at one time and allows small calves to have a better chance to compete for hay. It also spreads the feeding area, resulting in cattle distributing manure over a larger area. The disadvantage to unrolling hay is that daily feeding is required and that it is not suitable for all producers.

After the hay-feeding season is over, producers should drag and smooth the feeding areas. A tire drag is an inexpensive and quite effective tool for this job. It does not clog up with debris but rather breaks up clods, spreads cow patties and helps level rough areas. Spreading the cattle manure smoothes the ground and helps reduce spot grazing.

Travel Lanes

Travel lanes are designed to ease movement of cattle on the farm. The use of well-designed lanes increases the producer's control of cattle movement and helps to limit the damaging effects of cattle movement on a small area.

Keep travel lane size to a minimum, allowing just enough room for maintenance and equipment transport. The amount of time cattle spend in the travel lane should be kept to a minimum, reducing the amount of manure deposited in this area. Careful planning of shade and feed locations helps in the movement of animals along the travel lane. Travel lanes should not be placed on steep slopes. A travel lane on a 15-percent slope generates more than twice the solids in runoff than a travel lane on a 7-percent slope.

Shade

Shade is important to cattle productivity and should be managed properly. Cattle may select natural shade as a loafing area, or producers may provide artificial shade to provide heat relief for their cattle. If cattle use the shade a few hours a day, manure accumulation and loss of vegetation will result. Move portable shade on a regular basis to allow for vegetative regrowth. Rotate pastures or use electric fencing to keep cattle from concentrating in one small area if they are loafing under natural shade. This reduces the potential for damage to trees and vegetation.

FIGURE 10. Shade is important to cattle productivity and should be managed to reduce potential non-point source pollution.

Additional Management Concerns

Carcass Disposal

Arkansas currently recognizes six acceptable methods for the disposal of large animal carcasses:

- Rendering
- Extrusion
- Burial
- Incineration
- Composting
- Cooking for swine food

Normally, a beef or dairy producer is limited by practicality to rendering or burial, with burial being the most widely practiced method. Cooking for swine food and extrusion require permits and specialized equipment. Composting and incineration require specialized facilities and equipment. If rendering is not feasible, select the most remote area possible for burial of dead animal carcasses. Avoid soils with a high water table. Do not bury carcasses within 300 feet of a stream or pond. For additional information on the proper procedures for carcass disposal in Arkansas, contact the Arkansas Livestock and Poultry Commission or the Arkansas Department of Environmental Quality.

Confinement Areas

In Arkansas, a concentrated animal feeding operation (CAFO) is classified as any lot or facility where cattle are confined and a significant portion of the vegetation is not maintained during the normal growing season. Due to the high concentration of animals and the absence of vegetation in these facilities, proper manure management is critical to preserve water quality. These facilities should be designed to allow for the collection, storage and utilization of the manure generated.

Confined operations may require a permit from the Arkansas Department of Pollution Control and Ecology. Several factors determine if a permit is required, including the number of head at the facility, whether the stockpiled manure is protected from the weather and the location and topography of the facility. For details about permit requirements and the permitting process, contact the Arkansas Department of Environmental Quality.

If a confined operation is in use or is being planned, your local conservation district office and the Natural Resources Conservation Service can assist in developing one or more alternative manure management plans.

Conclusions

The practices covered in this publication promote sound manure management for Arkansas beef producers. By following these practices, cattlemen can improve herd health, forage production and overall management efficiency while protecting the quality of Arkansas' water resources.

In Summary . . .

- A well-managed grazing system is essential to good cattle manure management. Use stocking rates that do not exceed the pasture's carrying capacity.
- Minimize the size of all heavy areas.
- Select sites for heavy use areas that have good drainage and minimum slope. Avoid environmentally sensitive areas. Limit cattle access to bodies of water.
- Maintain a vegetative filter strip downslope of all heavy use areas. Maintain proper widths corresponding to the slope of the site.
- Rotate feeding sites to allow recovery from heavy use. Move temporary structures, such as feeders, hay rings or mineral boxes on a regular basis.
- Water cattle from tanks when possible.
- Dispose of dead animals properly.

References

Ball, D. M., C. S. Hoveland and G. D. Lacefield. 2005. Southern forages. Potash and Phosphate Institute (PPI) and the Foundation of Agronomic Research, Norcross, GA.

Cunningham, K., C. Stuhlinger and H. Liechty. 2009. Riparian buffers: Types and establishment methods. FSA5027. Cooperative Extension Service, University of Arkansas, Little Rock, AR.

Lane, C. Preventing water contamination from beef cattle. PB 1426. University of Tennessee Agricultural Extension Service, Knoxville, TN.

MidWest Plan Service. Livestock waste facilities handbook. MWPS-18. Iowa State University, Ames, IA.

Rieck, A., K. VanDevender and J. Langston. Regulation No. 5 – Liquid waste management systems. Cooperative Extension Service, University of Arkansas, Little Rock, AR.

Schmidt, J. L., and B. F. Wolfley. Clean water for Washington, Protecting groundwater: Managing livestock on small acreage. EB1713. Cooperative Extension, Washington State University, Pullman, WA.

Sheffield, R. E., S. Mostaghimi, D. H. Vaughan, E. R. Collins, Jr., and V. G. Allen. 1997. Off-stream water sources for grazing cattle as a stream bank stabilization and water quality. BMP, Transactions of the ASAE, 40(3):595-604.

Sweeten, J. M. Cattle feedlot waste management practices for water and air pollution control. B-1671. Texas Agricultural Extension Service, Texas A&M University System.

Sweeten, J. M., C. Baird and L. Manning. Agricultural and silvicultural non-point source pollution management, "Animal waste management." L-5043. Texas Agricultural Extension Service, Texas A&M University System; Texas State Soil and Water Conservation Board.

Welch, T. G., R. W. Knight, D. Caudle, A. Garza and J. M. Sweeten. Agricultural and silviculture non-point source pollution management, "Grazing management." L-5041. Texas Agricultural Extension Service, Texas A&M University System; Texas State Soil and Water Conservation Board.

Printed by University of Arkansas Cooperative Extension Service Printing Services.

MP375-PD-3-11RV