

Providing Water for Beef Cattle in Rotational Grazing Systems

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Water is the most essential nutrient for cattle production. Water is used in almost every bodily function, including digestion, milk production, and excretion. Given the role and function of water in relation to animal production, health, and welfare, it is critical that abundant, clean water is available in any livestock production operation. Livestock must have immediate access to water within every paddock of a rotational grazing system to realize maximum efficiency and production.

Despite its importance, water is often the most poorly addressed component of animal nutrition on the farm. Although water may be available to cattle, the sources vary significantly within and among farms. Sources for water on farms range from full access to streams and ponds to city water-fed troughs located throughout the operation. The quantity, quality, and location of the water supplied can greatly influence feed intake, forage utilization and persistence, herd behavior, and manure distribution. Table 1 shows the relationship between air temperature, feed intake, and water consumption rates per head. Factors such as relative humidity, type of animal, shade availability, and distance to water also play important roles in determining the water intake rates of cattle. When designing a watering system, budget around 30 gallons per head per day to make sure that water is plentiful for your herd. Taking a thoughtful approach to water quality and quantity may help cattle producers achieve their long-term goals of increased production and profitability.

Water Sources

Not all water resources on a farm are equal. Depending on the source, there could be any number of contaminants in water that could affect cattle production. Research has demonstrated a positive relationship between access to clean drinking water and performance factors such as growth, reproduction, and milk production. Animals that drink clean,

Table 1. Water consumption requirements for cattle (gal/head/day)

Temp. (°F)	Gal/lb DM*	500 lb calf (12 lb DMI*)	750 lb calf (16.6 lb DMI)	1,100 lb dry cow	1,100 lb lactating cow
40	0.37	4.4	6.1	7.4	8.1
60	0.46	5.5	7.6	9.2	10.1
80	0.62	7.4	10.3	12.4	13.6
90	0.88	10.6	14.6	17.6	19.4

*DM = dry matter; DMI = dry matter intake.

Sources: ID-143, ID-170, Winchester and Morris

contaminant-free water are generally less prone to illness and disease, gain more weight, and produce more milk. The advantages of abundant, clean water include:

- Increased dry matter intake
- Increased average daily gains
- Increased milk production
- Decreased potential for illness and disease
- More efficient grazing and forage management
- Improved manure distribution

The disadvantages of limited water availability and/or poor water quality are:

- Reduced dry matter intake
- Inefficient average daily gains
- Reduced milk production
- Increased susceptibility to heat stress
- Illness or death caused by certain algal blooms or other water quality pollutants
- Inefficient grazing and forage management
- Concentrated manure distribution

Producers should exercise as much control as they can over both the quality and quantity of water provided to their animals. An inventory of water sources should be made on a field by field basis. Sources of water typically found on a farm are described below.

Streams

It is easy to understand why producers would want to utilize water from streams. They are pre-existing resources and are free for agricultural use. However, more than half of all streams that have been

evaluated are impaired, meaning that the streams are polluted and do not support one or more designated use (e.g.: drinking water, aquatic habitat, recreation). In Kentucky, agriculture is believed to be the main source of impairment in approximately 40 percent of impaired streams. Common agricultural pollutants are a result of runoff containing sediment, pesticides, fertilizers, and manure. Some areas also have urban runoff, including spills, effluent discharges, and sanitary sewer overflows from residential, commercial, and industrial sources as well. Depending on the concentration, these pollutants can cause poor water quality, which may be detrimental to cattle health and performance. Stream water quantity can also be unreliable during summer or have extreme fluctuations in flow throughout the year, depending on the size of the watershed area and the influence of neighboring properties.

Stream riparian areas normally contain trees (Figure 1). The combination of shade and water is a natural lure for cattle. Most research studies agree that mismanagement of riparian areas and streams can cause degradation of water and stream banks. Allowing cattle to have free access to streams and ponds can cause hoof problems, leptospirosis, mastitis, and other diseases. Conversely, providing an off-stream source of clean water may improve cattle production and grazing efficiency, and protect riparian areas. Shade structures can also be used to lure cattle away from riparian areas and encourage more efficient pasture utilization.

Ponds

Farm ponds are probably the most common water source for cattle and can be advantageous due to their location within a pasture and the fact that they provide essentially free water. The volume stored can provide water for livestock for long periods of time. They may also be used for fishing and other recreational activities, enticing producers to utilize existing ponds or create new ones. Some producers allow cattle to use existing ponds, and others consider ponds to be a liability and fence them off or fill them in. Reasons for excluding livestock from ponds range from the potential for disease transmission to poor water quality. Producers have lost cattle to the physical hazards associated with ponds, such as cattle falling through ice, sinking in mud, or drowning.

Algal blooms in ponds can be a source of poor drinking water quality (Figure 2). Harmful algal blooms (HABs) can produce a toxic compound known as microcystin, which may lead to livestock mortalities. Livestock should be excluded from ponds with visible algal blooms to reduce the potential for health impacts. If ponds with algal blooms must be used, it would be wise to have the water tested for microcystin.

Clear advantages exist when cattle are excluded from ponds and provided with alternative water.

Limited Access

Limiting the access of cattle to ponds and streams using heavy-use area ramps and fencing has been suggested as the lesser of the two evils when a stream or pond must be used as a water source. This approach is simple and inexpensive, especially when state or federal cost-share will design and fund the practice. Bank erosion is re-

duced since livestock do not have full access to the water source. Limiting access also means that sediment, nutrient, and bacterial loading are reduced, although not eliminated. Water quality may still negatively affect animal production.

Gravity-Fed Watering Structure

Completely excluding livestock from a pond and installing a system to deliver the water to a trough using pumps or gravity is an ideal method to provide water from a pond to livestock. The



Figure 1. The combination of shade and water in riparian areas is a natural lure for cattle. Photo by Amanda Gumbert



Figure 2. Algal blooms are common occurrences in farm ponds. Not all algal blooms produce toxic compounds; however, it would be advisable to avoid using ponds with visible algal blooms for drinking water for livestock. Photo by Dan Miller

approach minimizes erosion, thereby extending the life of the pond. It keeps the cattle out of the pond and reduces sediment and turbidity. Cattle that do not have access cannot fall through ice, get stuck in mud, or drown. Hoof problems and water borne disease transmission are greatly reduced. Overall water quality is improved. Producers need only establish the system, provide maintenance, and make sure that the watershed area leading to the pond is free from pollutants. Again, cost-share opportunities are available to design and fund this type of practice, providing that the topography and site conditions are suitable.



Figure 3. Developing springs can provide producers with an inexpensive, clean water source. Depending on their location, developed springs can be used to deliver water away from sensitive areas by gravity flow. Photo by Amanda Gumbert

Wells

Existing wells are common on many farms throughout Kentucky. Wells range in depth from tens to hundreds of feet and often pass through multiple geologic layers. The cost of drilling, installing, and developing new wells can vary greatly depending on the depth of the well and the type of geology that is encountered. The groundwater from wells varies in quality and can also vary in reliability. Common groundwater quality issues include low or high pH, heavy metal contamination, and/or high dissolved salt/sulfur content, which can be harmful or fatal to livestock. Groundwater wells have the potential to produce high quality water; however, it would be advisable to test the water quality of all groundwater wells prior to watering livestock from these sources.

Generally, well water must be brought to the surface with a pump. Pump requirements vary depending on the depth to water, change in elevation to the tank, and the distance water will be delivered from the well. Traditional AC-powered pumps may be used in areas that have access to on-grid power. Alternative energy pumping solutions should be evaluated for use in remote locations to potentially provide water in pastures that may have no other drinking water source.

Alternative energy pumping systems should include batteries or additional water storage to provide a backup when solar or wind energy is below minimum electrical generation thresholds.

Developed Springs

Fifty percent of Kentucky is either medium or heavy karst. Therefore, springs and seeps are features that can be found on many farms. Springs and seeps are areas on the farm where groundwater emerges and becomes surfacewater. If you have springs on your farm, they can be valuable livestock watering sources depending on the quality of the water. The flow may seem low at times, but the volume it produces can add up quickly.

Developing a spring involves routing emerging groundwater to storage tanks for collection and use for livestock watering (Figure 3). The main benefit of spring water is that it has a cool, constant temperature year round, which makes it more freeze-resistant than surfacewater resources in winter. The disadvantages of these systems are that the flow may stop during drought conditions, and they may not be where you need them the most. Once again, the water quality of the spring should be tested prior to use.

Developed springs should be considered as an option in remote areas within your rotational grazing system. Cost-share dollars are available for designing and constructing developed springs.

Water Harvesting

Water harvesting includes tapping into water from springs and seeps, but it also includes catching rainwater from roofs (Figure 4). Collecting water from roofs can provide significant quantities of high-quality water for livestock in a short amount of time. For example, during a one-inch rainfall event, approximately one gallon of water can be collected for every 1.6 square feet of catchment area (roof). The benefit of this type of system is that the producer is collecting free, high-quality water. All that has to be done is to design and implement the system using existing structures. This may provide cattle with water in remote locations where a water source does not currently exist or it is not economically feasible to provide otherwise. Water harvesting systems can be installed using inexpensive technology. Improved stormwater diversion through water harvesting practices can reduce the runoff of nutrients and manure from production areas as well.

Plumbing Fixtures

Producers can gain significant cattle production and health benefits by providing city water to fountains, tanks, and troughs. Properly located features can provide environmental benefits. Studies have shown that stream banks and water quality in streams can be improved by providing what is called “alternative water”—alternative in that the cattle are provided an option other than surfacewater. City water, a developed spring, and delivered water are just some of the options for alternative water sources. Figure 5 shows a tire waterer that has been installed to provide plentiful, clean water.



Figure 4. Harvesting water from a roof can provide producers with an alternative water source that is both clean and inexpensive. Photo by Lee Moser

Contaminants

Several waterborne illnesses and diseases can spread from contaminated water sources. Contaminants in water can also cause foul odors that reduce water consumption. Producers should provide water sources that force livestock to walk a distance no less than 150 feet from feed bunkers to reduce the amount of feed deposited in and around tanks, troughs, or bowls. Producers should also get in the habit of routinely cleaning the waterer. The ability to drain a waterer needs to be included in the design of watering systems. The drain design should allow for draining the waterer without creating erosion, mud, saturated bedding, and other conditions that may create health problems for livestock.

The location of a watering source is critical. Watering sources can influence grazing, compaction, and manure/nutrient deposition patterns. The watering source should be placed on a summit position because a high site should contain well-drained soils. The key is to choose a location that isn't heavily erodible, without the potential to create runoff that can pollute nearby water sources. Mineral



Figure 5. Large volume tire waterer tank installed in heavy-use area. Photo by Lee Moser

supplements should also be located away from water and feeding areas to further distribute traffic and manure (unless increased magnesium intake is necessary during grass tetany season).

Various water sources may have low or high pH or contain heavy metals, biological contaminants, or high dissolved salt/sulfur concentrations, which can be harmful or fatal to livestock. It is advisable that water sources for livestock are

tested for water quality based on *Drinking Water Quality Guidelines for Cattle* (ID-170).

Distance Traveled and Drinking Space

An optimized rotational grazing system should be designed so that cattle do not have to travel more than 800 feet for water. The guidelines for providing water extend beyond distance, however.

If cattle come to water as a group, 5 to 15 percent of the group should be able to drink at the same time. At 5 percent, one animal in twenty would have access to a waterer. Each drinking animal should have 20 inches of space at a circular tank and 30 inches at a straight tank. At 15 percent, three animals would drink at one time and would require up to 90 inches of space. A single-hole, automatic watering fountain may be suitable when animals tend to drink one at a time, the herd is small (less than 20), the cattle do not travel more than 800 feet for water, the pastures are small (<10 acres) and close to square in shape, and the cattle can see the waterer and the herd at the same time. There may be times of the year when a single-hole waterer would cause herd stress and displays of dominance. When travel distances increase to 800 or more feet, cattle may come up as a group, especially if the thermal heat index (THI) is in the medium to high range. Again, 5 to 15 percent of the group should be able to drink at one time.

Along with providing enough space for more than one animal to drink at a time, the water supply needs to be adequate. The water supply rate, volume of water, and allotted space need to be greater than or equal to the demand in order to allow non-dominant animals an opportunity to drink as much water as they need. Cattle are known to drink water at a rate of two gallons per minute and as high as six gallons per minute when extremely thirsty. If more than one animal can drink at once, the supply rate must be equal to the combined drinking capacity of the animals. If the flow rate cannot keep up with demand, then storage or additional volume in the form of increased tank size should be provided to offset the difference.

There are two rules for how much water to provide based on the water storage capacity of the tank. For small tanks, the flow rate should be equal to the maximum expected consumption rate multiplied by the maximum number of animals that can use the structure at one time. When flow rates cannot meet the cattle's consumption rate, large tanks should be used. For large tanks, the storage capacity of the tank should contain at least two gallons of water for every

cow in the herd and should be able to be refilled in a timeframe that ensures all cattle have water available when needed. This practice gets them back into the field and grazing.

Economics

Abundant, clean water provides production benefits. Production benefits can be translated directly into economic benefits. Increased animal production (gain) and the potential to increase the carrying capacity of pastures through more efficient water and forage utilization are achievable benefits when alternative water sources are combined with recommended pasture configurations (e.g.: square pastures, less than 800 feet to water, water away from shade sources) and a rotational grazing system. Increasing production through better water availability and quality means animals can be finished quicker and producers can get them off the farm faster. The result could provide potential reductions in feeding costs, management, and medication costs. The cost of installing and providing alternative water sources can often be recovered within one to five years through economic gains associated with increased production and operational efficiency.

To determine if implementing water quality and quantity BMPs or installing a new watering source will be cost effective, consider both the monetary cost and the expected environmental and economic benefit of increasing animal production and evaluate a break-even point and potential profit realization. A producer's goal should be to improve production efficiency by providing appropriate water sources and implementing conservation best management practices (BMPs) to improve water resources, which may be eligible for state cost-share programs.

Application

Implementing a rotational grazing system that provides water within 800 feet should create grazing patterns that take full advantage of the forages within a field. However, pasture features such as the shape of the field, artificial or natural shade, drainages, etc., can change grazing patterns. Manure deposits beneath trees and near water sources (e.g. drainages

and waterers) increases soil fertility in the area. Cattle that seldom leave shade trees in summer can create a manure pack, which can lead to hoof problems, pink eye, and other health issues.

Figure 6 shows fertility values for soil test phosphorus (STP) in pounds per acre for a cattle pasture. The distribution of soil fertility in this pasture shows elevated values along the stream, under trees, and near a watering fountain. It is an indication of how much time cattle spend near shade and water sources. Overgrazing fields with drainages can lead to denuded forages and erosion, which will limit the forage production potential of a field. Once gullies form, the effort needed to control further erosion is greatly increased. Gully plugs, grade stabilization structures, and other erosion control treatments could be implemented but seldom are.

The image also shows areas of low fertility throughout the remaining field (Figure 6). STP values of less than 45 pounds per acre would benefit from additional fertility. Producers could improve forage yields by improving low soil fertility. Conversely, values above 200 could cause environmental and animal production issues. The goal of rotational grazing is to evenly distribute manure across the field and to manage soil fertility by keeping it balanced, while utilizing forage in the most efficient manner. Fencing off streams and providing alternative sources of shade and water can help to more evenly distribute manure and nutrients throughout your pastures. Strategically locate alternative shade and water resources away from each other to force cattle to travel back and forth, thus improving manure distribution. Mineral supplements and feeding areas can also be strategically located to further improve nutrient distribution within your pastures. These combined practices can provide both environmental and production benefits.

Summary

Rotational grazing systems are not effective if water is not readily available to every paddock. If the watering source is of poor quality, improperly located, or a limited resource due to inadequate flow rates and space limitations, then produc-

tion may be limited. As a result, animal performance will not be optimized. Livestock may be more prone to diseases and illnesses if the supply is contaminated and intake rates are reduced. Ultimately, a producer's goal should be to always keep cattle hydrated and to limit stress. Beef cattle producers have the opportunity to enhance herd health and performance by improving water quantity and quality throughout their operation. On-farm water sources should be evaluated for water quality based on *Drinking Water Quality Guidelines for Cattle* (ID-170). A critical evaluation of water sources and managerial adjustments to create ideal watering sources may result in improved performance and profits.

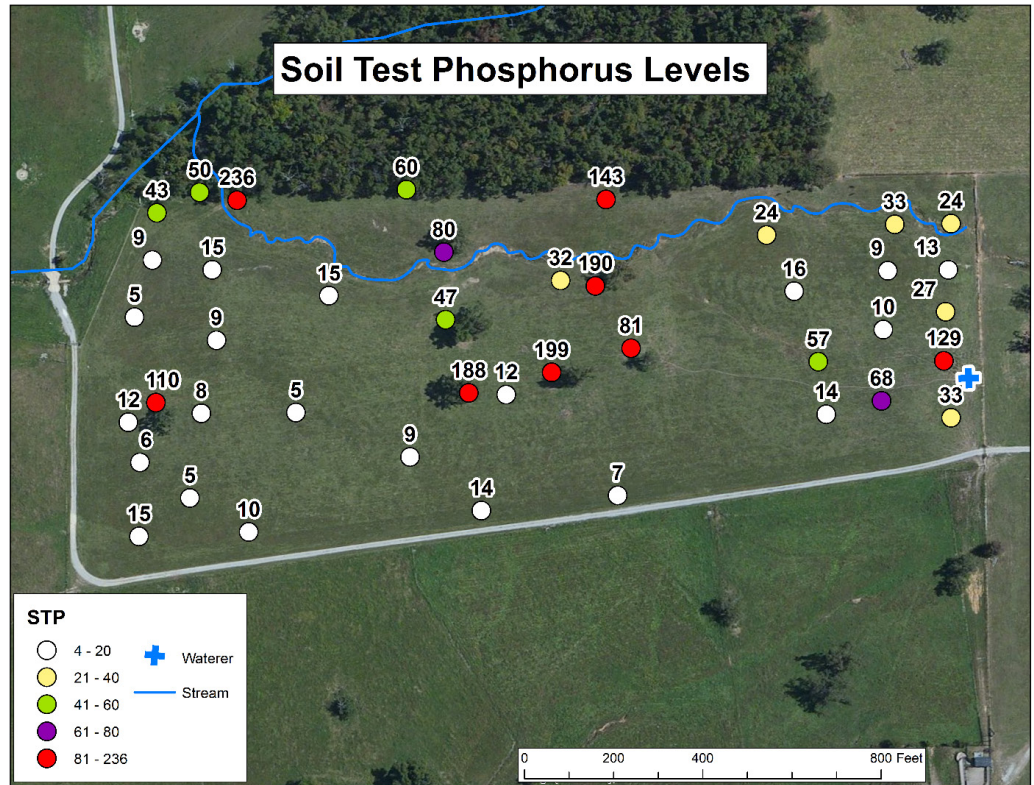


Figure 6. Soil test phosphorus (STP) distribution within a rectangular shaped pasture with a waterer at one end. Higher fertility is associated with increased time cattle spend lingering near the water sources and shade trees. Figure by Lee Moser

Suggested Publications and References

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