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Selection of Alternative Livestock Watering Systems

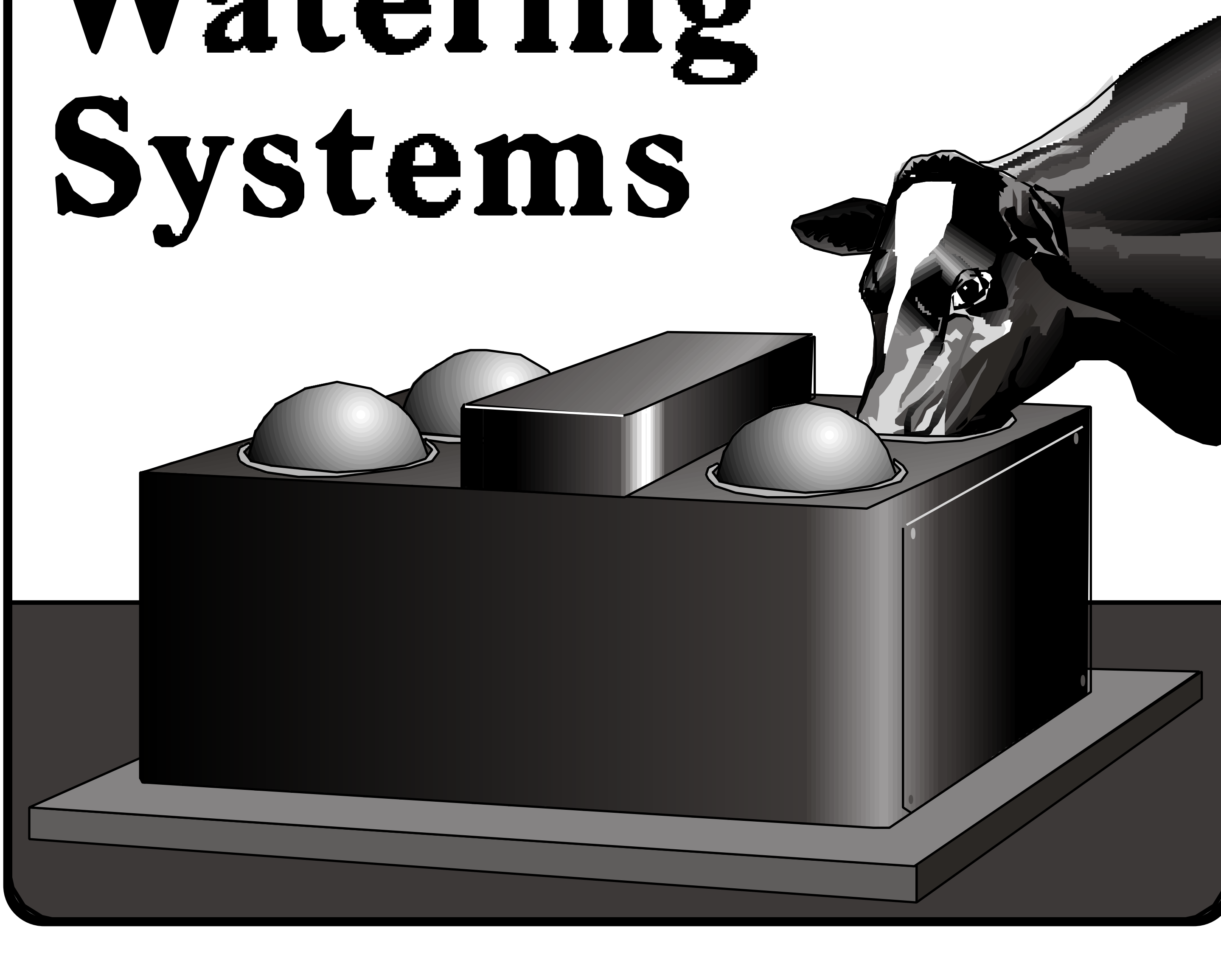

Table of Contents

Selection of Alternative Livestock Watering Systems

Robert T. Burns, Assistant Professor
Michael J. Buschermohle, Associate Professor
Agricultural and Biosystems Engineering

Introduction

Due to efforts to use improved grazing strategies, such as intensive rotational or paddock grazing, livestock producers need dependable and economically alternative methods of providing water to livestock. In addition, efforts to improve water quality have resulted in a new emphasis on the establishment of buffer strips and riparian zones along streams. In most cases, the establishment of these zones requires the exclusion of livestock. Livestock producers who rely on streams to provide water for their animals must develop alternative watering systems before they can rotate animals into grazing paddocks that do not adjoin streams or ponds, or before they can implement best management practices that require livestock exclusion from streams.

Several options are available to producers when choosing a livestock watering system. These systems can be divided into three basic types: direct access, gravity flow and pressure systems. The best system type for a particular producer will depend on many factors, including site layout, water requirement, availability and cost of utility water and electricity, as well as water source type and location. This publication provides basic descriptions of some livestock watering system alternatives, and discusses some of the positive and negative aspects of each.

Controlled Direct Access

Allowing animals to water directly from a stream or pond is historically the most commonly used livestock watering method. While this method is simple and inexpensive, it has limitations. Animals may have to travel long distances to drink when only one water access point is available in a large pasture. This is particularly a problem in rotational or paddock grazing systems. In scenarios where direct access is a viable option, benefits may be gained by the use of controlled access points designed to better facilitate livestock watering. Benefits such as reduced stream bank damage, reductions in erosion and the resulting sedimentation, improved riparian areas along streams and safer animal access to streams can be realized by excluding animals from all areas of the stream except well-designed and constructed improved access points.

Examples of improved access points are geotextile and aggregate reinforced stream crossings or access points. These crossings are constructed in full crossing and limited access configurations. Figure 1 illustrates a full stream crossing that can be used by animals as a water access point and also serves as an equipment crossing point. The crossing is underlain with synthetic geotextile material and finished with gravel to provide an all-weather stream access and crossing area. Figure 2 illustrates a cattle access area in a stream. The electrified chains prevent cattle from going up or down the stream from the access area provided. See the Agricultural and Biosystems Engineering departmental publication ***Construction of Farm Heavy Use Areas Using Geotextiles*** **(**WQ-01-00)***,*** for information on using geotextiles to construct heavy-use or high-traffic areas such as improved livestock access areas to streams.

Figure 1. Full Stream Crossing

Figure 2. Cattle Access Area

Gravity Systems

When a water source is higher than the deliver or usage point, gravity flow systems may be a good choice. Like direct access systems, gravity systems are relatively simple and inexpensive, since no external power source is required to move the water. Every 2.31 feet in elevation change is equal to 1 psi (pounds per square inch) in pressure. So, if 5 psi of pressure is required to operate a livestock water-tank float-valve, 12 feet of fall from the water line to the usage point is required.

Figure 3. Equipment Tire Tank

Most gravity systems are simply tanks equipped with float valves located lower than the water source, which is usually a pond. The water delivery pipe should be sized appropriately, so adequate flow into the tank is achieved. When building a pond, the outlet pipe should be installed during construction of the pond. It is difficult to install a pipe through a pond berm or levee after construction due to potential leakage problems. Figure 3 shows a heavy equipment tire modified as a livestock water tank. Used pan and large rock quarry truck tires of this size can be converted into livestock water tanks that hold approximately 300 gallons of water. These tires can usually be obtained free because of the cost companies must pay for their proper disposal. The tank shown in Figure 3 uses a float valve to control the water supply. As animals drink, the valve opens and allows more water to gravity flow into the tank. When the tank reaches the full level, the float holds the valve in the closed position.

Figure 4. Insulated Tank

The use of gravity systems is limited to locations where the water supply is above the delivery or usage point. Ponds or springs may fit this requirement and work well as gravity supply water sources, while streams are usually at the lowest point in a pasture and seldom can be used in this manner. Gravity tank systems can be installed so they are freeze-proof in all but the coldest weather by using insulated tanks or employing electric heaters or solar-powered bubblers. Several types of freeze-proof tanks are currently available. Heated tanks may not be feasible, since electricity for heater operation may not be available. Many freeze-proof tanks are simply well insulated and have some type of closure, such as floating balls, to seal off the water opening and help prevent freezing when animals are not drinking (Figure 4). An air-gap heat well is used to insulate the water delivery pipe where it enters the tank and to allow warmer air from below the soil freeze line to contact the tank. Allowing continuous water flow through the system will also reduce freezing problems. This may be an option when using a spring as the water source, but is not feasible with a pond.

AC Electric Pumping Systems

Standard AC-current, electric-pressure water systems are many times the best choice for providing livestock water on the basis of all-around convenience and dependability. The use of these systems is limited by the proximity of electric power to the water source. AC-pumping systems may use ponds, springs, streams or wells as their water source. The distance limitations vary with the power requirement of the pump to be used. As the distance between power supply and pump location increases, larger electric wire is required to avoid excessive voltage drop. The distance at which it becomes too costly to install an AC system depends on the pump current requirement and the cost of other feasible alternative systems at a given location.

The pump amperage requirement can be minimized by selecting 220-volt pumps over 110-volt units, when a 220-volt power supply is available. Submersible and standard suction-lift model electric AC pumps are available for pressure water systems. Submersible pumps are commonly used in wells, but may be installed in ponds or streams with proper pump selection. A submersible pump does not require priming and is freeze-proof because the pump is submerged below the water's surface. A suction-lift pump must be placed close enough to the water surface to ensure that the elevation difference between the water surface and pump does not exceed the lift capacity of the pump. This type of pump must be protected from freezing if it will be operated during cold weather.

Ram Pumps

Ram pumps are very simple hydraulic pumps that use the energy in falling water to pump a portion of the water to a height greater than the source. Ram pumps are very dependable when installed under the correct conditions. The diagram shown in Figure 5 outlines the basic parts of a ram pump. As water flows through the poppet, or clack valve, it is wasted until the flow reaches a velocity sufficient to close the valve. The water then travels through a check valve into the compression chamber. The compression chamber is filled with air that is compressed by the force of the water rushing in. The compressed air then forces the water out of the compression chamber. Due to the check valve, the only available flow path is out through the delivery pipe. Figure 6 shows a picture of a small ram pump that provides approximately two gallons per minute to a cattle water tank approximately 75 feet higher than the pump.

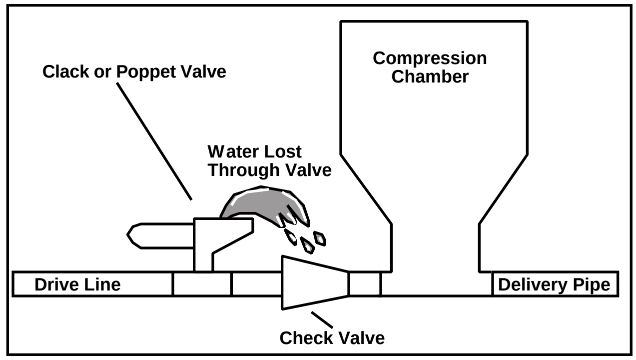

Figure 5. Ram Pump Components

Figure 6. Ram Pump

Ram pumps require no electrical power to operate and are inexpensive, considering that the original cost of the pump installation and infrequent maintenance are the only costs associated with the units. The amount of water a ram pump will provide is directly proportional to the available elevation head from the water source to the pump location and the volume of inflow water available to the pump. A ram pump will pump from 2 to 20 percent of the pump inflow volume, depending on the vertical fall to the pump and the elevation increase to the delivery point. While ram pumps can provide water to considerable elevations (up to 500 feet), the output flow is generally low. Although ram pumps will operate with very little fall, a minimum of about 10 feet of fall is required to achieve flows useful for livestock-watering needs.

A typical ram pump installation in a small stream or spring might provide one to two gallons per minute of output flow with a 10-foot vertical fall (driving head). Ram pumps provide low flows, but the flow is continuous. To take advantage of this continuous flow, tanks large enough to store water when livestock are not drinking are used to provide adequate water in higher water consumption periods. The pipe used to deliver water to the ram pump, called the drive pipe, must be mounted rigidly for proper operation. The drive pipe should be three to six times as long as the vertical head operating the pump. Drive pipes for ram pump sets with driving heads of 15 feet or less should be about six times the length of the drive head. Higher driving head installations of more than 25 feet should use about three times the driving head in drive-pipe length.

Solar DC-Pumping Systems

Solar pumping systems provide an alternative method to water livestock in areas where utility AC power is not available. Solar-pumping systems can be used to provide pressurized water from low-lying streams or ponds to locations of higher elevation. Solar DC-current pumping systems can be operated as either 12- or 24-volt systems, with or without batteries. University of Tennessee agricultural engineering Extension specialists have found 24-volt systems that use batteries to store the energy provided by the solar panels to be the most dependable combination under Tennessee conditions.

Figure 7. Solar Panels

Two solar panels, as shown in Figure 7, are used to charge a pair of deep-cycle, marine batteries. These batteries are wired in series to provide 24 volts to a DC-powered submersible pump. A pressure tank and pump control switch (shown in Figure 8) are used to control the water flow to a tank fitted with a float valve. The pressure tank and pump control switch control the water flow like they would in a home well system. These systems provide flow rates in the two- to three- gallon per minute range. While AC-pumping systems would be preferred over solar-powered DC systems on the basis of simplicity and capacity, solar-pumping systems can provide pressure water-delivery systems to areas where no other system could be operated. For more information concerning solar-livestock watering systems, see The University of Tennessee Agricultural Extension Service publication ***Solar Powered Livestock Watering Systems*** *(*PB1640). This publication gives specific information about the design, component selection and installation of solar- powered, DC-current, water-pumping systems designed to provide water for up to 50 beef animals.

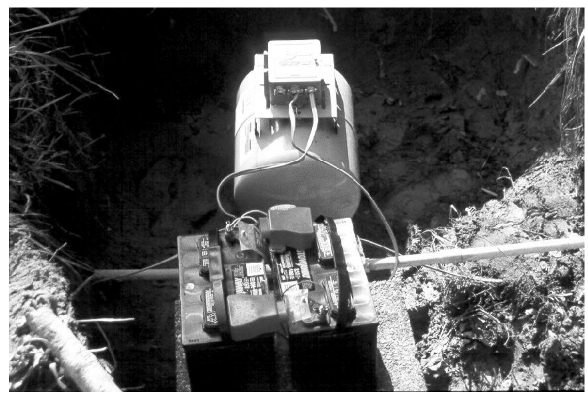

Figure 8. Pressure Tank and Batteries

Sling Pumps

Sling pumps provide an alternative means of pumping water in areas where electrical power is not available. Sling pumps use the energy provided by a flowing stream of water to pump water to a higher elevation. The sling pump is placed in the stream, as shown in Figure 9. Sling pumps are available in several sizes, but require a minimum of approximately 2.5 feet of water to operate in. Sling pumps also require a minimum stream velocity of approximately 1.5 feet per second to operate. A stream meeting both of these requirements will usually be substantial in size. The pumps are approximately 4 feet long and 2 feet in diameter at the large end. The unit has a series of blades attached to the nose of the sling pump body, as shown in Figure 10. The flowing water turns the blades and rotates the entire pump body. The pump body has pipe wound in a coil inside the unit, as shown in Figure 11. As the pump body rotates, water is forced through the pipe and pumped to the delivery location. The water-delivery pipe is connected to the nose of the sling pump and is routed from the pump through the stream and on to the water tank location.

Figure 9. Operating Sling Pump

Figure 10. Sling Pump

Figure 11. Inside of Sling Pump

Flow rates of one to two gallons per minute can be expected from sling pumps and can be provided to heights greater than 50 feet. Larger sling pumps provide larger flows, but also require higher stream velocities to operate. Like a ram pump, a sling pump will provide a low flow rate continuously. Storage tanks are usually used to store enough water to meet the livestock water requirements.

Although sling pumps have no operating costs in terms of electrical energy, they do have high maintenance requirements. Any floating debris caught in the blades, such as trash, sticks and leaves, can stop the pump from rotating. The pump must be well secured to prevent loss during high-water events. Frequent monitoring and periodic cleaning of the unit are required for dependable operation.

Nose Pumps

Nose pumps are simple diaphragm pumps that provide water when operated by livestock. When an animal pushes the pump arm or paddle with its nose, about a quart of water is pumped into a small drinking bowl by the animal's action. Nose pumps provide water to one animal at a time at a low flow rate, so their use is limited to small numbers of animals. These units must be set reasonably close to the water's surface in terms of elevation. Most nose pumps can lift water approximately 15 feet. Manufacturers suggest that the units be protected from freezing, which limits their use to warm months. Figure 12 shows a typical nose pump installation.

Figure 12. Nose Pump

Summary

The type of livestock watering system that will perform the best for you will depend on the specific situation at your farm. Table 1 provides a comparison of the system types covered in this publication. Each system type is rated as low, medium or high across several categories. These ratings can be used as a basic guide to determining which system types could be considered for use on your farm. For example, if you have a large number of cattle and require high water-flow rates, you can quickly exclude those system types indicated as having low flow rates by the table. Do not confuse low and high to mean bad and good. A pump system may be listed as both “low” for cost and water flow rate, which would indicate that it was inexpensive, but did not provide much water when compared to the other systems listed.

It is also important to note that the low, medium and high ratings are meant to be relative ratings within this group of listed systems. The cost comparisons assume that a water source already exists. For example, for a gravity-flow system, the cost of a pond is not considered, only the components needed to construct the system using an existing pond. It should also be noted that relative costs are compared on a per-system basis. Different system types can provide water to different numbers of animals under any given set of conditions. For this reason, two systems with a “low” cost might be required to provide water to the same number of animals as a single “high” cost system might handle. Each system has requirements that limit the locations at which it could be successfully installed. Table 2 indicates basic site requirements for each system types covered by this publication.

Table 1. Comparison of Alternative Livestock Watering Systems

System Type	Initial* Cost	Operating Cost	Maintenance	Reliability	Ability to Freeze-Proof	Water Flow Potential
Direct Access (Ponds & Streams)	Low	Low	Med	High	Med	High
Gravity Flow (Tank Systems)	Low	Low	Low	High	Med	Med
Utility Power (AC Electric)	Med	High	Med	High	High	High
Solar (DC Electric)	High	Med	Med	Med	High	Low
Ram Pump (Water Storage)	Med	Low	Med	High	Med	Low
Sling Pump (Water Storage)	Med	Low	High	Med	Med	Low
Nose Pump (Mechanical)	Low	Low	Low	Med	Low	Low

* Cost comparisons assume an available water source is already present and are based on individual system cost and not a per-animal basis.

Table 2 - Installation Considerations for Alternative Livestock Watering Systems

System Type	Considerations
Direct Access (Ponds & Streams)	Water source should be within reasonable distance from pasture location (preferably < 2000 feet) and must supply water year round.
Gravity Flow (Tank Systems)	Water source must be located at a higher elevation than livestock watering area. (10 feet suggested minimum elevation head).
Utility Power (AC Electric)	Utility electric power must be within a reasonable distance to water source. (Distance limit depends upon pump current requirements).
Solar (DC Electric)	Clear view of horizon for solar panel location. Area out of flood plain for construction of freeze-proof dry housing for electronic components and batteries.
Ram Pump (Water Storage)	Water source must be located at a higher elevation than pump set (> 10 feet), and adequate flow from spring or stream must exist (> 10 GPM).
Sling Pump (Water Storage)	Stream with adequate velocity (> 1.5 ft/sec) and depth (> 30 inches) nearby.
Nose Pump (Mechanical)	Pump must be located < 15 feet higher than water source.

For additional information and assistance concerning alternative livestock watering systems, contact your county Agricultural Extension office or your county Natural Resources Conservation Service (NRCS) office.

More information on ram, sling and nose pumps may be obtained from:

Rife Hydraulic Engine Manufacturing Company
P.O. Box 70
Wilkes-Barre, PA 18703

1-800-RIFE RAM
717-823-5730

More information on solar pumping systems may be obtained from:

Solar Water Technologies, Inc
426-B Elm Avenue
Portsmouth, Virginia 23704

www.solarwater.com

1-800-952-7221
757-398-0098

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