AEN-175

Rain Traps for Watering Livestock in Remote Locations

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The availability of abundant, clean water can be the most limiting factor for a grazing operation. Rainfall has been harvested for thousands of years to provide water for crops, humans, and livestock. A familiar example is a cistern adjacent to a barn or house. This old concept still offers opportunities and, with a little ingenuity, can be used to provide abundant, clean water for almost any situation and location. Modern technologies can also be applied to this ancient technique in the form of materials and devices to create practical and economical catchments, conveyances, storages, and automation. A rain trap is one method of rainwater harvesting that can be used to provide water for livestock in remote pastures.

The purpose of this document is to provide background information on the design of a rain trap and how this practice should be operated and managed. Individuals interested in using this practice should contact the Kentucky Natural Resources Conservation Service (NRCS-KY) and the Kentucky Division of Conservation (DOC) for technical and cost-share assistance. Once a contract has been developed with the relative agencies, a site-specific plan will be designed and implemented based on the NRCS practice standard Water Harvesting Catchment (Code 636).

What Is a Rain Trap?

A rain trap consists of a watertight ground cover used for collecting precipitation, which is then conveyed to a closed reservoir for storage. Stored water can then be distributed to livestock using either gravity flow to reach lower elevations or solar energy to power a pump for upland distribution.

Benefits

- Rain traps can be placed in underutilized or otherwise unproductive areas of an operation.
- The concept can be implemented on rented land and moved to a new location when the lease expires.
- A rain trap can provide water with higher quality compared to a pond, which may harbor harmful algae blooms (HABs) (Figure 1).

Disadvantages

- A rain trap requires fencing to exclude livestock. However, this requirement should be the same for a pond.
- Implementing a rain trap requires some technical expertise that the producer may not have.
- The volume of water collected can be limited by drought.
- Storage tanks, such as aboveground polyethylene tanks, may require additional design criteria to meet state or local building codes and permit requirements.
- Aboveground storage tanks may freeze in winter.

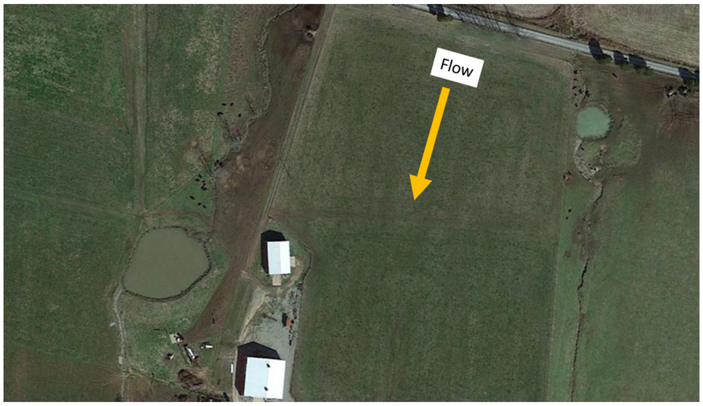

Figure 1. A livestock operation with several winter-feeding areas that drain into ponds used to meet their drinking water requirement.

Designing a Rain Trap System

To establish a rain trap, a catchment liner (e.g., 35-mil pond liner) is spread across the ground. The slope of the ground should allow the water to flow to a corner of the liner. A one-percent slope is necessary for water to flow, but a slope of two to ten percent works more efficiently. Earthen berms can be created to contain the water within the trap, or ditches can be installed along the perimeter to collect the flow. A benefit of using gravel-filled ditches is that the gravel can also hold the liner in place, in addition to filtering large particles and trash from the flow. Moreover, a flat profile can be created when using ditches, which will lessen the volume of leaves and debris deposited within the trap, as compared to when berms are used.

Water collected by the trap can be diverted into a holding tank for long-term storage. Stored water can then be fed by gravity to a water trough below the tank (Figure 2). If the downhill side of the rain trap is not an ideal location for watering stock, collected water can be pumped to an optimum location for a watering trough (Figure 3). A rain trap can be automated to pump water with a solar-powered water pump, float switch, and controller.

Rain Traps Versus Ponds

A valid question is "Why implement a rain trap rather than a pond?" As with any management decision, choosing to build a rain trap or a pond should be approached rationally, taking into consideration the advantages and disadvantages of both options.

Ponds can offer many benefits. They are simple projects and can be adapted to a variety of locations. Multiple examples can be seen in practice, and experienced contractors are readily available for implementation. Ponds will generally store a long-term supply of water, and they do not rely on mechanical or electronic parts that can fail. They can also be used for fishing and other recreational activities, in addition to fire suppression.

Ponds also carry limitations, in terms of environmental, financial and livestock safety concerns. Sedimentation and bank erosion can limit the life of the reservoir's storage. Direct livestock access can cause poor water quality, and both livestock access and upland runoff can lead to pollution. The relative costs of both the initial construction and later restoration are high, and ponds that do not hold water are difficult to repair. In addition, the runoff needed to refill the reservoir will be limited during periods of low rainfall, and when rainfall is heavy, erosion in emergency spillways can be a common problem.

Ponds can pose dangers for livestock, as steep banks can be hazardous when muddy and animals walking on the pond in winter can fall through the ice. During freezing conditions, a hole may need to be chopped through the ice for the animals to access water. Also, ponds are generally not suitable for sandy or rocky soil.

Preparing a Rain Trap Site

When readying a site for a rain trap, the area must be excavated to remove any brush, roots, or sharp objects, which could puncture the liner. Installing geotextile fabric under the liner to protect it from puncturing is also an option. Excavated soil can be used to create earthen berms to enclose the rain trap, or a flat rain trap can also be created, utilizing ditches for collecting flow. Any exposed soil can be reseeded to prevent erosion.

A rain trap can be designed to collect upland water. However, if the upland water flow has any pollutants, the flow can be diverted by placing a diversion ditch or berm on the upper side of the trap (Figure 4).

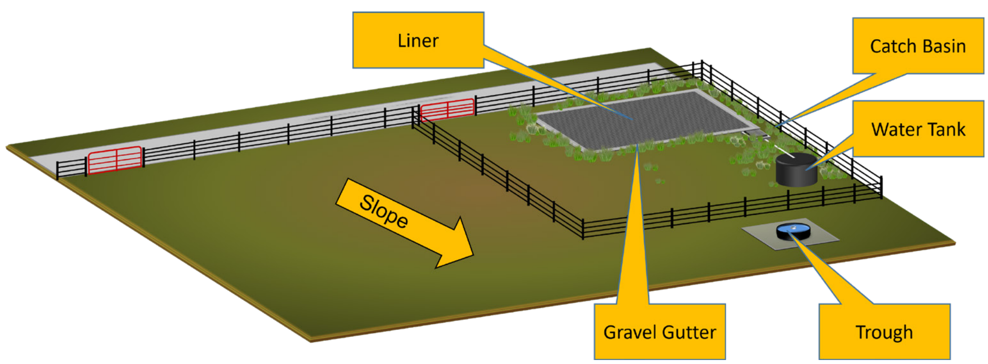

Figure 2. A gravity-fed rain trap. A fence excludes livestock from the trap. (Illustration by Donnie Stamper)

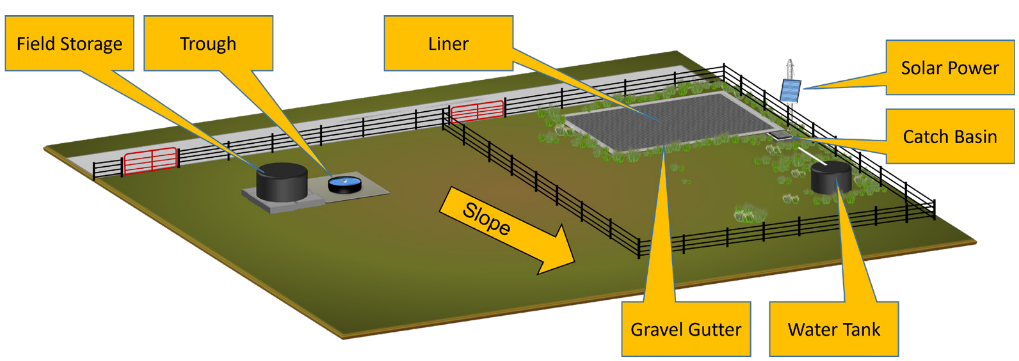

Figure 3. A solar-powered rain trap. (Illustration by Donnie Stamper)

Installation Examples

Figure 3 is an illustration of the rain trap built at the Eden Shale Farm, in Owenton, Kentucky. The figure shows the relative location, size, and shape of the rain trap, the solar array, the water tank below the trap, the field storage tank in the pasture, and the tire waterer used to provide water to the livestock. This trap captures approximately 6,800 gallons of water monthly and was created for 34 cow-calf pairs, which are rotated to a fresh pasture after approximately five to seven days.

The benefits of providing a cost-effective water distribution system and expanding the grazing operation were the motivating factors for this demonstration project. It also offered the opportunity to demonstrate a water-harvesting technology that could provide a localized watering system for livestock producers. Moreover, the ability to graze pastures that were previously unusable, due to a lack of water, could potentially pay for the cost of the system within several years.

Figure 5 is a ground-view image of the actual trap built at the Eden Shale Farm. A gravity-fed system for the collected rainwater was not an option at this location. Therefore, a solar-powered pump and distribution system were included in the design.

The Eden Shale Farm stretches over two square miles, with an archaic plumbing matrix dating back to the 1950s. As a matter of routine, several water line leaks are repaired every year. The rain trap system, by comparison, has an overall length of less than 300 feet. The short length of this system and its modern plumbing are beneficial to this farming operation.

A catch basin was included in the design as a collection point and sediment trap (Figure 6). It was placed at the lowest collection point but above the elevation of the water storage tank. A single 3,000-gallon water storage tank was placed on a bench at a lower elevation to allow filling by gravity. A second water storage tank was added the following year to increase holding capacity. Six-inch PVC pipes were installed to fill the tanks, allow overflow to dis-

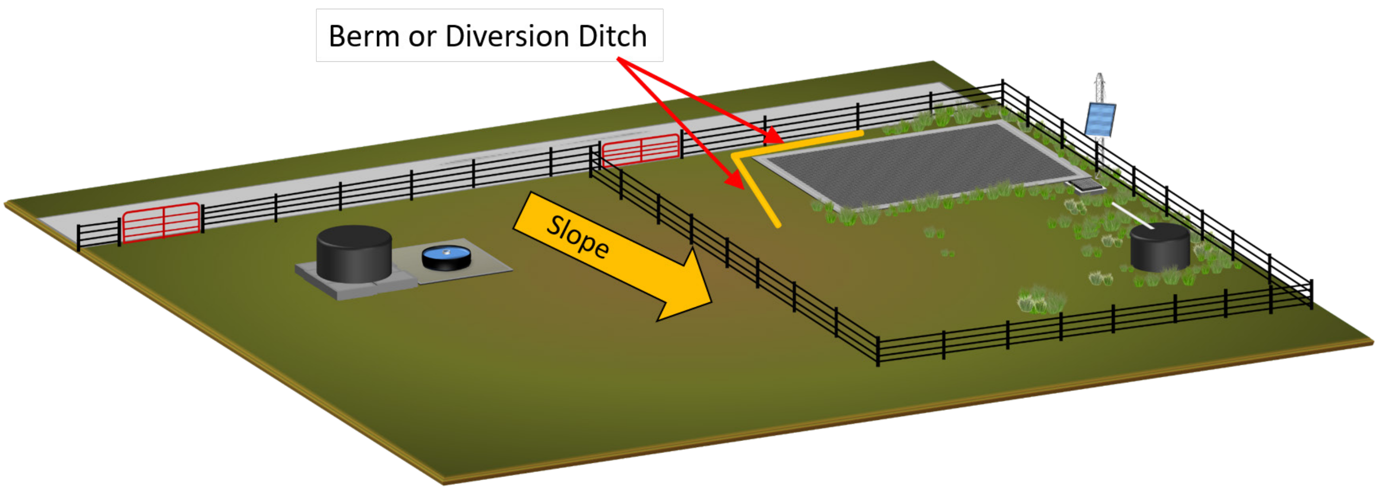

Figure 4. A rain trap with an upland diversion created to redirect flows that may contain pollutants. (Illustration by Donnie Stamper)

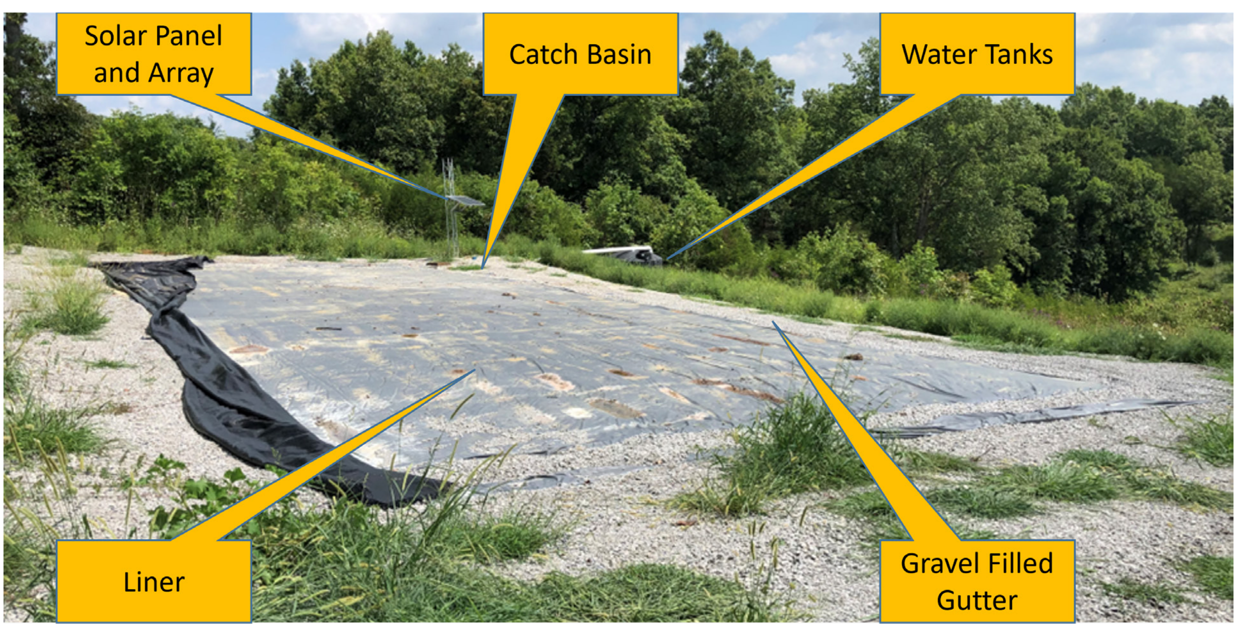

Figure 5. The rain trap area after construction, during which the brush and trees were removed and the land was graded to create the final surface for the trap. In the background is the solar panel and array used to power the water pump system. The top of the water tank, which stores a portion of the collected water, can barely be seen. A second water tank was added the following year.

charge, and drain the tanks for the off-season (winter). All storage facilities must have an overflow channel or pipe to carry excess flow away from the facility for safe disposal without excessive erosion.

Water troughs below the elevation of the storage tanks could be filled by gravity. However, this was not possible at this location. A solar panel was mounted to an array and connected to a controller (Figure 7) to pump the stored water upland (about 40 feet in elevation change) to the field storage tank and tire waterer placed in the field (Figure 8). Water from the field storage tank fills a tire waterer by gravity, using a mechanical float.

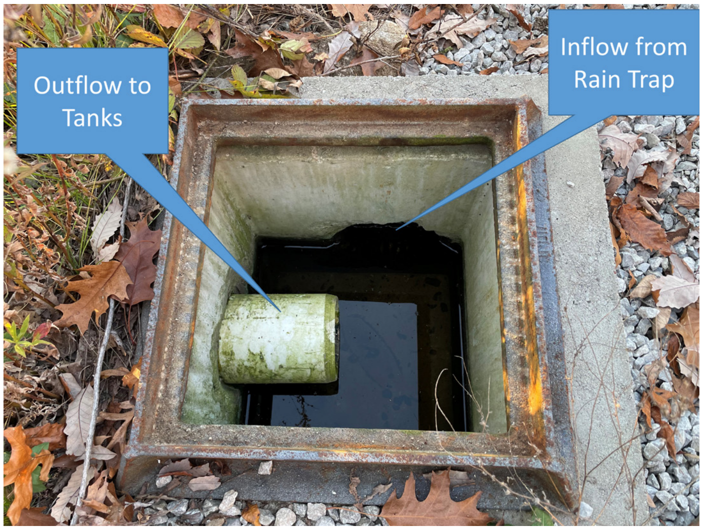

Figure 6. A catch basin collects the flow in one location, provides a chance for sedimentation to occur, and transfers the collected water to storage. The catch basin also includes a trash grate, which was removed for the photo.

Figure 7. A solar-powered pumping system is a useful tool for remote locations. This one is used to pump collected water to a livestock waterer located 275 feet away and 40 feet higher in elevation. The iron grate in the foreground covers the catch basin.

Figure 8. A harvested-water storage tank (field storage) placed in the grazing area provides the required amount of water during the grazing period. Water stored in the tank is gravity-fed into the waterer.

Operation and Maintenance Checklist

Operation

- In spring, close the drain valve on the collection tank and begin collecting water.
- Remove any sediment from the catch basin. Inspect the liner for damage. (NOTE: Drain tape can be used to repair small tears.)
- Reconnect the pump, if one is used.

Maintenance

- Inspect the liner for issues that could affect the operation of the rain trap (tears, signs of animal traffic, solar degradation, etc.), particularly after storm events and before periods of heavy use.
- Inspect for erosion at inflow and outflow areas, and repair if necessary.
- Where appropriate, conduct inspection and maintenance of fencing.
- Routinely check and clean the catch basin.
- Have the stored water tested for drinkability. For more information on water testing, consult Drinking Water Quality Guidelines for Cattle (ID-170).
- Check and maintain pump and float valve, as needed.
- Monitor system closely to ensure livestock are rotated from field prior to running out of stored water.
- Clean the waterer weekly when animals are present. The waterer should be emptied and cleaned before the next pasture rotation.

Winterization

- Winterize the system when risk of freezing temperatures is imminent (drain system, remove pump, etc.).
- Remove any debris that may obstruct the flow of runoff.

Summary

A rain trap is a practical application to solve the problem of providing water to remote pastures that may not have an adequate water supply. This system provides the ability to capture water with good water quality that is suitable for livestock consumption. A rain trap can be a better option for providing water than a pond, in that it can be placed where it is needed to control livestock distribution and thereby improve utilization and management of pastures. A rain trap can provide drinking water to livestock using gravity or solar energy. Moreover, a rain trap system may also be used to improve the distribution of cattle and improve grazing efficiency for multiple pastures. Access to previously unusable pastures due to a lack of water in isolated locations could potentially pay for the cost of these systems within several years. This concept may be an asset to livestock producers who need a water source on rented land, as the rain trap could be designed to be removable, either in whole or in part, after the lease agreement ends and transferrable to another location. Individuals interested in this practice should consider contacting the Natural Resources Conservation Service (NRCS) for technical assistance.

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