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Fences and Livestock Water for Pastures under Center Pivot Irrigation

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This NebGuide discusses a variety of fence designs and livestock water placements for center pivot irrigated pastures.

Irrigated pastures produce more forage and maintain stands longer under well-managed short-duration rotational grazing systems, compared with continuous grazing. The key management objectives for optimizing irrigated pasture production and stand life are:

1. Incorporate periods of non-use or deferment to allow plant recovery after grazing.
2. Leave adequate leaf area (based on stubble height) to increase the rate of plant recovery and production during deferment.
3. Use high livestock densities to improve harvest efficiency.

Reliable fencing and livestock water systems are essential for economically efficient irrigated pasture enterprises.

Fencing Pastures

Fencing around the outside of a pivot is usually permanent fence constructed of multiple strands of barbed wire or smooth, high-tensile electric wire. Allowing cattle to move freely between irrigated pasture and other types of forage, such as rangeland or dryland pasture, reduces the efficiency of irrigated pastures. Cattle should be restricted to one forage resource at a time, but can be moved between different forages in some management systems.

When fencing the perimeter of an irrigated pasture, do not include dryland areas such as “pivot corners” inside square or rectangular fences. Trampling damage and overgrazing can be severe, especially on sandy soils. Consequently, unprotected “pivot corners” are rapidly reduced to wasteland. Small non-erosive areas can be included within the pasture system for loafing, feeding or watering sites, but not for grazing purposes. Perimeter fences should nearly coincide with the outer limits of water application but may deviate from a perfect circle to facilitate fence construction.

The most conventional way to create paddocks for rotation grazing is for the fences to radiate from the center, making “pie-slice shaped” paddocks *(Figure 1)*. A minimum of five paddocks is recommended for an efficient grazing rotation system. A greater number of paddocks can be created, depending on management objectives.

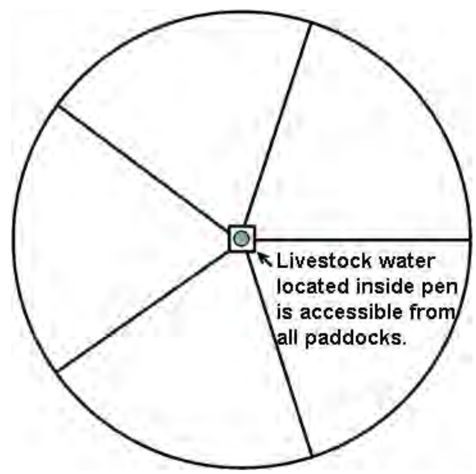

Figure 1. Example of a five-paddock irrigated system (pie-slice) with a centrally located livestock watering area.

A fenced lane can be constructed along one of the cross-fences to provide easy access to the pivot center or for moving livestock to the center for placement in a specific paddock. If more than one pivot is to be grazed, fewer cross-fences are needed for each pivot as long as the total number of paddocks for all pivots is sufficient for an effective rotation grazing system *(Figure 2)*.

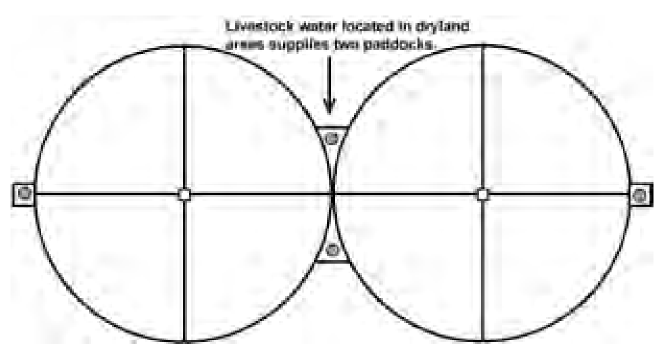

Figure 2. An example of a fencing arrangement for two adjacent center pivots to create eight paddocks with livestock water located on dryland areas.

Another irrigated pasture fencing design involves the construction of one circular paddock around the pivot center with cross-fences that divide the remaining concentric area into four arc-shaped paddocks *(Figure 3)*. An advantage of these designs is that they reduce the number of pivot towers that will have to cross fences. In the case of a nine-tower pivot system fenced as in *Figure 3*, four towers would be inside the circular paddock. Harvesting hay within circular or arc-shaped paddocks also may be easier, compared with a pie-slice paddock. A similar fencing design with six equally-sized paddocks is shown in *Figure 4*.

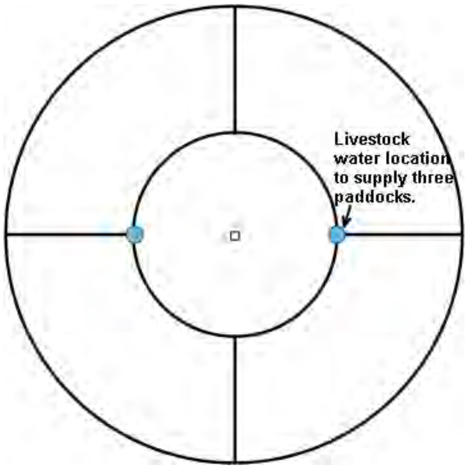

Figure 3. Example of a fencing design for a five-paddock system that incorporates a round center paddock. Each water location serves three paddocks. *Note:* **To create five equal-sized paddocks, the diameter of the circular paddock should be 45 percent of the diameter of the entire irrigated circle and the outside concentric area can be divided into four equal-sized paddocks as illustrated in the diagram.**

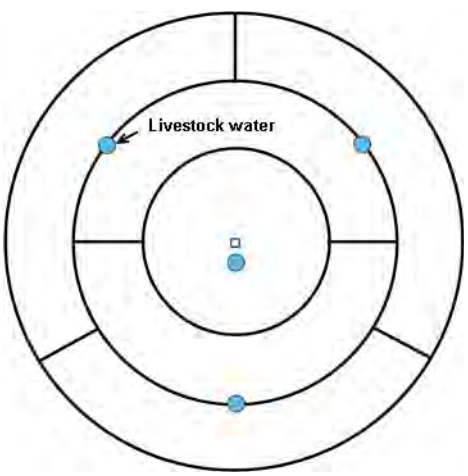

Figure 4. Example of a fencing design for a six-paddock system that incorporates a round central paddock and five additional arc-shaped paddocks. Additional cross-fences can be used to create more paddocks. *Note:* **To create six paddocks of equal size, the diameter of the center paddock should be 41 percent of the diameter of the entire irrigated circle. The outside diameter of the interior concentric area should be 71 percent of the diameter of the entire irrigated circle.**

A disadvantage of circular and arc-shaped paddocks is that they do not easily facilitate irrigation of an individual paddock. With a pie-slice design, irrigation water is often applied after livestock have finished grazing a paddock, or a paddock containing livestock could be skipped if one did not want to irrigate the paddock currently being grazed. In addition, the total length of fence required to form circular and arc-shaped paddocks will be slightly greater, compared with pie-slice fence designs for the same number of paddocks.

Fencing Materials

Both perimeter and interior cross-fences can be built as permanent-type construction, electric fence or a combination of both. Permanent barbed wire fence for irrigated pasture is more expensive to construct than electric fence but may be justified if a strict separation of different groups of cattle is important, such as two different breeding herds or yearling heifers separated from the breeding herd. Permanent barbed wire interior fence would normally consist of three or four strands of wire, using a non-electrified gate to allow passage of the towers. Some type of bracing is required at each side of the gate to maintain the tightness of the wire. This added cost is a major deterrent to using permanent fence. Permanent cross-fences significantly reduce management flexibility as one's irrigated pasture program evolves.

High-tensile electric fences are commonly used because they require less labor and are more economical to install than permanent barbed-wire fences. A considerable diversity of temporary electric fence products such as poly-wire, poly-tape or cable are readily available. Wood posts and bracing are often used at the beginning, corners and end of electric fences. Adequate insulation is necessary for most wood or metal posts. Fiberglass or plastic posts work well for intermediate fence segments. Two-wire electric fences are normally used when sheep, yearlings or calves are being confined. Single-wire electric fence should be 1/2 to 2/3 as high as the animal's back. A height of 30 inches is usually satisfactory for yearlings or larger cattle but may need to be lowered for calves. Electric fence energizers can be either 12-volt-battery powered, solar or a 115-volt AC type receiving current from a power line. Low-impedance energizers provide the highest levels of efficiency and effectiveness. Energizers vary in their capabilities. It is important to select an energizer with specifications and ratings that match your total length of fence and operating conditions. Proper grounding at the charger is very important for maintaining adequate charge along the entire fence. Fence construction costs vary widely depending on the type and materials used. If pasture fencing is developed as part of a USDA cost-share program, the fence must meet the practice specifications in the Field Office Technical Guide.

Crossing Fences with Pivot Towers

When a permanent barbed wire or electric fence is used for cross-fencing, gates can be constructed for the towers. These gates can be spring-loaded arms that allow tower passage. For electric fences, a commercially-available "hot-gate" can be used *(Figure 5)* or lengths of flexible high-tensile wire can serve as the "stingers" as shown in *Figure 6*. To facilitate charging the entire length of the fence through the gate openings, an insulated wire connecting the fence on each side of the opening is buried beneath the wheel track *(Figure 6)*. The wire should be buried deep enough so that the tower wheels do not contact it even when wheel track ruts develop. It is important to use insulated wire that is designed and rated for underground installation to minimize the possibility of shorting out the current. For added protection, the electric wire can be placed in a plastic conduit with the ends sealed with silicone caulking.

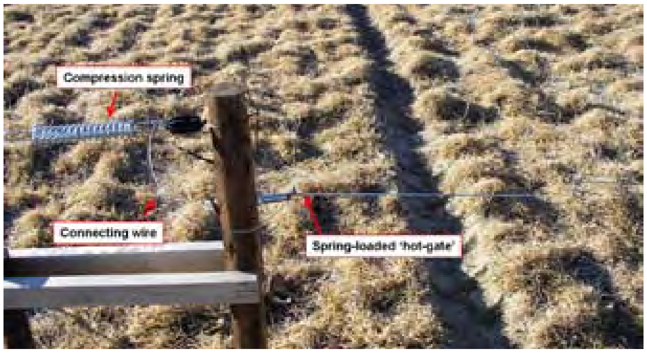

Figure 5. **Pivot tower crossing using a commercially-available spring-mounted "hot-gate."** *Note:* **Also shown in this photograph is a compression spring used to maintain wire tension in the fence.**

Figure 6. **Pivot tower gate for a two-wire high-tensile electric fence.** *Note:* **In this example, insulated wire in conduit is buried beneath the wheel-track to connect both sides of the fence and a wooden plank has been placed in the wheel track to reduce rut development through the gate.**

Another common option for crossing fences with pivot towers is the use of "drive-over" or "break-over" posts. These posts are usually made of fiberglass and are most often used with one to three strands of high-tensile electric wire. These posts are commercially available or can be constructed. Some drive-over posts have a metal plate hinge that connects the post to another post or stake that is driven into the ground *(Figure 7)*. With this type of drive-over post, wire tension keeps the post in an upright position when not being crossed by a tower. Therefore, compression springs *(Figure 5)* are critical for maintaining proper wire tension. Compression springs are usually placed at both ends of cross-fences.

Figure 7. **Drive-over post used in conjunction with a single-strand high-tensile wire.** *Note:* **Drive-over posts should be installed within 2 to 5 feet of the tower wheel.**

Another type of commercially-available drive-over post is shown in *Figure 8*. This product consists of a fiberglass post that is connected to the base via a spring. The base is secured to a 24- to 30-inch length of steel T-post that is driven into the ground.

Figure 8. **Commercially-available drive-over post used in conjunction with a single-strand high-tensile wire.**

One drive-over post is needed for each tower. Conventional posts can be used for the rest of the fence. Most drive-over post systems need an insulated wire-diverter mounted on the underside of the sprinkler tower base beam *(Figure 9)*. Some wire-diverter designs include a deflecting rod that aids in getting the wire(s) started in a downward direction for the pivot tires to cross. The depth of wheel tracks at the fence crossings should be periodically monitored to ensure that they are not getting too deep for the pivot tire to effectively get the wire(s) started in a downward direction. This is a common cause of fence being damaged or torn out by center pivots. Wooden planks or wood chips placed at the crossing points will reduce rut development. For some drop-nozzle irrigation systems, "boom-backs" are available that will divert water from the tower nozzles so they sprinkle the area behind the wheels. This results in wheel travel on drier and firmer soil.

When using a drive-over fencing design, the fence should be offset or placed at a slight angle from the pivot *(Figure 9)*. This will ensure that only one or two pivot towers are crossing and are in contact with the fence at any time. If all towers were crossing the fence at the same time, excessive stretch on the wire may occur.

Figure 9. **Pivot completing crossing of fence with drive-over posts.** *Note:* **The angle of the fence is offset from the pivot to ensure that only one or two towers are in contact with the fence at any time.**

Livestock Water

Important considerations for livestock water include: 1) source, 2) volume and storage needed, 3) delivery and tank placement, and 4) economics. Because of the high livestock density in most irrigated pasture systems, it is very important to have a livestock watering system that is reliable and capable of keeping up with demand. Daily water requirements for different classes of beef cattle on irrigated pasture are shown in *Table I*. There can be variability in the amount of water consumed on irrigated pasture, compared with other forage types such as rangeland. Factors such as moisture content of the forage, air temperature and travel distance all influence daily water intake. A 130-acre irrigated pasture at times may be stocked with 200 or more cow-calf pairs, resulting in a total daily requirement of 3,000 or more gallons. Four hundred yearlings could have a total daily requirement of 4,000 gallons.

Table I. Daily water requirements for different classes of beef cattle on irrigated pasture.

Class of cattle	*gallons/head/day*
Cow - calf pairs	12 – 15
Dry cows	10 – 12
Yearlings (500 – 800 lb)	8 – 10

A well with a submersible pump is generally a reliable source of livestock water. A pressure system may be needed at the well to facilitate delivery of water to the watering locations. Underground pipeline is a common way to get water from the well to the desired livestock watering points *(Figure 10)*. USDA cost share programs are available to offset the cost of water development. Technical guidance, proper installation methods and material specifications are available in the NRCS Field Office Technical Guide.

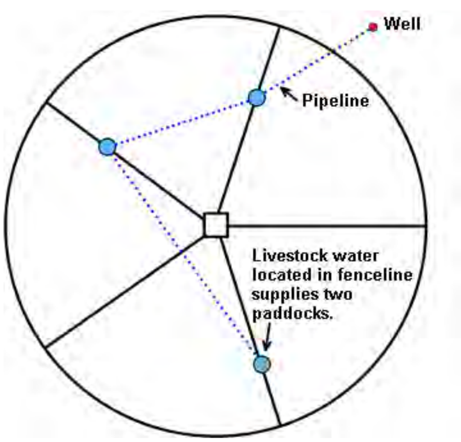

Figure 10. A five-paddock irrigated pasture system (pie-slice) with livestock water delivered to tanks through an underground pipeline. Tanks can be located about 1/2 to 2/3 of the distance from the pivot center.

Livestock watering systems should be independent of the irrigation system so that availability of water for cattle does not depend on operating the irrigation system. The irrigation system could serve as an emergency source of livestock water, but should not be the primary source. Other emergency water plans may include hauling water or having a portable generator to run submersible pumps.

Tanks should have the capacity to provide two to three days of storage supply in case the pump system stops operating due to electrical outage or mechanical failure *(Figure 11)*. Well-designed water systems and backup plans are critical for animal health and performance while the system is being repaired.

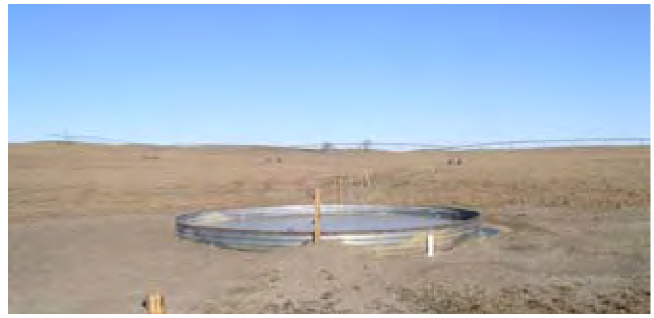

Figure 11. A large diameter livestock tank with adequate storage capacity. The larger diameter facilitates splitting the tank with a cross-fence. A tank such as this also could be used in a central watering area or in a water pen. Multiple tank locations may be needed depending upon the fencing design.

Livestock watering points can be located near the pivot head, within paddocks at a distance from the pivot head, between paddocks on the fenceline, at the perimeter of the paddocks or at a stable location off of the irrigated acres. A disadvantage of water located at the center is that there can be a tendency for trails to develop as cattle funnel into the watering area *(Figure 1)*. In addition, grazing distribution within a paddock may not be uniform, particularly at lower stocking densities because cattle may not graze at distances far from water. Locating water tanks in the fence line about 1/2 to 2/3 of the distance from the pivot head *(Figure 10)* or along the perimeter of the paddocks may improve grazing distribution. Water pens, constructed with electric fence, can be used at water tank locations and will reduce the size of the "sacrifice area" around a tank.

Possible water tank locations for adjacent pivots are shown in *Figure 2*. For combinations of circular and arc-shaped paddock designs, possible livestock water locations are shown in *Figures 3* and *4*.

Acknowledgment

This publication is a revision of the NebGuide *Cross Fences for Pastures under Center Pivot Irrigation* (G581) by James T. Nichols, Range and Forage Specialist (retired), UNL West Central Research and Extension Center, North Platte.

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