FENCING FOR OPTIMUM GRAZING

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Controlled or rotational grazing can result in better utilization of forage resources. By better forage management through controlled grazing, producers may increase profitability of cattle/forage systems. To effectively develop a controlled grazing system, however, fencing must be used to subdivide the pasture into sub-fields or paddocks. The animals may then be rotated among the paddocks to optimize forage and beef or dairy production from the system. Alfalfa grazing can play an important part in such a system.

Planning the "best", or optimum, fencing strategy should be done with the overall goal in mind of improving profitability. Key factors that describe the optimal system will include the number of paddocks needed, type of fence construction, water supply plan, and overall layout of the system. Although the optimum will be different for each farm, there are some general principles that apply to all farms.

PADDOCK NUMBER

One of the key management questions asked by producers considering a controlled grazing system is "How many paddocks should I use?". Obviously, there are no simple answers to this question. The most profitable, or optimum, number will vary depending upon individual farm circumstances and resources. These include the forage base and land, the animal type and number, and the management time and capability of the producer. However, there are some general guidelines that should be applicable to most situations.

Forage resources/land base

The forages to be used should be selected to provide good quality and supply over the grazing season. Cattle may graze more effectively on certain forages according to season. For example, endophyte-contaminated fescue is better used in the spring and fall as opposed to during the summer-slump period. Alfalfa might be an ideal forage crop to provide an alternative for the "slump" period. You may wish to creep graze calves ahead of cows onto alfalfa, or strip-graze across an alfalfa paddock. Therefore, separate paddocks will be needed for differing forage types. All fences used to develop a controlled grazing system need not be permanent. Portable, or temporary, fences may sub-divide fields which may later be used for cropping. Temporary fencing usually provides economic advantages when small paddocks are required.

The farm's soil types and land characteristics will influence the number and layout of paddocks. Almost all land classes are suitable for some form of grazing, while Class V and better land is suitable for intensive grazing.

The land's slope and orientation with respect to north (aspect) greatly influence plant environment and forage growth. Animals will tend to alter their grazing behavior depending upon the forage production of an area and its environment. If a paddock is non-homogeneous (that is, it contains areas of differing slope, soil and forage type), animals will tend to overgraze and undergraze in the same field. This fact makes the number of paddocks with respect to slope and aspect of the land very important.

Animal type/number

The type of animal used for grazing will influence the number of paddocks required. For example, stocker vs. cow-calf, dry versus lactating dairy cows, or multiple groups of similar animals may dictate that added paddocks be used to manage groups with differing needs.

How many paddocks?

Cattle should be concentrated into paddocks they can use in 3 to 7 days, according to most agronomists. Pastures generally need 25 to 30 days of rest. Therefore, 5 to 10 paddocks are recommended for a controlled grazing program.

In most cases, four paddocks are the minimum number that should be considered in a controlled grazing system. In some systems, three paddocks may be enough, but a system with four or more paddocks will generally be easier to manage and will provide more uniform grazing. Contrary to intuition, a two-field rotation is probably the most difficult system to manage properly. The forage growth tends to be more uneven, and one field tends to "get ahead" of the other in this kind of rotation. Further subdivisions allow management of the controlled grazing system to be more effective and consistent.

Systems with as many as 40 or more paddocks have been used in New Zealand and tested in some degree in the U.S. However, for most operations, the added benefits above approximately 8-10 paddocks are not worth the added costs of additional fencing, water, labor and management. An exception may be on many dairy operations, where cows are moved at least twice daily already, and a 12 or 24 hour rotation might become practical.

Incremental Fencing Costs for Increased Paddock Numbers

Each step in subdividing a farm into paddocks requires additional investment, but the first one or two steps are the most costly. Consider an example for a typical possible change from a single field, continuous system to a multiple-paddock system on an 80-acre farm. The following steps and costs are possible:

1. Add a single division fence, along with a training lot, and fence the pond.		
800' of division fence (3 wire)	@20¢/ft	$ 160
1600' of lot fence (6 wire)	@$1.00/ft	1600
High voltage, low impedance, solid-state energizer	$300	300
SUBTOTAL		$ 2060
2. Add more fence to create four paddocks		
1300' of permanent 3-wire fence	@20¢/ft	260
300' of permanent single wire fence	@10¢/ft	30
SUBTOTAL		$ 390
3. Add fence to create six paddocks		
1200' of permanent 3-wire fence	@20¢/ft	240
1200' of single-wire temp. fence	@10¢/ft	120
SUBTOTAL		$ 360
4. Add fence to create eight paddocks		
660' of polyethylene tape fence	@15¢/ft	$ 99
TOTAL FENCING SYSTEM COST FOR 8 PADDOCKS, INCLUDING TRAINING LOT, LANES AND POND FENCING	or	$ 2909 $36/acre

The above costs are in a mid-range of many system costs. Creative use of available materials, such as 1/2" electrical conduit for posts, can lower the costs, while commercially available posts will raise the costs of your fencing. On all but the training lot fence, labor is a low percentage of the total cost, since the single wire fences and even the 3-wire fences are low-tension installations.

Return for Fence Investment

As you will hear in other presentations at this conference, the potential is great with for using alfalfa as a portion or as a major part of a controlled fencing system. Compared to a conventional continuously-grazed high-endophyte fescue pasture, the returns are high. You might expect 150 lbs. of beef/acre from grazing stockers on such a continuous fescue system, while demonstrations in Kentucky have shown over 1000 lbs of beef production per acre in alfalfa grazing trials.

Table 1 shows the costs and the needed returns to pay for a fencing system in three years on our example 80-acre operation.

Table 1. Costs and beef production required to recover fencing costs for a new 80-acre fencing system.

Number of Paddocks	Fence system cost ($)		Annual beef production increase required, lb/acre[1]	
	Marginal	Total	Marginal	Total
1	0	0	0	0
2	2060	2060	10.7	10.7
4	390	2450	2.0	12.7
6	360	2810	1.9	14.6
8	99	2909	0.5	15.1

1. Assumes a 3-year simple payback and 80¢/lb price for stocker cattle marketed.

From Table 1, for a controlled grazing system with two paddocks, an increase in production of 10.7 lb/acre/year of beef will pay for the fence in 3 years. An added marginal investment to create 4 paddocks will only require the marginal return of 2 lb/acre more per year, or a total added production of 12.7 lb/acre. As you can see from the table, once the base system is in place, subdividing the fields using portable fence is very cost-effective. Only 15.1 lb/acre/year production is required to recover the cost of an 8-paddock fencing system. The beef production increases needed are easily achievable and have been demonstrated on many commercial farms in Kentucky for stocker situations. In other operations, such as cow-calf or dairy, the same approach can be used to calculate fencing benefits. Of course, in all cases, other costs are incurred including water supply, added labor and management and overhead (interest, etc.). Where the basis for a training lot exists already, a simple electrified fence offset could cut costs greatly for the first phase by reducing the cost of the lot fence to as low as one tenth of the $1600 cost shown.

FENCE CONSTRUCTION

Fence type

The most economical fence type for controlled grazing fencing systems has been found to be a combination of permanent electric smooth high-tensile wire fence and temporary portable polyethylene and steel braided fence (available on reels). An advantage of the reel is that it allows rapid set-up and take-down of fence for temporary arrangements or for strip grazing. Portable fiberglass fence posts are often used with the portable braided wire, using one strand of wire for large animals and two strands for calves. The high tensile wire for the permanent fence can often be installed using a "low-tension" technique, since it is electrified.

Fence construction

The type of wire suggested for permanent boundary fence installations is New Zealand-type high tensile wire. This is 12 1/2 ga. high tensile smooth wire which is heavily galvanized (Class III). Also, smaller diameter high tensile wires are now being used, particularly on interior division or paddock fences. These include 14 1/2 ga. and 16 ga. thicknesses. The use of such wire has implications in energizer selection (since smaller wires have a greater resistance to current flow) and in allowable length of fencing to be energized.

For interior and temporary fences, a more flexible, low-tension wire is becoming more popular. The smaller diameter, high tensile wire can be used, but many producers prefer a slightly softer grade of wire since it is somewhat easier to work with in moving and handling the fence. An excellent alternative for very temporary installations is braided wire containing very fine gage steel wires braided with polyethylene strands into a wire, ribbon or tape. These wires work quite well for installations of up to 1200 ft. Because of the lower cross sectional area of the steel, energizer requirements differ from that of smooth high tensile wire.

Wire spacing. As discussed previously, wire spacing depends upon the type of livestock being fenced. Table 2 presents suggested wire spacings for permanent or temporary electric fences.

Table 2. Suggested wire spacings for permanent and temporary electric fences.

Cattle type	Wire Spacing Above Ground (for wire numbers)				
	1	2	3	4	5
Cows	30"				
Cows & calves	17"	38"			
Hard-to-hold	17"	27"	38"		
Boundary	5"	10"	17"	27"	38"

Energizer selection

No standard exists for rating energizers in the United States. In practice, many producers are purchasing energizers which are larger than may be necessary to attempt to ensure an adequate current level on the fence and to provide for expansion. Therefore, the major factors influencing energizer selection (aside from length of fence and number of wires) should be personal preference, price, warranty and availability of service. Hopefully, in the future, new standards will make it easier to compare energizers according to performance.

WATER SUPPLY

Requirements and Sources

Water requirements vary depending upon the type and size of the animal, and on the time of year. Table 3 summarizes the requirements for beef cattle. Table 4 indicates the space requirements for waterers. Note that tank or water space requirements are higher for animals on pasture as opposed to dry lot conditions.

Table 3. Water requirements for beef cattle, gallons/day.

Animal Type	50° F	90° F
400 pound calves	4-7	8-15
800 pound feeders	8	15-18
1000 pound feeders	9-10	18-20
Cows and bulls	9-14	18-27

Source: MWPS-6 Beef Housing and Equipment Handbook

Table 4. Waterer space requirements for beef cattle.

Animal Weight	Water cup/bowl (hd/space)		Tank (hd/ft. of perimeter)	
	on pasture	in lot	on pasture	in lot
400-800 lb	18	25	10	16
1000 lb	15	20	10	16
1300 lb	14	18	10	16

Source: MWPS-6 Beef Housing and Equipment Handbook

Sources of water for grazing include municipal systems, springs, ponds, wells or other farm sources. The use of streams as water supplies can potentially cause problems both in terms of health of the animals, and by increasing stream bank erosion and water pollution.

Fencing of streambanks is becoming a topic of greater interest not only by agricultural producers, but by the general population concerned with non-point source pollution. Several states have or are considering regulations to require stream bank fencing. In those instances, pumps and a distribution system will be required to supply water to grazing animals. Ponds should also be fenced with a water tank placed below the pond to keep animals out of the pond.

Water location

The most desirable arrangement for water supply is to provide water within each paddock, so that animals do not have to travel back and forth between the forage and water. A separate water supply may be provided to individual paddocks by using above-ground plastic pipe to deliver water to portable troughs for summer grazing. Buried water lines may also be installed to individual paddocks, but the expense is much greater and payback will be much longer. If permanent water lines are installed, the paddock locations should be well defined prior to installation.

Costs for supplying a distributed portable water system generally range from $10-25/acre. An alternative is to use a lane for access to water. Lanes of up to 1/4 mile to a central water source may be used instead of providing remote water tanks or building additional ponds. When such lanes are used, however, animal performance will be reduced since the animals will use extra energy travelling to the water source, and may tend to congregate there rather than go back out to the paddock to eat.

OVERALL SYSTEM LAYOUT

Once the boundary fence has been established, further subdivisions may be created with a combination of permanent and temporary fencing to create four or more paddocks. The fences should follow the main contour of the land to provide fields of similar soil type and slope.

Two or three-wire electric fences are adequate for major divisions and lanes, with 5-wire electric fence used for a barn lot or "training" lot. Smaller paddock subdivisions may be developed with single wire construction, or two wires for a cow-calf situation. Creep fences or gates can be used to allow grazing of high-quality forage by calves ahead of the cows.

The fence need not be straight. Although a straight fence will be shorter, it is better to follow the contours of the land rather than maintain a straight line. All paddocks can be arranged to have access to a central lot so that stock have a source of water and can be handled easily.

Pie-shaped fencing systems are sometimes planned so that animals may have access to a central water source. However, there are problems with such arrangements, and they are **not recommended**. The area around the water source often becomes a mud hole from cattle congregating to such a small area. Research shows that 6% or more of the pasture in such an arrangement becomes a sacrifice area because of cattle trails converging to one central location. Also, creating paddocks that follow land contours is often more difficult with the pie-shape, depending upon the terrain of the particular farm. In terms of fence requirements, research indicates that a rectangular paddock system with a central lane to water required 17% less fence than the "pie" design, and the lane would contain less than 1% of the pasture.

Additional Temporary Subdivisions

Although a four-paddock fencing system gives a workable rotation system, slope, orientation and forage type differences within paddocks could still cause uneven grazing. A combination of portable and permanent fencing could be used to give the more uniform paddocks desired. Temporary fences also allow for larger areas to be cropped, or for making hay, while still creating the smaller paddocks that give better control for grazing.

Gate Placement

Gate placement is important in a controlled grazing system because animals are moved frequently. A gate should be in a corner of the paddock. It should be located with ease of animal movement in mind so that when the lead animal moves out of the paddock down the lane, others will follow out the gate rather than along the inside of the paddock fence.

SUMMARY

Some general guidelines for planning controlled grazing fencing systems, developed from experience and demonstrations, can be summarized as follows:

1) Concentrate cattle into paddocks they can use in 3 to 7 days. Pastures generally need 25 to 30 days of rest. Therefore, at least 4 or 5 paddocks are recommended to begin a controlled grazing program. Three paddocks are the minimum which should be considered.
2) Use only a portion of a farm the first year to gain experience managing the system before expanding to a larger part of the farm.
3) The initial four or more paddocks may be laid out with permanent, low-tension fences and then subdivided using temporary fences.
4) Provide paddocks to enclose areas as similar possible in terms of soil, forage and slope/aspect characteristics.
5) Distributed water supplies using temporary surface pipe or permanent systems will promote increased forage intake and reduce the problems with cattle standing idle in a central water area. Initially, lanes of up to 1/4 mile miles to a central water source are less costly than providing water to each paddock, but performance may be reduced.
6) Avoid the pie-shaped design unless it is particularly suited to a farm's resources.

Fencing systems for controlled grazing must be tailored to each individual farm. There are common principles, though, which should be used for every farm. Producer experiences in Kentucky indicate that a wide diversity of types of installations can be successfully implemented, from a single wire, low investment system to a multi-wire permanent installation.

For more information on fencing system planning, consult the following references, available through your County Extension Office:

"Planning fencing systems for intensive grazing management". ID-74, University of Kentucky Cooperative Extension Service.

"Creep grazing for beef calves". ID-76, University of Kentucky Cooperative Extension Service.

"High-tensile wire fencing". NRAES-11, Northeast Region Agricultural Engineering Service, Cornell University, Ithaca. Available from Farm Plan Service, Univ. of Ky. (cost item).

"Constructing high-tensile wire fencing" (12:50 minute videotape). Tape No. V11-AE-0432. Agricultural Communications Services, University of Kentucky Cooperative Extension Service.