Picking Apples off the Grazing Tree: How Far Can We Extend the Grazing Season Profitably?

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Introduction

Will grazing more and feeding less hay always increase profitability? There are many cases where cattle farmers could graze more days profitably. I would guess that more than half the cattlemen in Kentucky and the region could find ways to do so. But the statement is not universally correct and we need to evaluate the specific situation to determine if increasing grazing days will pay off.

The idea that we can be more profitable by grazing more days and feeding less hay is a powerful one, and at first glance seems reasonable. I have seen figures stating the average cost of a grazing day and then comparing this to the average cost of a hay feeding day. The *average* hay feeding day is shown to be considerably more expensive (correctly) and thus the argument goes that by each additional day we can graze, we will save the difference. If this difference is $.50 per grazing day for example, and we have 50 cows, we are saving $25 for each extra day that we graze the herd. Unfortunately, the economics behind this simple math breaks down upon closer examination.

The most important reason that this logic doesn't hold is that as we push the envelope and graze more and more days, those last few days grazing will not be at the same cost as the average cost of grazing – they will be higher, potentially much higher. The most effective way I have found to help farmers understand this phenomenon without using lots of economic jargon is the following analogy: Think about picking apples out of one of those big standard sized trees that used to be popular in orchards, during a banner year when it is loaded with apples. Where do you start picking? You get all the fruit that you can easily reach from the ground, correct? This is where you can pick most efficiently. Pretty easy, what do you do next? Well, you might get on your tippy toes and a go around the tree and get a few more. Were you as efficient in terms of apples picked per minute as you were when your feet were firmly planted on the ground? No, not quite.

Then what? If you grew up picking apples, you will probably know to gently pull down some of the longer, flexible branches to reach more apples, right? Are you as efficient here as on your tippy toes? Again, not quite. The cost to pick those apples has increased again. So you have picked all the apples you can by pulling branches down. What do you do next? Depending on your coordination and dexterity, you either get a ladder or you climb up into the tree to start working on the rest. Are you going to be as efficient in either case as you were previously? Definitely not. The point of this analogy is that you are proverbially and literally picking the low

hanging fruit first, and then go on to the apples that are harder and harder to reach. Thus we start by picking the fruit that has the lowest cost, and as we work up into that tree, the cost per apple keeps increasing and increasing. Would you pick every last apple on that 30 foot tall tree? Probably not. Why? Because the cost of some of the apples, the ones that are hardest to reach, will likely be greater than the value of those apples. But if we used the *average cost* of picking an apple (when we were picking on the ground) as our guide for what we should do, and not the actual cost to pick those last apples, it would tell us to pick every last apple (i.e. graze 365 days a year).

Think of grazing in this same light: The Grazing Tree. What are most livestock farmers going to do first to increase the number of grazing days and reduce the amount of hay they need to feed? The low hanging fruit years ago was simply applying nitrogen to pastures to boost production. Today, with nitrogen costs 4-5 times higher than it was 15-20 years ago, learning how to establish and manage a good clover stand is the new low-hanging fruit. This is probably the lowest cost method of increasing grazing days. What's next on the Grazing Tree? Realizing that everyone's Grazing Tree looks a bit different the next lowest hanging fruit is probably learning how to implement effective rotational grazing. These first two areas are where the Cooperative Extension Service in Kentucky has made great strides in my opinion. Both are relatively low cost methods to increase grazing days. But unfortunately, at some point we run out of apples at this level. What next?

Well, we could stockpile fescue: Set aside pasture in early August to build up forage reserves, and defer this grazing into late fall and winter. This will buy us additional grazing days. Unfortunately, many cattle farmers won't have excess pasture production in August to remove a portion of it from the rotation. If they did, they would be understocked for much of the grazing season, which is a cost of its own (foregone profit for the removed animals). So there would also be an indirect cost of reduced stocking rate in addition to the direct costs such as the nitrogen. Thus our cost to graze additional days keeps increasing.

To increase grazing days further beyond applying nitrogen and stockpiling we would likely have to reduce stocking rates even further so that our winter forage stockpile will be stretched further with fewer animals. This increases our grazing cost per day due to the foregone profit of the de-stocked animals as well as less total utilization of the total forage base (more will be wasted from the spring surplus with fewer animals keeping up with the heavy growth).

Thus the higher we continue to go in the Grazing Tree, the higher and higher the cost of a grazing day becomes. The average cost of a grazing day from the base pasture system (the low hanging fruit) has been long passed by. At some point, and that point will be different on every farm in Kentucky, the cost to graze an additional day will be greater than the benefit (reduced hay feeding day).

For quite a few years in the cattle cycle, up until about 2010 or 2011, we could have profitably climbed a lot further up into the Grazing Tree than we can today. During that time, profitability for cow-calf farms was low at best, and losing money at worst. In a situation like this, reducing

stocking rate is not much of a cost: If you are making next to nothing per animal, less animals will not change overall profit by much. But if at the same time you are significantly reducing cost per animal by feeding less hay, your overall profitability will increase.

The last two years, however, with profits of $300-500 per cow, reducing stocking rate comes at a very high cost. If we have to reduce stocking rate by just 10% to implement a particular practice, that is a $50 indirect cost per cow that we need to add to the direct costs of that practice. Thus the same practices, or the degree that we push them, that may have been economically viable for extending the grazing season in 2006 may not be economically viable today. Put another way, you are better off having a relatively low stocking rate and reducing the hay fed per cow when profitability is low, and having a relatively high stocking rate and increasing the hay fed per cow when profitability is high. This, I'm afraid, is a concept that many cattle farmers as well as extension specialists have failed to grasp.

Extended Grazing Analysis

The analysis that follows is an example showing the tradeoff between reduced hay costs and reduced stocking rates. A forage distribution-availability model was used to simulate a well-managed 100 acre farm in central Kentucky with a base forage production of 3.6 tons/acre. Table 1 details the forage availability for the base pasture. Note this represents the base availability, but there were allowances for excess forage to be carried over into the next period specified as follows:

April-May 20% could be carried into June
June-August 40% could be carried into fall

These percentages are all relative to total forage production in that period. Thus up to 40% of summer forage production is allowed to be carried over into fall (if available). The reason for the low allowed carry-over in April-May is because most of the remaining forage at this time will have become over-mature and would either be refused by the cattle, trampled, or bush-hogged to make room for new vegetative growth (mob-graziers would likely take exception to this rule). By early summer, most of the re-growth after grazing will be vegetative, and more can be carried forward with much less loss in quality or usage.

Table 1. Forage Distribution Details (availability)

Period	Pasture (Percentage of Total Production)
April 1 - May 31	50%
June 1 - June 30	15%
July 1 - July 31	10%
Aug 1 - Aug 31	5%
Sept 1 - Nov 30	20%
Totals	*100%*
Note: Modified by forage carryover rules	

To account for deterioration of the pasture as winter progresses, the following losses in winter grazing days were used (after December 1):

December → 5% loss
January → 10% loss
February → 15% loss
March → 20% loss

These represent the percentage loss in total grazing days after December 1 for each scenario (they are not cumulative). For example, with the 30-day hay feeding scenario (graze to March 1) we would lose approximately 14 grazing days of the calculated 90 due to wintering losses. A slightly lower stocking rate would be recalculated to reach the desired grazing period.

Stocking rates and total hay consumption are summarized in Table 2 for seasonal hay feeding periods of 150, 120, 90, 60, 30, and 0 days. Stocking rate and total hay fed are inversely related and is at the heart of the tradeoff between reducing hay feeding and reduced stocking rate. The base scenario in which the other scenarios are compared is 150 days of hay feeding (5 months). For context, the Kentucky average is likely between 120 and 150 days. All other hay feeding scenarios are compared against this base of 150 hay feeding days. The base stocking rate is 57 cows (spring calving) which amounts to 163 tons of hay fed (average as fed intake of 2.5% and waste rate of 15%).

Table 2. Hay Feeding and Stocking Rate Details

Hay Feeding Days	Stocking Rate (Cows per 100 Acres)	Hay Fed (tons)
150	57.0	163.0
120	49.8	114.5
90	41.5	71.5
60	33.7	38.5
30	28.0	16.1
0	23.6	0.0

Note: 1300 lb cows spring calving

Net hay value and base gross profit are the parameters that are varied to represent multiple scenarios for various farms and markets. Net hay value is simply the cost of the hay (produced or purchased) less net nutrient value. The net nutrient value represents the modified value of the nutrients distributed on pastures or hayfields during feeding. The effectiveness is represented as a percentage based on how much of the original nutrients are used effectively by the pasture or hayfield where they are fed and is determined primarily by two factors: 1) if the hay is fed in an area that can efficiently use the nutrients (low to medium soil test levels) and 2) if the hay is fed in a manner that the waste (cattle excrement and waste hay) is distributed effectively throughout the area. Upper limits on P and K are likely in the 75%

Table 3. Fertilizer Value Worksheet (Example)

	Price ($/lb)	lbs per ton hay	% Effective as Fertilizer	Effective (lbs/ton)	Effective Nutrient Value per ton
Nitrogen	**$0.45**	**35**	**25%**	8.75	$3.94
P_2O_5	**$0.45**	**12**	**50%**	6.00	$2.70
K_2O	**$0.35**	**53**	**50%**	26.5	$9.28
Total					***$15.92***

level with N about half of this rate. Table 3 shows an example where P and K have 50% effective recycling values at 2016 prices. In this example, the combined values for N, P, and K are roughly $16 per ton of hay fed. Combined values with P and K at 75% effective recycling values would be roughly $24/ton. This effective nutrient value would be subtracted from the hay cost to create the net hay value. For example, if hay can be purchased/produced at $90/ton and we allow for a $15/ton fertilizer credit, the net value would be $75/ton.

The base gross profit per cow is needed to estimate the foregone loss of profit from a reduced stocking rate (fewer animals). Gross profit is estimated by taking calf revenues (modified by expected weaning rate) and subtracting out variable costs and cow depreciation/interest.

The higher the base profit per cow is, the more benefit the model will have for stocking rate increases and vice-versa. Table 4 shows and example of variable costs and the summary below shows all the other calculations in a base gross profit scenario. The reason pasture rent and pasture maintenance are zeroed out is that they will be the same in all scenarios (100 acres of pasture each).

Table 4. Variable Costs per Cow per Year (Example)

Pasture Rent	**2.0**	acre	**$0.00**	**$0**
Pasture Maintenance	**2.0**	acre	**$0.00**	**$0**
Hay	**2.86**	ton	**$75.00**	**$215**
Labor	**2.0**	hours	**$15.00**	**$30**
Mineral			**$24.00**	**$24**
Vet			**$20.00**	**$20**
Breeding			**$45.00**	**$45**
Marketing			**$35.00**	**$35**
Machinery (feeding)			**$15.00**	**$15**
Trucking			**$10.00**	**$10**
Other			**$17.00**	**$17**
Total Per Cow				***$411***

Total Costs/Cow:

Variable Costs	$411
Cow Depreciation	$104
Cow Interest	$32
Total Costs	$547

Total Revenue:

525 lb calf x $1.45/lb x 85% weaning rate = $647

Gross Profit (150 day feeding scenario) = $627 – $547 = $100 per cow (does not account for fixed costs)

The profit change for the hay feeding periods compared to the 150 day hay feeding period are summarized in Tables 5 and 6. Profit change is computed by taking the net hay savings (hay value less nutrient value) compared to 150 hay feeding days and then subtracting the gross base profit per cow from the 150 hay feeding day scenario multiplied by the number of decreased cows (reduced stocking rate). Table 5 shows various base profits for 150 feeding days over variable costs ($0 - $500 per cow) for the situation where net hay cost (hay cost less net nutrient value) is $50/ton. If the base profit when feeding hay for 150 days was $100 over variable costs and we looked at decreasing this to 90 days of hay feeding, the resulting profit change is $809. This means that if we reduced our stocking rate accordingly to reach 90 hay feeding days (41.5 cows from Table 2) from 150 hay feeding days (57.0 cows from Table 2) we would be expected to increase profit by $809. If our base profit over variable costs was $250 per cow, we would expect to decrease profit by $1516 (-$1516) by reducing the stocking rate.

Table 5. Profit Change Compared to 150 Hay Feeding Days $50/Ton Net Hay Value (Price Less Nutrient Value)

	Base Profit over Variable Costs (150 Hay Days)				
Hay Feeding Days	$0	$50	$100	$250	$500
150	-	-	-	-	-
120	$1,396	$1,036	$676	-$404	-$2,204
90	$2,359	$1,584	$809	-$1,516	-$5,391
60	$2,894	$1,729	$564	-$2,931	-$8,756
30	$3,199	$1,749	$299	-$4,051	-$11,301
0	$3,374	$1,704	$34	-$4,976	-$13,326

Note: 1300 lb cows spring calving

Notice that only at the lowest base profit ($0) is feeding no hay the most profitable option, and even there it was only $500 more profitable compared to the 60 day feeding option. When the base profit over variable costs was $100 per cow or greater, the no-hay feeding scenario was the least profitable option evaluated. When profitability is high ($250 and $500 over variable costs) such as last two years, having a stocking rate low enough to not feed any hay would have been costly. For example, compared to the 90-day feeding scenario, the no-hay feeding scenario would have had reduced profits of $3460 and $7935 with $250 and $500 base profits respectively. With the $50/ton net hay value (hay price less net nutrient value), the small gains in profit from the lowest stocking rates during the low profit years do not outweigh the large losses in profit during the high profit years. *The 90 and 120 day hay feeding scenarios appear to be the best compromise for stocking rate/hay feeding using the $50/ton net hay value*.

Table 6 shows various base profit for 150 feeding days over variable costs ($0 - $500 per cow) for the situation where net hay cost (hay cost less net nutrient value) is $75/ton. While favoring lower stocking rates relative to the previous scenario ($50/ton net hay value), the small gains in low profitability years still did not outweigh the losses in high profitability years. *Here, the 60 and 90 day hay feeding scenarios appear to be the best compromise for stocking rate/hay feeding using the $75/ton net hay value (hay price less net nutrient value)*.

Table 6. Profit Change Compared to 150 Hay Feeding Days $75/Ton Net Hay Value (Price Less Nutrient Value)

	Base Profit over Variable Costs (150 Hay Days)				
Hay Feeding Days	$0	$50	$100	$250	$500
150	-	-	-	-	-
120	$2,093	$1,733	$1,373	$293	-$1,507
90	$3,538	$2,763	$1,988	-$337	-$4,212
60	$4,340	$3,175	$2,010	-$1,485	-$7,310
30	$4,798	$3,348	$1,898	-$2,452	-$9,702
0	$5,062	$3,392	$1,722	-$3,288	-$11,638
Note: 1300 lb cows spring calving					

Caveats: There were a number of items that were not accounted for in this analysis that would impact outcomes to some degree. First, forage quality differences were not accounted for in the various scenarios. In Kentucky, the forage quality of stockpiled forage is typically better than average quality hay, but this is not always the case, particularly toward the end of winter. Conversely, forage quality during the growing season would likely be better at the higher stocking rates (still low by most conventional standards) as rotations would be shorter in length with younger growth. The end result could sway the results in either direction but would likely favor the higher grazing day scenarios at least to a small degree. It is an area where further research and modeling is needed.

Second, the model used did not allow spring surplus pasture to be cut for hay (for the hay feeding scenarios). This may make the hay feeding scenarios more favorable if it could be custom baled at a reasonable price ($25-40 per ton). This would likely only have a small impact but should be modeled at some point.

Conclusions

Reducing hay feeding from typical levels (120-150 days) comes with a cost in reduced stocking rates and forage utilization during the growing season. During times of low profitability the reduction in hay costs will outweigh the reduction in stocking rates. However, in times of high and moderate profitability the reduction in stocking rate will outweigh the benefit from reduced hay feeding. *A stocking rate that can keep hay feeding days to 60-90 days appears to be the best compromise between stocking rate and hay feeding in the scenarios evaluated here. This stocking rate would also give you the flexibility to both increase and decrease stocking rates during both extremes of the cattle cycle as appropriate*.

A spreadsheet tool that allows you to calculate grazing and hay feeding costs is available at: http://www.uky.edu/Ag/AgEcon/pubs/GrazingHayCostCalc.xlsx

A video that goes into greater detail on the economics of extended season grazing can be seen at: https://www.youtube.com/watch?v=KcJgOvCJf30