Evaluating the Economics of Pasture Based Systems for the Beef Cow Herd

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Introduction

The rapidly changing agricultural commodity markets have put economic pressure on the beef cattle industry of the United States. Rising corn and soybean prices put demand on farmland for grain planting, which in turn brought increased farmland demand from other farm sectors such as potato, sugar beet and dairy. Over this period the beef markets were not strong and beef farms across the United States and here in Michigan had a hard time competing for farmland. As a result significant acres of pastureland and hay fields were converted to row crop production. Fortunately beef markets have recovered to historical new highs and profitability has returned to the pasturelands. With this brighter economic picture, remaining beef and livestock farms are contemplating pasture improvements. Additionally a few new individuals are considering venturing into the beef industry and are wondering about the economics of renting or buying land.

Pasture economics are rarely analyzed and thus are not well understood. Pasture land is often leftover, sometimes non-tillable land that is viewed as not having as much economic value. The expensing calculation of pasture land can also be complex as native pasture is a long lived perennial sod and improvements to it in the form of major fence repair, water facilities, etc. are usually not an annual expense, but instead a long term depreciable expense complicating the calculation.

Procedure

This analysis will compare native pasture and improved pasture projected expense budgets for 2014 and correlate the yield to historic pasture yield data conducted by MSU researchers at the MSU research facilities in East Lansing and Lake City.

Analysis

The accompanying budgets (table 1 & 2) project the cost of common expense items for pastures in Michigan based on the year 2014. The assumption for the Native Pasture land in Table 1 is land that has not experienced additions of seed nor commercial fertilizer for at least the past 25 years. It does assume some additional fencing for minimal rotational grazing. The Improved Pasture land in Table 2 has a frost seeding application every three years with annual fertilizer application based on MSU soil test recommendations for average pasture soils in the Missaukee/Osceola County area of Michigan.

Based on these budget projections by the author the cost of Native Pasture land is less than half the cost of Improved Pasture Land - $87 compared to $202 per acre annually. The largest expense of the Native Pasture land is land ownership/rent itself at 57% of the total cost. Not surprisingly the largest expense of the Improved Pasture is the fertilizer cost which is $75/acre and 37% of the total expense.

Table 1

Native Pasture Budget, 2.3 T/acre 2014

Expenses	Quantity	Price per Unit	Total per Acre
Seeding Yr. Costs (50 yr. stand life)		$100/a	$2.00
Fertilizer			
Potash	0 lbs ($455/t 0-0-60)	$0.38	$0.00
Nitrogen	0 lbs ($600/t 46-0-0)	$0.58	$0.00
Lime			0
Fence	Exterior & Interior, 25 yr. life		$10.40
Water System			$ 2.00
Land Charge (taxes & land ownership cost or rent)			$50.00
Equipment Repairs			$ 8.20
Equipment Depreciation			$ 3.75
Utilities			$ 2.00
Misc. (fuel, weed control, energizer, depreciation)			$ 9.00
TOTAL SELECTED CASH EXPENSES			**$87.35**

Table 2

Improved Pasture Budget, 4.0 T/acre 2014

Expenses	Quantity	Price per Unit	Total per Acre
Seeding Yr. Costs (30 yr. stand life)		$180/a	$ 6.00
Frost Seeding Legumes (every three years)		$ 35/a	$11.66
Fertilizer			
Potash	30 lbs ($455/t 0-0-60)	$0.47	$11.40
Nitrogen	110 lbs ($535/t 46-0-0)	$0.58	$63.80
Lime	1 ton every 7 years ($35/t)		$ 5.00
Fence	Exterior & Interior, 25 yr. life		$10.40
Water System (pipe in pasture, tank & fittings)	HDPE plastic 2,000 ft. @ $0.70; 20 yr. life		$ 5.00
Land Charge (taxes & land ownership cost or rent)			$50.00
Equipment Repairs			$ 8.20
Equipment Depreciation			$10.00
Utilities			$ 3.00
Misc. (fuel, weed control, energizer, depreciation)			$17.50
TOTAL SELECTED CASH EXPENSES			**$201.96**

If one does strictly a cost comparison there is no doubt the Native Pastureland is less of a financial outlay. But we must ask what increased yield and carrying capacity can be realistically expected from the additional inputs with the Improved Pasture System? We have 16 years of nitrogen fertilizer on grass research at MSU and 12 years of frost seeding pasture research that gives us good indications of what to expect over a wide range of weather conditions. But first let's look at what research says about the efficiency or utilization of the forages in three different feeding systems.

Based on pasture research at the University of Missouri measuring the pasture utilization of different grazing systems and using the cost analysis in Tables 1 & 2 we can draw the following conclusion in Table 3:

Table 3

Cost of Forage Feeding Comparison for the Beef Cow Herd

Feeding System		Cost per Ton of Forage
Feeding dry hay (16% moisture) priced @ $105/ton, assuming an 8% storage loss & 10% feeding loss, 82% utilization	-	$151/ton of DM consumed
Grazing Native Pasture, 2.3 tons DM/acre, 14 day rotations, 40% utilization	-	$ 95/ton of DM consumed
Grazing Improved Pasture, 4.0 tons DM/acre, 4 day rotations, 65% utilization	-	$ 78/ton of DM consumed

So when we factor in utilization, and equate all forages out to the same dry matter level, we see that the Improved Pasture system, even though it costs more than the Native Pasture system will yield a lower cost consumed forage than native, un-improved pasture and the other option of feeding hay. Now let's look at the question, can we really expect to receive 4.0 ton/acre of forage dry matter on average, every year, if we make pasture improvements.

Table 4

Dr. Milo Tesar's Nitrogen on Orchard Grass Trial at Lake City, 1968 - 1977

Nitrogen Applied	Avg. Yield	Range of Yields
0	2.09 tons/acre	0.93 – 2.64 tons/a
50# spring	3.02 tons/acre	1.69 – 4.01 tons/a
50# spring; 50# late June	3.72 tons/acre	2.23 – 5.46 tons/a
100# spring; 100# late June	4.60 tons/acre	3.28 – 6.33 tons/a
Grass/legume mix, no nitrogen added (alfalfa & some clover)	4.27 tons/acre	3.07 – 6.31 tons/a

All yields are 16% moisture hay equivalents. Wide yield ranges are attributed to two drought years and two years with excellent growing conditions over the ten year period.

Table 5

Economic Analysis of Dr. Tesar's 10 Yr. Lake City Trial with 2014 Prices

N Applied	Increase Above Control	Yield Value Above Control Less Cost of Fert. & Spread
0 (control)	-	-
50# spring	0.93 tons	$64/acre
100# split	1.63 tons	$103/acre
200 # split	2.51 tons	$142/acre
Grass/legume	2.18 tons	$205/acre

$110/ton hay value used, $0.58/lb. N; $11/acre spreading fee, Grass/legume assumes clover addition every fourth year with $3.00/lb. red clover.

Table 6

Dr. Richard Leep's Nitrogen on Grass Research at East Lansing over 3 years (2003 – 2005)

N Applied	Yield of Orchard Grass	Yield Value Above Control Less Cost of Fert. & Spread
0	2.38 tons/acre	-
50# May; 50# July	4.64 tons/acre	$169/acre
50# spring; & 50# after next 3 harvests	6.43 tons/acre	$286/acre

Assuming 2014 prices of $110/ton forage value at 16% moisture hay equivalent value, $0.58/lb. of N, $11/acre per application spreading cost.

Table 7

2012 & 2013 Pasture Nitrogen Trial MSU Lake City BioAg Research Station

Trials	Annual Yield	Value	Costs of Treatment	Net Value	Comparison to Control
Control No fertilizer applied	2.50 tons/a of dry matter	$275/a	0/a	$275/a	-
60# N/a Spring applied Urea	3.21	$603/a	$95/a	$508/a	+$37/a
60# N/a Spring applied Urea + Super U	3.17	$597/a	$97/a	$500/a	+$29/a
Frost Seeding	2.76	$519/a	$45/a (1)	$474/a	+$3/a
110# N/a Spring applied Urea	3.69	$694/a	$132/a	$562/a	+$91/a
110# N/a Spring applied Urea & Super U	3.2	$602/a	$136/a	$466/a	-$5/a
60# N/a Spring applied Urea Plus 50# N/a Summer applied Super U	3.23	$608/a	$145/a	$463/a	-$8/a

Trial conducted by Jerry Lindquist, MSU Extension Grazing Educator.

Fertilizer for trial supplied by the Falmouth Cooperative of Falmouth & McBain, MI.
2012 was a drought year. 2013 was very dry in July – September.

(1) Frost seeding of red clover failed in 2012 and had to be repeated in 2013 with white clover

From these budgets and research trials one can make decisions on whether or not to improve pastures based on many factors which may include:

- livestock stocking rates and carrying capacities (do you have extra land or do you have too many grazing animals and need more forage yield)
- capital resources and/or credit for input costs (can cash flow handle the cost of pasture improvement)
- comfort with risk (after investing $50-100/acre in your pastures can you handle the stress of a dry summer)
- is part of the farm mission to reduce carbon footprints, be low input, etc.

- can the animal component that is selling meat, milk, or fiber be profitable based on these costs of forage production?

These and many more questions must be answered when making these important decisions.

Farms are advised to utilize these projections and research trials to guide them in calculating their own budgets to better determine which pasture management system is better for their situation.

Based on current livestock prices and on the research presented in this paper it does appear for most farms that grazing livestock is again profitable. Pasture improvements may be justifiable for farms wishing to increase carrying capacity and/or wishing to extend their grazing season. Following are pasture grazing guidelines to achieve optimum efficiency in a pasture grazing system:

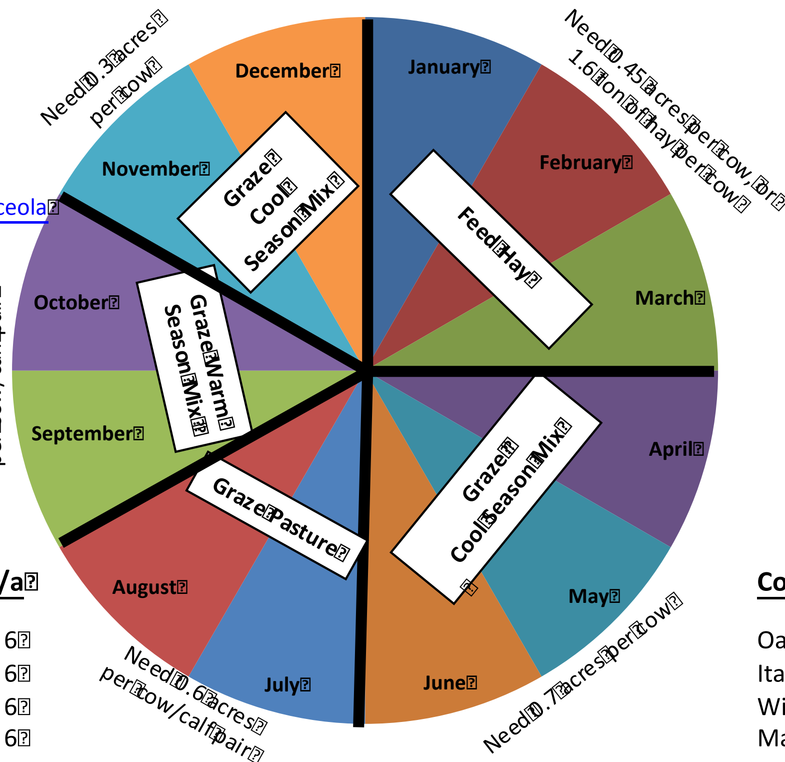
1. **Graze as many days as possible –** a ton of pasture forage will cost you roughly 1/2 the price to grow vs. the cost to make a ton of hay: $78/ton for pasture forage vs. $151/ton for hay when all are adjusted to dry matter and consumption utilization is factored in.
2. **Proper forage rest is critical** – grazing down the top pasture growth reduces the plant's root mass and depth, soil moisture will be located deeper in the soil profile in dry weather so resting the pasture 20 – 30 days in May & June and 30 – 55 days in July – Oct allows the roots to regrow and go deeper to find moisture and nutrients in the soil.
3. **Do not graze shorter than 5 inches** – animals should be removed from paddocks when the theoretical average forage height is still 5-6 inches; this is the height at which research says the remaining leaves and stems will still intercept 95% of the sun's solar energy with only 5% reaching the soil surface (the sun's solar energy warms the soil evaporating soil moisture excessively in mid-summer and decreasing biological activity). Grazing shorter than this height also removes the growing center of the cool season grass plants that store most of their energy in the crown or the stem of the plant. Grazing too low also leads to plant moisture stress and potentially to plant die off which allows weeds opportunities to creep in. Kentucky bluegrass and tall fescue are the grass exceptions to this height rule as they do tolerate and recover better from lower grazing.
4. **Do not graze a stand longer than 3 to 5 days** – it is best to size paddocks small enough that the herd has to be moved every 3 days in the spring, every 4 days in mid-summer and at least every 5 days in late summer. Plants after being eaten will start to re-grow a new leaf in as short as 3 days in the spring when growth is rapid and as early as 5 days in August and September if there is adequate soil moisture. Once grazed this re-growth should be rested for the periods mentioned in item #2 above or plant stunting will result.
5. **Re-graze once forage reaches 10 to 12 inches of height** – an average height of 10 -12 inches will assure that the plant's roots have re-grown to optimum levels in their reach into the soil to obtain moisture and find nutrients. It also assures that the plants have stored an optimum amount of energy in their vascular storage system.
6. **Graze before the average height is over 16 inches tall** – for optimum forage quality, solar efficiency and animal gain/acre try to graze before the height reaches 16". Plants above this height turn reproductive, reduce their ability to take in solar energy as their cell structure changes, lower their feed quality, and shade out shorter plants especially

legumes. Pasture growth above this height either needs to be mowed for hay or grazed using high density stocking rates in paddocks with very small area to trample down the remaining stems into the soil surface building soil organic matter.

7. **Graze half leave half** – this crude rule of thumb simply means if the average pasture height is 12 inches tall at turn-in, the animals should be removed from the stand when the average height is 6 inches tall. Many producers realize that they will have less grazing days by pulling the herd out at 6" rather than maybe 3" and are reluctant to pull them when there is still good grass there, but what they never get to experience is that on average they will be able to return to that paddock much quicker because at 6" the forage plants were never set back that much and will re-grow to 12 inches that much quicker.
8. **Soil test and follow the recommendations whenever financially possible** – don't let fertility be your weak link.
9. **Need more grass growth? Make sure it has enough N every spring –** over 16 years of research at MSU shows that for every 1 lb. of nitrogen applied to grass per acre, the forage growth response of 18% moisture hay equivalent was an extra 36 lbs. of forage per acre. For example if you applied in the spring 130 lbs./acre of 46-0-0 which is 60 lbs. of nitrogen/acre on average the research shows the increase hay equivalent yield should be 2,160 lbs. of forage/acre. Invest $43/acre of fertilizer (spreading cost included) and see a yield response of $108/acre. In drought years the return was only 24 lbs. of hay/lb. of N/acre or $72 of extra hay value, but in the years of good rainfall the yield was 54 lbs. of hay/lb. of N/acre or $162 of extra hay equivalent per acre. A fourfold return on your investment!
10. **Let the legumes supply Nitrogen naturally –** having 40% of the pasture forages be a legume like red or white clover, Birdsfoot trefoil, or alfalfa will provide as much yield as putting on 120 lbs. of N/acre. Even if you have to frost seed in new legumes every 2-3 years the annual cost will be 1/4 of the cost of 120 lbs. of N will be (only $20/acre vs. $86/acre). Try to achieve legume diversity by adding legumes that are lacking in the pasture first and then rotate every two to three years with red clover one time, white clover the next and Trefoil the next if necessary. Alfalfa does not frost seed well. Do not increase clovers and alfalfa % much above 40% as livestock bloat is a risk.
11. **Utilize manure better by decreasing pasture size –** the average meat animal recycles from 70 – 90% of the nutrients they consume on pasture back on the pasture in their manure and urine. If the stocking rate is 3 – 5 acres per a cow/calf pair for the grazing season they only remove 3 -5 lbs. of P_2O_5 and 2 lbs. of K_2O per acre per season. But they may not recycle (deposit) these nutrients evenly across the pasture. If we give them large pastures that they can roam and graze for 2 – 3 weeks or longer, they may graze nutrients from the open spaces and then loaf back in the shaded areas depositing a larger portion of the nutrients in the loafing area and around water sources. University of Missouri research found that if we give cattle a pasture to continuously graze all summer that it would take 25 years before manure was deposited on every square yard of that pasture. Not good uniform recycling! But if cattle were rotated every two weeks to new pasture it would take approximately 8 years to randomly cover every square yard with manure. If we can reduce the grazing allotment down to only enough area to graze in 4 days and move them after 4 days, this increased stocking density would provide for complete manure coverage every 4.5 years.

12. **Consider and utilize all nutrient sources -** lime and processed fertilizer sources are the norm but scrape your winter feed areas, bale graze in pastures and hay fields, consider fly ash, compost, poultry litters and others as ways to improve pasture soil fertility.
13. **Find more land to graze –** we may be driving by land every day that has grazing potential. With leasing contracts of 10 – 15 years fence building can be economical on rented land.
14. **Include annual forage multi-specie cover crops into your pasture system** – these plantings can extend your fall and spring grazing periods with high quality feeds while providing crop rotation that may improve soil quality and crop yields. See the diagram on the following page for details.

Beef Cow Herd Annual Feed Supply
Utilizing Multi Specie Cover Crop Mixes



For more info go to:
http://msue.anr.msu.edu/county/info/osceola
under "Grazing"

Note that the cool season mix acreage for Nov-Dec and for April-June will be the same crop.

Acreage requirements per cow do not include feed requirements for replacement heifers.

Warm Season Mix Example lbs/a

Sorghum/Sudan grass hybrid	6
Hybrid millet	6
Forage soybean	6
Italian ryegrass	6
Mammoth red clover	2
Sunflower	1
Radish	1
Turnip	1

All blended in large seed box of grain drill and seeded after risk of spring frost is gone.

Cool Season Mix Example lbs/a

Oats	6
Italian ryegrass	6
Winter triticale	6
Mammoth red clover	2
Hairy vetch	1
Radish	2
Turnip	2

All blended and seeded in grain drill large seed box in July – mid August after a hay, oat or wheat harvest.