ECONOMIC ANALYSIS OF FORAGE SYSTEMS DESIGNED TO INTENSIFY BEEF PRODUCTION

Sub-theme: Working with global and local food markets (resilient farming business, global food security)

Damona Doye, Adam McGee and David Lalman

Oklahoma State University, Stillwater, Oklahoma, USA

Abstract:

Intensified livestock production systems have the potential to produce more beef per acre. However, these systems may be more costly and not necessarily more profitable, making them less sustainable from an economic perspective. Ongoing experiments are being conducted to evaluate the productivity differences between an extensive system using native rangeland exclusively and an intensive system that incorporates winter and summer annual forages produced on cropland. Data from these experiments are used to estimate economic returns for different production stages (cow/calf, stocker, hay) and the system. For the two years analyzed, the intensive system generated substantially more profit at the cow/calf stage in year two, leading to more profit on average for the two years for this phase. The stocker phase contributed much less to system net returns than the cow/calf enterprise in either system but was more profitable in both years for the extensive system. Hay production in the intensive system in year two was not profitable. Average net income for the two systems was similar for the two years, with the extensive system generating slightly more returns to risk and management.

Keywords: *cow/calf, stocker, systems, grazing, profitability, intensive*

Introduction

Production agriculture faces multi-faceted demands on it from global interests. Sustainable intensification has been conceptualized as technology to accommodate the food needs of a growing population while addressing quality concerns, including cultural and environmental benefits valued by society (Barnes and Poole, 2012). The Food and Agriculture Organization of the United Nations (FAO) has defined an approach to transform agricultural systems to better support development and ensure food security in a changing climate as climate smart agriculture with three main objectives: “sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible” (http://www.fao.org/climate-smart-agriculture/en/). These types of initiatives mean research is needed to identify how changes might be implemented in production agriculture and the trade-offs that may result.

Beef production is a vital part of the U.S. agricultural economy. In 2015, U.S. cattle and calf production was valued at $60 billion with exports valued at $5.6 billion (USDA/ERS, 2017). Beef production is also one of the most common enterprises on U.S. farms. In 2012, the Census of Agriculture counted 2,109,303 farms, and approximately 35 percent had cattle and calves (USDA/NASS, 2014).

Prolonged and widespread drought contributed to a downsizing of the U.S. cowherd and has raised concerns about the economic viability of beef cattle grazing systems under a changing climate (Osie, Steiner and Saleh, 2015). In the southern Great Plains, producers' options range from maintaining cows in extensive systems using native range year-round to more intensive systems that include introduced forages plus annual winter or summer crops to full confinement feeding. Production risks associated with forage based systems may be compensated for by adding confinement options for cattle maintenance, but this can raise input costs as well as animal welfare concerns. For cow/calf production, this alternative is considered mostly during times of prolonged drought in the U.S. but is perhaps not unusual in countries with scarce land. In environments where both precipitation and soils limit forage productivity, developing a forage system that can meet the cows' nutritional needs year-round is challenging. In ideal years on well-managed native pastures in moderate climates, limited supplemental feed or hay may be needed. Using cropland to produce forage in combination with dry lot feeding may allow for greater stocking density on native rangeland during the growing season as well as strategic rest periods. However, intensifying beef production maximizing pounds produced per land unit may not meet other social goals or lead to profitability that sustains producers economically.

Cost-effective forage production and utilization are critical to profitable beef production. Research shows that meeting the cows' nutritional needs is a large portion of the production costs (often one-third to more than one-half of operating costs) in a cow/calf operation (Kansas Farm Management Association, 2015; USDA/ERS, 2015). The land charge for forage (rent for leased pasture; otherwise, ownership costs) may account for most of the forage cost for native pasture and a significant portion for introduced forages. Systems which incorporate annual forages may reduce the need for purchased supplements or hay (and their associated delivery) but require additional outlays for planting and fertilization. Other factors influencing the capacity to introduce annual forages into a production system include land availability, water sources, fencing, ability to move cattle, labor and management. Unlimited access to high quality winter forage may not be optimal for cattle as productivity losses are associated with cows that become too fat. Annual pasture production may be more sensitive to rainfall than native forage, thus associated with more production and financial risk. And, producers may reasonably have different goals for their operation, including maximizing:

- Beef production for a given land base, beginning with calf production.
- Profit for a cow herd of a given size through weaning.
- Profit for a cow herd to include retention of calves after weaning.
- Profit from beef production (cow/calf and/or stocker) to a specified land base.

Objectives

To explore the profitability of intensified beef production (and increased flexibility to mitigate impacts of potential drought), research was conducted to identify differences between a land-extensive native range system and one that incorporates summer and winter annual forages plus partial confinement. This paper builds on that research by analyzing the economics of the two systems, using production data to estimate costs and returns to each forage system and the different enterprises within it by year: cow/calf through weaning; stocker (from weaning to sale to feedlot for finishing); hay; total system. Our hypothesis is that an intensive system is higher cost; whether the returns to that system are also higher is uncertain.

Literature Review

Previous economic studies of livestock/forage systems often focus on profitability of a specific segment such as grass feeding stockers (Springer et al, 2010), a complementary enterprise combination such as dual-purpose stocker grazing and biomass production (Lowe II et al, 2015), or an alternative market, such as pasture-raised beef for packaging and local sale (Evans et al, 2004). These studies often use representative farms. Lewis et al (2012) use a representative farm to analyze the investment in a perennial pasture system with assumptions about performance. Rawlins and Bernardo (1991) evaluate the tradeoffs between risk and expected returns in beef forage systems.

Other studies use mathematical models and simulation to evaluate potential outcomes under different scenarios. Lust, Collete and Schlater (2010) use linear programming to identify optimum grazing scenarios for individual producer constraints. Pope and Shumway (1984) analyze management of intensive forage-beef production under yield uncertainty using simulation and find that the assumption of constant average forage production may grossly overestimate expected net returns. Eisele et al (2012) use a Monte Carlo simulation replicating input and output price distributions based on historical data to evaluate profitability of two weaning strategies and alternative feeding systems, finding that normal weaning is preferred from a profitability standpoint but early weaning has a lower standard deviation; feeding concentrates at times is merited with some ownership strategies. Dhoubhadel and Rawlins (2013) create stochastic cow herds and associated returns to explore the effect of market year and traits on profits under nine different systems. While rankings varied, selling raised yearlings or fat cattle dominated three herd types (average, light, and heavy cows). Osei, Steiner and Saleh (2015) transfer simulated crop yields to an economic simulation model to compare a baseline projection to an extended drought scenario, noting net income per farm is projected to decline by one-third or more with prolonged drought. Bastian et al (2009) analyze purchasing hay and partial herd liquidation under drought and price scenarios using a multi-period linear programming model, concluding that partial liquidation of livestock tends to provide better returns than purchasing feed during extended drought.

More closely related to this paper are studies based on multi-year production research that incorporate economic analysis. Anderson et al (2005) evaluate production and economic efficiency of two beef systems from calving to slaughter over three years, with one finishing calves in the feedlot for 211 days and the other grazed longer and finished in the feedlot for 90 days. Calving rates did not differ between systems despite differences in cow weight and body condition. The shorter feedlot system has lower cost per weaned calf and thus lower weaning breakeven prices. Feedlot performance and characteristics differed with the shorter feedlot treatment having greater profit potential when finished steers are sold on a live basis, but no difference when calves are sold on a grid.

A multi-year study of the impact of calf age at weaning on cow and calf performance and production economics shows calf age at weaning affects cow weight and body condition score but not pregnancy rates (Story et al, 2000). Annual cow costs are higher for the late weaning cows; replacement heifer development costs are higher for the early weaned calves. Feedlot performance differs, leading to differences in net income per steer, with normal and late weaning groups having lower breakeven prices than the early weaning calves. Net income calculations are sensitive to timing of sales.

Jones et al (2013) assess the economic viability of limited-roughage diets fed to wintering cows in an on-farm, semi-confinement system, tracking both production and economic data. They find high concentrated confinement systems diets provide viable alternatives to forage based cow-calf systems but do not attempt to ascertain whether these alternatives are profitable.

In their analysis of three pasture systems for grass-fed beef production, Bhandari, Gillespie and Scaglia (2014) point out that failure to account for the value of labor leads to different profitability rankings and that the complexity of management should be considered. In studying the economics of rotational grazing in the Gulf Coast region, Gillespie et al (2011) (compare profitability and labor use with rotational grazing at three stocking rates and continuous grazing, finding that profitability is lowest for low stocking rate rotational grazing and labor requirements are greatest both on a per-acre and per-cow basis with high stocking rate rotational grazing.

In discussing economic impacts of diversified cropping systems, Mulik (2015) points out that producers often value performance of the individual components of a production system more than the overall system performance and that incentives to adopt diverse, environmentally beneficial systems are lacking. Parvez et al (2012) estimate revenue for hay and grazing for different forages, then use different management decision criteria to analyze alternative forage crops as a means of providing producers a risk-reducing alternative to traditional forage crops during periods of increased environmental risk. Rankings based on expected value, max-min critieria, minimum variance for forage or grazing values differ significantly. Hence, knowing a producer's risk preferences and tolerances is important in making recommendations. In an article focused on New Zealand dairies, Shadbolt et al. (2005) note the importance of management, stating "a good manager will deliver a good operating profit regardless of whether the farm is a low, medium or high input system (p. 373)."

Methods

Oklahoma State University's Department of Animal Science initiated a multi-year study in the fall of 2013 to evaluate two grazing systems: yearlong continuous grazing (EXT) on native range and an intensive system (INT) utilizing a combination of drylot, limited wheat grazing, annual pastures and native range. Analyzing the differences in production beyond the cow/calf stage and for multiple years is important as the effects from one year and one stage may carry over to the next. Each treatment consisted of three replications of fall calving mature Angus and Angus-Hereford commercial cows.

EXT cows had year-round access to 13.34 acres of native range per cow/calf pair, a conservative stocking rate for the area. Cows were provided supplemental protein from October through March and hay only during periods of snow or ice accumulation when grazing was restricted (Lalman, 2015).

The grazing schedule for the INT system is highlighted in Table 1. The INT cattle were fed more hay but received fewer supplements due to the high quality of forage at different periods (production management details in McGee et al., 2016). Using limit-grazed winter wheat pasture as a protein supplement for cow/calf pairs has been shown to be profitable in Oklahoma, primarily due to increased average daily gain (ADG) of calves compared to cow/calf pairs grazing on native pasture (Altom and Schmedt, Apple et al, 1991; Apple et al, 1993).

Table 1. Grazing Schedule for Intensive System

Grazing Period	Year	Dates	Days	Feed/Forage	Acres/Cow
Winter	2013	12/9-3/27	109	Dry Lot limit Graze Wheat	0.99
	2014	12/4-4/3	120	Dry Lot Limit Graze Wheat	0.74
Spring Grazeout	2013	3/27-5/7	41	Ad Libitum Wheat	0.99
	2014	4/3-5/1	28	Ad Libitum Wheat	0.74
Early Summer	2013	5/7-7-16	69	Native Rangeland	8.40
	2014	5/1-6/19	49	Native Rangeland	7.90
Late Summer	2013	7/22-8/22	30	Sorghum-sudan, Cow peas, and Sun hemp	0.49/cow and 0.74/calf
	2014	6/22-8/11	48	Red River Crabgrass	0.49/cow and 0.49/calf
Fall	2013	8/22-12/4	102	Native Rangeland	8.40
	2014	8/11-12/3	112	Native Rangeland	7.90

Cattle performance was measured by cow body weight, cow body condition score (BCS), and calf average daily gain (ADG). INT cow body weight and BCS were greater for all time points except late summer in year one; for year two, both treatments were similar except winter (McGee et al, 2016). To fully utilize the forage, stocker enterprises were included in the system and a hay enterprise was added in INT year two. INT calves had a greater ADG for winter and spring graze-out, but gain slowed when moved to native range for early summer grazing, at which time EXT calves experienced compensatory gain, gaining 0.44 pounds more per day than INT counterparts (McGee et al, 2016). Cow reproductive performance as measured by cows culled due to being open or having aborted a calf also differed between the systems (Table 2).

Table 2. Number of Cows Culled Presumed Due to Treatment Effects

Year	INT	EXT
2013	4	2
2014	4	1

Estimated net returns were developed for each replication of the EXT and INT systems for each year and each enterprise within the production system: cow/calf through weaning, stocker and when surplus forage was available, hay. Net returns are returns to management and risk. In the cow/calf enterprise, revenues include the value of calves at weaning with the calf crop assumed to be equally split between heifers and steers plus a $200 loss associated with a cow culled due to being open or having lost a calf (if any). As cows were raised, this value represents the difference between the cull cow sale and the cost of a replacement female and associated transaction costs. Operating costs in the cow/calf enterprise include hay, protein supplement, mineral, labor, breeding expenses, vet medicine and supplies, machinery fuel/lube/repair costs, pasture rental and establishment costs (where appropriate and shared with other enterprises based on use) and operating interest. Labor costs are based on actual records with INT systems including 228 hours in 2013 and 208 hours in 2014 while EXT systems had 156 hours in 2013 and 202 hours in 2014. Fixed costs include depreciation, interest, taxes and insurance on a portion of a tractor, truck (EXT system), ATV (INT system), chute, alley, pens and fencing. INT treatments include additional electric fencing with expenses prorated over 7 years.

In the stocker enterprise, revenue is based on prices received for calves sold through local markets. Operating costs include the value of the calf transferred from the cowherd at weaning, mineral, supplement, labor, veterinary medicine and supplies, pasture rent and prorated pasture establishment costs and operating interest expense. In 2014, EXT stockers were provided protein supplement. Feed and labor costs for low stress weaning are included with the stocker enterprise.

In the hay enterprise, revenue is based on market prices for hay with costs of harvesting based on prevailing custom rates (Doye and Sahs, 2016) and operating interest expense. Hay is used in the following year within the treatment and is expensed at the same market price.

Results

Table 3 summarizes EXT system net returns for 2013 and 2014 by enterprise within the system. Calf revenue was slightly lower in 2014 compared to 2013 as weaning weights were significantly lower. However, fewer cows were culled for being open in 2014. Total revenue for the two years differed about $600 with 2013 higher. Cow/calf total operating costs for 2014 were lower than 2013 as hay and protein costs were lower. Net income for the cow/calf enterprise in 2013 and 2014 was very similar at $8,644 and $8,774 respectively.

In the EXT system, stocker revenue in 2014 was significantly higher as the stocking rate was approximately doubled, with significantly more gain per stocker and average market prices for calves similar to 2013, despite the change to a mix of half heifers and half steers. Although stocker operating costs were higher due to supplement fed, net income for stockers was higher in 2014.

The cow/calf enterprise contributed the majority of system net income in both years. System net income was $11,338 in 2014 compared to $8,208 in 2013. Per cow net income was $586 and $641 for 2013 and 2014 respectively; net income per land unit was $19.3/ha in 2013 and $19.0/ha in 2014.

Table 4 summarizes INT system net returns for 2013 and 2014. In 2014, the number of cows was increased to an average of 17.7 cows from 14. Though average weaning weights were lower in 2014, calf revenue was significantly higher due to higher average calf prices and more calves. Cull cow losses were similar in 2014, leading to higher total revenues in 2014 compared to 2013. Cow/calf operating costs were higher in 2014 primarily due to higher hay costs (more prairie hay was fed along with sorghum hay produced the previous year) and pasture costs were higher as Bermuda pasture plus fertilizer cost more than sorghum.

The INT stocker enterprise was profitable in 2013 and excess forage was baled. Hay costs (prorated expenses for forage establishment plus custom hired harvesting) exceeded its market value, leading to a hay enterprise loss. In 2014, more stocker calves were included and more pounds of gain were added but the stocker operation resulted in a loss and no forage remained to be harvested.

INT system net income was $8,219 in 2013 and $9,591 in 2014. The cow/calf enterprise was profitable both years but the hay operation in 2013 was costly as was the stocker operation in 2014.

Table 5 compares the overall averages for 2103 and 2104 for the EXT and INT systems. The land base for the EXT system was approximately 1/3 larger and supported fewer cows. In the cow/calf enterprise, calf revenues were significantly higher in the INT system as weaned calves were roughly 70 pounds heavier relative to EXT in both years. This result was not surprising given the earlier research cited. Though cull cow losses were greater in the INT system, total cow/calf enterprise revenue averaged about $5,000 more than the EXT system, heavily influenced by the larger difference in year two. As hypothesized, cow/calf operating costs were also higher on average in the INT system relative to the EXT system due to higher hay ($1,300) and pasture costs ($2,000). Labor costs were a bit higher in the INT system while protein supplement costs were lower. For this two year period, net returns to the cow/calf enterprise were approximately $1,000 higher for the INT system relative to the EXT system. Returns per cow were higher while returns per unit of land were lower for the EXT system.

Stockers in the EXT enterprise had a higher ADG than INT stockers, contributing to more revenue on a gain basis. With significantly lower operating costs and similar fixed costs, the EXT stocker operation added to the system profitability while the INT stocker was a drain on profitability. A hay enterprise was only included in the INT system in one year and did not add to profitability.

Table 3. Average Budgets for the EXT Replications, 2013 and 2014

			2013 EXT				2014 EXT	
	$/cow	$/ha	$/a	Total	$/cow	$/ha	$/a	Total
Cow/calf (CC)								
C/C Revenue								
Calf sales	1,501	45	110	19,978	1,445	42	103	19,272
Cull cows	(10)	-0.3	(1)	(133)	(5)	-0.1	(0)	(67)
Total C/C Revenue	1,491	44.3	109	19,844	1,440	41.7	103	19,205
C/C Operating Costs								
Prairie hay	20	0.6	1	262	12	0.4	1	163
Protein supplement	102	3.0	8	1,360	65	1.9	5	871
Mineral	10	0.3	1	131	10	0.3	1	131
Labor	61	1.8	4	809	47	1.4	3	624
Vet medicine, supplies	38	1	3	505	38	1	3	511
Native pasture lease	228	6.8	17	3,037	228	6.6	16	3,037
Breeding	51	1.5	4	680	52	1.5	4	692
Machinery, fuel, lube, repairs	47	1.4	3	623	47	1.4	3	623
Operating interest	17	0.5	1	222	15	0.4	1	200
C/C Total Operating Costs	573	17.0	42	7,630	514	14.9	37	6,852
C/C Total Fixed Costs	268	8.0	20	3,571	268	7.8	19	3,578
C/C Total Costs	841	25.0	62	11,201	783	22.6	56	10,431
C/C Net income	650	19.3	48	8,644	657	19.0	47	8,774

July 2017 - ISBN 978-92-990062-5-2 - www.ifmaonline.org - Congress Proceedings

Table 3. Average Budgets for the EXT Replications, 2013 and 2014 (cont.)

	2013 EXT				2014 EXT			
	$/cow	$/ha	$/a	Total	$/cow	$/ha	$/a	Total
Stocker								
Stocker Revenue								
Heifers					157	2.3	6	1,044
Steers	106	1.7	4	742	68	1.0	2	456
Total	106	1.7	4	742	112	3.2	8	1,501
Stocker Operating Costs								
Mineral	0	0.0	0	5	1	0.0	0	17
Weaning ration, supplement	4	0.1	0	56	18	0.5	1	243
Labor	4	0.1	0	53	6	0.2	0	84
Vet medicine, supplies	9	0	1	120	10	0	1	132
Pasture	3	0.1	0	45	6	0.2	0	81
Machinery fuel, lube, repairs	2	0.0	0	20	2	0.1	0	32
Operating interest	1	0.0	0	9	1	0.0	0	18
Stocker Total Operating Costs	23	0.7	2	309	45	1.3	3	606
Stocker Total Fixed Costs	10	0.3	1	137	11	0.3	1	141
Stocker Total Costs	33	1.0	2	446	56	1.6	4	747
Stocker Net Income	27	0.4	1	168	56	1.6	4	753
System Net Income	678	19.7	49	8,812	713	20.6	51	9,528

	$/cow	$/ha	$/a	Total	$/cow	$/ha	$/a	Total
C/C Revenue								
Heifers	748	33	81	10,470	729	38	93	12,890
Steers	839	37	90	11,749	828	43	105	14,630
Cull cows	(19)	(1)	(2)	(267)	(11)	(1)	(1)	(200)
C/C Total Revenue	1,568	68	169	21,953	1,550	80	197	27,387
C/C Operating Costs								
Prairie hay	94	4	10	1,310	99	5	13	1,747
Sorghum hay	-	-	-	-	75	4	10	1,321
Protein supplement	35	2	4	494	15	1	2	267
Mineral	10	0	1	137	10	1	1	173
Labor	59	3	6	832	51	3	6	898
Vet medicine, supplies	36	2	4	509	36	2	5	636
Native pasture lease	139	6	15	1,949	110	6	14	1,949
Bermuda lease, fertilizer					44	2	6	782
Cropland: lease	29	1	3	407	22	1	3	387
Wheat establishment	146	6	16	2,038	118	6	15	2,076
Sorghum establishment	26	1	3	368		-		
Breeding	49	2	5	680	49	3	6	858
Machinery fuel, lube, repairs	44	2	5	609	35	2	4	609
Operating interest	20	1	2	280	20	1	3	351
C/C Total Operating Costs	687	30	74	9,613	683	35	87	12,056
C/C Total Fixed Costs	295	13	32	4,132	226	12	29	3,992
C/C Total Costs	982	43	106	13,745	909	47	116	16,048
C/C Net Income	586	26	63	8,208	641	33	82	11,338

July 2017 - ISBN 978-92-990062-5-2 - www.ifmaonline.org - Congress Proceedings

Table 4. Average Budgets for the INT Replications, 2013 and 2014

	2013 INT				2014 INT			
	$/cow	$/ha	$/a	Total	$/cow	$/ha	$/a	Total
Stocker								
Stocker Revenue								
Heifers					(2)	(0)	(0)	(30)
Additional heifers					(0)	(0)	(0)	(6)
Steers	47	2	5	665	18	1	2	318
Additional steers					(11)	(1)	(1)	(188)
Stocker Total revenue	47	2	5	665	6	0	1	94
Stocker Operating Costs								
Mineral	0	0	0	6	2	0	0	32
Weaning ration, supplement	4	0	0	50	12	1	2	210
Labor	4	0	0	53	5	0	1	84
Vet medicine, supplies	9	0	1	133	12	1	2	210
Pasture	13	1	1	184	11	1	1	191
Grass establishment	2	0	0	21	53	3	7	930
Machinery fuel, lube, repairs	0	0	0	4	0	0	0	7
Operating interest	1	0	0	14	3	0	0	50
Stocker Total Operating Costs	33	1	4	464	97	5	12	1,714
Stocker Total Fixed Costs	9	0	1	130	7	0	1	127
Stocker Total Costs	43	2	5	594	104	5	13	1,841
Stocker Net Income	5	0	1	70	(99)	(5)	(13)	(1,747)

	$/cow	$/ha	$/a	Total	$/cow	$/ha	$/a	Total
Cow/Calf (CC) Enterprise								
Hay Revenue	68	3	7	958				
Hay Operating Costs								
Custom harvesting	30	1	3	414				
Grass establishment cost	39	2	4	551				
Land rent	2	0	0	21				
Operating interest	2	0	0	31				
Hay Total Costs	73	3	8	1,017				
Net Income: Hay Production	(4)	(0)	(0)	(59)				
System Net Income	587	26	63	8,219	542	28	69	9,591

Table 5. Average Budgets for the INT and EXT Treatments, 2013-2014

	EXT Average				INT Average			
	$/cow	$/ha	$/a	Total	$/cow	$/ha	$/a	Total
Cow/Calf (CC)								
C/C Revenue	692	123.94	50	9,221	739	214.42	87	11,680
Steers	781	139.85	57	10,403	834	241.99	98	13,190
Cull cows	(7)	(1.32)	(1)	(100)	(15)	(4.32)	(2)	(233)
C/C Total Revenue	1,465	262.48	106	19,525	1,559	452.69	183	24,670
		-				-		
C/C Operating Costs								
Prairie hay	16	2.87	1	213	96	28.02	11	1,529
Sorghum hay		-			37	11.74	5	660
Protein supplement	84	15.05	6	1,116	25	7.07	3	380
Mineral	10	1.76	1	131	10	2.85	1	155
Labor	54	9.65	4	716	55	15.90	6	865
Vet medicine, supplies	38	7	3	508	36	11	4	572
Native pasture lease	228	40.80	17	3,037	125	35.87	15	1,949
Bermuda lease, fertilizer					22	7	3	391
Cropland lease		-			25	7.31	3	397
Wheat establishment		-			132	37.86	15	2,057
Sorghum establishment		-			26	6.99	3	368
Breeding	52	9.23	4	686	49	14.11	6	769
Machinery fuel, lube, repairs	47	8.38	3	623	39	11.22	5	609
Operating interest expense	16	2.84	1	211	20	5.79	2	316
C/C Total Operating Costs	544	97.43	39	7,241	685	198.71	80	10,834
C/C Total Fixed Costs	268	48.07	19	3,574	261	74.83	30	4,062
C/C Total Costs	812	145.50	59	10,816	945	273.54	111	14,896
C/C Net Income	654	116.98	47	8,709	614	179.15	73	9,773

July 2017 - ISBN 978-92-990062-5-2 - www.ifmaonline.org - Congress Proceedings

Table 5. Average Budgets for the INT and EXT Treatments, 2013-2014 (cont. 2)

	EXT Average				INT Average			
	$/cow	$/ha	$/a	Total	$/cow	$/ha	$/a	Total
Cow/Calf (CC) Enterprise								
Stocker Enterprise								
Stocker Revenue								
Heifers	78	6.92	3	522	(1)	(0.29)	(0)	(15)
Additional heifers		-			(0)	(0.06)	(0)	(3)
Steers	87	8.16	3	599	33	9.21	4	491
Additional steers		-			(11)	(3.28)	(1)	(188)
Stocker Total revenue	109	15.08	6	1,121	27	7.21	3	379
Stocker Operating Costs								
Mineral	1	0.15	0	11	1	0.34	0	19
Weaning ration, supplement	11	1.99	1	149	8	2.35	1	130
Labor	5	0.92	0	68	4	1.25	1	68
Vet medicine, supplies	9	2	1	126	11	3	1	171
Pasture	5	0.84	0	63	12	3.44	1	187
Grass establishment		-			27	8.48	3	476
Machinery fuel, lube, repairs	2	0.35	0	26	0	0.02	0	6
Operating interest	1	0.18	0	13	2	0.53	0	32
Stocker Total Operating Costs	34	6.13	2	457	65	19.63	8	1,089
Stocker Total Fixed Costs	10	1.87	1	139	8	2.44	1	128
Stocker Total Costs	45	8.00	3	597	73	21.99	9	1,218
Stocker Net Income	42	6.11	2	461	(47)	(14.78)	(6)	(838)

July 2017 - ISBN 978-92-990062-5-2 - www.ifmaonline.org - Congress Proceedings

Table 5. Average Budgets for the INT and EXT Treatments, 2013-2014 (cont. 3)

	EXT Average				INT Average			
	$/cow	$/ha	$/a	Total	$/cow	$/ha	$/a	Total
Hay Production								
Hay Revenue					68	18.22	7	958
Hay Operating Costs								
Custom harvesting					30	7.87	3	414
Grass establishment cost					39	10.49	4	551
Land rent					2	0.41	0	21
Operating interest					2	0.58	0	31
Hay Total Costs					73	19.35	8	1,017
Net Income: Hay Production					(4)	(1.13)	(0)	(59)
System Net Income	695	123.09	50	9,170	565	163.81	66	8,905

July 2017 - ISBN 978-92-990062-5-2 - www.ifmaonline.org - Congress Proceedings

When returns to all enterprises (cow/calf, stocker and hay) are summed, average net income for the two systems was similar for the two years, with the extensive system generating slightly more returns to risk and management. This suggests that intensive systems may be economically feasible. This research focuses solely on production costs and does not account for possible environmental and welfare concerns with partial confinement feeding. Though management intensity differs between the two systems, no value for management has been included. Thus, the simpler extensive system which is familiar might reasonably be preferred by producers. This study does not address the potential costs of transitioning to a different system, which could include educational and investment costs, with cash flow impacts. And, individual producers may be limited by cropland availability that would constrain their ability to implement more intensive systems. Additional research to assess risks associated with the two systems would be beneficial. For instance, the impact of variability in winter and summer seasonal precipitation on the two forage systems, its impact on summer annual forage establishment and growth for either system has not been evaluated and could impact the overall risk to producers using different forage systems.

Relative returns to different stages of production (cow/calf, stocker) change over time with changes in cattle prices and this will impact the financial returns to a system and stages within it, independent of the production levels achieved at any stage. Prices of supplements and other inputs can also change significantly over time which affects returns to systems that rely on external inputs. Further research will include sensitivity tests on prices of inputs and outputs and the resulting impacts on net income under different scenarios.

Summary and Conclusions

Integrated research and extension projects by animal scientists and agricultural economists are important in clearly identifying tradeoffs between production systems. Ongoing experiments are evaluating productivity differences between an extensive system using native forage and an intensive system incorporating winter and summer annual forages. Our findings show that a more intensive forage system has the potential to increase beef production on a smaller land base with returns to management and risk that are similar to a more traditional extensive system. For the two years studied, the intensive system generated substantially more profit at the cow/calf stage in year two, leading to more profit on average for the two years for this phase. The stocker phase contributed much less to system net returns than the cow/calf enterprise in either system but was more profitable in both years for the extensive system. Hay production in the intensive system in year two was not profitable. Average net income for the two systems was similar for the two years, with the extensive system generating slightly more returns to risk and management.

From an individual producer’s perspective, profitability may be a factor in deciding the best strategy but the level of management required and the availability of land and labor are also important. Ultimately, producers will weigh their goals and their available resources (land, labor, capital and management) in deciding the best plan for individual operations.

References

Anderson, R., R. Rasby, T. Klopfenstein and R. Clark. 2005. "An Evaluation of Production and Economic Efficiency of Two Beef Systems from Calving to Slaughter." Journal of Animal Science 83:694-704

Altom, W., T. F. Schmedt. 1983. "Limit Grazing Small Grain Pastures." Proceedings. National Wheat Pasture Symposium, October 24-25, 1983. Stillwater, OK. P. 297-317.

Apple, K., K. Lusby, A. Hutson and G. Provence. 1991. "Evaluations of Wheat Forage in Wintering Programs for Cow Calf Operations." Oklahoma Agricultural Experiment Station Research Report. P. 167-171.

Apple, K., K. Lusby, A. Hutson and G. Provence. 1993. "Evaluations of Wheat Forage in Wintering Programs for Cow Calf Operations – Year 2." Oklahoma Agricultural Experiment Station Research Report. P. 131-136.

Barnes, A.P. and C. Poole. 2012. "Applying the Concept of Sustainable Intensification to Scottish Agriculture." Contributed Paper. 86th Annual Conference of the Agricultural Economics Society. University of Warwick. United Kingdom. April 16-18.

Bastian, C., P. Ponnamaneni, S. Mooney, J. Ritten, W.M Frasier, S. Paisley, M. Smith and W. Umberger. 2009. "Range Livestock Strategies Given Extended Drought and Different Price Cycles." Journal of the American Society of Farm Managers and Rural Appraisers.

Bhandari, B.D., J. Gillespie and G. Scaglia. 2014. "Analysis of Three Pasture Systems for Grass-fed Beef Production: Labor Use and Profitability." Selected Paper. Southern Agricultural Economics Association Annual Meeting, Dallas, Texas. February 1-4.

Doye, D. and R. Sahs. 2016. "Oklahoma Farm and Ranch Custom Rates, 2015-2016." Oklahoma Cooperative Extension Service Current Report 205.

Dhoubhadel, S. and M. Stockton. 2013. "Economic Differences Among Beef Production Systems of the Nebraska Sandhills." Selected Paper. Southern Agricultural Economics Association Annual Meeting. Orlando, Florida. Feb. 3-5.

Eisele, K., J. Ritten, C. Bastian, S. Paisley, and S. Lake. 2012. "Economic Comparison of Waning and Feeding Strategies for Beef Production." Journal of the American Society of Farm Managers and Rural Appraisers.

Evans, J, G. D'Souza, M. Sperow and E. Rayburn. 2004. "An Economic Analysis of Pasture-Raised Beef Systems in Appalachia." Selected Paper. Agricultural and Applied Economics Association Annual Meeting. Denver, Colorado. August.

Food and Agriculture Organization of the United Nations. 2017. http://www.fao.org/climate-smart-agriculture/en/. Accessed February 2.

Gillespie, J., W. Wyatt, B. Venuto, D. Blouin, R. Boucher, W. Nipper, B. Qushim. 2011. "The Economics of Rotational Grazing in the Gulf coast Region: Costs Returns and Labor Considerations: Phase II." Selected Paper. Southern Agricultural Economics Association Annual Meeting. Corpus Christi, Texas. February.

Gunter, S.A., K.A. Cassida, P. A. Beck and J.M. Phillips. 2002. "Winter-annual Pasture as a Supplement for Beef Cows." J. Anim. Sci. 80:1157-1165.

Jones, K., D. Lust, K. Brooks and M. Vestal. 2013. “Cost Effectiveness of On-Farm Semi-Confinement Systems for Cow-Calf Production.” Selected Paper. Southern Agricultural Economics Association Annual Meeting. Orlando, FL. February.

Kansas Farm Management Association. 2015. https://www.agmanager.info/kfma/enterprise-reports. Accessed 1/31/17.

Lalman, D. 2015. “Supplementing Beef Cows.” Oklahoma Beef Cattle Manual 7th edition, Chapter 21, pg 197.

Lewis, C., B. Malcolm, R. Farquharson, B. Leury, R. Behrendt, and S. Clark. 2012. “Economic Analysis of Improved Perennial Pasture Systems.” AFBM Journal 9:2.

Lowe II, J., C. Boyer, A. Griffith, G. Bates, P. Keyser, and J. Larson. 2015. “Grazing Beef Steers on Native-Warm Season Grasses: Implications for Beef and Biomass Production.” Selected Paper. Southern Agricultural Economics Association Annual Meeting. Atlanta, Georgia. January 31-February 3.

Lust, D., L. Almas, W. Colette, and L. Schlater. 2010. “Alternative Livestock/Dryland Forage Systems in the Texas Panhandle.” Selected Paper. Southern Agricultural Economics Association Annual Meeting. Orlando, Florida. Feb. 6-9.

McGee, Adam, J. Cole, C. Bayliff, M. Redden, C. Spencer, J. Warren, D. Doye, R. Reuter, G. Horn, D. Lalman. 2016. “Intensified Cow/calf Production in the Southern Great Plains.” Great Plains Grazing Field Research Symposium, Stillwater, OK, pg 84-89

Mulik, K. 2015. “Economic Impacts of Diversified Cropping Systems.” Selected Paper. Agricultural and Applied Economics Association and Western Agricultural Economics Association Annual Meeting. San Francisco, CA. July.

Osei, E., J. Steiner, and A. Saleh. 2015. “Economic Viability of Beef Cattle Grazing Systems Under Prolonged Drought.” Selected Paper. Agricultural and Applied Economics Association and Western Agricultural Economics Association Annual Meeting. San Francisco, CA. 2015.

Parvez, M.R., S. Fausti, T. Nleya, P. Johnson, K. Olson and J. Rickertsen. 2012. “Alternative Annual Forage Crop Options for Northern Great Plains Cattle Producers: A South Dakota Case Study.” Staff Paper 2012-2. Department of Economics. South Dakota State University.

Pope, III C. A. and C. R. Shumway. 1984. ”Management of Intensive Forage-Beef Production Under Yield Uncertainty.” Southern Journal of Agricultural Economics. December. P. 37-43.

Rawlins, R. and D. Bernardo. 1991. “Incorporating Uncertainty in the Analysis of Optimal Beef-Forage Production Systems.” Southern Journal of Agricultural Economics. July. P. 213-225

Shadbolt, N., C. Holmes, M.B. de Machado, D. Silva-Villaocorta. 2005. “How Best to Compare Low and High Input Pastoral Systems.” International Farm Management Congress Proceedings. Brazil.

Springer, J. R. Reuter, J. Rogers, J. Biermacher. 2010. “What is the Potential for Intensively-Managed, Year-Round Lightweight Stocker Cattle System in the Southern

Plains?" Selected Poster. AAEA, CAES & WAEA Joint Annual Meeting Denver. Colorado. July 25-27.

Story, C., R. Rasby, R. Clark and C. Milton. 2000. "Age of Calf at Weaning of Spring-Calving Beef Cows and the Effect on Cow and Calf Performance and Production Economics." J. Anim. Science 78:1403-1413.

United States Department of Agriculture Economic Research Service (USDA/ERS). "Animal Products: Cattle and Beef Statistics and Information." https://www.ers.usda.gov/topics/animal-products/cattle-beef/statistics-information.aspx. Accessed 1/31/17.

United States Department of Agriculture Economic Research Service (USDA/ERS). 2015. "Commodity Costs and Returns." https://www.ers.usda.gov/data-products/commodity-costs-and-returns/commodity-costs-and-returns/#Recent%20Costs%20and%20Returns:%20Cow-calf. Accessed 1/31/17.

United States Department of Agriculture National Agricultural Statistics Service (USDA/NASS). 2014. 2012 Census of Agriculture. https://www.agcensus.usda.gov/Publications/2012/ Accessed 1/31/17.

Acknowledgements:

The Animal Science research is being conducted through grants provided by the Dr. Kenneth & Caroline Eng (-K-) Trust Fund and the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award numbers 2012-02355 and 2013-69002-23146. We thank Roger Sahs for assistance in estimating fixed costs and verifying budget numbers.