ECONOMIC ANALYSIS OF CONSERVATION TILLAGE WINTER SMALL GRAINS FORAGE PRODUCTION IN ARKANSAS

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ABSTRACT

Winter grazing of stocker cattle on small-grain pastures may be a profitable income option for cattle and wheat producers in Arkansas. However, a large portion of land area that could potentially benefit from this production system is highly erodible, and care should be placed on choosing the appropriate forage production method to ensure the existing natural resource base is not degraded over time. This study evaluates the profitability of reduced till and no-till production of winter wheat/rye forage using two years of small grains pasture and steer weight gain data from the Livestock and Forestry Branch Station (LFBS) near Batesville, Arkansas. The results indicate that both conservation tillage methods are profitable when compared with conventional "clean till" small grains forage production.

INTRODUCTION

Winter wheat is one of the most common winter annuals grown in the United States due to its high forage quality and adaptability to a wide rage of climates. Soft red winter wheat is the common wheat type grown in the southern United States and is the primary wheat type produced in Arkansas. Soft red winter wheat is almost exclusively harvested for grain in Arkansas with over 90 percent of total wheat area planted in the Delta region of the state. Production systems that integrate stocker cattle with soft red winter wheat production may have value both in Arkansas and the southern United States. Grazing stocker cattle on soft red winter wheat may provide an alternative income source to Arkansas wheat and cattle producers.

Research conducted from 1996 to 2001 at the Livestock and Forestry Branch Station (LFBS) near Batesville, Arkansas has shown that stocker calves can be productively grazed on soft red winter wheat during the winter (Daniels et. al., 2002). However, conventional "clean till" planting methods were used exclusively in this research. Soil erosion is a major concern with conventional till production of winter small grains forage. Much of the land area that could potentially be used for winter wheat forage production in Arkansas is highly erodible, and

practices that maintain surface residue such as reduced till or no-till may be more appropriate in areas susceptible to soil erosion.

Rainfall is also critical for forage production and can be an important consideration when either inadequate or overabundant. While dry conditions limit forage establishment and growth with conventional till management, mud affects livestock footing and increases grazing difficulty. Reduced till and no-till practices, which leave stubble on the ground, have been shown to conserve summer moisture by limiting weed growth and reducing evaporative losses. Under wet conditions, no-till managed forage might permit grazing on lands that would otherwise be unsuitable at the same moisture content under conventional till management.

Profit generation is an important consideration when evaluating alternative winter small grains forage production methods. Conventional till requires the use of large and expensive pieces of equipment and is very fuel and labor intensive. Reduced till and no-till require less machinery and equipment and are less fuel and labor intensive. However, reduced till and no-till substitute herbicides either partially or exclusively for tillage for weed control, and the additional cost of herbicide applications can be substantial (Epplin et al., 1982). This study evaluates the profitability of grazing stocker calves on soft red winter wheat and rye forage produced with conventional till, reduced till, or no-till methods. Steer weight gain data and forage production data from two years of winter small grains forage research at the LFBS are used to calculate the costs and returns of forage production and stocker grazing for the three tillage treatments.

MATERIALS AND METHODS

The three tillage treatments evaluated in this study are Conventional Till (CT), Reduced Till (RT), and No-Till (NT). The CT strategy consists of chisel plowing to a depth of 10 inches and heavy disking followed by use of a light disc or cultivator for weed control. Winter wheat and rye seed are planted into the prepared seedbed using a no-till drill. The RT strategy consists of applying glyphosate one week prior to planting, followed by no more than two light disking passes with 50 percent residue remaining on the soil surface. A broadcast spreader is used to plant winter wheat and rye seed and a harrow was used to drag the field to cover the seed. The NT strategy controls weeds exclusively using one application of glyphosate 2 weeks prior to planting. Wheat and rye seed is planted directly into the stubble using a no-till drill.

An enterprise budget approach was used to evaluate the economic costs and returns of winter small grains grazing for each tillage method. Budgets were developed for both pasture (winter wheat/rye forage) and non-pasture (animal) expenses following methods used by Doye and Krenzer (1989) and Daniels et al. (2002). Annual winter wheat and rye forage production budgets were developed for each tillage method for the grazing periods Fall 2003 - Spring 2004 and Fall 2004 - Spring 2005 using the Mississippi State Budget Generator. The budgets were generated using input and field operation data from experimental winter small grains pastures at the LFBS. Per acre annual forage production budgets by tillage method and grazing period are presented in Table 1. All cost data are reported in 2004 dollars. Both RT and NT have smaller pasture production costs than CT due to savings in labor, fuel, and machinery fixed expenses resulting from fewer land preparation operations.

Non-pasture (animal) production costs were calculated on a per steer basis for the 2003-2004 and 2004-2005 fall and the spring grazing periods to reflect expenses associated with steer receiving, death loss, and hauling. Non-pasture production costs were estimated based on historical receiving data from the LFBS. Feed and hay expenses and mineral expenses were

estimated at $0.38/day/steer and $0.07/day/steer, respectively, for each receiving period. Steer receiving began September 15 for the fall period and January 15 for the spring period and continued until the date when steers were turned out onto small grains pastures. The fall and spring receiving periods for 2003-2004 totaled 43 and 47 days, respectively, for all tillage treatments. The fall receiving period for 2004 varied by tillage treatment and totaled 83 days for reduced till, 80 days for conventional till, and 63 days for no-till. The spring receiving period for 2005 totaled 55 days for all tillage treatments. Death loss was estimated assuming a 3.5 percent mortality rate multiplied by steer purchase value. All animal non-pasture costs were converted to a per-acre basis by multiplying by the stocking rate used in each grazing period (1.5 steers per acre and 2.25 steers per acre for fall and spring 2003-2004, respectively; 1.01 steers per acre and 2.28 steers per acre for fall and spring 2004-2005, respectively). Per-acre non-pasture production costs are presented by tillage method and grazing period in Table 2.

Steer purchase and sales prices were calculated using 1991-2000 Arkansas feeder cattle price data from Cheney and Troxel (2004). All price data were adjusted to 2004 dollars using the Producer Price Index. Fall steers were bought on September 15 at 425 lbs per steer, while spring steers were bought on January 15 at 478 lbs per steer. September Medium and Large No.1 400-500 lb steer price data was used to calculate the average purchase price for fall steers, while January Medium and Large No.1 400-500 lb steer price data was used to calculate the average purchase price for spring steers. The ten-year average fall and spring purchase prices were $102.60/cwt and $104.85/cwt, respectively. Steers were sold upon completion of small grains grazing in late January through early February for the fall grazing period and in late April through early May for the spring grazing period. January-February Medium and Large No.1 500-600 lb steer price data were used to calculate the average sales price for steers grazed in the fall-winter, while April-May Medium and Large No.1 600-700 lb steer price data were used to calculate the average sales price for steers grazed in the winter-spring. The ten-year average fall and spring sales prices were $97.75/cwt and $93.38/cwt, respectively. The fall and spring purchase and sales weights used in the analysis along with gains per steer and gains per acre are presented by tillage method and grazing period in Table 3.

RESULTS AND DISCUSSION

Per-acre costs and returns of winter small grains production and grazing are presented by tillage method and grazing period in Table 4. Accompanying cost and returns data on a per-steer basis and a per-pound of gain basis are presented in Table 5 and Table 6, respectively. Costs and returns were calculated for the fall grazing period alone (September-January), the spring grazing period alone (January-May) and both the fall and spring grazing periods combined (September-May).

Net returns per acre were generally low or negative when steers were grazed using either the fall grazing period only or the spring grazing period only. The NT strategy was the only tillage method to produce a positive average net return during the fall grazing period ($4.68/acre). The NT strategy produced enough revenue to cover all costs during the fall 2003-2004 grazing period ($14.59/acre), but was unable to cover pasture costs during the fall 2004-2005 grazing period and generated a net loss of -$5.22/acre in that year. None of the strategies produced a positive average net return during the spring grazing period.

Net returns were more favorable when steers were grazed in both the fall and the spring. The combined fall and spring returns to non-pasture costs were generally sufficient to cover pasture

costs during both study years. The one exception was the CT strategy, which was unable to cover its pasture costs in 2004-2005 (-$50.50/acre) and resulted in an average net loss of -$15.85/acre during both years. Both conservation tillage strategies outperformed the CT strategy in profitability. The NT strategy produced the largest average net return ($85.32/acre), followed by the RT strategy ($38.76/acre). Higher weight gains rather than pasture cost savings appear to be the reason for higher profitability of the conservation tillage strategies relative to CT. Both NT and RT produced larger average gains per acre than CT over the two-year period (Table 3).

It must be noted that costs for controlling ryegrass were included in the return calculations of this study. Ryegrass was controlled in the study to maintain pure plots for accurate wheat and rye forage measurements. Ryegrass would be more of a concern if winter wheat were harvested for grain in addition to being grazed by steers. Cattle producers may not be concerned with ryegrass in a typical grazeout strategy in which wheat is not harvested for grain. However, producers would incur the same costs if they wished to control for some other grass species like fescue prior to planting winter small grains forage.

The costs of ryegrass control were $19.62/acre for CT (the cost of disking twice in the summer following grazing) and $13.03/acre for both RT and NT (the cost of applying glyphosate following grazing). If these costs were not incurred (i.e., ryegrass were not a concern), the average net returns over the two-year period would be $ 3.77/acre for CT, $51.79/acre for RT, and $98.35/acre for NT.

CONCLUSIONS

The results indicate that conservation tillage is profitable for production of winter small grains forage in Arkansas. The economic benefits of conservation tillage over conventional "clean till" management appear to be both savings in pasture production costs and increased gross revenues resulting from larger steer weight gains. Larger steer weight gains appear to be the primary factor driving higher profitability of conservation tillage relative to conventional till.

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Table 1. Per Acre Winter Wheat and Rye Pasture Production Expenses by Tillage Method and Grazing Period, 2004 Dollars.

	Fall 2003 - Spring 2004			Fall 2004 - Spring 2005			Average		
Expense Item	**CT [a]**	**RT**	**NT**	**CT**	**RT**	**NT**	**CT**	**RT**	**NT**
Crop Seed	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Diesel Fuel	16.84	4.95	4.29	18.12	4.95	4.29	17.48	4.95	4.29
Fertilizer & Lime, Fall	46.40	42.05	43.68	41.14	36.45	42.53	43.77	39.25	43.10
Fertilizer, Spring	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32
Herbicides	0.00	18.00	18.00	0.00	18.00	18.00	0.00	18.00	18.00
Operator Labor	19.09	5.84	7.30	20.91	5.84	7.30	20.00	5.84	7.30
Repairs and Maintenance	10.56	2.93	4.18	11.32	2.93	4.18	10.94	2.93	4.18
Total Direct Expenses:									
Fall	116.89	97.77	101.45	115.49	92.17	100.30	116.19	94.97	100.87
Spring	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32
Total Fixed Expenses	23.77	25.47	24.62	6.53	6.53	6.53	9.07	9.07	9.07
Total Expenses	156.98	157.28	157.13	120.62	115.02	117.82	126.84	125.69	126.26

[a] CT = Conventional Till; RT = Reduced Till; NT = No-Till.

Table 2. Per Acre Non-Pasture Steer Production Costs by Tillage Method and Grazing Period, 2004 Dollars.

Item	CT [a]	RT	NT
		Fall 2003	
Feed and Hay	24.51	24.51	24.51
Labor	6.90	6.90	6.90
Minerals	4.52	4.52	4.52
Vet and Medical	18.00	18.00	18.00
Death Loss	22.90	22.90	22.90
Hauling	6.00	6.00	6.00
Total	82.82	82.82	82.82
		Spring 2004	
Feed and Hay	40.19	40.19	40.19
Labor	6.90	6.90	6.90
Minerals	7.40	7.40	7.40
Vet and Medical	18.00	18.00	18.00
Death Loss	39.47	39.47	39.47
Hauling	9.00	9.00	9.00
Total	120.96	120.96	120.96
		Fall 2004	
Feed and Hay	30.77	31.92	24.23
Labor	6.90	6.90	6.90
Minerals	5.67	5.88	4.46
Vet and Medical	12.15	12.15	12.15
Death Loss	15.45	15.45	15.45
Hauling	4.05	4.05	4.05
Total	74.98	76.35	67.24
		Spring 2005	
Feed and Hay	47.60	47.60	47.60
Labor	6.90	6.90	6.90
Minerals	8.77	8.77	8.77
Vet and Medical	18.22	18.22	18.22
Death Loss	39.95	39.95	39.95
Hauling	9.11	9.11	9.11
Total	130.54	130.54	130.54

[a] CT = Conventional Till; RT = Reduced Till; NT = No-Till.

Table 3. Weight Data Used in the Economic Analysis by Tillage Method and Grazing Period.

Item	CT [a]	RT	NT
		Fall 2003	
Purchase Weight (lbs/steer)	425	425	425
Initial Grazing Weight (lbs/steer) [b]	457	459	462
Sales Weight (lbs/steer)	547	550	588
Total Gain/Steer (lbs)	91	92	125
Total Gain/Acre (lbs)	137	138	188
		Spring 2004	
Purchase Weight (lbs/steer)	478	478	478
Initial Grazing Weight (lbs/steer)	510	508	520
Sales Weight (lbs/steer)	647	646	655
Total Gain/Steer (lbs)	137	138	135
Total Gain/Acre (lbs)	308	311	304
		Fall 2004	
Purchase Weight (lbs/steer)	425	425	425
Initial Grazing Weight (lbs/steer)	489	496	473
Sales Weight (lbs/steer)	600	587	620
Total Gain/Steer (lbs)	111	92	147
Total Gain/Acre (lbs)	112	93	149
		Spring 2005	
Purchase Weight (lbs/steer)	478	478	478
Initial Grazing Weight (lbs/steer)	505	494	499
Sales Weight (lbs/steer)	612	632	629
Total Gain/Steer (lbs)	106	138	130
Total Gain/Acre (lbs)	241	314	296
		Total Gain/Acre (lbs):	
2003-2004	445	449	491
2004-2005	354	407	445
Average	399	428	468

[a] CT = Conventional Till; RT = Reduced Till; NT = No-Till

[b] Steer weight at beginning of small grains grazing period and at termination of receiving period.

Table 4. Per Acre Returns and Costs by Tillage Method, 2003-2004 and 2004-2005 in 2004 Dollars.

	2003-2004			2004-2005			Average		
Item	**CT [a]**	**RT**	**NT**	**CT**	**RT**	**NT**	**CT**	**RT**	**NT**
				Per Acre Returns and Costs, Fall Period					
Gross Returns	802.03	806.43	862.15	593.62	580.76	613.40	697.82	693.59	737.78
Purchase Costs	654.22	654.22	654.22	441.44	441.44	441.44	547.83	547.83	547.83
Non-Pasture Costs	82.82	82.82	82.82	74.98	76.35	67.24	78.90	79.59	75.03
Pasture Costs	140.66	104.30	110.52	140.96	98.70	109.94	140.81	101.50	110.23
Net Returns Above Total Specified Costs:	-75.67	-34.92	14.59	-63.77	-35.74	-5.22	-69.72	-35.33	4.68
				Per Acre Returns and Costs, Spring Period					
Gross Returns	1359.37	1357.27	1376.18	1301.45	1343.98	1337.60	1330.41	1350.62	1356.89
Purchase Costs	1127.62	1127.62	1127.62	1141.32	1141.32	1141.32	1134.47	1134.47	1134.47
Non-Pasture Costs	120.96	120.96	120.96	130.54	130.54	130.54	125.75	125.75	125.75
Pasture Costs	156.98	120.62	126.84	157.28	115.02	125.69	157.13	117.82	126.26
Net Returns Above Total Specified Costs:	-46.19	-11.94	0.76	-127.69	-42.90	-59.95	-86.94	-27.42	-29.59
				Per Acre Returns and Costs, Fall and Spring Periods					
Gross Returns, Fall	802.03	806.43	862.15	593.62	580.76	613.40	697.82	693.59	737.78
Purchase Costs, Fall	654.22	654.22	654.22	441.44	441.44	441.44	547.83	547.83	547.83
Non-Pasture Costs, Fall	82.82	82.82	82.82	74.98	76.35	67.24	78.90	79.59	75.03
Net Returns above Non-Pasture Costs, Fall	64.99	69.39	125.11	77.19	62.96	104.72	71.09	66.18	114.91
Gross Returns, Spring	1359.37	1357.27	1376.18	1301.45	1343.98	1337.60	1330.41	1350.62	1356.89
Purchase Costs, Spring	1127.62	1127.62	1127.62	1141.32	1141.32	1141.32	1134.47	1134.47	1134.47
Non-Pasture Costs, Spring	120.96	120.96	120.96	130.54	130.54	130.54	125.75	125.75	125.75
Net Returns above Non-Pasture Costs, Spring	110.79	108.69	127.60	29.59	72.12	65.74	70.19	90.40	96.67
Total Returns to Non-Pasture Costs	175.78	178.08	252.70	106.78	135.09	170.46	141.28	156.58	211.58
Pasture Costs	156.98	120.62	126.84	157.28	115.02	125.69	157.13	117.82	126.26
Net Returns above Total Specified Costs	18.80	57.45	125.86	-50.50	20.07	44.77	-15.85	38.76	85.32

[a] CT = Conventional Till; RT = Reduced Till; NT = No-Till

Table 5. Returns and Costs Per Steer by Tillage System, 2003-2004 and 2004-2005 in 2004 Dollars.

	2003-2004			2004-2005			Average		
Item	**CT [a]**	**RT**	**NT**	**CT**	**RT**	**NT**	**CT**	**RT**	**NT**
				Returns and Costs Per Steer, Fall Period					
Gross Returns	534.69	537.62	574.76	586.49	573.79	606.04	560.59	555.70	590.40
Purchase Costs	436.14	436.14	436.14	436.14	436.14	436.14	436.14	436.14	436.14
Non-Pasture Costs	55.22	55.22	55.22	74.08	75.43	66.43	64.65	65.33	60.83
Pasture Costs	93.77	69.54	73.68	139.27	97.52	108.62	116.52	83.53	91.15
Net Returns Above Total Specified Costs:	-50.45	-23.28	9.73	-63.00	-35.31	-5.16	-56.73	-29.29	2.28
				Returns and Costs Per Steer, Spring Period					
Gross Returns	604.16	603.23	611.63	571.48	590.16	587.36	587.82	596.69	599.50
Purchase Costs	501.17	501.17	501.17	501.17	501.17	501.17	501.17	501.17	501.17
Non-Pasture Costs	53.76	53.76	53.76	57.32	57.32	57.32	55.54	55.54	55.54
Pasture Costs	69.77	53.61	56.37	69.06	50.51	55.19	69.42	52.06	55.78
Net Returns Above Total Specified Costs:	-20.53	-5.31	0.34	-56.07	-18.84	-26.32	-38.30	-12.07	-12.99
				Returns and Costs Per Steer, Fall and Spring Periods					
Gross Returns, Fall	213.87	215.05	229.91	180.46	176.55	186.47	197.17	195.80	208.19
Purchase Costs, Fall	174.46	174.46	174.46	134.20	134.20	134.20	154.33	154.33	154.33
Non-Pasture Costs, Fall	22.09	22.09	22.09	22.80	23.21	20.44	22.44	22.65	21.26
Net Returns above Non-Pasture Costs, Fall	17.33	18.50	33.36	23.47	19.14	31.84	20.40	18.82	32.60
Gross Returns, Spring	362.50	361.94	366.98	395.64	408.57	406.63	379.07	385.25	386.81
Purchase Costs, Spring	300.70	300.70	300.70	346.96	346.96	346.96	323.83	323.83	323.83
Non-Pasture Costs, Spring	32.26	32.26	32.26	39.68	39.68	39.68	35.97	35.97	35.97
Net Returns above Non-Pasture Costs, Spring	29.54	28.98	34.03	9.00	21.92	19.99	19.27	25.45	27.01
Total Returns to Non-Pasture Costs	46.87	47.49	67.39	32.46	41.07	51.82	39.67	44.28	59.60
Pasture Costs	41.86	32.17	33.82	47.81	34.97	38.21	44.84	33.57	36.02
Net Returns above Total Specified Costs	5.01	15.32	33.56	-15.35	6.10	13.61	-5.17	10.71	23.59

[a] CT = Conventional Till; RT = Reduced Till; NT = No-Till

Table 6. Returns and Costs Per Pound of Gain by Tillage System, 2003-2004 and 2004-2005 in 2004 Dollars.

	2003-2004			2004-2005			Average		
Item	**CT [a]**	**RT**	**NT**	**CT**	**RT**	**NT**	**CT**	**RT**	**NT**
				Returns and Costs Per Pound of Gain, Fall Period					
Gross Returns	5.88	5.84	4.60	5.28	6.24	4.12	5.58	6.04	4.36
Purchase Costs	4.79	4.74	3.49	3.93	4.74	2.97	4.36	4.74	3.23
Non-Pasture Costs	0.61	0.60	0.44	0.67	0.82	0.45	0.64	0.71	0.45
Pasture Costs	1.03	0.76	0.59	1.25	1.06	0.74	1.14	0.91	0.66
Net Returns Above Total Specified Costs:	-0.55	-0.25	0.08	-0.57	-0.38	-0.04	-0.56	-0.32	0.02
				Returns and Costs Per Pound of Gain, Spring Period					
Gross Returns	4.41	4.37	4.53	5.39	4.28	4.52	4.90	4.32	4.52
Purchase Costs	3.66	3.63	3.71	4.73	3.63	3.86	4.19	3.63	3.78
Non-Pasture Costs	0.39	0.39	0.40	0.54	0.42	0.44	0.47	0.40	0.42
Pasture Costs	0.51	0.39	0.42	0.65	0.37	0.42	0.58	0.38	0.42
Net Returns Above Total Specified Costs:	-0.15	-0.04	0.00	-0.53	-0.14	-0.20	-0.34	-0.09	-0.10
				Returns and Costs Per Pound of Gain, Fall and Spring Periods					
Gross Returns, Fall	1.80	1.80	1.76	1.68	1.43	1.38	1.74	1.61	1.57
Purchase Costs, Fall	1.47	1.46	1.33	1.25	1.08	0.99	1.36	1.27	1.16
Non-Pasture Costs, Fall	0.19	0.18	0.17	0.21	0.19	0.15	0.20	0.19	0.16
Net Returns above Non-Pasture Costs, Fall	0.15	0.15	0.25	0.22	0.15	0.24	0.18	0.15	0.25
Gross Returns, Spring	3.06	3.03	2.80	3.68	3.30	3.01	3.37	3.16	2.90
Purchase Costs, Spring	2.54	2.51	2.30	3.23	2.80	2.57	2.88	2.66	2.43
Non-Pasture Costs, Spring	0.27	0.27	0.25	0.37	0.32	0.29	0.32	0.30	0.27
Net Returns above Non-Pasture Costs, Spring	0.25	0.24	0.26	0.08	0.18	0.15	0.17	0.21	0.20
Total Returns to Non-Pasture Costs	0.40	0.40	0.51	0.30	0.33	0.38	0.35	0.36	0.45
Pasture Costs	0.35	0.27	0.26	0.44	0.28	0.28	0.40	0.28	0.27
Net Returns above Total Specified Costs	0.04	0.13	0.26	-0.14	0.05	0.10	-0.05	0.09	0.18

[a] CT = Conventional Till; RT = Reduced Till; NT = No-Till