The Economics of Rotational Grazing in the Gulf Coast Region: Costs, Returns, and Labor Considerations, Phase II

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Abstract: Profitability and labor associated with rotational grazing at three stocking rates and continuous grazing at a medium stocking rate are compared. On a per-acre basis, profits are lowest for low stocking rate rotational grazing. Labor is greatest on both per-acre and per-cow bases with high stocking rate rotational grazing.

Keywords: Time and Motion Study, Conservation, Louisiana, Cow-Calf

Introduction

The benefits of rotational stocking (grazing) of cattle have been discussed for many years, with arguments for its use generally including improved soil conservation and greater productivity. Rotational grazing in general has received increased attention in the last few years as forage-fed beef and milk from pasture-based (in some cases certified organic) dairying have gained attractiveness to consumers. Previous research on the profitability associated with rotational grazing has been somewhat mixed, with research in Phase I of the present study showing greater profitability with continuously stocked pastures at a medium stocking rate relative to rotational grazing at a high stocking rate (Gillespie et al.). The objective of Phase II of this study, reported in this paper, was to determine whether alternative stocking rates under rotational stocking would improve the profitability associated with this practice. We focus on costs, returns, profitability, and labor requirements.

Rotational grazing has been argued to result in greater productivity, particularly through improved pasture persistence, better forage utilization, less waste from trampling, and lower soil erosion. In cases where there are 5 to 10 fenced paddocks, grazing on a particular paddock may occur for 3 to 7 days, allowing it to "rest and regrow" for 25 to 35 days. Significant capital investment associated with watering equipment and increased fencing, as well as increased labor associated with moving animals, increases the cost associated with rotational relative to continuous stocking. Louisiana State University Agricultural Center Publication #2884 lists many of the advantages and disadvantages associated with rotational grazing. Though there are a number of advantages, only 19% of Louisiana beef producers used it with ≥5 paddocks in 2002 (Kim). In determining a "typical" stocking rate for Louisiana producers, unpublished surveys used by Boucher and Gillespie (2004, 2005) in determining beef production costs and returns show wide variability in choice of stocking rate.

Previous Literature

The effects of stocking rate and rotational grazing on forage and animal productivity have been studied extensively, though few studies have addressed the economic aspects of rotational grazing. We are aware of one previous study (Gillespie et al.) that has provided a thorough evaluation of the labor requirements associated with alternative grazing systems – that study was a report of Phase I of the present study.

Studies that have not found differences in end-of-season standing crop between continuous and rotational grazing at similar stocking rates include Jung et al.; Pitts and Bryant, Anderson; and Thurow et al. Chestnut et al. did not find large differences in fescue forage availability when comparing rotational with continuous grazing. Studies have been conducted on a number of different forage species, examples including Chestnut et al. with fescue, Derner et al. with little bluestem, and Cassels et al. with tall prairie grass. The results have been mixed, depending upon species and location. In comparing forage quality between rotational and continuous grazing, the results have also been inconsistent among studies (Bertelson et al., Hafley, Aiken, and Popp et al.).

A number of studies have compared steer and/or heifer animal performance under rotational versus continuous grazing (e.g., Bertelson et al., Hafley, Aiken, Hart et al., Gillen et al., Bransby et al., Wachenheim et al.). Fewer, however, have examined cow-calf production. In comparing heavily and moderately-stocked continuous grazing with very heavily-stocked rotational grazing under extensive rangeland conditions, Heitschmidt et al. found production per cow, weaned calf crop, mean conception rate, and net return per cow and per acre to not differ among systems, though production per acre was greatest for the rotational grazing system. Stocking rate was concluded to have a greater impact on productivity than whether continuous or rotational grazing was used. Chestnut et al. found no differences in calf weaning weight or calf average daily gain between continuous and rotational grazing when grazing fescue pastures at equal stocking rates. On the other hand, grazing bermudagrass-fescue pastures, McCann found weaning weight per acre to be 36% higher under short-duration rotational grazing than with continuous grazing at an equal stocking rate.

Though the above studies are only a subset of the rotational grazing versus continuous grazing studies that have been conducted over many years, little information has been available to Gulf Coast cow-calf producers to help them select a grazing strategy. Phase I of this study (Gillespie et al.) provided information on the productivity and profitability of rotational grazing under a high stocking rate (RH, 1.1 cows/acre) versus continuous grazing at high (CH, 1.1 cows/acre), medium (CM, 0.8 cows/acre), and low (CL, 0.5 cows/acre) stocking rates. Results indicated that, on both per-cow and per-acre bases, the RH treatment could not compete with the CM or CH treatments, regardless of whether labor expenses were included in the profitability measures. That study was conducted in 1999-2001, a period of significant drought, versus the present Phase II study, which was conducted in 2004-05, resulting in shifts in relative competitiveness between CM and RH from Phase I to Phase II.

Methods

This study, conducted as a biological and economic experiment at the Iberia Research Station in Jeanerette, Louisiana, compared four stocking rate / grazing management systems. In one field (rep), pasture groups were 16 acres each, while in a second field, pasture groups were 10-acres each. Treatments were randomized to pastures by field with repeated measures by pasture during 2004-05. The 4 treatments were high stocking rate rotational grazing (RH) with 1.1 cows per acre, medium stocking rate rotational grazing (RM) with 0.8 cows per acre, low stocking rate rotational grazing (RL) with 0.5 cows per acre, and medium stocking rate continuous grazing (CM) with 0.8 cows per acre. The rotational grazing treatments had 8 paddocks each. Stocking rates for treatments for Phase I (1999-2001) of this study had been determined based upon unpublished survey results of Louisiana beef producers, used in annual beef costs and returns estimates (Boucher and Gillespie, 1999). In Phase I, the high stocking rates used for both RH and CH resulted in animals being frequently moved to a drylot and fed hay and other feedstuffs, with the RH treatment faring rather poorly in terms of profitability. It was, thus, determined that in moving to more rotational grazing treatments in Phase II, the RH stocking rate of 1.1 acres/cow should be the heaviest stocking rate. Furthermore, the continuous grazing treatment with the highest profitability in Phase I, CM, would be the continuous grazing treatment for comparison to three rotational grazing treatments. Since both CM and RH were included in Phase I and the same production practices and record-keeping systems were used, this would provide the additional benefit of allowing for further investigation of differences in the CM and RH treatments.

Beginning in February, 2004, mature, spring-calving, straight-bred Brangus cows and their suckling calves were stocked on pastures year-round for two years. Cows were weighed 5 times annually and Spring-born calves were weighed at weaning. For each pasture, simulated bite samples of forage were obtained to determine diet quality, and forage mass was determined monthly by clipping 5 10 m^2 areas to ground level. The samples were obtained in the rotational pastures 1 to 2 days following a rotation. When there was low forage availability, cows and their calves were moved to a drylot and fed hay, mineral supplement, and protein. Portable shades were constructed in each pasture such that they could be moved with cows and calves when rotated.

For each pasture, detailed cost and input records were kept. Persons working on the experiment recorded any labor activity that was conducted, including the date, time required, number of persons conducting the activity, and the nature of the activity. This data allowed for a time and motion study for each system such that labor could be compared among grazing strategies. The time and motion analysis is similar to that conducted by Gillespie et al. Field staff used for this study was extensively trained for all tasks and only the most conscientious staff who enjoyed working with cattle were allowed to work on the study. Therefore, we believe that our labor estimates are in the range of what one might expect on commercial operations, which would be expected to vary among farms. If our estimates differ from the mean labor requirement on commercial operations, the relative differences in labor time among treatments are expected to be similar to those found on commercial operations.

Each occasion when a tractor, truck, ATV, implements, or other equipment was used for a field operation on any pasture, the operation, date, time, and equipment used was recorded. Herbicide, insecticide, lime, fertilizer, seed, and other inputs were recorded for each pasture, including amount, date applied, and cost. Hay and baleage yields were recorded, as were all feedstuffs fed in the drylot. Cattle purchases and sales were recorded, including reason for removal. If a cow had an injury or disease, palpated open, failed to calve, or died, she was removed from the herd and replaced with another cow and her suckling calf.

Cow-calf production budgets by Boucher and Gillespie (2004, 2005) were modified for each pasture each year to represent the costs and returns associated with that pasture. Therefore, with 4 treatments × 2 years × 2 fields, a total of 16 budgets were developed. *Direct expenses* included costs associated with harvesting hay and baleage from pasture, mineral mix, protein block, vaccinations and dewormers, ear tags, marketing commission, fuel, repairs and maintenance, other pasture expenses, and interest on operating capital. *Fixed expenses* included interest and depreciation on machinery and equipment. We did not include entries for cull heifers since replacement heifers were not kept and cull cows were simply replaced by cows with suckling calves. Because of this, a 100% calving rate was assumed, which would be a limiting assumption for a commercial operation.

Calf prices were estimated for each pasture each year based upon the market weight of the calves. An equation was estimated using ordinary least squares regression using monthly calf prices per hundredweight, as reported in Louisiana auctions for 2003-05 for the following four size classes: 300-400 lbs, 400-500 lbs, 500-600 lbs, and 600-700 lbs. The following equation was estimated:

(1) $$P_{calf} = 162.6348 + 8.4940 * Steer - 0.2191 * Weight + 0.0001 * Weight^2 - 4.4851 * Winter - 3.8869 * Spring - 1.2707 * Summer + 29.3388 * Year2004 + 39.7293 * Year2005 - 0.0210 * Weight2004 - 0.0286 * Weight2005.$$

where *Steer* is a dummy variable indicating the animal is a steer (versus a heifer); *Weight* is calf weight; $Weight^2$ is the calf's weight, squared; *Winter, Spring,* and *Summer* are dummy variables for Winter, Spring, and Summer, with Fall as the base; *Year2004* and *Year2005* are dummy variables for years 2004 and 2005, respectively, with 2003 as the base, and *Weight2004* and *Weight2005* are interaction terms between the year dummy variables and calf weight. Adjusted 205-day calf weight means for each pasture were entered into (1) to determine expected price.

Hay and baleage prices were determined based upon their cost of production, including labor, with hay cost of production as determined by Boucher and Gillespie (2004, 2005) and baleage cost of production adjusted accordingly as shown in McCormick et al. (2002). Input prices are the result of annual surveys of Louisiana agricultural businesses during 2004-05 to estimate annual costs and returns estimates for beef cattle and forage crop production (Boucher and Gillespie, 2004, 2005).

Labor was divided into six categories, based upon entries in the daily log. *Working Cows and Calves* involved deworming, vaccinating animals, brucellosis testing, administering fly tags, weaning animals, weighing animals, body condition scoring and palpating cows, and similar tasks. *Checking and Routine Tasks* involved daily checking of animals, grass height, and fences; pulling calves; burying animals; placing hay bales, baleage, supplemental feed, and minerals in the drylot; and administering medicine. *Forage Management* involved baling hay and baleage, fertilizing, clipping, spraying pastures, and planting ryegrass. *Repairs and Maintenance* involved repairing shades and fences. *Moving Animals and Shades* involved moving animals among paddocks in the rotational grazing treatments and to the drylot when insufficient forage was available. *Miscellaneous Tasks* was any additional labor that did not fit into one of the other categories. *Total Labor* was a summation of all labor.

A mixed model with treatments fixed, pastures within treatments random, and years as fixed repeated measures effects was used to determine differences in costs, returns, labor usage, and net returns among treatments. The Kenward-Roger Degrees of Freedom method was used.

Results

Table 1 presents labor useage, income, expenses, and returns over expenses results, each presented on both per-cow and per-acre bases. Per-acre comparisons are likely to be of greater interest for the farmer with a fixed amount of land on which to graze cattle.

Labor Usage

Significant differences were not found for working cows and calves on either per-cow or per-acre bases. While there were numeric differences on a per-cow basis (0.52 hours/cow for RH versus 1.00 hours/cow for RL), the differences were non-significant at the $P \leq 0.05$ level. Examining on a per-acre basis, any increase in working time was not proportionate to the number of animals, as substantial effort was required to corral animals for working but actual working time per animal was not great. For checking and routine tasks, significant differences were not found on a per-cow basis. However, on a per-acre basis, RH had the greater labor requirement. With more animals per acre, there was more medicine to administer, feed to provide, etc., thus the higher number.

Labor required for forage management was greatest with RL on a per-cow basis, and lowest for CM on a per-acre basis. More hay and baleage were harvested on the RL treatment, and the costs of doing so were spread over fewer animals, thus the greater labor required. Surprisingly, labor for repairs and maintenance did not differ statistically among the treatments either on per-acre or per-cow bases, though numerically the CM treatment had the lower raw mean, which is not surprising since there were no cross-fences to repair in that treatment.

Labor required for moving animals and shades was rather substantial for each of the rotational grazing treatments. Among the rotational grazing treatments, there were no differences in means on a per-cow basis, but RH and RM had significantly greater labor requirements for moving animals and shades than RL. Under heavier stocking, the animals must be moved more often; thus the greater labor requirement. Time required for moving animals in CM was very low, as animals were moved only to the drylot, and this occurred only if forage availability was insufficient. Labor differences were not found among treatments for miscellaneous tasks.

Total labor on a per-cow basis differed among each of the treatments. It was lowest with the CM treatment, followed by RH, RM, and finally RL, with the total hours per cow ranging from 3.77 to 11.34. On a per-acre basis, CM was still the lowest, but the rotational treatments reversed in order, with RH having the greatest labor per acre and RL the lowest of the rotational treatments. As stocking rate increased in the rotational treatments, labor requirements per-acre increased primarily because of increased checking / routine tasks and more frequent movement of the animals among paddocks.

Labor requirements can have a significant impact on cost. If operator and hired labor are priced at $9.60/hr, then the range is $36.19/cow to $108.86/cow in moving from CM to RL, while the range is $28.32/acre to $67.01/acre in moving from CM to RH. The discussion below, however, will better characterize cost of production and profitability differences among systems, depending upon whether labor is included.

Costs and Returns

Table 1 shows income, expenses, and returns over expenses for the four treatments for 2004-05. Significant differences in income from calves were not found on a per-cow basis; however, on a per-acre basis, RH had the highest associated returns, followed by both medium stocking rate treatments (RM and CM), and finally RL. Similar results were found when returns from hay and baleage were included in the income measures. Though lower stocking rates on the rotational grazing treatments led to more hay and baleage being made relative to RH and CM, the differences in harvest were not great enough to cause total income per cow to differ statistically among treatments. These results differ from those found in Gillespie et al. for Phase I, where both high stocking rate treatments (RH and CH) had significantly lower revenue per cow than the lower stocking rate continuous treatments. This is mainly due to the differential in calf weights by stocking rate being greater in Phase I than in Phase II, as those years were generally drier than 2004-05, so the high stocking-rate cows and their calves did not fare as well in Phase I. Perhaps another factor is that we fed a higher plane of nutrition (supplemental feed) during drylotting of Phase II and calf growth may have been less adversely affected, i.e., cows continued milking well.

Total direct expenses per cow were highest with RL; the other three treatments did not differ from one another ($P \leq 0.05$). On a per-acre basis, direct expenses were highest for RH (though not statistically greater than RM). The remaining treatments did not differ from one another ($P \leq 0.05$). Return over direct expenses did not differ among treatments on a per-cow basis, but on a per-acre basis, RH had higher return over direct expenses than RL. Both fixed and total expenses per cow were highest for RL, as they could be spread over more animals as stocking rates were increased. Both fixed and total expenses per acre were highest for RH.

Regardless of whether labor expense was included in the return over total expenses measure, on a per-cow basis, there were no differences. On a per-acre basis, net return over total expenses, with or without labor expense being included, was highest for RH and lowest for RL. Neither RM nor CM differed from any other treatment using these measures.

It is useful to compare overall results of CM with RM since these differ by system but not stocking rate. As expected, labor requirements differed. However, no significant differences in any of the economic measures were found between CM and RM. While these results might suggest that only stocking rate matters, not grazing system, such a general conclusion would be inconsistent with Phase I results, where high cost associated with RH led to lower profitability in RH relative to CH.

Comparing Phase I and Phase II Results

In comparing results from Phase II with those of Phase I, what is striking is that, in Phase I, CM and CH were the most profitable treatments on both per-cow and per-acre bases.

However, no significant differences in profitability are found in RH and CM in Phase II, with RH actually having numerically higher per-acre net returns than CM. This calls for further investigation of the reasons behind the change in relative competitiveness of the two treatments. Because CM and RH were the two common treatments during Phase I and Phase II and they were treated the same during both phases (other than the fact that hay and baleage were made in Phase II, but not in Phase I, partially because more hay was available for cutting during Phase II, but also because hay-making equipment was not always available in Phase I), we make further comparisons of these two treatments by combining Phase I and Phase II data. A comparison between these two treatments is particularly relevant since CM represents a common stocking rate for Louisiana continuous grazing production, and it is expected that, when using rotational grazing, the stocking rate could be increased up to the range of that in RH. Combining Phase I and Phase II allows for more years of data for comparison. Since hay was not made in Phase I, returns from hay are not included in the Phase II revenue for this comparison.

Results of the combined Phase I and Phase II analysis are shown in Table 2. Similar to individual results for Phase I and Phase II, total labor is greater for RH than CM, a difference of less than three hours per cow and almost five hours per acre. Working cows and calves, as well as checking and routine tasks are the greatest users of labor. However, as expected, moving animals and shades requires significantly greater labor for RH than CM, both on per-cow and per-acre bases.

Income from calves was greater for CM than RH on a per-cow basis, but greater than RH than CM on a per-acre basis. On a per-acre basis, direct, fixed, and total expenses were greater for RH than CM. While return over total expenses (not including labor) was higher for CM than RH on a per-cow basis, this measure did not differ on a per-acre basis. Overall, using all five years of data, we cannot conclude that either of the two treatments is more profitable, contrary to the results from using only Phase I. In Phase I, weaning weights were lower in the RH treatment than the others, 70 pounds lighter than CM, while in Phase II, weaning weights for RH were only 44 pounds lighter than CM. The years of Phase II produced greater rainfall than the Phase I years. Less time was spent in the drylot during Phase II compared to Phase I. Furthermore, unlike Phase I, during Phase II both hay and baleage were made in some cases on the pastures and ungrazed forage residues were less.

Conclusions and Discussion

Our Phase I results showed RH to be less profitable than either CH or CM, leading us to state, "This study calls into question whether, for beef producers, rotational grazing has economic advantages over continuous grazing in the Gulf Coast region." (Gillespie et al.). With two additional years of data, we cannot conclude that a high stocking rate rotational grazing strategy results in lower profitability; in fact, RH had the highest associated mean profit of the four Phase II treatments, statistically higher than that of RL. By combining Phase I and Phase II results, we can compare the two treatments that were common to both – RH and CM. Our results now show, on a per-acre basis, no significant differences in profitability between the two. Results from Phase II provide evidence that, up to a point, a higher stocking rate used with rotational grazing will lead to increased profitability on a per-acre basis. This is the case regardless of whether labor expenses are included. Gillespie et al. indicated that further studies on the grazing systems was justified; we continue to believe this is the case, as there is significant variability in production conditions among years, which can switch the relative competitiveness among grazing strategies. By comparing the economic performance of CM with RM, we cannot conclude that system (rotational versus conventional grazing) impacts short run profitability. We do note, however, that Phase I results showed RH to be less profitable than CH; both treatments had equal stocking rates but differed in grazing system.

In considering the universality of our results, we believe forage species is of importance. Using Gulf Coast grasses such as bahia and bermudagrass, it must be recognized that these low-growing grasses store carbohydrate reserves in the stolons and rhizomes, different from the upright species such as switchgrass and bluestem, where reserves are stored in the stem base areas such that they are easily accessible to grazing animals. Grazing low-growing Gulf Coast grasses over extended periods will less likely reduce forage productivity than with more upright species. Another consideration for selection of a grazing system is preference. Rotational grazing is a best management practice (Louisiana State University Agricultural Center, 2002) that has substantial conservation benefits that can impact long-run productivity.

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Table 1. Labor Use, Income, Expenses, and Returns Over Expenses, 2004-2005.

Labor Measure	Rotational High	Rotational Medium	Rotational Low	Continuous Medium	Rotational High	Rotational Medium	Rotational Low	Continuous Medium
	Per Cow				Per Acre			
Labor Usage, Hours								
Total Labor	6.18^{a}	8.10^{b}	11.34^{c}	3.77^{d}	6.98^{n}	6.34^{no}	5.56^{o}	2.95^{p}
Working Cows and Calves	0.52^{a}	0.75^{a}	1.00^{a}	0.69^{a}	0.58^{n}	0.59^{n}	0.49^{n}	0.54^{n}
Checking and Routine Tasks	2.40^{a}	2.33^{a}	2.98^{a}	2.28^{a}	2.67^{n}	1.83^{o}	1.46^{o}	1.78^{o}
Forage Management	0.80^{a}	1.61^{a}	3.90^{b}	0.51^{a}	0.90^{no}	1.26^{no}	1.90^{n}	0.40^{o}
Repairs and Maintenance	0.75^{a}	1.13^{a}	1.23^{a}	0.22^{a}	0.83^{n}	0.88^{n}	0.60^{n}	0.17^{n}
Moving Animals and Shades	1.78^{a}	2.28^{a}	2.22^{a}	0.06^{b}	1.98^{n}	1.78^{n}	1.09^{o}	0.05^{p}
Miscellaneous Tasks	0.02^{a}	0.00^{a}	0.05^{a}	0.01^{a}	0.02^{n}	0.00^{n}	0.23^{n}	0.00^{n}
Income, Expenses, and Returns Over Expenses, Dollars								
Income from Calves	583.89^{a}	589.66^{a}	603.19^{a}	609.81^{a}	648.00^{n}	462.76^{o}	301.65^{p}	478.62^{o}
Total Income	591.44^{a}	636.05^{a}	710.74^{a}	609.80^{a}	656.31^{n}	499.60^{o}	355.37^{p}	478.62^{o}
Direct Expenses	205.06^{a}	232.98^{a}	342.04^{b}	224.95^{a}	227.71^{n}	182.54^{no}	171.02^{o}	176.44^{o}
Return Over Direct Expenses	386.39^{a}	403.06^{a}	368.30^{a}	384.85^{a}	428.56^{n}	317.05^{no}	184.35^{o}	302.13^{no}
Fixed Expenses	174.46^{a}	204.37^{a}	282.88^{b}	190.96^{a}	193.69^{n}	160.22^{o}	141.45^{o}	149.92^{o}
Total Specified Expenses	379.53^{a}	437.36^{a}	624.92^{b}	415.92^{a}	421.41^{n}	342.77^{o}	312.47^{o}	326.36^{o}
Return over Total Expenses	211.91^{a}	198.68^{a}	85.82^{a}	193.89^{a}	234.89^{n}	156.79^{no}	42.91^{o}	152.22^{no}
Ret over Tot Exp, with Labor	152.57^{a}	120.93^{a}	-23.37^{a}	157.74^{a}	167.86^{n}	95.90^{no}	-10.47^{o}	123.87^{no}

Least squares means within a row (and under the same subheading, i.e., “per acre” and “per cow”) having any superscript in common do not differ at the 0.05 level of significance.

Table 2. Labor, Income, Expenses, and Return Over Expenses, Rotational High Versus Continuous Medium, 1999-2001, 2004-2005.

Measure	Rotational High	Continuous Medium	Rotational High	Continuous Medium
	---------------Per Cow--------------		-----------------Per Acre--------------	
---Labor Usage, Hours---				
Total Labor	8.24[a]	5.32[b]	9.15[n]	4.26[o]
Working Cows and Calves	1.81	2.34	2.00	1.89
Checking and Routine Tasks	2.36	2.00	2.62	1.59
Forage Management	0.79[a]	0.60[b]	0.88[n]	0.48[o]
Repairs and Maintenance	1.19[a]	0.21[b]	1.25[n]	0.17[o]
Moving Animals and Shades	2.23[a]	0.11[b]	2.45[n]	0.09[o]
Miscellaneous Tasks	0.05	0.05	0.06	0.04
---Income, Expenses, and Returns Over Expenses, Dollars---				
Income from Calves	513.08[a]	546.16[b]	567.68[n]	435.63[o]
Direct Expenses	254.41	240.07	281.33[n]	191.83[o]
Return Over Direct Exp (No Labor)	258.67	306.08	286.34	243.77
Fixed Expenses	145.78	147.53	161.32[n]	117.45[o]
Total Specified Expenses	400.19	387.60	442.65[n]	309.28[o]
Return Over Total Exp (No Labor)	115.91[a]	158.55[b]	128.35[n]	126.33[o]

Least squares means within a row (and under the same subheading, i.e., “per acre” and “per cow”) having any superscript in common do not differ at the 0.05 level of significance.