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Economic Evaluation of a
Fed-Cattle Production System Incorporating Corn Grazing

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Introduction

Production System

Corn grazing is the practice of allowing cattle to harvest a standing corn crop by grazing. Even though grazing of immature corn is equivalent to grazing high-quality forage, our discussion will focus on grazing of the mature crop. Several studies have described the feasibility of grazing standing corn as a component of a fed-cattle production system (Johnston, 1998; Dingles and Dingles, 2002; Johns et al., 2002; Bell, 2007). Interest in corn grazing has been motivated by a number of compelling factors. Corn grazing could potentially provide an additional enterprise for Mississippi cattle producers that would add further value to their current production, make more intensive use of existing factors of production, and generate additional economic activity in rural communities.

There are two aspects to consider in evaluating the feasibility of a corn-grazing enterprise: its technical feasibility (i.e., can the production system be successfully implemented?) and its economic feasibility (i.e., does the proposed production system enhance the long-run profitability of the operation?). With respect to technical feasibility, numerous demonstration projects over the last 3 years in multiple locations around the state have been technically successful (Bell, 2007). These projects and others (Broome et al., 2000; Dingels and Dingels, 2002; Triplett et al., 2002; Gower et al., 2003) demonstrate that it is now possible — with the use of newer technologies like herbicide-tolerant seed varieties in conjunction with no-till planting — to produce a corn crop on pasture-based land, which was not previously suited to corn production because of excess slope, soil characteristics, and vegetative cover. It is possible to control the grazing of a mature corn crop with cattle, but animal average daily gains (ADG) are not consistent, depending on many factors (stocking rate, weight, management, etc.). Johns et al. (2002) strip grazed mature standing corn and reported that steers "performed similarly to steers fed a blended commodity ration with rolls of hay." However, the ADG of steers on corn grazing was -0.62 pound from 1 to 32 days, 1.62 pounds from 32 to 65 days, and 1.88 pounds from 65 to 78 days. Johnston (1998) reported 2.16 pounds of ADG in a 56-day corn-grazing trial using 791-pound heifers. In 3 years of observation with steers, Dingles (2002) reported ADGs ranging from 1.39 to 1.57 pounds. In three studies, Bell (2007) reported ADGs from 1.5 to 2.71 pounds. The practice of grazing mature corn, while not widely practiced, is not new. A fifth generation Ohio corn farmer and cattle feeder related how his grandfather had grazed corn in the early 1900s (personal communications, Benson McClarren, Maple Row Farm, Delta, Ohio). Corn production practices have changed recently with the refinement of minimum-tillage methods (Broome et al., 2000) and the release of Roundup Ready® (glyphosate-resistant) corn seed (Monsanto Company, St. Louis, Missouri).

Corn grazing is very similar to feeding whole-shelled corn in a feed bunk. The diet of cattle grazing mature corn consists primarily of the grain in the ears. Because this high-grain diet can result in digestive disturbances, the practice is to start grazing of corn while it is in the soft dough stage, thus allowing the cattle access to a high-quality forage as their diet changes to a higher energy diet as the corn matures. This is similar to a starter ration when feeding whole shelled corn (St. Louis, 1985, 1986; Morrison, 1987). A 2-week period from the corn soft dough stage to maturity is sufficient to prevent digestive disturbances. Animals began grazing by consuming stalks and leaves, then transitioned to consuming ears as the plants matured (Bell, 2007). In addition, cattle should be fed supplemental protein because mature corn (8% crude protein) does not meet the protein requirements of the cattle (approximately 12%, NRC, 1996).

The stocking rate for corn grazing is calculated differently from crops that have regrowth. Once the corn crop matures, it stops growing. The carrying capacity of a field of mature corn solely depends on grain yield. Grain yield is estimated before grazing by standardized sampling methods for counting kernels in a measured row length (1/1,000 acre, MSUcares, 2007). After yield is estimated, the producer then decides how long he wants to keep the steers by setting stocking rates (head per acre) higher or lower. Grazing should cease before moisture in the grain causes molding and alfatoxins toxic to cattle. Because alfatoxins are not likely to occur until at least December, it is possible for steers to reach 1,200 pounds and grade USDA Choice (Schake and Schake, 1996), assuming they were heavy enough at the beginning of the corn-grazing program (approximately 900 pounds on or around July 1).

The cost of gain (COG) is crucial to the profitability of fattening cattle. In a corn-grazing system, this would be directly related to average daily gain (ADG). As ADG of cattle increases, COG usually decreases, thus it is usually desirable to maximize ADG. Mississippi corn-grazing studies show ADG to be directly related to the amount of corn grain available per head daily. As seen in Figure 1, a clear relationship resulted when stocking rates from eight different trials (Bell, 2007; St. Louis, unpublished) were standardized to a 1,000-pound basis and grazing animal days (GAD) per bushel of corn available.

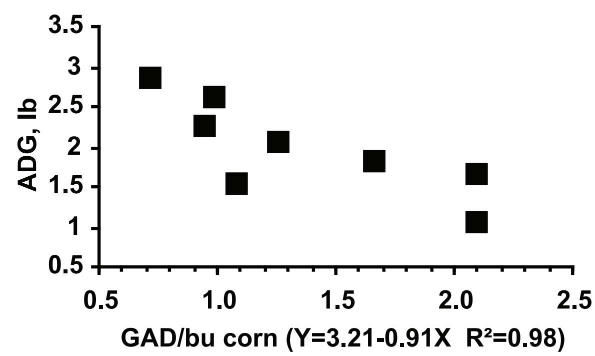

Figure 1. Relationship between steer average daily gain (ADG) and grazing animal days (GAD) per bushel of corn offered in corn grazing.

Marketing

Mississippi, and in fact the entire Southeast, is well adapted to cattle production. Both cow/calf production and stocker-cattle grazing systems using winter annual pasture (primarily ryegrass) are economically significant agricultural enterprises in this part of the U.S. The term "stocker cattle" refers to calves immediately after weaning that are suitable for placement into grazing or other backgrounding programs before placement in a feedlot for finishing. Cattle-feeding operations, however, are virtually nonexistent in the Southeast. In fact, USDA data suggests that a relatively small number of calves are retained in the Southeast beyond weaning (Anderson et al., 2002). Virtually none are kept beyond the feeder cattle stage. The term "feeder cattle" refers to calves that have completed a grazing or other backgrounding program and are ready for placement into a finishing program.

Since fed cattle are not commercially produced in Mississippi, the existing marketing infrastructure and institutions are not well suited to the marketing of fed cattle. Attempting to market fed cattle in Mississippi through traditional markets would result in a greatly discounted price for a number of reasons. First, slaughter facilities are in Midwestern states centralized around large commercial feedlots. Covering transportation costs alone would necessitate a significant discount in the price paid for fed cattle. Because of the time and distance fed cattle would have to travel, they would be much more likely to arrive at slaughter facilities with some bruising, and the stress of the long-distance transport would increase the incidence of dark cutting carcasses. These factors would also contribute to significant price discounts. In reality, even if these problems did not exist, large commercial packers would not buy fed cattle in Mississippi, or use their grid pricing (carcass weight, grade, etc.), due to the relatively small number of cattle and the high transaction costs that this would imply.

While the Southeast may not be well suited to cattle feeding for a number of reasons (climatic conditions, environmental concerns, lack of infrastructure — including access to meat packers), some means of retaining calves beyond the feeder-cattle stage could provide an opportunity to capture additional value from the region's cattle production. Corn grazing is being actively investigated as a means of achieving this goal. Additionally, animals grazing pasture or fields where crops are grown are specifically exempt from confined animal feeding regulations.

There is a growing demand for beef sold in niche markets. "Grass-fed," "home-raised," "natural," and "organic" labels on beef appeal to many consumers because of their growing desire for healthier foods and desire to know the origin of their beef (American Farmland Trust, 2007). Some Mississippi cattle producers are selling cattle directly to consumers as "freezer beef," which is an ill-defined designation. It can be any size (600 to 1,400 pounds live weight), any age (less than 1 year to more than 2 years), or any quality (lean or fat) and still be called "freezer beef." Because it usually has lower quality (tenderness, juiciness, and flavor), most freezer beef is packaged as ground beef with only the high-quality cuts packaged as steaks. The price that consumers pay for the lower quality freezer beef usually saves them money over what they would pay in retail stores.

Some consumers will consistently pay more than the retail price if their beef has acceptable tenderness, juiciness, and flavor, whether "grass-fed," "home-raised," "natural," "organic," or not. Most successful niche markets for beef meet these criteria. Most cattle that have a USDA quality grade of Choice meet these criteria, particularly if the carcasses are aged 2 weeks or more before packaging. Beef of this quality can be produced in Mississippi (St. Louis and Little, 2007), and corn grazing could be a part of this production if it were profitable.

Objectives

The objective of this study was to assess the economic feasibility of a corn-grazing system for growing and fattening cattle in Mississippi. Specifically, this research compared the expected profitability of stocker and finishing cattle production systems that include a corn-grazing component with that of a traditional cattle-feeding enterprise. Moreover, this study introduced and explored a number of qualitative issues impacting the potential feasibility of corn grazing as a stand-alone, fed-cattle production system.

Corn Grazing Followed by Feedlot Finishing

Methods

Data from a 2004 corn-grazing demonstration project (a part of Bell's data, 2007) were used to evaluate the long-term profitability of two systems. In the demonstration project, 49 head of beef-type steers strip-grazed approximately 30 acres of standing corn from mid-July to mid-September. After corn grazing, these steers were sent to a south Texas feedlot for finishing. Before corn grazing, these steers had been through a full season of grazing ryegrass. A contemporary group of 48 steers were sent directly from ryegrass pasture to the same south Texas feedlot. While this does not technically provide a control group for this study, it does provide a fairly realistic basis for comparing the corn-grazing system to a more typical finishing system for feeder cattle coming off of winter grazing. The steers sent directly to the feedlot off of ryegrass were of a similar breed and type to the cattle sent into corn grazing, but the groups were not randomly selected. The heavier steers coming off of ryegrass were sent directly to the feedlot, while the lighter steers were held for corn grazing. Both groups were raised from a long-established commercial-grade Experiment Station herd at Mississippi State University.

Data for this study consist of production data on both cattle production systems (i.e., corn grazing/feedlot vs. feedlot), as well as cattle and feed prices and costs associated with the production of corn and management of the grazing system. With respect to the production data, individual animal data

Table 1. Summary statistics for price data used in comparing corn grazing with traditional cattle finishing production system.

Variable	Mean	Std. Dev.
Feeder steers (May, $/cwt)	74.38	15.28
Fed steers (September, $/cwt, dressed)	114.43	16.65
Fed steers (January, $/cwt, dressed)	119.15	17.45
Corn (June, $/bu)	2.79	0.82
Corn (September, $/bu)	2.69	0.49
Cottonseed meal (June, $/ton)	143.12	29.21
Cottonseed meal (September, $/ton)	147.16	25.22
Whole cottonseed (Annual, $/ton)	108.75	13.39

Note: All prices cover the period from 1995 through 2006, with the exception of January fed-steer prices, which cover the period from 1996 through 2007.

consist of cattle weight at relevant points in the production system (end of ryegrass grazing, beginning of corn grazing, end of corn grazing, and slaughter). Pen-level data was available on feed intake in the feedlot. Costs associated with raising corn for grazing were obtained by budgeting the actual production practices using the Mississippi State University Budget Generator and 2007 prices. In this system, corn was not grown according to a typical corn production system. Glyphosate-tolerant corn was no-till planted into land typically used as pasture rather than cropland. Also in this system, harvest-related expenses were not relevant since the standing corn was grazed rather than mechanically harvested. Cattle prices for feeder and fed cattle, as well as prices for individual components of feedlot rations, were obtained from USDA.

In order to evaluate the long-run profitability of either production system, it is necessary to account for the behavior of prices over a significant period of time. For this reason, cattle and feed prices over the 10-year period from 1995 through 2004 were obtained. These prices were used in stochastic simulation to generate 5,000 possible price outcomes. Using these simulated prices, a distribution of 5,000 possible revenue outcomes was calculated for each of the two production systems.

For each year covered by the data, a May average price to value steers was obtained at the end of ryegrass grazing. A fed-cattle price from the following September was obtained to value the fed cattle that had been placed on feed right off of ryegrass grazing, and a fed-cattle price from the following January was used to value cattle that had been through corn grazing before placement in the feedlot. These months correspond to the month of slaughter for the two different groups of steers. Feed ingredient prices were obtained for the month of placement on feed (June for the group coming off of ryegrass, September for the group coming off of corn grazing). The whole-cottonseed price is an exception to this practice. Only annual prices were available for whole cottonseed. Table 1 summarizes the data used in this study, including descriptive statistics for each variable.

All simulated price series were correlated using a procedure adapted from Naylor et al. (1966), which uses information from the covariance matrix of the empirical data to correlate random variables from a multivariate normal distribution. [For a detailed explanation, justification, and applications of this procedure, see Clements et al., (1971); Krzanowski (1988, pp204-205); Trapp, (1989); Anderson et al., (2003, 2004)].

The simulation of feeder cattle prices was complicated by the very wide spread in the weights of cattle coming off ryegrass (range from 675 to 1,105 pounds). A further complication was the fact that for Mississippi markets, prices on weights above the 700- to 800-pound category were not consistently available. To deal with this issue, a price for this category of steers was simulated. That price was then adjusted by a slide based on historic prices in order to obtain a weight-appropriate feeder steer price. For example, from 1995 though 2004, the May price on 700- to 800-pound steers averaged 6.8% lower than the price on 600- to 700-pound steers. Since prices were not consistently available on weights over 800 pounds, the slide for heavier weight categories was simply based on an interpolation of the slide from lighter weight categories. Table 2 reports the price slides used in this study.

The simulation of feed costs was complicated by the variety of feed ingredients used in the feedlot

Table 2. Price/weight slides used to adjust May feeder cattle prices.

Weight category	Price slide
700 to 800 pounds	-6.81%
800 to 900 pounds	-6.01%
900 to 1,000 pounds	-5.31%
1,000 to 1,100 pounds	-4.69%
1,100 to 1,200 pounds	-4.15%

Note: The price slide shows by what percentage the price in the state weight category differs from the price in the next lowest weight category.

rations for both sets of cattle. A time-dependent series of prices was not available for all of these ingredients. Prices were available for corn, cottonseed meal, and whole cottonseed. To simulate a distribution of feed costs, the total value of the corn, cottonseed meal, and whole cottonseed actually fed was calculated using a stochastically simulated price for each item. This figure was then divided by the value of corn, cottonseed meal, and whole cottonseed actually fed based on 2004 prices (the year of the demonstration project) to create an index value. This index value was multiplied by the actual total ration cost to obtain a simulated ration cost value. This process was repeated for each of the 5,000 simulated outcomes. This approach to the simulation of ration cost ignores changes in the cost of other ration components, a factor that would most likely increase variability in the ration cost. However, this approach also ignores possible modifications to the ration composition in response to changing price relationships, which would reduce variability in the ration cost.

Table 3. Roundup Ready® corn for grazing, summer 2007, 135-bushel yield goal, non-Delta areas of Mississippi.[1]

Item	Unit	Price	Quantity	Amount
		$		$
DIRECT PREHARVEST EXPENSES				
Custom spraying				
Application by air (5 gal/A)		4.50	1.00	4.50
Fertilizers				
Lime DL (spread)	ton	40.00	0.50	20.00
Am Nitrate (34% N)	cwt	17.00	1.53	26.01
Phosphorous (46% P_2O_5)	cwt	15.00	1.09	16.31
Potash (60% K_2O)	cwt	14.00	0.83	11.62
Fert 10-34-0	cwt	17.00	0.50	8.50
UAN (32% N)	cwt	13.00	4.00	52.00
Herbicide				
Glyphosate Plus 4L	pint	2.30	5.50	12.65
2, 4-D Amine 4L	pint	1.66	1.00	1.66
Atrazine 4L	pint	1.18	4.00	4.72
Seed				
Corn seed	thousand	1.45	28.00	40.60
Labor				
Operator and unallocated	hour	9.41	0.88	8.32
Diesel fuel				
Tractors	gal	2.41	2.87	6.92
Repair & maintenance				
Tractors & implements	acre	3.67	1.00	3.67
TOTAL DIRECT PREHARVEST EXPENSES				217.48
FIXED EXPENSES				
Tractors & implements	acre	12.22	1.00	12.22
TOTAL SPECIFIED EXPENSES				229.70
PREHARVEST COST OF PRODUCTION[2]	$/bushel			**1.91**

[1]Adapted from Agricultural Economics (2006) with harvest and postharvest expenses removed. Interest on operating capital included in capital budget.
[2]Cost per bushel based on 120-bushel-per-acre yield.

Using simulated beginning cattle value, ending cattle value, and total ration cost, a gross margin was calculated for each production system (i.e., corn grazing/feedlot vs. feedlot). For the corn grazing/feedlot production system, the gross margin is calculated as follows:

$$(1)\quad GM_{CG} = FEDVAL_{CG} - INVAL_{CG} - FEED_{CG} - CGCOST - INT_{CG},$$

where GM_{CG} is the gross margin for the group of cattle in the corn grazing/feedlot production system; $FEDVAL_{CG}$ is the final value of the cattle at the end of the finishing phase; $INVAL_{CG}$ is the value of the feeder cattle placed into the corn grazing/feedlot system (valued at the end of the preceding ryegrass grazing period); $FEED_{CG}$ is the total cost of feed fed to the cattle while in the feedlot; and INT_{CG} is the opportunity cost of capital. Interest is charged at a 5% annual rate on 100% of the value of feeder cattle and 50% of the total feed cost. *CGCOST* is the cost of producing the corn for grazing. A budget for corn production in this system is included in Table 3.

For the traditional feedlot production system, the gross margin is calculated as follows:

$$(2)\quad GM_{FL} = FEDVAL_{FL} - INVAL_{FL} - FEED_{FL} - INT_{FL}.$$

All variables are as previously described. Note that equation 2 does not include any expense for corn production. Interest is calculated exactly as in equation 1.

Equations 1 and 2 do not include any charges for labor, veterinary and medicine expenses, yardage in the feedlot, and a number of other minor expense items. That is why the figures calculated here are referred to as gross feeding margins rather than as net returns. The assumption implicit in this approach is that these other expense items would not differ significantly between the two production systems.

Results

A summary of the distribution of gross feeding margins for each production system is presented in Table 4. The traditional production system of sending cattle directly to the feedlot off ryegrass grazing yields considerably higher average returns. While the standard deviation of returns from this system is also higher, the coefficient of variation (which reports the standard deviation as a percent of the mean) is considerably lower, indicating a much more favorable risk-return tradeoff for the traditional feedlot production system compared with the corn-grazing system.

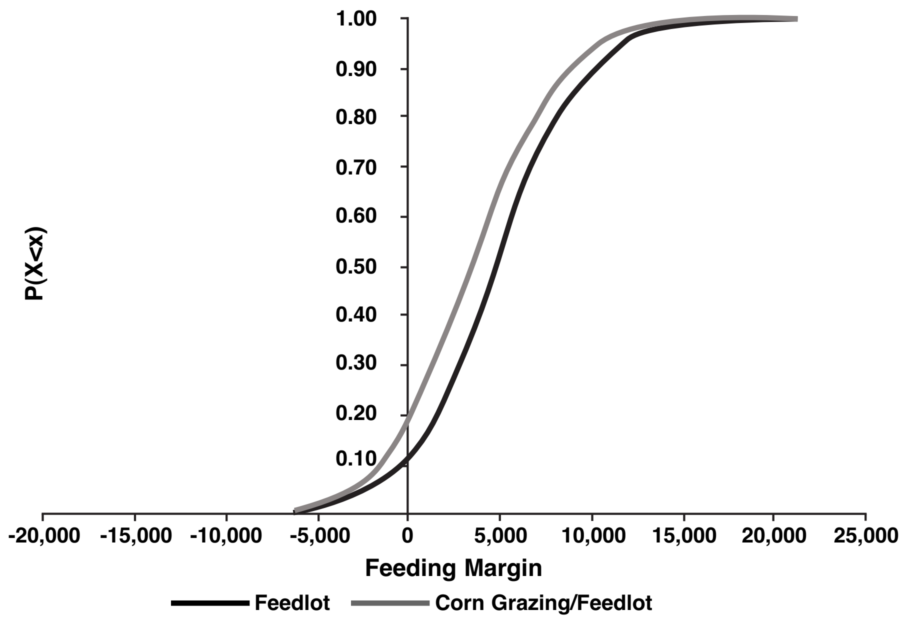

Figure 2. Cumulative distribution function for gross feeding margins from alternative fed-cattle production systems

A more complete view of the risk-return characteristics of each production system can be obtained from the cumulative distribution functions (CDFs) of gross feeding margins from each production system. Figure 2 presents these CDFs. Note that at nearly every point (except for the extreme lower tail), the CDF of the traditional production system lies to the right of the corn grazing/feedlot system. The point where the gross feeding margin is zero for each of these distributions provides a good point of reference for comparison. Figure 2 indicates that for the traditional feedlot production system, the gross feeding margin will be equal to or below zero for roughly 15% of the scenarios. For the corn grazing/feedlot system, the gross feeding margin will be zero or lower for about 30% of the scenarios.

Table 4. Summary of gross feeding margin distributions for corn grazing/feedlot and feedlot fed-cattle production systems.

	Feedlot		Corn grazing/feedlot	
	Total	Per head	Total	Per head
Mean gross feeding margin	$4,331.76	$92.17	$3,297.56	$67.30
Std. dev. of gross feeding margin	4,086.37	86.94	4,116.24	84.01
Minimum gross feeding margin	-$15,296.97	-$325.47	-$9,612.09	-$196.17
Maximum gross feeding margin	$20,094.00	$427.53	$20,652.55	$421.48
Coefficient of variation	0.94		1.25	

Note: The feedlot group contained 47 head of cattle; the corn grazing/feedlot group contained 49. Means and standard deviations are calculated over 5,000 simulated outcomes.

Discussion

Using corn grazing as a component of a cattle-finishing production system does not appear, based on the results of this study, to offer any opportunity to increase returns to cattle finishing. It is very important, however, to consider the limitations of this study. One obvious limitation is that it is based on only 1 year of production data (though longer-term cattle and feed price relationships were accounted for through the use of stochastic simulation).

The most serious limitation of this evaluation is that data were not available on the physical characteristics of the corn-grazing cattle at intermediate points in the feeding period. The steers that grazed corn were fed for about the same length of time in the subsequent feedlot phase of production as the steers that went to the feedlot off ryegrass grazing. A limited amount of data from a corn-grazing trial in Tennessee (Bell, 2007) indicates that cattle are not ready for harvest coming right off corn grazing; however, it is not clear just how much additional feeding is necessary to produce adequate finish on corn-grazed cattle. It is very likely that the cattle used for this study could have been marketed as finished cattle (with no significant discounts) after a considerably shorter feeding period than was actually employed. This would significantly reduce the costs in the corn grazing/feedlot production system. Further research could help to clarify how much feeding beyond the corn-grazing phase is actually needed to reach a satisfactory quality grade.

A further limitation of this study is that it was not possible to consider corn grazing as a terminal phase of production. It is difficult to establish a value for steers coming directly off corn grazing. As noted previously, they are not quite finished steers in the traditional sense, and it would be inappropriate to try to value them as such. On the other hand, they are much larger and further along in the finishing process than typical feeder cattle. There is essentially not a market for “feeder steers” weighing more than 950 pounds, such as these corn-grazing steers.

It is possible that corn-grazed cattle could be sold through direct marketing to consumers or specialty retail outlets. Such a niche marketing strategy could capitalize on the extensive nature of this production system — appealing, for example, to consumers concerned about animal welfare issues associated with confinement production systems or to health-conscious consumers desiring less fattened beef. Modifications to the system could perhaps provide additional selling points (e.g., avoiding the use of growth hormone implants). One problem with this approach could be the heavy reliance of this production system on genetically modified corn varieties — a point not likely to appeal to the type of consumer favorably disposed to (and willing to pay a premium for) the other aspects of this production system. Evaluation results of the quality and key sensory aspects (taste, color, etc.) of meat from cattle directly off corn grazing have been positive (Imamoglu, 2007) and will provide useful information for assessing the feasibility of the development of a niche market for corn-grazed beef.

CORN GRAZING BUDGETS

Methods

Budgets were developed for corn grazing and corn for grain. Corn grazing was further divided into two systems: (1) finishing steers in Mississippi and (2) shipping heavy steers for finishing in western feedlots. Animal expense budgets, corn (pasture) expense budgets, and break-even analyses were developed for each scenario.

To arrive at a stocking rate (head per acre), the relationship in Figure 1 (ADG = 3.21 - 0.91 x GAD/bushel of corn) was used in a simulation of cost of gain (COG) shown in Figure 3. Assumptions for the simulation were that 700-pound steers would graze corn that yielded 120 bushels per acre for 120 days. The average of beginning and ending steer weights was adjusted to a 1,000-pound basis and then multiplied by 106 days to calculate GAD.

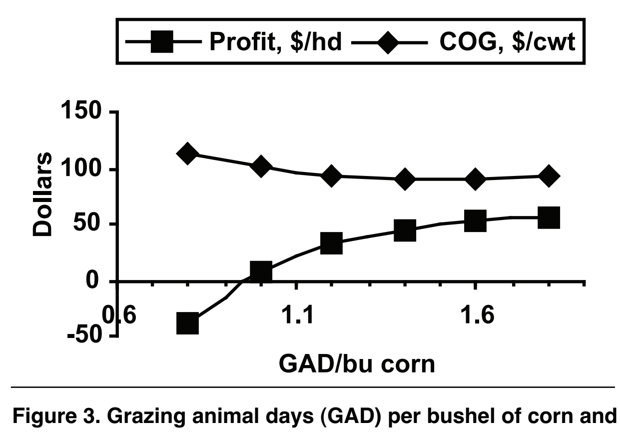

Figure 3. Grazing animal days (GAD) per bushel of corn and its affect on cost of gain (COG) and profit per head

Example: Input 1.4 GAD per bushel, 700-pound steers will reach 932 pounds in 120 days (1.94 pounds ADG). Average weight is 816 pounds [(700+932)/2]. Corn 120 bushels per acre yield times 1.4 GAD per bushel equals 168 GAD per acre. On 1,000-pound basis, stocking rate is 1.4 head per acre (168/120). Stocking rate adjusted for the average weight is 1.72 head per acre (1.4*1000/816). Costs of the corn and steer prices changed only the scale and did not change the shape of the curve. From Figures 1 and 3, 1.4 GAD per bushel of corn yield was chosen for the following budgets.

Assumptions for no-tillage corn production are those for non-Delta areas of Mississippi (Agricultural Economics, 2006). They are to plant a Roundup Ready® corn hybrid treated with Poncho® (Bayer CropScience, Research Triangle Park, North Carolina) insecticide at a seed drop of 28,000 seeds per acre with 30- to 40-inch row spacing as early as possible (February or March), depending on latitude and/or soil temperature (> 50°F). Glyphosate herbicide is applied in February and April at a rate of 2 pounds of active ingredient (AI) per acre and again in May at 1.5 pounds AI per acre. In addition, in February 2, 4-D amine herbicide is applied at a rate of 1 pound AI per acre. In April and May, atrazine herbicide is applied at a rate of 2 pounds AI per acre. Fertilizer is applied at planting and in April to supply a total of 183 pounds of N, 67 pounds of P_2O_5, and 50 pounds of K_2O per acre.

Assumptions for finishing cattle by grazing corn in Mississippi were from July 1 to December 3 (155 days). Steers weighed 900 pounds and reached 1,200 pounds when they finished (ADG = 1.94 pounds). Heavy (900-pound) steers were chosen for this scenario because December is about as late as corn can be safely grazed before alfatoxins begin to affect the grain quality and because lighter weight steers would not be fat enough by December. Steers with selected genetics (moderate frame, British breeds) will grade USDA Choice when they weigh 1,200 pounds (Schake and Schake, 1996).

For growing stocker cattle by grazing corn, grazing was from July 1 to November 29 (120 days). Steers weighed 700 pounds when grazing began and 932 pounds when they finished (ADG = 1.94 pounds). The weight of steers chosen was based on findings of St. Louis (1985; 1986) and Morrison (1987) showing that steers less than 700 pounds performed less well on whole shelled corn. This scenario assumes cattle will be shipped to a western feedlot for finishing. The steers on both grazing systems were fed a protein supplement daily to meet the nutrient requirements of the animals. Land rent of $25 per acre was charged to the producer. This is consistent with typical pasture lease rates in the area.

Environmental conditions are assumed for Mississippi, where corn can be planted in late February or early March and can be ready to graze (soft-dough stage) by mid-June or early July. Also, temperature, rainfall, and soil nutrients are adequate to produce an average of 120 bushels of corn per acre. Other assumptions are listed as footnotes to the tables.

Results and Discussion

The 2007 budget for production of corn for grazing is $229.70 per acre (Table 3). Cost per head to fatten steers from 900 to 1,200 pounds in 155 days was $381.09, resulting a cost of gain (COG) of $126.99 per hundredweight (Table 5). The COG to grow stocker steers from 700 to 932 pounds in 120 days was $110.05 per hundredweight (Table 6). Break-even prices are shown in Tables 7 and 8. Cost of producing corn for grain, and not grazed, would be $293.12 per acre or $2.44 per bushel (Table 9).

Compared with western feedlots where the cost of gain (COG) ranges from $58 to $62 per hundredweight (personal communications 11/02/07, Gregory Feedlots, Inc.), corn grazing is not competitive. Our COG was $126.99 per hundredweight for a steer weighing 900 pounds and finishing at 1,200 pounds in 155 days (Table 5). **However, by selling in niche markets, corn grazing might be profitable.** From Table 8, a 900-pound steer purchased at $80 per hundredweight would have to sell for **more than** $87.77 per hundredweight to make a profit. In a niche market, beef would likely sell on a hot-carcass or retail-cut basis. Assuming 61% dressing rate, the hot-carcass weight of a 1,200-pound animal would be 732 pounds. The $87.77 per hundredweight for live weight would translate to $144 per hundredweight for hot-carcass weight before hauling, processing, etc. A local slaughter plant charges $10 per head plus $0.35 per pound of hot-carcass weight for processing. The yield of meat in the freezer is about 70% of hot carcass weight, so meat would have to sell for about $2.58 per pound for 512 pounds of meat in Mississippi niche markets [(12x87.77)+(.35x732)+10)/(1200*.61*.70)]. For niche marketing of USDA Choice beef, a price over $2.58 per pound may be reasonable to cover hauling, marketing, etc., and still make a profit. In the future, as corn production costs increase, retail beef prices will likely increase. Corn grazing cost estimates for 2009 are more than $400 per acre (compared with Table 3), which will result in a break-even cost of more than $102 per head or $2.91 per pound of meat, using the same assumptions. As a comparison, using retail prices with a 25% markup, the value of the same "meat in the freezer" was about $4.55 per pound in 2007.

It is uncertain whether Mississippi producers would harvest corn to feed their own cattle because of the expenses of on-farm storage for the crop (bins, augers, fuel, etc.). If they want to fatten steers in a drylot, perhaps the best option might be to sell the corn crop at a profit ($2.44-per-bushel production cost, Table 9) and buy feed as needed for steers. Byproduct feeds are usually less expensive than corn and can be formulated to result in the least COG (St. Louis and Little, 2007). An added advantage of drylot feeding is that steers can be purchased and sold in any month, whereas selling of animals from corn grazing would be seasonal. It is generally accepted that a year-round supply of cattle that will grade Choice is needed to expand and keep a niche market for beef. Cattle weighing more than 800 pounds are most economically fattened in Mississippi in the winter and sold off of ryegrass pasture in the spring. However, the cost of fattening cattle for sale for the rest of the year is higher but unknown.

Our scenario of corn grazing stocker cattle from 700 to 932 pounds in 120 days is not economically feasible as a single enterprise. By combining stocker and finishing enterprises, the previous study addressed the economics more thoroughly. A profit in the finishing phase is necessary to compensate for the high COG of corn grazing. Data used in the previous study is encouraging as it shows a very high ADG in the finishing phase (Bell, 2007). However, as mentioned, a finishing phase shorter than 106 days may have been beneficial. For example, feedlots normally have four or five "step-up" rations; the first has the most fiber with the least energy, while the last has the highest energy concentration. The purpose is to prevent digestive disorders as the cattle adapt to higher concentrate diets. Cattle leaving corn grazing are already on a high-concentrate ration of whole shelled corn. After being taken off this ration and being hauled, they cannot go directly to the final finishing ration without digestive disorders. However, they do not need to start at the lowest energy ration, designed for cattle coming from an all-forage diet. By starting with a higher energy ration, the feeding period might be shortened for cattle coming from corn grazing. Lowell Mosier (personal communications), studying corn grazing in Nebraska, suggested a period of 40–50 days to complete finishing of animals following corn grazing.

Another concern meat packers have of cattle coming from pasture is a yellow fat color that discounts the value and sometimes gives the meat a "grassy" flavor. Feeders believe that cattle should be fed for a short period (80–100 days) in a feedlot to remove yellow fat. Imamoglu (2007) has shown that cattle harvested directly from corn grazing do not show yellow fat. Yellow fat is a result of a diet high in carotene, a Vitamin A precursor, which is prevalent in green forages. The only green forage available to corn-grazing animals is the volunteer grass that grows in strips that have been grazed out. By fencing off grazed strips and

Table 5. Finishing steers by grazing Roundup Ready® corn in Mississippi, 900 to 1200 pounds in 155 days, 1.94 pounds ADG.

Item	Unit	Price	Quantity	Amount
			$	$
DIRECT EXPENSES				
Pasture[1]	acre	217.48	0.97	210.69
Protein supplement[2]	cwt	7.50	1.55	11.63
Salt and minerals[3]	cwt	14.75	0.39	5.72
Dewormers	head	2.99	1.00	2.99
Fly control	head	1.16	1.00	1.16
Fences, feeders, building repair	year	14.33	0.92	13.13
Feeding fuel & repair[4]	hours	0.00	0.05	0.00
Rent	acre	25.00	0.97	24.22
Labor	hours	10.00	1.08	10.82
Death loss[5]	dol.	810.00	1.00%	8.10
Marketing[6]	dol.	960.06	0.00%	0.00
Interest on calf[5,7]	dol.	810.00	3.58%	29.03
Interest on operating capital[8]	dol.	280.71	5.50%	15.44
Total direct expenses				333.28
Direct cost of gain	$/cwt			111.06
FIXED EXPENSES[9]				
Interest on investment[8]	year	365.65	3.67%	13.41
Insurance & taxes[8]	year	365.65	1.83%	6.70
Depreciation[8]				
Fencing	acre	5.03	0.89	4.47
Pasture planting equipment	acre	7.58	0.89	6.73
Feeding equipment	hours	0.00	0.05	0.00
Buildings & improvements	year	18.00	0.92	16.50
Total fixed expenses				47.81
TOTAL SPECIFIED EXPENSES				381.09
Total cost of gain	$/cwt			126.99

[1]From Table 3.
[2]Hand-fed 1 pound per head daily at $150 per ton.
[3]Fed free choice 0.25 pound per head daily at $14.75 per hundredweight.
[4]Machinery and equipment needed for feeding. Other machinery and equipment included in Table 3.
[5]Based on purchase price of $90 per hundredweight.
[6]Based on sale price of $80 per hundredweight.
[7]Interest for 5 months.
[8]Interest for 11 months.
[9]Assumes 25-head capacity.

denying access to grass, yellow fat will not be an issue. In addition, by denying grass in the diet, ADG should improve (St. Louis, 1985, 1986; Morrison, 1987).

Corn grazing has value for various types of wildlife. Dropped kernels of corn and open fields provide food for various wildlife species over an extended period. In contrast, grain mechanically harvested is made available for individual fields in a short time. Mourning doves have utilized grazed fields to the extent that bird counts were 50 to 100 times those of mechanically harvested fields in the vicinity (Manning, 2005). For dove hunters, the attraction is a result of an agricultural practice rather than baiting the field. Fee hunting for wildlife can be an additional source of income that might pay for crop expenses with animal gains as a bonus. Landowners in south Mississippi charge from $25 to $50 per gun per day for quality dove hunting where birds are abundant. In 2006, Mississippi Department of Wildlife, Fisheries and Parks (MDWFP), in their Private Lands Dove Field Program, sold individual field permits from $55 to $200 to hunt on privately owned land (MDWFP, 2006). Other wildlife, including deer, turkey, and quail, utilize the corn in the system. Producers with potential income from fee hunting may want to plant corn and manage it for

Table 6. Growing stocker steers by grazing Roundup Ready® corn in Mississippi, 700 to 932 pounds in 120 days, 1.94 pounds ADG.

Item	Unit	Price	Quantity	Amount
			$	$
DIRECT EXPENSES				
Pasture[1]	acre	217.48	0.58	126.78
Protein supplement[2]	cwt	7.50	1.20	9.00
Salt and minerals[3]	cwt	14.75	0.30	4.43
Dewormers	head	2.99	1.00	2.99
Fly control	head	1.16	1.00	1.16
Fences, feeders, building repair	year	13.63	0.83	11.36
Feeding fuel & repair[4]	hours	0.00	0.06	0.00
Rent	acre	25.00	0.58	14.57
Labor	hours	10.00	1.05	10.51
Death loss[5]	dol.	700.00	1.00%	7.00
Marketing[6]	dol.	839.09	0.00%	0.00
Interest on calf[5,7]	dol.	700.00	2.87%	20.07
Interest on operating capital[8]	dol.	180.80	5.00%	9.04
Total direct expenses				216.90
Direct cost of gain	$/cwt			93.36
FIXED EXPENSES[9]				
Interest on investment[8]	year	332.13	3.33%	11.07
Insurance & taxes[8]	year	332.13	1.67%	5.54
Depreciation[8]				
Fencing	acre	7.16	0.49	3.48
Pasture planting equipment	acre	7.58	0.49	3.68
Feeding equipment	hours	0.00	0.06	0.00
Buildings & improvements	year	18.00	0.83	15.00
Total fixed expenses				38.77
TOTAL SPECIFIED EXPENSES				255.67
Total cost of gain	$/cwt			110.05

[1]From Table 3.
[2]Hand-fed 1 pound per head daily at $150 per ton.
[3]Fed free choice 0.25 pound per head daily at $14.75 per hundredweight.
[4]Machinery and equipment needed for feeding. Other machinery and equipment included in Table 3.
[5]Based on purchase price of $100 per hundredweight.
[6]Based on sale price of $90 per hundredweight.
[7]Interest for 4 months.
[8]Interest for 10 months.
[9]Assumes 25-head capacity.

Table 7. Return above costs per head and break-even sale price for finishing steers by grazing Roundup Ready® corn in Mississippi, 900 to 1200 pounds in 155 days, 1.94 pounds ADG.[1]

SELL	PURCHASE PRICE									
PRICE	70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00
$/cwt	$/cwt	$/cwt	$/cwt	$/cwt	$/cwt	$/cwt	$/cwt	$/cwt	$/cwt	$/cwt
60.00	-243.23	-288.23	-333.23	-378.23	-423.23	-468.23	-513.23	-558.23	-603.23	-648.23
65.00	-183.23	-228.23	-273.23	-318.23	-363.23	-408.23	-453.23	-498.23	-543.23	-588.23
70.00	-123.22	-168.22	-213.22	-258.22	-303.22	-348.22	-393.22	-438.22	-483.22	-528.22
75.00	-63.22	-108.22	-153.22	-198.22	-243.22	-288.22	-333.22	-378.22	-423.22	-468.22
80.00	-3.21	-48.21	-93.21	-138.21	-183.21	-228.21	-273.21	-318.21	-363.21	-408.21
85.00	56.79	11.79	-33.21	-78.21	-123.21	-168.21	-213.21	-258.21	-303.21	-348.21
90.00	116.79	71.79	26.79	-18.21	-63.21	-108.21	-153.21	-198.21	-243.21	-288.21
95.00	176.80	131.80	86.80	41.80	-3.20	-48.20	-93.20	-138.20	-183.20	-228.20
100.00	236.80	191.80	146.80	101.80	56.80	11.80	-33.20	-78.20	-123.20	-168.20
105.00	296.81	251.81	206.81	161.81	116.81	71.81	26.81	-18.19	-63.19	-108.19
	BREAK-EVEN SALE PRICE ($/cwt)									
	80.27	**84.02**	**87.77**	**91.52**	**95.27**	**99.02**	**102.77**	**106.52**	**110.27**	**114.02**

[1]From Table 5.

Table 8. Return above costs per head and break-even sale price for growing stocker steers by grazing Roundup Ready® corn in Mississippi, 700 to 932 pounds in 120 days, 1.94 pounds ADG.[1]

SELL PRICE	PURCHASE PRICE 70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00
$/cwt	*$/cwt*	*$/cwt*	*$/cwt*	*$/cwt*	*$/cwt*	*$/cwt*	*$/cwt*	*$/cwt*	*$/cwt*	*$/cwt*
60.00	-147.51	-182.51	-217.51	-252.51	-287.51	-322.51	-357.51	-392.51	-427.51	-462.51
65.00	-100.90	-135.90	-170.90	-205.90	-240.90	-275.90	-310.90	-345.90	-380.90	-415.90
70.00	-54.28	-89.28	-124.28	-159.28	-194.28	-229.28	-264.28	-299.28	-334.28	-369.28
75.00	-7.66	-42.66	-77.66	-112.66	-147.66	-182.66	-217.66	-252.66	-287.66	-322.66
80.00	38.95	3.95	-31.05	-66.05	-101.05	-136.05	-171.05	-206.05	-241.05	-276.05
85.00	85.57	50.57	15.57	-19.43	-54.43	-89.43	-124.43	-159.43	-194.43	-229.43
90.00	132.18	97.18	62.18	27.18	-7.82	-42.82	-77.82	-112.82	-147.82	-182.82
95.00	178.80	143.80	108.80	73.80	38.80	3.80	-31.20	-66.20	-101.20	-136.20
100.00	225.42	190.42	155.42	120.42	85.42	50.42	15.42	-19.58	-54.58	-89.58
105.00	272.03	237.03	202.03	167.03	132.03	97.03	62.03	27.03	-7.97	-42.97
	BREAK-EVEN SALE PRICE ($/cwt)									
	75.82	**79.58**	**83.33**	**87.08**	**90.84**	**94.59**	**98.35**	**102.10**	**105.85**	**109.61**

[1]From Table 6.

wildlife by corn grazing. In so doing, the combined wildlife, stocker, and finishing enterprises may be profitable.

Corn grazing has value as an alternative method for problem weed control. Using conventional methods, a production season is lost in controlling of some weed species because of residual activity, grazing restrictions, or lack of ground cover. Glyphosate applications over RoundUp Ready® corn will successfully control many of these problem weeds [smutgrass, bahiagrass, dallisgrass, johnsongrass, vaseygrass, carpetgrass, fescue, black berries, dew berries, etc. (Byrd and McDaniel, 2004)]. With corn grazing, the cost of the conventional herbicide is saved (up to $50 per acre for some weeds), and a production season on the land is not lost.

ADG predictions were based on cattle weighing an average of 911 pounds for the grazing period. For fattening steers from 900 to 1,200 pounds, the average weight would be 1,050 pounds. ADG of steers this much heavier might not be as rapid because they are depositing more body fat in relationship to muscle compared with lighter cattle. On the other hand, some of the same cattle used in Study 1 were sent to the feedlot and gained exceptionally well (more than 4.4 pounds ADG in 106 days).

Table 9. Roundup Ready® corn harvested for grain, summer 2007, 135 bushel yield goal, non-Delta areas of Mississippi.[1]

Item	Unit	Price	Quantity	Amount
			$	*$*
DIRECT PREHARVEST EXPENSES[2]				217.48
DIRECT HARVEST EXPENSES[3]				
Hauling				
Grain cart	bu	0.16	120.00	19.20
Labor				
Operator and unallocated	hour	9.41	0.53	4.96
Diesel Fuel				
Tractors and combine	gal	2.41	2.73	6.58
Repair & Maintenance				
Tractors & implements	acre	5.02	1.00	5.02
Interest				
Operating capital[4]	acre	11.26	1.00	11.26
TOTAL DIRECT EXPENSES				264.50
FIXED PREHARVEST EXPENSES[2]			12.22	
FIXED HARVEST EXPENSES[3]				16.40
TOTAL FIXED EXPENSES				28.62
TOTAL SPECIFIED EXPENSES				293.12
COST OF PRODUCTION[5]	$/bushel			**2.44**

[1]Adapted from Agricultural Economics (2006).
[2]From Table 3.
[3]Combining, hauling, and stalk shredding.
[4]Interest of $10.99 preharvest and $0.27 postharvest.
[5]Cost per bushel based on 120-bushel-per-acre yield. Does not include drying and storing costs.

Summary and Conclusions

In this study, a fed-cattle production system consisting of grazing steers on standing corn before placement in the feedlot was compared with a more traditional production system in which steers were placed in the feedlot immediately after the ryegrass-grazing season. Stochastic simulation of cattle and feed prices was used to develop a distribution of possible outcomes for gross feeding margin for each of these production systems. Results indicate that the system incorporating corn grazing did not compare favorably to a more traditional feedlot system in terms of either the level or variability of returns.

A number of limitations to this study were noted, highlighting potential areas for further research related to this topic. Notably, it would be quite useful to know how much a subsequent feeding phase could be shortened by corn grazing, particularly for cattle weighing more than 1,000 pounds.

Budgets were compared for steers weighing 700 and 900 pounds when grazed on standing corn for 120 and 155 days, respectively. Animal weights when corn grazing ended were estimated to be 932 and 1,200 pounds, respectively, for the two scenarios. The lighter weight cattle are typically more suitable for feedlot finishing than the heavy cattle. The heavy cattle would be suitable for developing a niche market for cattle "finished" with corn grazing as an alternative to finishing in a feedlot. Recent studies of cattle processed off corn grazing with no subsequent feeding have shown that the quality of the product was equal to or better than the commercially available sample used in comparison.

Profit potential for local marketing of fat cattle from corn grazing is encouraging. However, a year-round supply of "finished" cattle is needed to develop a niche market. Alternative methods of economically growing and fattening cattle are needed in combination with corn grazing. Additionally, for year-round production, some information on performance of lightweight cattle (300 to 600 pounds) on corn grazing could be useful.

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