Turfgrass – Sod Production: An Economic Evaluation

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Abstract

Notable economies of size were found both in establishment and continued operation of turfgrass-sod farms in Alabama. Over a seven-year time horizon, bermudagrass was the most profitable grass to produce on each farm size analyzed. Both zoysiagrass and centipedegrass also had positive economic returns over the time horizon.

The turfgrass-sod industry has experienced tremendous growth in the last 40 years, from its nascent state in the 1960s to a substantial economic force in several areas of the country today. In the 1960s, about 1,000 sod farms encompassing 105,000 acres were estimated to be generating annual farm-level revenues of roughly $100 million nationally (Lokey, 1984). By 1995, the industry was estimated to include 30 million acres generating $45 billion in revenue (Duble, 1996). In Alabama between 1978 and 2002, the industry expanded from 26 to 89 growers producing roughly 3,000 and 23,000 acres, respectively (Cain, 2002). By 2002, Alabama farm-level receipts from turfgrass production approximated $200 million, surpassing cotton as the top crop by several million dollars.





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Turfgrass firms have merged and expanded to take advantage of substantial economies of size and scale. They have increased efficiency with the introduction of improved technology, much of it developed or augmented by the growers. They have developed and/or introduced alternative product forms and turfgrass species. Growers are attempting to differentiate their products through advertising and branding.

While several studies have analyzed economic relationships for this dynamic industry (Adrian et. al., 1996; Adrian et. al., 1995; Adrian et. al., 1992; Martin and Wells, 2001; White et. al., 1991; and Hall et al., 1988), there is need for additional timely economic information. Appraisers, lenders, producers (current and potential), researchers, extension agents, and others need viable economic data for informed decision making. This paper adds to the base of economic information using current data from growers, especially as related to economies of size and scale and appropriate enterprise selection using price sensitivity analysis.

This paper aims to address a frequently asked question by potential new producers: How much money do I need to get into business? In addition, the paper will address three questions of importance to both current and potential growers: 1) Which grass should I grow? 2) How large should my operation be to enhance efficiency? and 3) What prices are needed to justify production of long-season, premium-priced grasses? While the analysis evaluates warm-season grasses of the South, the approaches and estimates provide insight into economic relationships for other areas of the country and grass species.

Methods and Assumptions

At the outset of this study, a brief survey was mailed to all identified producers in Alabama. The survey questioned growers about acreage by grass specie grown. Growers were also questioned as to whether they would complete a more detailed survey. Thirty-six growers consented to the more detailed survey. This questionnaire was mailed in January, 2000 with a follow-up mailed in February, 2000. Twenty-two of these firms returned completed surveys.

The case study approach was used as the basis for developing costs, returns, and investment requirements for alternative sized turfgrass operations: 100, 250, 550, 850, and 1,200 acres. Owner/operators of farms approximating these sizes volunteered participation and provided a detailed list of machinery complements and a tour of their operations. They also provided a discussion of their business philosophies and general operational procedures, processes, and practices.

This information was used as the base to synthesize the alternatively sized operations. A 100-acre farm was chosen to represent a beginning commercial farm size. A farm having 250-acres was included to evaluate a smaller operation that should be a more profitable and sustainable size than the 100-acre farm. A 550-acre farm was analyzed because several growers indicated that operations beyond this size exceed the management capacity of a single manager or owner-operator, often requiring organizational restructuring or increased delegation. The two larger sizes were evaluated to analyze the leveling-out of the average costs as farms expand beyond current more prevalent large operations.

For the analysis, capital investment levels were based on all new machinery and equipment complements for the alternatively sized operations. Participating growers were asked to identify items that were considered excessive or needed. These items were added to or deleted from their respective example machinery complements. Costs and prices for machinery and equipment were derived from various equipment dealers.

Information provided by growers was used to develop input into linear programming (LP) models analyzed using Microsoft Excel Solver. Models were constructed to determine the most profitable mix of grass species and comparable profit and breakeven square yard prices for three warm-season species: bermudagrass, zoysiagrass, and centipedegrass. Models were developed for the alternative sized farms and a seven-year planning horizon. The seven-year cycle was chosen because it approximates the useful life of many of the turfgrass-specific capital items and is a period of sufficient length to evaluate viability of the enterprises.

Simplifying assumptions, each of which could have a substantial impact for an actual farm situation, include: financing is available for fixed and operating outlays at 10% and 9%, respectively, and excess cash could generate a 4% return. Operating labor is available at $8.00 per hour plus overhead and benefit costs. A seven-year planning cycle was evaluated with wholesale prices held constant in the initial analysis at averages determined in a marketing survey of growers: $1.05, $2.37, and $1.41 per square yard for bermudagrass, zoysiagrass, and centipedegrass, respectively. In the evaluations of price sensitivity, prices for two grasses were held at these average levels while the other grass price varied until it entered the optimal solution, that is, when it became economically attractive to grow.

Nature of Turfgrass Operations

Constraints were placed on production levels to represent grower responses to market preferences and production realities. Most growers desire to maintain a somewhat diverse product mix. Thus, in the initial analysis, available acreage was allocated to include 70% bermudagrass and 15% each of zoysiagrass and centipedegrass. Additionally, given requirements for start-up, only 25% of the bermudagrass acreage and none of the other grasses could be harvested in the first year. In the second and succeeding years, 80% of the Bermuda grass acreage could be harvested twice per year and 67% of the zoysia and centipede grasses could be harvested once per year.

Bermudagrass improves cash flow through more frequent turnover, while zoysia and centipede provide a premium price per unit, though production cycles vary substantially among the grasses. Turnover rate for these grasses can vary depending on weather conditions, production practices, location, and time of year. For example, a marketable bermudagrass could be produced in as little as three to four months from regeneration under ideal conditions in the southern parts of the southern tier of states, while marketable centipede and zoysia grasses would generally require fourteen to sixteen months.

Soil preparation, which includes liming, grading, fertilization, and removal of debris, is usually accomplished by the producer. When initially established and at various multi-year intervals, fields are usually custom fumigated using methyl bromide at a rate of roughly $1,600 per acre. Initial establishment is usually by sprigging for bermudagrass, while zoysiagrass is plug planted and centipedegrass is seeded. Reestablishment is most frequently from ribbons left at harvest for all three grasses. However, bermudagrass reestablishment is sometimes supplemented with application of sprigs and centipedegrass growers sometimes overseed the ribbons.

Analysis

Turfgrass-sod production is a capital intensive enterprise. Capital outlays ranged from $0.5 to $3.6 million for 100-acre to 1,200-acre farms, respectively (Table 1). Maintenance and establishment equipment was generally the largest outlay category, claiming between 31 and 41 percent of the total capital investment for all alternative sized operations. Harvesting equipment was next in prominence (23%) for 100-acre operations, but irrigation (22%) and delivery (25%) equipment were next largest for the 1,200-acre operations. Some growers have opted for contract trucking to reduce capital outlays. However, this alternative increases operating expenses for rentals and leases. On a per acre basis, capital outlays ranged from approximately $5,100 for 100-acre operations to $3,000 for 1,200-acre farms. Economies of size were most notable in moving from the smallest operation (100 acres) to the mid-sized operation (550 acres), with about 84 percent of the per acre establishment cost reduction being achieved by this size.

Table 1. Capital Investment and Percent of Total Outlay for Alternative Sized Turfgrass-Sod Farms, Alabama, 2001

	Size (Acres)									
	100		250		550		850		1,200	
Item	$0	%	$0	%	$0	%	$0	%	$0	%
Buildings and Office Equipment	21	4	39	3	58	3	79	3	97	3
Equipment										
Harvesting	117	23	191.8	16	206.8	11	272.6	10	371.6	10
Maintenance and Establishment	202	39	378.5	31	701.6	38	1139	41	1438	40
Irrigation	85	17	205	17	415	23	670	24	790	22
Delivery	87.5	17	392.5	33	457.5	25	610	22	915	25
Total	512	100	1207	100	1839	100	2771	100	3612	100

Table 2 provides information on the per acre costs of production, for the first year of the operation. The fixed costs will remain constant in subsequent years, but variable costs will need to be adjusted upward after the first year of operation to reflect the production cycles of the grasses. For bermudagrass,

Table 2. Costs Per Acre for Alternative Sized Turfgrass Farms, Alabama, 2002

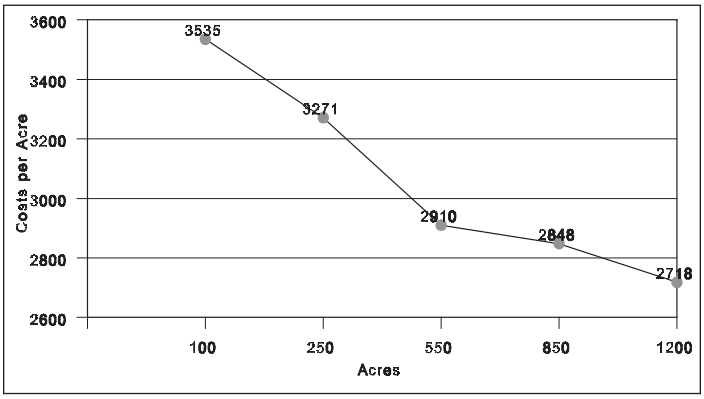
Item	Size (Acres) 100	250	550	850	1,200
Variable Costs					
Herbicides	50	50	50	45	45
Insecticides and Fungicides	25	25	25	20	20
Fertilizer and Lime	135	135	135	121	121
Fuel and Lubrication	140	140	140	140	140
Pallets	360	360	360	324	324
Irrigation	39	39	39	39	39
Repairs	342	242	168	161	148
Hired Labor	480	640	640	602	533
Interest on Variable Capital (@9%)	147	148	146	133	130
Other Variable Costs	250	250	250	250	250
Subtotal	1968	2029	1953	1836	1751
Fixed Costs					
Land Rent	100	100	100	100	100
Insurance	41	39	27	26	24
Depreciation	670	602	418	408	380
Interest on Fixed Capital (@10%)	256	241	167	163	150
Operator Labor Management	400	160	145	235	233
Miscellaneous	100	100	100	80	80
Subtotal	1567	1242	957	1012	967
Total	**3535**	**3271**	**2910**	**2848**	**2718**

Because of rounding of pennies, some column figures may not add up exactly. Variable costs are for the first year of operation. To account for costs of harvesting, re-establishment, etc., in subsequent years, variable costs should be doubled for bermudagrass and adjusted upward by factors of 1.5 and 1.25 for zoysia and centipede, respectively.

which is assumed in the analyses presented here to be harvested twice a year, these costs need to be doubled to account for reestablishment charges and the additional harvesting and cultural practices associated with rapidly growing grass. For zoysia, after the first year, variable costs per acre must be adjusted upward by a factor of 1.5 to reflect its production cycle. Similarly, centipede variable costs must be adjusted upward by a factor of 1.25. Thus, for the 100-acre farm, with 70 acres of bermudagrass, 15 acres of zoysiagrass, and 15 acres of centipede grass, variable costs for the second year and beyond would be $356,700 for the entire farm. For the 1,200 acre farm, with 840 acres of bermudagrass, and 180 acres each of zoysiagrass and centipede grass, variable costs after the first year would climb to $3,808,425 per year.

Total costs in the first year ranged from $3,535 per acre for the 100-acre farm to $2,718 per acre for the 1,200-acre farm with variable costs ranging from 56 percent of the total for the smaller operation to 64 percent for the larger one (Table 2). Major cost components involved depreciation, labor, interest on borrowed capital, and pallets. While both variable and fixed costs per acre decreased as the operation size increased, the decrease was greater for fixed costs. The largest farms had 38 percent lower fixed costs per acre than the smallest farms. By contrast, variable costs per acre decreased by 11 percent. Figure 1 provides a graphical view of the average annual total costs for the different sized operation.

Figure 1. Costs Per Acre for Alternative Sized Turfgrass-Sod Farms, Alabama, 2002



Cash flow over a seven-year planning horizon provides a useful means for evaluating the economic situation of a turf farm. Tables 3 and 4 provide cash-flow estimates for the 100-acre and 1200-acre operations, respectively. Positive cumulative cash levels are generated by years 5, 4, 3, 3, and 3, for 100, 250, 550, 850, and 1,200 acre farms, respectively. Note that the 100-acre farm had about $333,000 of accumulated cash after year 7 while the 1,200-acre farm accumulated over $13 million. On a simple average per acre per year, this amounted to $477 and $1,597 for the 100-acre and 1,200-acre farms, respectively.

The above discussed cost, price, revenue, resource availability, and constraint estimates were analyzed using LP. When marketing constraints for grass species were not activated, all varied sized operations allocated all acreage to bermudagrass. It was the most profitable grass to grow given current average prices and its turnover rate.

The LP models were then used to evaluate the sensitivity of the optimal solution to grass prices. That is, other factors held constant, what would the price of centipede (or zoysia) have to be for it to be equally profitable to grow as bermudagrass – the comparable profit price. Over the alternative operation sizes for the seven-year planning horizon, zoysia must be in the $2.54 to

Table 3. Cash Flow Estimates for a Seven-year Planning Horizon for a 100-Acre Turfgrass Farm, Alabama, 2002

Item	Year 1	2	3	4	5	6	7
Receipts[1]							
Bermuda	73,500	470,400	470,400	470,400	470,400	470,400	470,400
Zoysia	0	95,274	95,274	95,274	95,274	95,274	95,274
Centipede	0	56,682	56,682	56,682	56,682	56,682	56,682
Total	73,500	622,356	622,356	622,356	622,356	622,356	622,356
Expenses							
Variable	196,800	356,700	356,700	356,700	356,700	356,700	356,700
Fixed	156,700	156,700	156,700	156,700	156,700	156,700	156,700
Borrowing from previous year paid back	0	305,200	213,906	114,395	5,929	0	0
Interest Earned	0	0	0	0	0	4,121	8,644
Cumulative Inflow/Outflow	-280,000	-196,244	-104,950	-5,439	103,027	113,077	117,600
Borrowing Needs	280,000	196,244	104,950	5,439	0	0	0
Compiled Yearly Cash	0	0	0	0	103,027	216,104	333,704

[1] Prices per square yard are $1.05 for bermuda, $1.41 for centipede and $2.37 for zoysia. Production includes 70 acres for bermuda, 15 acres of centipede and 15 acres of zoysia.

$2.56 range while centipede must reach $2.33 to $2.37 to offset

Table 4. Cash Flow Estimates for a Seven-Year Planning Horizon for a 1,200-Acre Turfgrass Farm, Alabama, 2002

Item	Year 1	2	3	4	5	6	7
Receipts[1]							
Bermuda	882,000	5,644,800	5,644,800	5,644,800	5,644,800	5,644,800	5,644,800
Zoysia	0	1,143,288	1,143,288	1,143,288	1,143,288	1,143,288	1,143,288
Centipede	0	680,184	680,184	680,184	680,184	680,184	680,184
Total	882,000	7,468,272	7,468,272	7,468,272	7,468,272	7,468,272	7,468,272
Expenses							
Variable	2,101,200	3,808,425	3,808,425	3,808,425	3,808,425	3,808,425	3,808,425
Fixed	1,160,400	1,160,400	1,160,400	1,160,400	1,160,400	1,160,400	1,160,400
Borrowing from previous year paid back	0	2,593,764	102,806	0	0	0	0
Interest Earned	0	0	0	95,866	199,678	307,643	419,927
Cumulative Inflow/Outflow	-2,379,600	-94,317	2,396,641	2,595,313	2,699,125	2,807,090	2,919,374
Borrowing Needs	2,379,600	94,317	0	0	0	0	0
Compiled Yearly Cash	0	0	2,396,641	4,991,954	7,691,079	10,498,169	13,417,543

[1] Prices per square yard are $1.05 for bermuda, $1.41 for centipede and $2.37 for zoysia. Production acres includes 840 acres of bermuda, 180 acres of centipede and 180 acres of zoysia.

the production cycle advantage for bermudagrass, Table 5. Given that average market prices are $2.37 for zoysia and $1.41 for centipede, the optimal solution for bermudagrass is fairly stable.

Table 5. Minimum Zoysia and Centipede Grass Prices to Generate Profit Comparable to Bermudagrass for Seven-Year Planning Horizon and Five Alternative Farm Sizes, Alabama, 2001

	Size (Acres)				
Grass	100	250	550	850	1,200
Zoysia	$2.54	$2.52	$2.52	$2.54	$2.56
Centipede	$2.33	$2.31	$2.31	$2.35	$2.37

The LP models were also used to isolate breakeven prices for each grass and alternatively sized operation over the seven-year production cycle, Table 6. With breakeven prices for bermudagrass ranging from $0.95/square yard for the 100-acre operation to $0.77/square yard for the 1,200-acre operation, profitability results at the average price of $1.05 across all sizes for bermudagrass. Similarly, the average wholesale price for zoysia of $2.37 is higher than breakeven levels for each farm size, $2.28 for the 100-acre to $1.80 for the 1,200-acre farm. Breakeven prices for centipede (from $2.07 for 100-acre to $1.62 for 1,200 acre) are higher than the average market price ($1.41) for each farm size, indicating that centipedegrass market prices need to increase substantially for centipedegrass to prove profitable.

Discussion

Table 6. Breakeven Prices for Bermuda, Zoysia, and Centipede Grasses for Seven-Year Planning Horizon and Five Alternative Farm Sizes, Alabama, 2001

	Size (Acres)				
Grass	100	250	550	850	1,200
Bermuda	$0.95	$0.92	$0.84	$0.81	$0.77
Zoysia	$2.28	$2.15	$1.95	$1.89	$1.80
Centipede	$2.07	$1.93	$1.74	$1.69	$1.62

Bermudagrass continues to be the profit-maximizing enterprise when compared to typical warm season zoysiagrass and centipedegrass competitors. The production cycle advantage of four to six months to grow it to marketable form versus fourteen to sixteen months for zoysia and centipede is difficult to overcome. Use of results of the analysis and average wholesale prices shows that the zoysiagrass price must increase about 8 percent and the centipedegrass price must increase by about two-thirds to generate profits comparable to bermudagrass.

Historical data indicates that farm-level turfgrass prices are somewhat slow to increase. Between 1978 and 1987, average farm level prices per square yard increased 6 percent, 49 percent, and 1 percent for bermuda ($0.85 to $0.90), zoysia ($1.21 to $1.80), and centipede ($1.12 to $1.13), respectively (Adrian et.al, 1981; White et.al., 1991). Similarly, between 1987 and 2002, bermuda, zoysia, and centipede average wholesale prices increased 24 percent, 96 percent, and 26 percent, respectively. Thus, over the two-plus decades, bermuda and centipede have experienced near a 1 percent average annual increase in farm level price while zoysia has increased about 4 percent annually.

Some growers have attempted to improve profitability of zoysia and centipede by shortening production cycles of these grasses by using mesh netting to improve the physical integrity of grass squares and rolls. Costs and operational issues have limited the effectiveness of this option.

On average over the 1978-2001 period, costs have increased much more than have sod market prices. Use of cost estimates from Adrian et al., 1981 and the current study indicate that total costs for the smaller operations have increased about 13 percent annually on average while the firms in the 250-acre and 550-acre range have experienced cost increases of 17 percent and 9 percent, respectively. Given these changes in costs and prices, growers' profit margins have been squeezed.

To cope with this problem, many growers have expanded the sizes of their operations to capture inherent economies of size. Figure 1 provides a view of estimates of average costs per acre for 2002 for various sized operations. Note the substantial economies up to the 550-acre size. Using 4,000 square yards per acre as the typical yield (roughly an 83% cutout), these costs translate to $0.88, $0.82, $0.73, $0.71, and $0.68 per square yard to cover costs. Note that the 1,200-acre farm has substantial flexibility over the smaller operations in terms of adjusting margins and maintaining profitability. Thus, economies of size are very important in the industry: larger is better, if you can develop and maintain markets.

Much of the size efficiency relates to the capital intensity of the industry. Capital outlays ranged from about a half million dollars for the 100-acre operation to $3.6 million for the 1,200-acre farm, slightly more than twice the levels required for each size in 1978. Some mix of debt and equity capital must be secured to meet this amount. Purchased land could add substantially to money capital needs, being $2-3,000 per acre in the area of analysis. (Note that the current study assumed rental of land at $100 per acre annually, a common practice and rate in the area of analysis.) Growers are obviously attempting to somewhat reduce capital requirements with this practice. Some growers are also using contract hauling to reduce outlays for transportation and handling equipment and the need to maintain licensed truck drivers on the payroll.

This analysis provides an update of costs, revenue, and investment levels and operation practices for turfgrass-sod farms. The industry has evolved to more efficiently meet competitive pressures and the desires of customers. Indications are that the industry is entering the maturing phase of development with substantial competition among growers and firms positioning themselves to better meet market requirements and to provide themselves an identity.

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