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Financial Performance of Selected Grass-Based Farming Systems in the Northern Tallgrass Prairie Region

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Abstract

We develop a series of new grass-based budgets for use in FINPACK, a standard farm finance analysis tool. The new budgets are then applied to an evaluation of plausible grass-based systems on three farms in the Northern Tallgrass Prairie region of Minnesota and North Dakota. The farms are used for illustration purposes only. We find no grass-based alternative that financially outperforms current non-grass operations. Nor do any score particularly well under a lender credit rating process that we adapted for this study. Our results suggest caution before one accepts claims that grass-based systems are uniformly feasible and financially desirable. There undoubtedly are individual situations in which such alternatives make financial sense, but their use may have to be accompanied by income supplements from external sources in order to further wide-spread adoption.

Introduction

As part of a broader state-funded effort, *Sustainable Grassland Conservation and Utilization*, the University of Minnesota's Department of Applied Economics was contracted to evaluate the financial implications of individual farming operations shifting to the use of grass, whether for hay or grazing. This report summarizes the findings of that investigation.

We provide three levels of analysis. The first is the development of specific farm-level grass system budgets for use with the FINPACK financial analysis system. These budgets, all of which are included in the appendix, enable users to examine the whole-farm implications of adoption of a variety of grass-based alternatives on all or a portion of the farm. These budgets are newly generated for the Northern Tallgrass Prairie study area.

The second level of analysis is the application of plausible grass-based alternative systems to each of three representative farms from the study area. These are real farms, although certain features of their operations have been altered to maintain privacy. We focus on several financial performance indicators commonly used by farmers and lenders to gauge the relative merits of farm operation decisions. The alternatives are compared against each other and against the farms' current land management choices, none of which includes extensive grazing or haying. Operations which have existing grass stands will face lower transition costs than those we represent here. Consequently, our results might be considered to lie on the lower end of expected financial performance of grass-based systems among all farms in the study area.

The third level of analysis is a comparison of grass-based alternatives among all the three farms and, by extension, across the entire study area. While we make no claim that these three farms are statistically representative of all farms in the study area, we do feel comfortable in drawing some generalities from analyses of grass-based alternatives among three quite different farms.

Readers need not work through all three levels of analyses sequentially. In particular, FINPACK users might choose to examine only the assumptions that underlie the new grass-based budgets and then immediately turn to the budgets themselves in the appendix. Or, readers interested only in questions such as how grass-based practices might fit into existing farm operations can turn to that section of the report.

The entire analysis is based upon conventional financial performance analysis. We do not contend that financial performance is, or should be, the sole criterion by which farmers make decisions. But we do contend that attention to finances should be a critical feature of all farm decision making.

Analysis Strategy

Our interest is the whole-farm financial implication of switching part or all of the farm to grass-based operations. A whole-farm approach is required because the capital investment and labor substitution implications of these switches cannot be handled by field-level enterprise analyses. We make extensive use of FINPACK, developed at the University of Minnesota[*], FINPACK is a suite of financial analysis software programs designed for farmers and lenders considering various alternative farming operations. It can be linked to farm recordkeeping systems, but it is not a records system itself. It permits farmers to ask three basic questions: Where am I now? Where do I want to be? How do I get there? For lenders, FINPACK permits exploration of three questions, too: Is this business sound? Is it going in the right direction? Can it repay its loans?

FINPACK is structured around a farm's financial balance sheet and a series of data banks, containing crop and livestock budgets as well as capital and financial data for the farm. By appropriately combining

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these, the analyst can generate year-end financial performance summaries (FINAN), anticipate month-by-month income and expenditure flows (FINFLO), and estimate average financial performance over a period of several years (FINLRB). It is the third component, the generation and analysis of alternative long-term farm plans, that we use in the present study. The results can be thought of as from a "typical" year over the next decade or so. Year-to-year fluctuations in yields, income, and expenses are collapsed into annual averages.

Because grass-based systems are argued to be less environmentally damaging than are annual crops, we initially explored the use of PLANETOR, a whole farm environmental impacts planning tool also developed at the University of Minnesota. There is a financial performance section in PLANETOR, permitting rudimentary exploration of finance-environment tradeoffs. However, PLANETOR, while well-suited to the analysis of annual crops, is not very sophisticated in its treatment of grass and pasture options. We judged the superior financial analysis capacity of FINPACK to outweigh the added environmental analyses potential of PLANETOR--when it comes to a consideration of grass-based systems.

Grass-Based Systems Budgets

We use FINPACK/FINLRB to analyze a series of grass-based alternatives using the actual records of three farms from the study area. These records were provided, with confidentiality guaranteed, by University of Minnesota Extension Service county faculty. The farms are typical of northwestern Minnesota and eastern North Dakota, but they do not constitute a statistically valid sample of area farms. Nor are they held up here as exemplars for other farmers. We use them simply to illustrate how the new budgets can be employed in the context of "real" farms. We expect--but we cannot prove--that the results reported here would be consistent with those obtainable from using the budgets in analyses across a wider range of farms in the study area.

Farm A is a 580 acre (much of it rented) grain/alfalfa hay operation milking 50 dairy cows and feeding 25 dairy steers. Farm B is a 1,600 acre grain operation (again, much of it rented) with no livestock at present. Farm C is a 910 acre largely grains operation currently pasturing 54 beef cows. Only Farm A is considered to be on financially solid footings.

The budgets listed in the appendix were developed after extensive examination of financial records of actual grassland haying and grazing systems from throughout western Minnesota and the eastern Dakotas. They reflect agronomic and economic conditions for the project area. Each budget was reviewed by appropriate specialists at the University of Minnesota, educators from the University of Minnesota Extension Service, and local farm management instructors. All the new budgets are configured for easy insertion into FINPACK, where they can be edited to suit local needs.

FINPACK allows the coupling of various enterprise budgets into a series of "alternatives." For example, an alternative might be 50% cash wheat, 20% cash grass hay, and 30% rotation pasture for dairy steers. In the sections that follow, we report our use of a series of alternatives on each of our representative farms. We first note the underlying assumptions we made to ensure some consistency across farms and to create the initial budgets.

Conversion to grass

Unless otherwise noted, all alternatives provided for the production of feed crops for livestock purposes, if required. Feed requirements per animal unit are shown in the budgets. These values were then multiplied by the number of animal units modeled in each alternative. We structured each alternative so that all the feed requirements could be met by on-farm production.

Grass hay fields and pastures are modeled as either "unimproved" or "improved" by fertilization. The latter increases yields and stocking rates. Pastures might be further improved by installation of paddocks for rotational grazing. We do not adjust fertilization requirements for different manure production levels from grazing.

The original expenditures for converting from other crops to grass or pasture, including fencing and winter shelter, are all considered here as capital expenditures, requiring five-year intermediate term credit. This initial cost is thus spread over most of the 5-8 year FINLRB analysis "horizon." Farms with existing grass cover, such as those coming out of federal Conservation Reserve Program contracts, may not face some of these establishment costs, depending upon grass quality.

We distinguish these capital expenditures from the recurring establishment expenses associated with grass hay field maintenance, which we call "renewal." One of the purported virtues of grass-based farming systems is the fact that grass is not an annual crop. Continuous soil coverage means less soil and wind erosion and associated pollution implications. But grass might not maintain its productivity at desired levels forever. Particularly in high management settings, farmers might renew grass hay fields by cultivation and reseeding every several years. During the restoration year, costs are higher and yields are effectively zero. In this study we approximate this practice by placing 15% of any improved grass hay fields into a renewal phase. This is equivalent to restoration every 7 years.

By contrast, alfalfa stands tend to be renewed every four years. We approximate this by placing alfalfa stands, if any, on a 25% annual renewal basis. Pastures, whether unimproved or improved by fertilization, do not receive such renewal treatment in the present study, although rotational grazing is said by some to increase grass quality when properly conducted. We reflect this by increasing the stocking rate and the rental rate for these systems.

If the farmer is currently growing some alfalfa hay, which all three of our study farms are, they will not--we assume--need to buy any new haying equipment. They will, of course, face increased costs for fuel, repairs, supplies, etc. We handle these in the new grass budgets or in the farm's overhead expenses, whichever is appropriate. Because the farms continue to grow wheat or corn under most of the alternatives examined here, they will not (we assume again) be able to sell any of their existing crop management equipment.

If the analyst is working with a farm on which there is no hay equipment to start with, it might be useful as a first approximation to analyze an incremental shift to haying by using custom cutting and baling expenditures, rather than new equipment purchases. The University of Minnesota Extension Service estimates these at $11/ac. plus $6/round bale (approximately one ton in weight), so it would cost roughly $40/ac. to harvest a 3-ton grass hay field with two cuttings (Minnesota Extension Service, *Minnesota Farm Custom Rate Survey*, FS3700-A, Revised 1997).

For those alternatives in which the entire farm is switched to grass hay, some of the existing machinery complement becomes surplus and could be sold. We do not, however, consider this one-time revenue formally in this study. The impact of such sales on overall average long-run financial performance would be relatively modest in most situations.

Physical Infrastructure

For each new pasture alternative, the farmer must install fencing, watering systems, and (except for buffalo) winter shelter. If the current farm plan indicated that a portion of these requirements already existed, capital expenses were adjusted accordingly. Farm A's current operation includes dairy facilities, so we assumed it already had a barn, a corral, and a feedlot. Both Farm B and Farm C were assumed to require new or expanded pole barns and feedlot space to handle additional livestock.

Fencing cost estimates were provided by a Minnesota custom fencing company. We assumed that all fencing (a one-time expenditure funded by an intermediate term loan) is installed by a contractor. This means the farmer faces no additional labor requirements during the installation period. All beef alternatives assumed a 3-strand fence around pastures. In a rotational grazing system, the perimeter fence is assumed to be 3-strand and interior partitions to be 2-strand. For buffalo operations, 5-strand perimeter and 3-strand interior fences are assumed. All fencing materials cost $.10 per foot per strand. Installation charges are an additional $.10 per foot per strand. We added an additional $300 for one-time miscellaneous fencing expenses.

For beef and dairy steer rotational grazing systems, paddocks of approximately ten acres were assumed. For example, if 88 acres of pasture were required, eight paddocks were constructed. Pastures were assumed to be square, and an even number of paddocks were required. Water is provided to the paddocks by a well located at the base of the pasture, and pipes distribute water to each paddock. The cost of the water line is $.25 per foot for materials and $.25 per foot for installation. The cost of drilling a well was estimated at $2,000. We added $200 for miscellaneous expenditures. Buffalo are managed with paddocks and rotational grazing more for breeding control than for grass management. The 50-head plan examined here required four 22-acre paddocks. (What we call "rotational grazing" in this study is a stylized representation of what is in actuality a wide range of intensive grazing practices. Operations often differ widely in how they actually manage their herds in a grazing setting. A good general reference is University of Wisconsin-Extension, *Pastures for Profit: A Guide to Rotational Grazing*, A3259, 1994.)

Output Prices and Input Costs

We use University of Minnesota Extension Service published long-run planning prices for all farm products except grass hay, for which we use the average sale price reported by several Minnesota and North Dakota farm records associations. In practice, grass hay prices can vary by 50%, depending upon quality, time of delivery, and place of delivery. Prices also fluctuate dramatically from year-to-year, depending upon weather. Costs for beef cows are $750 per head; bulls cost $1,200. Buffalo cows cost $4,000 and bulls $5,000 each. Pastures are assumed to be rented at $6/aum (animal unit month), except for improved pastures used for rational grazing, which rent for $8/aum. stocking rates vary with pasture quality.

Well-managed grass hay can approach the nutritive value of alfalfa hay. Consequently, it ought to sell for about the same on the market, because it can be substituted pound-for-pound for alfalfa in many feeding rations. This fact is not always borne out in reality, however. Many farmers report difficulty in selling grass hay, even if high-quality, at prices even close to alfalfa hay. Grass hay tends to be fed to beef cattle, while the more expensive alfalfa hay tends to be sold to dairy producers.

We reflect this reality in our budgets by setting a lower price for grass hay on the market. We do not, however, reduce the grass-alfalfa feed conversion factor in FINPACK from its default 1.0, although this would be possible. In effect, then, we say that a producer is well aware of the virtues of high quality grass hay, but the grass market is not. Unimproved hay appears somewhat more lucrative in these analyses than it really is, therefore, because the 1.0 feed conversion factor suggests a quality level for feeding that might not exist.

Selling grass hay to the market could involve longer hauls than farmers are used to for corn or wheat. Hay sales markets in the study area are few and far between. FINPACK budgets for conventional crops submerge marketing costs (principally, hauling the crop or the animal to the delivery point in town) into general overhead expenses. For cash hay, we have added a marketing cost of $5/ton ($0.10/ton-mile for a 50-mile one-way haul).

Where farms currently receive subsidies under the federal farm programs, we continue these payments under all alternatives. As of 1996, federal farm subsidies are not contingent upon current planting decisions.

All financing for capital expenses was assumed to be from credit through a single bank. All loans are intermediate at 5 years for pasture and grass establishment and 10 years for all other investments. Depreciation was calculated by using the farm's current depreciation schedule, per head of livestock values from the budgets, and 10% of relevant non-livestock capital purchases. Since there were no capital sales, no amount was subtracted from current depreciation levels.

Financial Performance Indicators

Tables 1-3 summarize the planting and cash flow effects of each of the examined alternatives on each farm, and Tables 4-6 show the calculated financial performance of the whole farm under each alternative. For the second set of tables we selected five from the sixteen performance indicators that FINPACK

calculates, one from each of the five major categories that financial analysts commonly consider. (Details can be found in Farm Financial Standards Council, *Financial Guidelines for Agricultural Producers*, Napierville, IL, 1995.)

a. Liquidity measures the farm's ability to provide cash when needed. We use the *current ratio* in this study, which is current assets divided by current liabilities. Generally, the higher is the current ratio, the better off is the farm.

b. Solvency suggests the ability to provide financial growth and security. The farm's *debt-to-asset ratio* is our indicator of solvency. Lower numbers are generally preferred, although extremely low ratios might suggest unexplored credit opportunities.

c. Profitability represents the ability to generate income. For this category, we use the *rate of return on farm assets*, frequently used to compare the farm's returns against those from other potential investments. Clearly, a higher rate of return is better.

d. Repayment capacity tells the lender how likely the farm is to meet its debt payments. We use the *term debt coverage ratio,* which indicates whether the business generates enough cash to cover term debt and interest payments. A number greater than 100 means that there is enough cash for this purpose. Larger values suggest that the farm has more of a financial buffer and a more secure financial position.

e. Efficiency is one measure of the farm's long-run use of assets. The *turnover rate*, which we use to represent this measure, is (loosely) the ratio of farm sales to total farm value. Higher rates suggest that the farm is making more efficient use of its resources.

The Alternatives

The number of possible variations on these basic budget themes is essentially limitless. We could only explore a few of what we considered to be the more plausible alternatives open to each farmer. Nearly all the alternatives that we explore are relatively modest shifts from current operations. We assume that most farmers are unlikely to immediately switch over to some wholly new grass-based system, involving substantial capital investment, skills acquisition, and new patterns of risk. Rather, we would expect farmers to try out new practices on just a portion of their farms, minimizing the purchase of new equipment and reducing (but not abandoning) existing farm infrastructure.

In characterizing these alternatives, we tried to not change the non-grass portions of the operation, except where the grass-based activity substituted for an existing activity. So, for example, we altered the dairy operation on Farm A only by shifting into grass those acres from which crops were previously sold to the market, rather than being fed. Because the farmer already had haying equipment, we added no new equipment and we assumed that labor hours were switched one-for-one from cash crops to cash hay operations. For new livestock activities, however, we had to add fencing, shelter for wintering when appropriate, and watering systems for pasture.

We do consider more dramatic operations changes in a few alternatives. These could obviously dramatically alter debt structures, labor needs, and risk exposure. In particular, a period of transition to a whole new system could be marked by little or no income from farming operations the first few years.

A quick assessment of the tables tells a simple tale. None of the grass-based alternatives, on any farm, is clearly superior to what the farmers are already doing. But a few are fairly close. Among the alternatives, steer grazing on improved pastures had the higher net incomes as well as the better financial performance. We find nothing in these tables that give one strong encouragement to suggest that these farmers should consider switching to grass-based systems--absent exogenous sources of income. There may, of course, be many non-financial reasons for such a switch, but we cannot examine these in the present context. In the next section, we examine whether some of our initial planning assumptions might erroneously lead us to this conclusion.

Table 1: Summary financial performance for grass-based systems: Farm A

Grass Management System	Pasture Land (acres)	Grass Hay Land (acres)	Other Land (acres)	Crop Income (dollars)	Livestock Income (dollars)	Total Cash Farm Expenses (dollars)	Net Cash Farm Income (dollars)
A.0: current operation	0	0	580	58,251	134,144	153,663	41,732
A.1: unimp. grass hay	0	390	190	21,840	134,144	135,191	23,793
A.2: imp. pasture; 25 dairy steers	32	0	548	57,422	134,144	158,336	36,230
A.3: imp. pasture; 75 beef cow-calf	94	0	486	42,815	143,647	158,835	30,627
A.4: imp. rot. pasture; 75 beef cow-calf	63	0	517	47,570	143,647	160,356	33,861
A.5: imp. grass hay; imp. rot. pasture; 75 beef cow-calf	63	327	190	30,159	143,647	158,912	17,895
A.6: imp. pasture; 50 buffalo cow-calf	88	0	492	49,505	149,100	174,558	27,047
A.7: imp. grass hay; imp. pasture; 50 buffalo cow-calf	88	302	190	33,434	149,100	173,179	12,355
A.8: imp. grass hay; imp. pasture; 100 beef steers	88	0	492	53,494	165,549	196,507	25,537
A.9: imp. rot. pasture; 100 beef steers	59	0	521	57,943	165,549	194,689	31,804
A.10: imp. grass hay	0	580	0	59,160	116,000	187,376	-9,216

Notes:
Farm A is a 580 acre grain/alfalfa hay operation milking 50 dairy cows and feeding 25 dairy steers. All options continue current milking cows but dairy steers are included only where noted in the first column. Grass Hay Land includes hay grown for on-farm livestock use and periodic renewal phases for improved stands. Other Land includes crops and alfalfa hay. Crop Income includes on-farm feed equivalents income. Livestock Income includes milk sales. Other Farm Income is not included in crop or livestock categories, but is included in Net Income.

Table 2: Summary financial performance for grass-based systems: Farm B

Grass Management System	Pasture Land (acres)	Grass Hay Land (acres)	Other Land (acres)	Crop Income (dollars)	Livestock Income (dollars)	Total Cash Farm Expenses (dollars)	Net Cash Farm Income (dollars)
B.0: current operation	0	0	1,600	280,820	0	280,958	34,167
B.1: imp. grass hay	0	1,300	300	195,600	0	268,905	-39,000
B.2: unimp. pasture; 100 beef cow-calf	500	0	1,100	149,210	36,862	258,800	-38,422
B.3: imp. pasture; 100 beef cow-calf	125	0	1,475	219,905	36,862	291,180	-108
B.4: imp. grass hay; imp. pasture; 100 beef cow-calf	125	1158	317	187,342	36,862	282,472	-53,325
B.5: imp. rot. pasture; 100 beef cow-calf	83	1200	317	191,662	36,862	284,325	-50,858
B.6: imp. pasture; 50 buffalo cow-calf	88	0	1,512	245,236	32,600	302,464	9,677
B.7: imp. grass hay; imp. pasture; 50 buffalo cow-calf	88	1212	300	177,862	32,600	290,177	-45,410
B.8: imp. pasture; 150 beef steers	131	0	1,469	242,558	74,324	342,486	8,701
B.9: imp. grass hay; imp. pasture; 150 beef steers	131	1169	300	181,230	74,324	334,040	-44,181
B.10: imp. grass hay; imp. rot. pasture; 150 beef steers	88	1212	300	185,568	74,324	335,166	-40,969

Notes:

Farm B is a 1,600 acre grain operation with no livestock at present. Grass Hay Land includes hay grown for on-farm livestock use and periodic renewal phases for improved stands. Other Land includes crops and alfalfa hay. Crop Income includes on-farm feed equivalents income. Government Payments is $33,305/yr. Other Farm Income and Other Government Payments are not included in crop or livestock categories, but are included in Net Income.

Table 3: Summary financial performance for grass-based systems: Farm C

Grass Management System	Pasture Land (acres)	Grass Hay Land (acres)	Other Land (acres)	Crop Income (dollars)	Livestock Income (dollars)	Total Cash Farm Expenses (dollars)	Net Cash Farm Income (dollars)
C.0: current operation	68	0	842	106,657	19,906	102,579	57,240
C.1: imp. grass hay	68	758	84	81,998	19,906	102,225	32,935
C.2: unimp. grass hay	68	758	84	51,788	19,906	68,797	36,153
C.3: imp. pasture; 46 beef cow-calf	125	0	785	86,307	36,862	109,878	46,547
C.4: imp. grass hay; imp. pasture; 46 beef cow-calf	125	683	102	66,468	36,862	107,550	29,307
C.5: imp. grass hay; imp. rot. pasture; 46 beef cow-calf	84	724	102	70,692	36,862	110,213	30,598
C.6: imp. pasture; 50 buffalo cow-calf	156	0	754	83,373	52,506	127,730	41,405
C.7: imp. grass hay; imp. pasture; 50 buffalo cow-calf	156	656	98	65,660	52,506	125,787	25,635
C.8: imp. pasture; 100 beef steers	156	0	754	88,015	69,455	149,008	41,718
C.9: imp. grass hay; imp. pasture; 100 beef steers	156	695	59	67,889	69,455	146,014	24,586
C.10: imp. grass hay; imp. rot. pasture; 100 beef steers	103	748	59	73,265	69,455	151,143	24,833

Notes:

Farm C is a 910 acre largely grains operation currently pasturing 54 beef cow-calf. All alternatives include current grazing for these animals. Livestock listed in the first column are additional to the current herd. Pasture land includes existing improved pasture. Grass Hay Land includes hay grown for on-farm livestock use and periodic renewal phases for improved stands. Other Land includes crops and alfalfa hay. Crop Income includes on-farm feed equivalents income. Government Payments is $15,256 per year. Other Farm Income and Other Government Payments are not included in crop or livestock categories, but are included in Net Income.

Table 4: Financial performance indicators for grass-based systems alternatives: Farm A

	liquidity	*solvency*	*profitability*	*repayment capacity*	*efficiency*
Grass Management System	**Current Ratio**	**Debt-Asset Ratio (%)**	**Return Rate on Farm Assets (%)**	**Term Debt Coverage Ratio (%)**	**Asset Turnover Rate**
A.0: current operation	1.02	30.0	3.3	121.9	35.8
A.1: unimp. grass hay	.93	34.7	0.4	33.6	26.3
A.2: imp. pasture; 25 dairy steers	.92	35.2	2.6	69.4	33.1
A.3: imp. pasture; 75 beef cow-calf	.91	41.0	1.7	66.0	29.8
A.4: imp. rot. pasture; 75 beef cow-calf	.90	41.1	2.1	66.1	30.5
A.5: imp. grass hay; imp. rot. pasture; 75 beef cow-calf	.84	44.0	-0.1	25.7	26.1
A.6: imp. pasture; 50 buffalo cow-calf	.76	55.1	2.4	54.9	24.3
A.7: imp. grass hay; imp. pasture; 50 buffalo cow-calf	.72	56.6	0.8	30.5	21.4
A.8: imp. grass hay; imp. pasture; 100 beef steers	.96	34.5	0.2	37.7	31.7
A.9: imp. rot. pasture; 100 beef steers	.96	34.6	1.4	58.2	32.5
A.10: imp. grass hay	.89	36.8	-4.5	-92.6	21.5

Table 5: Financial performance indicators for grass-based systems alternatives: Farm B

	liquidity	*solvency*	*profitability*	*repayment capacity*	*efficiency*
Grass Management System	**Current Ratio**	**Debt-Asset Ratio (%)**	**Return Rate on Farm Assets (%)**	**Term Debt Coverage Ratio (%)**	**Asset Turnover Rate**
B.0: Current Operation	.94	19.0	-3.1	41.9	26.5
B.1: imp. grass hay	.57	26.1	-6.8	-68.4	17.7
B.2: unimp. pasture; 100 beef cow-calf	.62	28.7	-7.6	-60.8	16.1
B.3: imp. pasture; 100 beef cow-calf	.72	26.7	-4.8	-11.5	22.0
B.4: imp. grass hay; imp. pasture; 100 beef cow-calf	.50	31.9	-6.9	-59.4	16.0
B.5: imp. rot. pasture; 100 beef cow-calf	.50	32.2	-6.7	-55.5	16.2
B.6: imp. pasture; 50 buffalo cow-calf	.59	33.5	-3.2	19.0	21.5
B.7: imp. grass hay; imp. pasture; 50 buffalo cow-calf	.43	38.1	-5.5	-28.1	15.6
B.8: imp. pasture; 150 beef steers	.83	21.9	-4.8	-10.9	23.5
B.9: imp. grass hay; imp. pasture; 150 beef steers	.55	28.0	-7.0	-66.3	17.1
B.10: imp. grass hay; imp. rot. pasture; 150 beef steers	.54	28.2	-6.7	-60.6	17.4

Table 6: Financial performance indicators for grass-based systems alternatives: Farm C

	liquidity	*solvency*	*profitability*	*repayment capacity*	*efficiency*
Grass Management System	**Current Ratio**	**Debt-Asset Ratio (%)**	**Return Rate on Farm Assets (%)**	**Term Debt Coverage Ratio (%)**	**Asset Turnover Rate**
C.0: current operation	.33	67.0	7.6	65.4	26.2
C.1: imp. grass hay	.28	70.2	6.9	41.3	19.9
C.2: unimp. grass hay	.28	70.2	7.5	44.3	15.4
C.3: imp. pasture; 46 beef cow-calf	.31	69.7	5.9	57.7	23.3
C.4: imp. grass hay; imp. pasture; 46 beef cow-calf	.27	72.3	6.2	39.6	18.6
C.5: imp. grass hay; imp. rot. pasture; 46 beef cow-calf	.27	72.5	6.3	41.3	19.0
C.6: imp. pasture; 50 buffalo cow-calf	.26	76.9	5.2	55.1	19.2
C.7: imp. grass hay; imp. pasture; 50 buffalo cow-calf	.23	78.4	5.6	41.4	16.1
C.8: imp. pasture; 100 beef steers	.31	68.6	5.1	52.8	23.4
C.9: imp. grass hay; imp. pasture; 100 beef steers	.27	71.4	5.5	34.3	18.4
C.10: imp. grass hay; imp. rot. pasture; 100 beef steers	.27	71.9	5.5	34.8	18.8

Sensitivity to Initial Assumptions

The various alternatives for which we provide financial performance measures are strongly dependent upon the basic structure of the farm and upon only moderately predictable future events. We saw in the tables that similar operations could perform differently among the three representative farms. In this section, we systematically vary a few key elements to gauge the sensitivity of our results to changes in initial conditions.

This examination could be conducted with respect to every element (and combination of elements) in every alternative on every farm. We don't exhaust those thousands of analyses here. We focus on one farm, three options, and a handful of key factors. What are the financial performance implications if the future turns out differently than that assumed in our initial analysis? In particular, what might it mean if we're "way off" on our assumptions about grass hay yields, livestock stocking rates, or wheat prices?

In what follows, we report the results of special FINLRB analyses based on the altered assumptions shown in Table 7. So, for example, we can see how the basic financial performance measures for the whole-farm-to-cash-hay option (Alternative A.10) shift if hay yields turn out to be much higher or much lower than we originally expected, all else equal. (A doubling or a halving of hay prices would result in identical sets of indicators.) The current operation and original alternatives in the table are repeated from Table 1 and Table 4.

Even favorable growing conditions will only modestly improve the financial performance of the intensive hay option. The indicators shift very little for substantial changes in livestock stocking rates due to different assumed grass quality. (We can think of this as a situation where the farmer could rent out the land for more (or fewer) animals, but can make no changes in facilities and grass quality.) This is in part attributable to the small increment in production associated with this alternative (A.9)--only 100 new beef steers. Lower wheat prices actually reduce the relative performance of the buffalo cow-calf alternative (A.6), because the farm still relies extensively on wheat production for its income.

Even very optimistic planning assumptions fail to lead to strong financial performance for grass-based alternatives. We suspect that a determined "tweaking" of the budget assumptions could "reveal" more positive results, but that would violate the spirit of the present research effort. Also, combinations of different assumptions, such as lower wheat prices and higher stocking rates, might make some of the grass-based systems more financially palatable to lenders. We vary only single assumptions in Table 7, however.

Table 7: Effects of selected variations in price and yield assumptions on financial performance indicators

	Current Ratio	**Debt-Asset Ratio (%)**	**Return Rate on Farm Assets (%)**	**Term Debt Coverage Ratio (%)**	**Asset Turnover Rate**	**Net Farm Cash Income**
current operation	1.02	30.0	3.3	122.2	35.9	41,732
original: whole farm to imp. cash hay (A.10)	.89	36.8	-4.5	-92.6	21.5	-9,216
+ 50% imp. grass hay yield	.89	36.8	0.9	17.7	27.1	20,364
- 50% imp. grass hay yield	.89	36.8	-9.8	-206.8	15.9	-38,796
original: imp. rot. pasture; beef steers (A.9)	.96	34.6	1.4	58.2	32.5	31,804
+ 50% aum stocking rate	.96	34.6	1.6	61.7	32.7	32,866
- 50% aum stocking rate	.96	34.6	1.1	54.4	32.3	30,638
original: imp. pasture; buffalo cow-calf (A.6)	.76	55.1	2.4	54.9	24.3	27,047
+ 50% wheat price						
new current op.	1.02	30.0	6.7	201.8	39.4	58,715
new A.6	.76	55.1	5.2	79.6	27.2	49,003
- 50% wheat price						
new current op.	1.02	30.0	-0.1	37.4	32.3	24,749
new A.6	.76	55.1	-0.4	17.1	21.3	5,092

Government Support for Grass-Based Systems

In the above analyses, we did not consider any possible external financial incentives or disincentives specifically designed to increase grass-based systems use. This is not to say, however, that we excluded all public policy effects on farming. All our runs were based on the same patterns of tax law, regulatory structure, non-grass commodity prices, and existing federal farm subsidies.

The results can be used to suggest necessary institutional changes if one were dissatisfied with the operation decisions that farmers (acting on purely financial motives) are likely to make. Among the myriad possible changes in public agriculture policy, we examine here only one.

Selection of the grass-based alternatives examined in this report would make farmers worse off than they are under current operations. If farmers make land management decisions strictly on the basis of financial performance, none of these alternatives will be selected. If the government, for whatever reason, would prefer that the farmer did select from among these alternatives, it has two broad courses of action. It could force farmers to switch to the lower-returns alternative, or it could pay farmers to do so.

In either situation, there is a financial impact--it's just a question of who bears the cost. Any alternative system such as grass hay, for example, will cost someone some money to implement. If done by regulation, the farmer bears the cost of the practice. If by taxation, the farmer will select grassland at the expense of foregone income (assuming the tax on the other practice is sufficiently high to induce change).

What if some outside party offered a cash payment in exchange for the farmer changing operations in a stated direction? The obvious real-world example here is the federal Conservation Reserve Program (CRP) which essentially leased some landowners' row-cropping rights for ten years. We can use our analyses to estimate the necessary per-acre annual payment (the simplest and most transparent subsidy scheme) to induce each farmer to switch from the base plan to any given alternative. Table 8 shows the reduced net income (from Tables 1-3) divided by the number of acres involved in the switch to three. Several situations show annual per-acre break-even payments below $100, which approaches the level currently paid under federal CRP contracts.

Were a paid conversion scheme to be implemented, it would probably have some other financial implications on such measures as debt service coverage, which we could treat in the current framework, or income tax treatment, which we can't treat here. These are expected to be relatively minor for the relatively modest changes examined in this report. (The whole-farm-to-hay alternative is an obvious exception to this generalization, of course.)

Table 8: Necessary annual per-acre external payment for break-even grass-based system adoption

Farm A switch to . . .	alternative	change in net income	additional acres of grass	break-even payment
all imp. grass hay	A.10	50,948	580	87.84
imp. grass hay; imp. rot. pasture; beef steers	A.9	25,797	398	64.82
imp. pasture; beef cow-calf	A.3	11,105	94	118.13

Farm B switch to . . .	alternative	change in net income	additional acres of grass	break-even payment
all imp. grass hay	B.1	73,167	1,300	56.28
imp. grass hay; imp. rot. pasture; beef steers	B.10	75,136	1,300	57.80
imp. pasture; beef cow-calf	B.3	34,275	125	274.20

Farm C switch to . . .	alternative	change in net income	additional acres of grass	break-even payment
all imp. grass hay	C.1	24,305	758	32.06
imp. grass hay; imp. rot. pasture; beef steers	C.10	32,407	783	41.39
imp. pasture; beef cow-calf	C.3	10,693	57	187.60

Note: Farm C grass acres are in addition to the 68 acres that are used in the current operation for grazing.

Lender Credit Assessments

The financing provided to farmers in the study area comes from three major sources: owner equity, supplier credit (short-term loans for seed, chemicals, and fuel, primarily), and commercial banks including the quasi-public Farm Credit System. A shift, in part or in full, to a grass-based farming system, would require additional capital for most farmers.

In considering requests for credit, commercial lenders usually employ some variant of what they call "scoring." Every loan is evaluated against a specified set of financial performance measures, many of them identical to those employed in this study. Indeed, many (but by no means all) lenders use FINPACK in their evaluation of credit applications. Other factors usually enter the decision as well. Among them are credit record, collateral, and other business with the lender.

We can approximate the scoring process of a typical lender by adapting several of our financial performance measures to one prominent lender's (Norwest Bank) scoring index. There are five factors in this system, summarized in Table 9.

Table 9: Credit Scoring System Factors

Factor Name	Lender's explanation	This study
debt/worth ratio	total liabilities divided by total net worth	same
current ratio	current assets divided by current liabilities	same
retained earnings trend ratio	three year average change in net worth divided by net worth at beginning	average annual change in net worth / average net worth
term debt service coverage ratio	change in net worth divided by interest and principal payments	term debt coverage ratio as calculated by FINPACK
own bank loan to collateral ratio	current, intermediate and real estate debt to bank divided by current intermediate and real estate assets	total liabilities divided by total assets

Each of the factors receives a score from 1 to 7, depending upon where the factor lies in a distribution based upon lender experience. (By assuming that all the farm's debt is with the same bank for this study, we make the score for that factor higher than it probably really would be.) The scoring system we use is calibrated by the ranges shown in Table 10.

Table 10: Credit Scoring System Calibration

	Factor Name				
lender score	**debt/worth ratio**	**current ratio**	**retained earnings trend (percent)**	**term debt service coverage ratio**	**loan to collateral ratio**
1	<.25	> 2.50	> 15.00	> 2.50	< .40
2	.26-.43	1.81-2.50	10.01-15.00	1.81-2.50	.41-.55
3	.44-.67	1.41-1.80	5.01-10.00	1.41-1.80	.56-.65
4	.68-1.00	1.01-1.41	0-5.00	1.01-1.40	.66-.80
5	1.10-1.50	.71-1.00	(5.00)-(0.01)	.76-1.00	.81-1.00
6	1.51-2.00	.25-.70	(10.00)-(5.00)	.50-.75	1.01-1.25
7	> 2.00	< .25	<(10.00)	< .50	> 1.25

Finally, the factor scores are averaged (equal weighting) to form an overall "risk rating" index. The lower is the rating, the better (the less risky) is a loan made to that farm. Table 11 shows the assignments used by this lender.

Table 11: Credit Scoring System Rating Scheme

Average Factor Score	Risk Rating
1.0 - 1.5	1
1.5 - 2.5	2
2.5 - 3.5	3
3.5 - 4.5	4
4.5 - 5.5	5
5.5 - 6.5	6
6.5 - 7.0	7

We use this procedure to calculate a risk rating for each farm's base plan and two alternatives similar across farms--grazing beef cow-calf on improved pasture and putting all available cropland into improved grass hay for sale on the market (Table 12). One could obviously do the same for any of the other alternatives as well, but these serve for illustration.

Not surprisingly, given our previous examination of each option's financial performance, neither of the grass-based alternatives outperforms the current management system on any of the farms, especially on Farm A. Farm C's high debt load makes it a poor credit risk even under its current management. Farm B, which has a very serious cash flow problem, as we showed earlier, nevertheless appears a slightly better credit risk than does Farm C, because of its lower debt.

Table 12: Risk Rating Calculations for Selected Grass-based Systems

	debt/worth ratio		**current ratio**		**retained earnings trend (percent)**		**term debt service coverage ratio**		**loan-collateral ratio**			
	value	*rating*	*value*	*rating*	*value*	*rating*	*value*	*rating*	*value*	*rating*	*average rating*	***Overall Risk Rating***
Farm A												
A.0 current operation	.33	2	1.02	4	-.1	5	1.22	4	.25	1	3.2	***3***
A.4 graze beef cow-calf	.54	3	.91	5	-2	5	.66	6	.35	1	4.0	***4***
A.10 all improved grass hay	.45	3	.89	5	-10	7	-.93	7	.31	1	4.6	***5***
Farm B												
B.0 current operation	.23	1	.94	5	-6	6	.42	7	.19	1	4.0	***4***
B.3 graze beef cow-calf	.36	2	.72	5	-10	7	-.12	7	.27	1	4.4	***4***
B.1 all improved grass hay	.35	2	.57	6	-14	7	-.68	7	.26	1	4.6	***5***
Farm C												
C.0 current operation	2.12	7	.33	6	-5	6	.65	6	.68	4	5.8	***6***
C.3 graze beef cow-calf	2.41	7	.31	6	-9	6	.58	6	.71	4	5.8	***6***
C.1 all improved grass hay	2.47	7	.28	6	-14	7	.41	7	.71	4	6.2	***6***

Is Grass a Better Alternative?

Does this study provide evidence of financial performance under certain grass-based systems sufficient to justify a recommendation that these farmers (all farmers?) get serious about switching? No. Unless an outside payment is provided, all three farmers are financially better off continuing their current operations (One is in serious financial straits with or without grass-based systems). The creation of an external income supplement conditional upon certain changes in land management could lead farmers like these to select grass-based options on purely financial grounds. Questions of labor allocation, risk exposure, and cash flow shortfalls remain largely unaddressed.

Only a substantial conversion to grass-based systems by a great many farmers in a relatively small region would result in noticeable changes in local economies. (There will be no significant effects on crop prices, which are affected only by nonlocal conditions.) The impacts could arise from changes in purchasing patterns (less wheat seed, say, or more demand for fencing) or in sales (more cattle to be marketed, say, or larger veterinary medicine sales). These effects would alter some of the prices farmers face for inputs. This project was not designed to measure the local economic effects, if any, from a large-scale conversion. To do that would require the use of an economic model such as IMPLAN, which translates a stated change in inputs and outputs into a series of changes in other parts of the local economy.

Analysts might be able to craft a farm-specific grass-based system that is financially superior to current management returns, given our budget assumptions. Even if such a system were found, however, its elusiveness--witness our inability to find one among the thirty-some alternatives examined in this study--suggests that expansion of grass-based systems in the study area will remain particular to individual farms. A one-size-fits-all system is unlikely. But individual farmers with appropriate non-financial motives, suitable management skills, and sufficient financial backing might be able to make grass “work” for them.

Subsequent analyses, in our judgment, should focus on use of the newly created budgets by trained FINPACK professionals working with individual farmers. We don’t think that additional broad-scale analyses such as that used in this study will lead to much further insight into the farm-level economics of grass-based systems.

Appendix: Default FINPACK budgets for Northern Tallgrass Prairie Region

On the following pages are grass-based system budgets that were developed for the present study. They were generated from our examination of existing farm records from throughout the study area. As always with FINPACK budgets, users can alter any or all of these numbers to suit local conditions.

Pasture, Unimproved

Unit	aum
	Long Range
Yield	1
Price	6.00
Product income	6.00
Miscellaneous income	-
Gross income	6.00
Seed	-
Fertilizer	-
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	-
Hired labor	-
Marketing	-
Total direct expense	0.00
Return over direct expense	6.00
Labor hours	-
Pasture equiv. (AUM)	1.0

Pasture, Improved

Unit	aum
	Long Range
Yield	4
Price	6.00
Product income	24.00
Miscellaneous income	-
Gross income	24.00
Seed	-
Fertilizer	25.00
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	3.36
Hired labor	-
Marketing	-
Total direct expense	28.36
Return over direct expense	-4.36
Labor hours	-
Pasture equiv. (AUM)	4.0

Pasture, Unimproved: Rotation Grazing

Unit	aum
	Long Range
Yield	1.5
Price	6.00
Product income	9.00
Miscellaneous income	-
Gross income	9.00
Seed	-
Fertilizer	-
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	-
Hired labor	-
Marketing	-
Total direct expense	0.00
Return over direct expense	9.00
Labor hours	-
Pasture equiv. (AUM)	1.5

Pasture, Improved: Rotation Grazing

Unit	aum
	Long Range
Yield	6
Price	8.00
Product income	48.00
Miscellaneous income	-
Gross income	48.00
Seed	-
Fertilizer	25.00
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	3.36
Hired labor	-
Marketing	-
Total direct expense	28.36
Return over direct expense	19.64
Labor hours	-
Pasture equiv. (AUM)	6.0

Pasture, Establishment

Unit	aum
	Long Range
Yield	-
Price	-
Product income	0.00
Miscellaneous income	-
Gross income	0.00
Seed	38.00
Fertilizer	50.00
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	-
Hired labor	-
Marketing	-
Total direct expense	88.00
Return over direct expense	-88.00
Labor hours	-
Pasture equiv. (AUM)	-

Grass Hay, Unimproved: Cash

Unit	ton
	Long Range
Yield	1.5
Price	40.00
Product income	60.00
Miscellaneous income	-
Gross income	60.00
Seed	-
Fertilizer	-
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	-
Hired labor	-
Marketing	7.50
Total direct expense	7.50
Return over direct expense	52.50
Labor hours	-

Grass Hay, Improved: Cash

Unit	ton
	Long Range
Yield	3
Price	40.00
Product income	120.00
Miscellaneous income	-
Gross income	120.00
Seed	-
Fertilizer	25.00
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	-
Hired labor	-
Marketing	15.00
Total direct expense	40.00
Return over direct expense	80.00
Labor hours	-

Grass Hay, Unimproved: Fed

Unit	ton
	Long Range
Yield	1.5
Price	40.00
Product income	60.00
Miscellaneous income	-
Gross income	60.00
Seed	-
Fertilizer	-
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	-
Hired labor	-
Marketing	7.50
Total direct expense	7.50
Return over direct expense	52.50
Labor hours	-
Hay equivalents (ton)	1.5

Grass Hay, Improved: Fed

Unit	ton
	Long Range
Yield	3
Price	40.00
Product income	120.00
Miscellaneous income	-
Gross income	120.00
Seed	-
Fertilizer	25.00
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	-
Hired labor	-
Marketing	15.00
Total direct expense	40.00
Return over direct expense	80.00
Labor hours	-
Hay equivalents (ton)	3.0

Grass Hay, Establishment

Unit	ton
	Long Range
Yield	-
Price	40.00
Product income	0.00
Miscellaneous income	-
Gross income	0.00
Seed	38.00
Fertilizer	50.00
Crop chemicals	-
Crop insurance	-
Drying fuel	-
Irrigation energy	-
Custom hire	-
Hired labor	-
Marketing	-
Total direct expense	88.00
Return over direct expense	-88.00
Labor hours	-
Hay equivalents (ton)	-

Dairy Steers: Grazing

Budget Unit	Per Head
	Long Range
Dairy Steers	
Quantity (lb.)	1200
Price (cwt.)	63.00
Product income	756.00
Miscellaneous income	-
Gross income	756.00
Purchase price (head)	90.00
Purchased feed	80.00
Veterinary	10.00
Livestock supplies	9.00
Marketing	8.00
Total direct expense	197.00
Labor hours	12
Death loss percent	4.0
Months on farm	18
Corn equivalents (bu.)	70.0
Hay equivalents (ton)	0.9
Silage equivalents (ton)	0.5
Pasture equiv. (AUM)	5.0
Feed expense	267.50
Death loss value	30.24
Return over budget expense	261.26

Beef Steers: Grazing

Budget Unit	Per Head
	Long Range
Grazing Strs	
Weight (lb.)	650
Price (cwt.)	77.00
Product income	500.50
Miscellaneous income	-
Gross income	500.50
Purchase weight (lb.)	450
Purchase price (cwt.)	87.00
Purchased feed	16.00
Veterinary	5.00
Livestock supplies	2.00
Marketing	7.00
Total direct expense	421.50
Labor hours	-
Death loss percent	1.0
Months on farm	6
Corn equivalents (bu.)	-
Hay equivalents (ton)	0.1
Silage equivalents (ton)	-
Pasture equiv. (AUM)	3.5
Feed expense	28.00
Death loss value	5.01
Return over budget expense	46.00

Beef, Cow-Calf: Grazing

Budget Unit	Per Cow
	Long Range
Beef Calves	
Quantity (head)	0.75
Weight (lb.)	450
Price (cwt.)	87.00
Product income	293.62
Cull income	75.00
Miscellaneous income	-
Gross income	368.62
Purchased feed	15.00
Breeding fees	-
Veterinary	17.00
Livestock supplies	7.00
Marketing	2.50
Total direct expense	41.50
Labor hours	-
Corn equivalents (bu.)	9.0
Hay equivalents (ton)	3.3
Silage equivalents (ton)	0.7
Pasture equiv. (AUM)	5.0
Feed expense	296.15
Return over budget expense	30.98

Bison, Cow-Calf: Grazing

Budget Unit	Per Cow
	Long Range
Bison Calves	
Quantity (head)	0.85
Weight (lb.)	400
Price (cwt.)	180.00
Product income	612.00
Cull income	50.00
Miscellaneous income	-
Gross income	662.00
Purchased feed	25.00
Breeding fees	-
Veterinary	20.00
Livestock supplies	2.00
Marketing	5.00
Total direct expense	52.00
Labor hours	-
Corn equivalents (bu.)	4.0
Hay equivalents (ton)	2.5
Silage equivalents (ton)	-
Pasture equiv. (AUM)	7.0
Feed expense	226.40
Return over budget expense	383.60