ENERGY SUPPLEMENTATION OF STOCKER CATTLE GRAZING WHEAT PASTURE: DEVELOPMENT OF A MANAGEMENT MODEL FOR WHOLE-FARM ECONOMIC ANALYSIS[1]

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Story in Brief

Studies were conducted to (1) evaluate a grain-based, high-starch versus a high-fiber energy supplement (fed at a level of about .75% of body weight) for growing cattle on wheat pasture and (2) develop a microcomputer management model for whole-farm economic analysis of supplementation programs within the provisions of the wheat commodity program. Both energy supplements helped stabilize stocking density on wheat pasture and increased daily gain by about .41 lb during the 1990-91 wheat pasture year. Whole-farm net returns were estimated for three government farm program alternatives for the 1990-91 year (non-participation, the 5-month option and 0/92) and three cattle price scenarios that reflected stocker/feeder price spreads in real dollars of -$22.00 (low), -$16.00 (moderate) and -$7.00 (high). The energy supplementation program (and increased stocking density) increased exposure to down-side price risk and resulted in lower whole-farm net returns under the low cattle price scenario. On the other hand, the energy supplementation program captured the benefits of favorable cattle price movements, and increased whole-farm net returns under the moderate and high price scenarios. The energy supplementation program also allowed more cattle to be purchased in the fall on seasonally low markets and to be available to graze-out a greater proportion of the wheat acreage base depending on the provisions of the wheat commodity program.

(Key Words: Growing Cattle, Energy Supplementation, Wheat Pasture.)

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Introduction

A broad objective of the Expanded Wheat Pasture Research Program is to develop supplementation programs and programs for delivery of new technologies that will decrease production risks of growing cattle on wheat pasture and increase stability of the enterprise. As a part of the studies within this objective, we have been conducting studies to evaluate a grain-based, high-starch versus a high-fiber energy supplement (fed at a level of .75% of body weight) for wheat pasture stocker cattle. This supplementation strategy should:

1. Allow stocking density to be increased.

2. Increase stability of the enterprise by buffering the potentially large swings in wheat forage availability that frequently characterize wheat pasture stocker programs during the fall/winter grazing period.

3. Improve the predictability of cattle performance. **NOTE:** If weight gains of growing cattle cannot be predicted with some degree of accuracy, realistic breakevens cannot be calculated. Realistic breakevens are prerequisite to sound marketing decisions.

Results of the second year (1990-91) of these studies including subsequent feedlot performance of the cattle are reported herein. In addition, a management model for evaluating the economics of the energy supplementation program within the provisions of the Wheat Commodity Program is presented.

Materials and Methods

Cattle Performance

One-hundred and ninety-two (192) fall-weaned steer calves (Brangus x black and black/white faced cows) were allotted to 9 treatment combinations as follows:

Supplement	Stocking density, acres/head[a]		
	2	1.64	1.38
	---- Number of Pastures ----		
Control[b], no energy supplement	2	2	2
High-starch supplement	1	2	2
High-fiber supplement	1	2	2

[a]11 to 13 steers/pasture.

[b]Steers had free-choice access to a commercial mineral mix (Wheat Gainer Mineral; Farmland Industries, Inc.) that contained 20% salt, 16% calcium, 4% phosphorus and 5.5% magnesium.

The steers grazed cleaned tilled wheat pasture (Pioneer 2157) for 107 days (November 21, 1990 through March 7, 1991). Control cattle received no supplement other than free-choice access to a commercial mineral mixture. The other cattle were hand-fed 6 days/week either a corn-based energy supplement (i.e., high-starch supplement) or a high-fiber energy supplement that contained about 47% soybean hulls and 42% wheat middlings (as-fed basis) as shown in Table 1. Energy supplements were fed for 100 days of the 107-day trial beginning on November 27.

At the end of the fall/winter grazing period on wheat pasture (March 7, 1991) the steers were placed on a native grass trap for two weeks. Because of very dry conditions and a shortage of wheat forage for graze-out, the steers were moved to the feedlot at Panhandle State University on March 21. Pen allotment in the feedlot was the same as on wheat pasture so that potential effects of the treatments on wheat pasture on subsequent feedlot performance of the cattle could be evaluated. The steers were adapted to a rolled corn finishing ration (NE_M and NE_G of about 94 and 61, respectively) during 18 days. After the feeding period, steers were processed at the Excel Packing Plant in Dodge City, KS; hot carcass weights and carcass quality grades were determined.

Economic Analysis of Energy Supplementation

Profit potential from supplementing wheat pasture stockers may be derived from two primary sources: (1) additional weight gain provided from supplementation during fall/winter grazing and (2) flexibility gained from having more cattle available for grazing during the graze-out period. Of

Table 1. Composition (% as-fed) of energy supplements[a].

Ingredients	Type of supplement	
	High-starch	High-fiber
Corn, ground	78.94	-----
Soybean hulls	-----	46.94
Wheat middlings	8.90[b]	41.74
Molasses, sugarcane	4.95	4.95
Calcium carbonate	1.75	1.50
Dicalcium phosphate	.60	-----
Micro-lite[c]	4.15	4.15
Salt	.65	.65
Rumensin 60 Premix	.067	.067
Nutrient content, as-fed		
NE_{gain}, Mcal/cwt	52.8	39.3
Crude protein, %	8.2	11.5
Calcium, %	.89	.89
Phosphorus, %	.44	.53
Magnesium, %	.46	.55
Monensin, mg/lb	40	40

[a] Fed as 3/16" pellets.
[b] Added to improve pellet quality (decrease fines) of the high-starch supplement.
[c] Micro-Lite, Inc., Chanute, KS.

course, the ability to realize fully the second advantage is contingent upon having sufficient acres available to graze-out all the cattle that were on hand during the fall/winter grazing period. This factor is tied largely to the Wheat Commodity Program provisions and becomes more critical as these provisions decrease the percentage of wheat acres harvested or favor graze-out.

To account for stocking rate influences and government commodity program considerations, supplementation programs are best analyzed on a whole-farm basis. A recently developed wheat/stocker management model was employed to conduct a whole-farm analysis of the proposed

supplementation programs. This model was developed to estimate net returns from wheat and stocker enterprises under alternative management systems and commodity program alternatives. Constructed on a LOTUS 1-2-3 spreadsheet, the model utilizes the logic of the Government Grain Program Analysis Worksheet (Anderson et al., 1991) to estimate deficiency payments. The current version of the model utilizes 1990-91 commodity program provisions, but it will be updated to reflect the 1991-92 program once these provisions are finalized. Enterprise budgets are specified for wheat production, fall/winter wheat pasture stockers and graze-out stockers. Based upon whole-farm input concerning the number of acres of wheat produced, number of head of stockers and wheat commodity program parameters (base acres, target prices, etc.), farm-level net returns are estimated.

Assumptions of the Analysis. For the whole-farm analysis, a 640-acre management unit was considered that was entirely planted to wheat. Calves were purchased in November and stocked at densities consistent with the grazing trials in Marshall, Oklahoma -- 2 acre/head (320 calves) for the control cattle and 1.5 acres per steer (427 calves) for the supplemented cattle. Average daily gains during the fall/winter grazing period were considered to be 2.05 and 2.40 pounds/day for the control and supplemented cattle, respectively. Stockers were placed on available graze-out acres in mid-March and assumed to gain an average of 2.5 pounds/day with no difference between control and supplemented cattle.

Enterprise budgets for both control and supplemented stockers were developed using two years of input use and livestock performance data from grazing trials at Marshall, OK. Income and operating cost information for both fall/winter and graze-out stocker enterprises are summarized in Tables 2a. and 2b. Net returns reported in the budgets are returns above operating costs and do not account for land or machinery ownership costs.

Livestock prices used in the analysis represent average market conditions facing wheat pasture stocker producers during the 1981-90 period. The price of steer calves in November ($89.73/cwt) reflects the 10-year average real price paid (1991 dollars) for 450 pound calves at the Oklahoma City Livestock Market. Price ratios were estimated between November steer calves and 685 pound (control) and 725 pound (supplemented) March feeders. Similar ratios were calculated between March calves and 835 pound (control) and 875 pound (supplemented) May feeders. Differences among these ratios reflect the weight differential as well as seasonal price trends. These ratios were applied to the average calf price to develop a set of average prices (in real terms) for the four classes of cattle sold. For example, the average ratio between March feeders and November calves was .875; therefore, the product of the ratio and calf price yielded a feeder price of $78.51.

Operating costs reflect cost of production during the 1990-91 season. Feed costs, $7.00/cwt, included ingredient costs as well as a milling charge of $30.00/ton for pelleting and grinding and a delivery cost of $12.00/ton. Control cattle were fed a commercial mineral at a rate of .25 lb/day. Mineral expense for the supplemented calves was included in the cost of the supplement. Labor requirements for the fall/winter period included a base amount for all cattle (1.27 hours/head for cattle stocked at a density of 2 acres/head and 1.09 for a stocking density of 1.5 acres/head), as well as labor required to feed supplement (.96 hour/head). The labor requirement for the graze-out enterprise was .71 hour/head. Machinery operating costs primarily reflect fuel, lubrication, and repair expenses for a 3/4 ton pickup. Hauling and marketing charges were assessed at rates of $.35 and $1.72/cwt, respectively. Interest on operating capital reflects the cost of capital used to purchase the calf and other expense items, and was estimated using an annual interest rate of 12 percent.

Total receipts from the fall/winter stocker enterprise increased approximately $24.00 per head as a result of additional gain provided by the supplementation program. Per-head expenses increased from $481.38 to $512.85 (Table 2a), primarily due to increased feed, labor, and machinery operating costs. Other operating costs that increased negligibly as a result of energy supplementation included interest on operating capital, hauling, and marketing charges.

Wheat production costs were $57.84 per harvested acre and $39.12 per non-harvested acre. Expected yield was 32 bushels/acre, and the price of wheat was $2.65/bushel.

Whole-Farm Economic Analysis

Farm-level returns were estimated for the hypothetical farm situation under three government program participation alternatives available to wheat producers during the 1990-91 production year: (1) non-participation in the wheat program, (2) the 5-month option, and (3) 0/92. Under the 5-month option, 30 percent of the total base was not eligible for deficiency payments. This acreage included the portion of base used for the Acreage Reduction Program (some refer to as set-aside, 15% for 1991) and the 15% Mandatory Non-payment Acres (or normal flex acres). Under 0/92, producers may devote up to all of their maximum payment acres to conservation uses and still receive 92% of their deficiency payment. Each farm situation is unique and future program provisions will differ from those of the 1990-91 wheat program. Nonetheless, the results provide some indication of the profitability of supplementation under a variety of program alternatives and economic conditions.

Table 2a. Enterprise budget for the production of wheat pasture stockers with and without energy supplementation.

	Unit	Price	Unsupplemented		Supplemented	
			Quantity	Value	Quantity	Value
Livestock Receipts:						
Total Receipts	cwt	79.55/78.51	6.98	555.57	7.38	579.59
Operating Inputs:						
Stocker Calves	cwt	89.73	4.65	417.24	4.65	417.24
Supplemental Feed	lb	0.07	0.00	0.00	403.00	28.21
Supplemental Hay	lb	0.03	200.00	6.00	200.00	6.00
Salt & Mineral	lb	0.15	28.75	4.31	0.00	0.00
Freight	cwt	0.35	11.63	4.07	12.03	4.21
Marketing	cwt	1.72	6.98	12.01	7.38	12.70
Vet-Med Expenses	hd	8.00	1.00	8.00	1.00	8.00
Mach. & Equip. Costs	hd	6.09/7.98	1.00	6.09	1.00	7.98
Interest Expenses	dol	0.12	144.27	17.31	152.17	18.26
Labor	hr	5.00	1.27	6.35	2.05	10.25
Total Operating Costs, $/head				481.38		512.85
Return above operating costs ($/head[a])				74.18		66.74

[a] Pasture costs are not included in this net return estimate. Because of differences in stocking density, per-head pasture costs will be lower for supplemented cattle.

Table 2b. Enterprise budget for the production of graze-out wheat pasture stockers.

	Unit	Price	Unsupplemented		Supplemented	
			Quantity	Value	Quantity	Value
Livestock Receipts:						
Total Receipts	cwt	73.67/72.60	8.61	634.22	9.01	653.94
Operating Inputs:						
Stocker Calves	cwt	89.73	4.65	417.24	4.65	417.24
Supplemental Feed	lb	0.07	0.00	0.00	403.00	28.21
Supplemental Hay	lb	0.03	220.00	6.60	220.00	6.60
Salt & Mineral	lb	0.15	28.75	4.31	0.00	0.00
Freight	cwt	0.35	15.59	5.46	16.39	5.73
Marketing	cwt	1.72	8.61	14.81	9.01	15.49
Vet-Med Expenses	hd	11.50	1.00	11.50	1.00	11.50
Mach. & Equip. Costs	hd	9.54/11.43	1.00	9.54	1.00	11.43
Interest Expenses	dol	0.12	253.37	30.40	267.18	32.06
Labor	hr	5.00	1.98	9.90	2.76	13.80
Total operating costs, $/head				509.76		542.07
Return above operating costs ($/head[a])				124.46		111.86

[a] Pasture costs are not included in this net return estimate. Because of differences in stocking density, per-head pasture costs will be lower for supplemented cattle.

Results and Discussion

Cattle Performance

Supplement intakes of the cattle on wheat were a little less than the target and averaged .60 to .68% of body weight. Performance of the steers and supplement conversions (lb/lb of increased gain per acre) are shown in Table 3. Weight gains were increased by both supplements by about .41 lb/day and the response was similar at all stocking densities as shown in Figure 1 where available forage is expressed as pounds per steer day. Gains of cattle were not influenced by type of supplement ($P>.80$) or stocking density ($P>.17$). While this is in contrast to results of the 1989-90 wheat pasture year (Horn et al., 1991), gains of cattle fed the two types of supplements differed by only .16 lb/day during the first year. In general, one would expect the difference in response by grazing cattle to high-fiber versus high-starch energy supplements to decrease as the amount of supplement fed decreases and as crude protein content of the forage increases. The level of supplement fed in this trial was relatively small and wheat forage contains excess crude protein. Mean conversion of the supplements was 5.00 (high-starch) and 5.25 (high-fiber supplement). These conversions are similar to those of the first year and are substantially less than conversions of 9 to 10 that have traditionally been used in evaluating the economics of energy supplementation programs for wheat pasture stocker cattle.

Feedlot performance of the cattle is shown in Table 4. While feed intakes of the cattle were high, this is consistent with the method of processing the corn, the observed gains and the net energy equations for growing/finishing beef cattle. Hot carcass weights averaged 750 lb and quality grade averaged low choice. Neither feedlot performance, hot carcass weight nor carcass quality grade was influenced significantly by supplementation, type of energy supplement or stocking density on wheat pasture ($P>.15$).

Whole-Farm Economic Analysis

Results of the whole-farm economic analysis are presented in Tables 5a and 5b. Farm-level net returns were estimated with and without the use of an energy supplementation program. The number of acres harvested and number of head in each stocker enterprise is reported at the top of each table. Total number of head grazed in the fall/winter season (320 and 427 head with and without supplementation) reflects the stocking densities referenced above. The number of stockers grazed out was determined by the number of non-harvested acres associated with each program alternative.

Table 3. Effect of type of energy supplement and stocking density on performance of steers grazing wheat pasture (1990-91).

	Type of energy supplement								
	None[a]			High-starch			High-fiber		
Stocking density, acres/head:	2.00	1.64	1.38	2.00	1.64	1.38	2.00	1.64	1.38
Number of steers	24	22	26	12	22	26	12	22	26
Number of pastures	2	2	2	1	2	2	1	2	2
Supplement consumption									
lb as-fed/day	.18	.19	.23	3.65	3.69	3.94	3.90	4.05	4.03
% of body wt	---	---	---	.60	.62	.66	.65	.68	.68
Initial wt, (11/21) lb	469	472	472	470	478	474	472	475	472
Final wt, (3/8) lb[b]	684	693	661	739	717	724	731	722	716
Daily gain[b] (107 days), lb	2.01	2.07	1.76	2.52	2.25	2.34	2.42	2.32	2.28
Beef gain, lb/acre	107	135	136	135	147	181	129	151	176
Supplement conversion[c]	---	---	---	6.62	6.04	3.95	8.78	6.12	4.38

[a]Steers had free-choice access to a commercial mineral mixture.
[b]Control vs supplementation ($P<.001$); high-starch vs high-fiber not significant ($P>.70$).
[c]Pounds of supplement (as-fed) per lb of increased gain per acre. Control cattle (light stocking density) equal base.

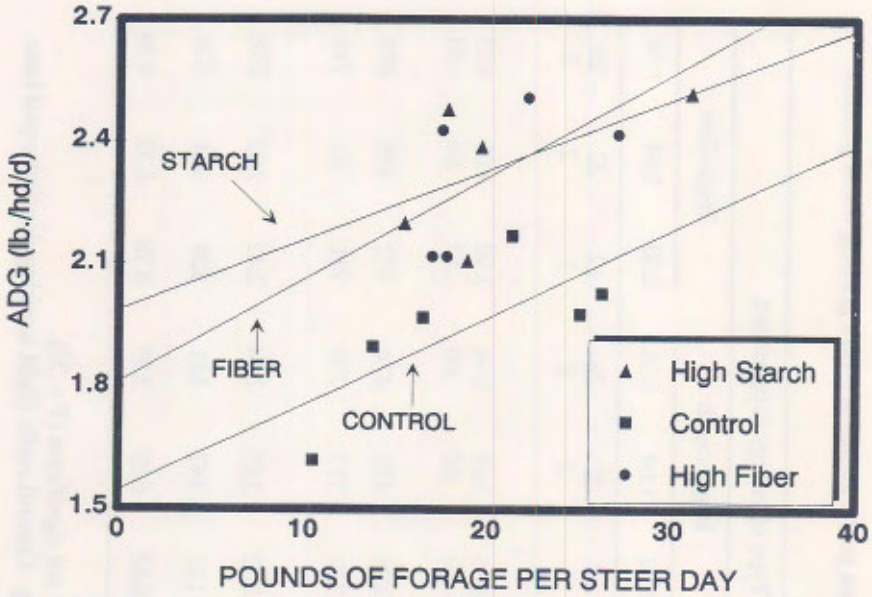

Figure 1. ADG vs pounds of forage per steer day.

Total revenues and costs are broken down by enterprise to provide an indication of the contribution of each enterprise to total net returns. Fall-winter stocker revenues reflect income earned had all cattle been sold in mid-March, while graze-out returns reflect additional revenue earned during the graze-out period. Graze-out costs also reflect the additional costs incurred during the graze-out period. The net return reported is a return to fixed factors of production and does not include fixed costs of farm machinery or a land charge.

Under the no-supplementation alternative (Table 5a), 320 calves were grazed through the fall/winter season and carried through the graze-out period. Differences in the number of acres harvested reflect the difference in non-harvested acres required to comply with the alternative wheat program options. Under the supplementation program (Table 5b), 212 acres were required to graze-out all steers. A portion of the herd was sold under the 5-month option since only 192 acres were not harvested (96 set-aside acres and 96 normal flex acres).

Use of the supplementation program increased farm-level net returns under each of the farm commodity program alternatives. Increases in net returns ranged between $4,546 and $6,151. As expected, returns were highest

Table 4. Feedlot performance and carcass data of steers[a].

	Type of energy supplement on wheat pasture		
	None	High-starch	High-fiber
Number of steers	69	57	60
Initial weight, lb	682	726	722
Final weight, lb	1108	1154	1175
First 56 days			
DM intake, lb/head/day	26.89	26.36	24.54
Daily gain, lb	4.52	4.47	4.33
Feed/gain	5.97	5.92	5.69
First 83 days			
DM intake, lb/head/day	26.30	26.15	24.64
Daily gain, lb	4.07	3.87	3.84
Feed/gain	6.52	6.76	6.44
125 Days			
DM intake, lb/head/day	25.71	24.71	24.56
Daily gain, lb	3.80	3.56	3.62
Feed/gain	6.77	6.94	6.78
Carcass Data			
Quality grade	Choice-	Choice-	Choice-
Hot weight, lb	743	752	752

[a] Feed intakes, daily gains, feed conversions, hot carcass weights and quality grades were not significantly influenced by supplementation, type of energy supplement nor stocking density on wheat pasture ($P > .15$).

Table 5a. Whole-farm net returns under three management options without energy supplementation, 640 acres.

	Non-part	5-Month option	0/92
Acres harvested	480	448	480
No. of head - fall/winter	320	320	320
No. of head - graze-out	317[a]	317	317
REVENUE, $			
Deficiency payment	0	14,336	14,742
Wheat (32 bu/A)	40,704	37,990	40,704
Stocker (fall/winter)	177,783	177,783	177,783
Stocker (graze-out)	24,932	24,932	24,932
TOTAL REVENUE, $	243,419	255,041	258,161
OPERATING COST, $			
Wheat	34,023	33,424	34,023
Stocker (fall/winter)	154,042	154,042	154,042
Stocker (graze-out)	8,996	8,996	8,996
TOTAL OPERATING COSTS, $	197,061	196,462	197,061
NET RETURN, $	46,358	58,579	61,100

[a] One percent death loss from fall/winter to graze-out periods.

under the 0/92 option under both the supplementation and no-supplementation alternatives. This option provided sufficient flexibility to graze-out all of the supplemented cattle (requiring one-third of planted acreage) while maintaining deficiency payments at the 78.2 percent level.

The 5-month option was included to illustrate the impact of supplementation in the event that 0/92 was not available and program compliance required a large portion of acreage to remain unharvested. In this case, increased stocking densities associated with supplementation can provide an opportunity to more efficiently utilize unharvested acreage. Without supplementation, 192 acres (30 percent) were not harvested even

Table 5b. Whole-farm net returns under three management options with energy supplementation, 640 acres.

	Non-part	5-Month option	0/92
Acres harvested	428	448	428
No. of head - fall/winter	427	427	427
No. of head - graze-out	423[a]	384	423
REVENUE, $			
Deficiency payment	0	14,336	15,570
Wheat (32 bu/A)	36,294	37,990	36,294
Stocker (fall/winter)	247,485	247,485	247,485
Stocker (graze-out)	31,522	28,550	31,522
TOTAL REVENUE, $	315,301	328,361	330,871
OPERATING COST, $			
Wheat	33,050	33,424	33,050
Stocker (fall/winter)	218,987	218,987	218,987
Stocker (graze-out)	12,360	11,220	12,360
TOTAL OPERATING COSTS, $	264,397	263,631	264,397
NET RETURN, $	50,904	64,730	66,474

[a] One percent death loss from fall/winter to graze-out periods.

though only 160 acres were required to graze-out all of the steers. Additional cattle could be purchased to utilize the excess pasture; however, seasonal price trends usually negate the possibility of earning a positive return over such a short grazing period. If a supplementation program was employed, an additional 67 steers would be available for graze-out and the unharvested acreage fully utilized. This example illustrates how supplementation can provide producers additional flexibility in meeting acreage set-aside requirements imposed by government commodity programs.

As stated earlier, benefits accruing from supplementation may be derived from increases in returns during both the fall/winter and graze-out phases. How were these benefits distributed between the two enterprises in this situation? Returns above operating costs from fall/winter grazing

increased from $23,741 ($177,783 - $154,042) to $28,498 ($247,485 - $218,987) as a result of implementing the supplementation program. This increase was derived entirely from the higher stocking density, because supplemented calves returned $7.44 per head less in the fall/winter period (see Table 2a). Therefore, under the cost and return situation presented, supplementation is not profitable if the increased carrying capacity is not utilized. If all calves were grazed-out, returns above operating costs for the graze-out enterprise were $15,936 and $19,162 under the no-supplementation and supplementation programs, respectively. Therefore, potential returns from livestock production increased approximately $7,983 from supplementation; approximately 60% of this return was derived from fall/winter grazing, while 40% was attributed to graze-out.

Net returns from supplementation under the three program participation alternatives are presented in Table 6 for three livestock price scenarios. The low price scenario reflects the average of the three lowest ratios between May feeders and November calves observed in the 1981-90 period. Conversely, the high price scenario reflects the average of the three highest ratios. The high, moderate, and low price scenarios reflect price spreads (in real dollars) of -$7.00, -$16.00 and -$22.00, respectively. Clearly, the profitability of supplementation is closely tied to the changes in cattle price over the grazing period. Increased stocking densities associated with supplementation provide an opportunity to increase returns under favorable price conditions, but they also yield low returns above operating costs when price movements are unfavorable. When profit potential from stocker production is low, returns earned without supplementation exceed those earned with supplementation under all three options. The value of a pound of gain is not sufficient to cover additional costs associated with supplementation. In this case, the majority of the total net return earned is provided by the wheat enterprise. Also, because the net return is a return above operating costs, sufficient income is not earned to pay land costs and other fixed expenses.

Several issues concerning risk must be addressed when considering a supplementation program. First, supplementation reduces one form of production risk by reducing the variability of fall/winter weight gains. However, the larger number of stockers grazed under supplementation presents a managerial challenge in the event that sufficient quantities of forage are not available for graze-out. Retained ownership through the feedlot is one alternative in this situation. Also, as shown in Table 6, the larger number of stockers also exacerbates effects of unfavorable price movements over the grazing season. The range of net returns under the three price situations presented in Table 6 provides some indicator of the price risk under each alternative. Clearly, the range of net returns is higher

Table 6. Whole-farm net returns ($) under alternative cattle price structures with and without energy supplementation.

Price scenario[a]	Non-part	5-month option	0/92
		No supplement	
Low	19,163	34,084	36,605
Moderate	46,358	58,579	61,100
High	71,360	83,581	86,102
		Energy Supplementation	
Low	18,331	32,608	33,901
Moderate	50,904	64,730	66,474
High	82,386	96,036	98,406
		Energy Supplementation vs No supplementation	
Low	-832	-1,476	-2,704
Moderate	3,736	6,151	5,374
High	11,026	12,455	12,304

[a] "Moderate" price scenario reflects prices reported in enterprise budget. "Low" ("High") scenario reflects average of three lowest (highest) May feeder to November calf ratios observed in 1981-90 period (in real dollars).

under supplementation. One must also consider the financial risk associated with having more capital tied up in wheat pasture stockers. Several risk management tools may be used to manage each of these sources of risk.

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