THE BEEF INDUSTRY IN THE APPALACHIAN AREA OF VIRGINIA

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PREFACE

This report is a part of research developed for regional research project S-67, "Evaluation of the Beef Production Industry in the South." This project is a cooperative effort of State Agricultural Experiment Stations in 12 southern states, the Farm Production Economics Division of the Economic Research Service, and the Tennessee Valley Authority.

The overall objectives of the regional project were: (1) to determine various resource characteristics and combinations employed in beef production in the South, evaluate selected operator attributes and appraise adjustment trends that have occurred; (2) to evaluate the micro and macro economic effects of selected aspects of alternative beef production systems; and (3) to estimate for selected alternative systems of beef production the relative effects on firm survival and/or growth of constraints, such as forage production risks, price risks, institutional restrictions, and changes in value of assets.

This study was made possible through the cooperation of Extension Agents, and the beef farmers in the Appalachian Area of Virginia who provided information concerning their operations.

SUMMARY

Beef Farms, Appalachian
Area of Virginia

A survey of a sample of beef farmers in the Appalachian Area of Virginia in 1969, indicates the predominant beef system for the area is the cow-calf system where calves are usually sold when weaned. However, weaned calves are fed and sold as feeders or slaughters by some farmers. On the basis of size, number of brood cows and average acres of open land per farm, the 3,676 beef farms are distributed as follows: 39% with less than 20 cows and 95 acres of open land; 28% with 20 to 49 cows and 236 acres of open land; 22% with 50 to 99 cows and 448 acres of open land; and 11% with over 100 cows and 792 acres of open land.

Approximately 30% of the operators of farms with less than 50 brood cows work off the farm more than 100 days per year. To a large extent only farms with 50 or more brood cows have silos and silo-unloading equipment. Operators in all size groups have more than 90% equity in the farm business.

Operations on all farms are quite extensive, more than 65% cropland is used for hay crops and pasture and less than 16% for row crops. Less than 20% of farms in any size group have any one livestock enterprise other than beef cows, yet some farms have sizable units of dairy cows, sheep, or swine.

Analytical Study

A linear programming model where the objective was to produce at minimum annual cost $7,000 disposal income to operator's labor, management and asset equity was used to determine optimum organization and combination of enterprises for the beef cow herd and the following alternatives of selling calves: (a) weaned calves; (b) yearling heavy feeders; (c) yearling light slaughters; and (d) yearling heavy slaughters. Each system was considered when the operator's asset equity was 0%, 50%, and 100%.

The present extensive cow-calf system where calves are usually sold when weaned requires 7.8 acres of open land per brood cow. In contrast, the results of this study indicate that an integrated cow-calf system where weaned calves are kept, fed, and sold as yearling light slaughters would require 2.31 acres of open land per brood cow.

By using an intensive integrated cow-calf system more than 60% of the beef farmers in the Appalachian Area (farmers with more than 20 brood cows and 95 acres of open land) could produce an annual disposable income greater than $7,000 without increasing land acreage. If the smaller farms were combined into larger units, and an intensive integrated cow-calf system was used by all farmers, the aggregate farm product sales for the beef farms of the Appalachian Area could be $34 million (1962-71 prices) more than sales in 1969 from all area farms, beef and non-beef. To attain the added sales would require an increase of $143 million in non-land investments.

To produce $7,000 disposable income required farms with 68 to 124 brood cows and 174 to 195 acres of open land when operator's asset equity was 100%. The lowest average investment to produce $7,000 returns to operator's labor, management, and equity capital was when weaned calves were put in the feed lot and finished and sold as yearling light slaughters. Investment ranged from $97,696 when operator's asset equity was 100% to $155,062 when operator's asset equity was 0%. The highest investment required for $7,000 disposable income was when calves were sold at weaning age (502-pound steers and 472-pound heifers). Investments ranged from $117,352 with 100% operator's asset equity to $459,718 when operator's asset equity was 0%.

Compared to the extensive nature of existing beef farms in the Appalachian Area, the programmed optimum farms usually had more than 70% of cropland in harvested crops and more than 40% of the cropland planted to row crops.

In all systems the predominant feeds for the beef-cow herds were: period 1 (January-March) corn silage; period 2 (April-June) bluegrass and tall grass-ladino clover pasture; period 3 (July-September) bluegrass pasture supplemented by corn silage, small grain silage, and grass silage and sudax pasture; and period 4 (Oct. - Dec.) largely corn silage, small grain silage, and tall grass-legume silage. Sources of feed for feeder animals were similar to beef-cow herd. The feed for finishing beef animals, both slaughter groups, were 44% of TDN from corn grain and 56% of TDN from corn silage.

THE BEEF INDUSTRY IN THE APPALACHIAN AREA OF VIRGINIA

Ralph G. Kline and Charles H. Cameron*

INTRODUCTION

The beef industry is an important and rapidly expanding segment of Virginia's economy. From 1959 to 1969 beef production for the state has expanded 22% (see Table 1). The most rapid growth has been in the Appalachian Area, 33%; followed by the Upper Piedmont, 29%; Shenandoah Valley, 15%; and other areas of the state, 6%. In 1969, approximately 92% of Virginia's beef production was in the Appalachian Area, Shenandoah Valley, and Upper Piedmont areas (see Figure 1). The value of all farm products sold in Virginia in 1940 was 51% from crops and 49% from livestock. In 1969, the value of all farm products sold was livestock 60% and crops 40%.[1]

In 1964, 84% of the Virginia beef cows (brood cows and heifers over two years old) were in herds of less than 100 cows, 65% in herds of less than 50 cows, and 33% in herds of less than 20 cows. In 1969, for the Appalachian, Shenandoah Valley, and Upper Piedmont areas of Virginia, respectively, 70%, 49%, and 65%, of beef cows were in herds of less than 100 cows; 33%, 24%, and 37%, were in herds of less than 50 cows; and 20%, 7%, and 15% of the cows were in herds of less than 20 cows (see Table 2).

There have been great structural changes in the farming sector during the past 20 years--larger farms, fewer farms, less available labor, and greater off-farm expenditures. These trends are predicted to continue during the next 10-year period.[2]

Although beef cattle production, especially the cow-calf operations, has increased rapidly in Virginia and other acres of the South, analyses of farm records indicate the net returns in many cases are low. To improve the competitive position of the southern beef industry will require adjustments in farm operations that will make possible more efficient utilization of available resources. The beef production industry, in Virginia (and other areas of the South), is an aggregation of heterogeneous farming systems varying greatly in size of operation, available resources, combinations of crops, and kinds of beef systems. If resources are to be used efficiently, plans for the future must be consistent with the future structure of the farm sector.

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[1] U.S. Department of Commerce, United States Census of Agriculture (Washington, D.C.: Bureau of Census, 1959, 1969).

[2] Agricultural and Economic Development and Farm Foundation, Implications of Changes (Structural and Market) on Farm Management and Marketing Research (Chicago, Illinois, April 24, 26, 1967).

Table 1.--Numbers of Beef Cattle by Areas and State, 1959-69[1]

Area[2/]	1959		1964		1969	
	Number	Percentage	Number	Percentage	Number	Percentage
Appalachian	286,090	28.37	297,414	27.89	380,420	30.89
Shenandoah	434,942	43.14	444,716	41.70	501,304	40.70
Piedmont	194,796	19.32	222,959	20.90	251,686	20.44
Others	92,473	9.17	101,376	9.51	98,144	7.97
Virginia	1,008,301	100.00	1,066,465	100.00	1,231,554	100.00

[1]These are the inventory numbers of all beef cattle, including brood cows and calves, on December 31 of the respective census year.

[2]Areas are part of national regional economic areas and differ somewhat from conventional definition of areas in Virginia. (see Appendix A).

Source: United States Census of Agriculture, part 24, Volume 1, 1959, 1964, and 1969, U. S. Department of Commerce, Bureau of the Census.

Area 1: Appalachian

Area 2: Shenandoah Valley

Area 3: Upper Piedmont

Areas are parts of larger economic regions of U. S. (see Appendix A)

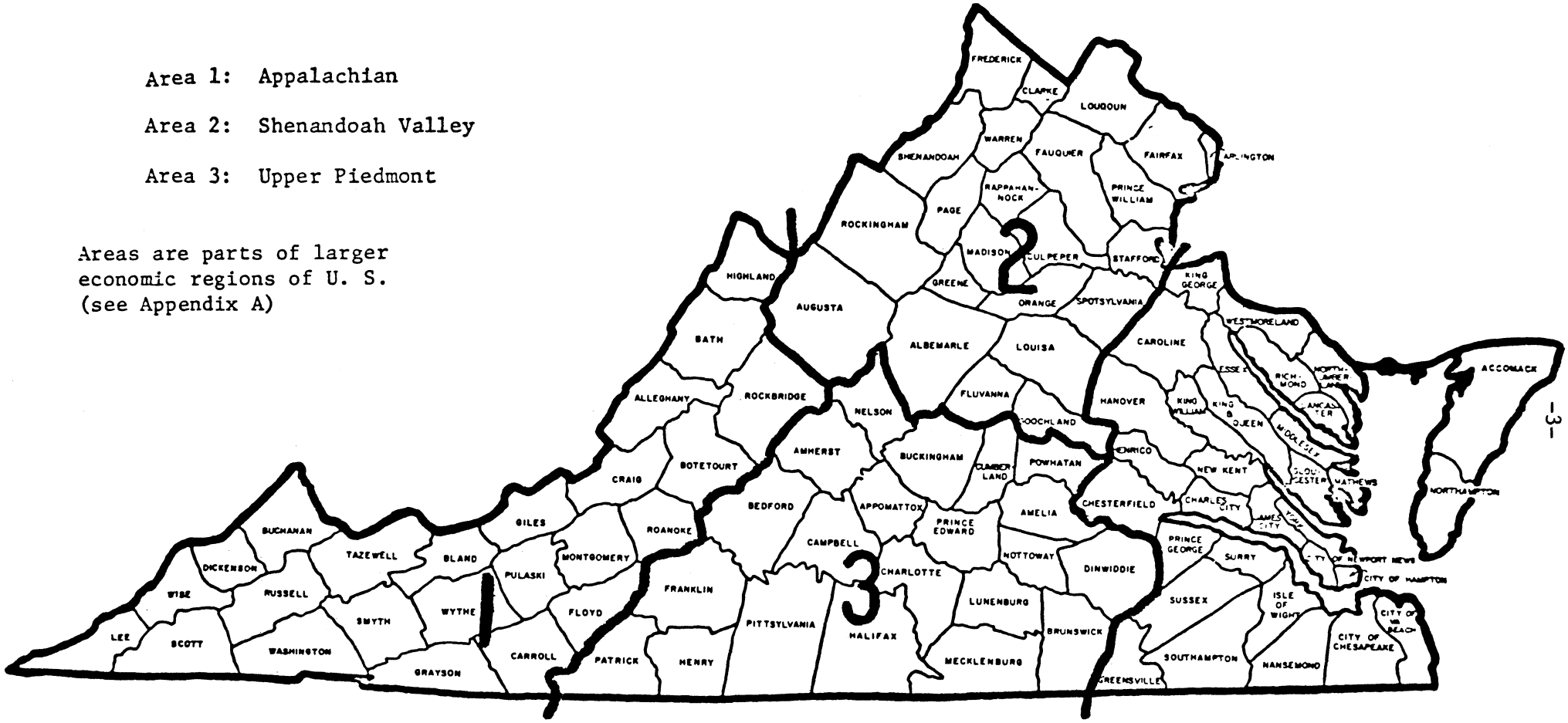

Figure 1.—Virginia Subregions Included in Southern Regional Beef Study

Table 2.--Number and Percentage of Farms with Beef Brood Cows and Number and Percentage of Beef Cows by Farm Size, Appalachian, Shenandoah Valley, and Upper Piedmont Areas of Virginia, 1969[1]

Major beef areas of Virginia and items	Farm size (beef brood cows per farm)[2]							
	Non-beef[3]	Less than 20	20-49	50-99	100-499	Over 500	Beef	All
Appalachian								
Number of farms	2615.7	1278.8	1039.0	799.2	399.6		3516.4	6132.10
Percent of farms	42.7	20.9	16.9	13.0	6.5		57.3	100.0
Cows per farm	5.0	11.9	30.9	65.0	103.8			
Number of cows (1000)	13.1	15.2	17.6	51.9	41.5		126.2	139.3
Percent of cows	9.4	10.9	12.6	37.3	29.8		90.6	100.0
Shenandoah Valley								
Number of farms	331.4	1040.6	1144.6	832.5	520.3	52.0[3]	3590.0	3921.4
Percent of farms	8.4	26.5	29.2	21.2	13.3	1.3	91.6	100.0
Cows per farm	5.3	12.7	30.7	64.9	148.0	600.6		
Number of cows (1000)	1.8	13.2	35.2	54.0	77.0	31.2	210.6	212.4
Percent of cows	0.8	6.2	16.6	25.4	36.3	14.7	99.2	100.0
Upper Piedmont								
Number of farms	675.55	954.7	716.0	437.6	198.9		2307.2	2982.7
Percent of farms	22.6	32.0	24.0	14.7	6.7		77.4	100.0
Cows per farm	7.9	12.1	33.5	70.9	194.8			
Number of cows (1000)	5.3	11.5	24.0	31.0	38.7		105.2	110.5
Percent of cows	4.8	10.4	21.7	28.1	35.0		95.2	100.0

[1]Source: Farm Survey 1969.

[2]Beef farms are farms that have 10 or more beef cattle (brood cows and all other above weaning age). The numbers of farms listed are farms with brood cows. Some beef farms (10 or more beef cattle) do not have brood cattle, and some farms listed as non-beef have less than 10 beef brood cows.

[3]Only one farm in sample. Expansion factor may have caused overestimate in this group.

With an awareness of the need for information concerning the economics of beef production in the South, personnel of Agricultural Experiment Stations in 12 southern states, the TVA, and FPED-ERS-USDA developed regional research project S-67, "Evaluation of Beef Production in the South."

OBJECTIVES

> The overall objectives of this project were: (1) to determine various resource characteristics and combinations employed in beef production in the South, and to evaluate selected operator attributes and appraise adjustments trends that have occurred; (2) to evaluate the micro and macro economic effects of selected aspects of alternative beef production systems; and (3) to estimate for selected alternative systems of beef production the relative effects on farm survival and/or growth of constraints, such as forage production risks, price risks, institutional restrictions, and changes in value of assets.[3]

The beef production industry will be analyzed for each of Virginia's major beef-producing areas: (1) Appalachian Area of Virginia and Tennessee (Virginia sector); (2) Shenandoah Valley; and (3) Upper Piedmont (see Figure 1, page 3). In each of these areas, the cow-calf system of beef production predominates. In 1969, 95%, 94%, and 89%, respectively, of beef farms with 10 or more beef cattle in the Appalachian, Shenandoah Valley, and Upper Piedmont areas of Virginia had a beef brood-cow herd. Calves were sold as weaned calves, feeders, or slaughters.

The present study relates to beef operations in the Appalachian Area of Virginia. The first objective is to describe the beef operations in the area--to identify resources and production practices followed and to observe the kinds of adjustments which may increase operator's returns.

The second objective is to determine for alternative beef systems the effects of the operator's equity on the requirement of each beef system to produce, at minimum annual cost, an annual return to operator's labor, management, and equity capital of $7,000, an annual return comparable to wages received by workers in industry. A range of equity conditions from 0% to 100% operator-ownership of assets will be analyzed. Requirements which will be evaluated include land and non-land investments, annual production costs, gross receipts, and size and structure of the farm businesses.

Equity capital is the value of the operator's ownership in items such as land, buildings, fencing, breeding, livestock, machinery and equipment, and perennial crops. Returns to operator's labor, management, and equity capital is a useful concept for the farmer whose disposable income for family living is the net returns from his labor, management, and assets. It is comparable to the disposable income of the wage earner in industry who also has some income from bank savings, stocks, bonds, or other assets. Although neither the 0% equity nor the 100% equity may be typical of conditions that will exist, these levels are useful in the study. The 0% equity condition

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[3] Charles P. Butler, Economics and Operational Characteristics of the Southern Beef Cattle Industry, Southern Cooperative Series, Bulletin 176 (Clemson University, Clemson, South Carolina: S-67 Regional Farm Management Research Committee, October 1972), p. vi.

exemplifies the operation where the farmer's objective is to consider returns above all cost, including the opportunity cost of owning equity in the business. The 100% equity condition exemplifies the objectives of the farmer who attempts to obtain a specified income from available assets regardless of whether or not he has complete equity in the resources.

Geographic Area

The Appalachian Area was chosen for the first phase of the study (see Figure 1, page 3). The area includes 24 counties in western Virginia and is bordered on the north and northwest by West Virginia, the west and southwest by Kentucky and Tennessee, and the southwest and south by Tennessee and North Carolina.

The major crops grown in the area are: corn, for grain and silage; alfalfa, tall grasses and/or legumes, for hay or silage; and small grain harvested as hay or silage. Burley tobacco is an important cash crop in the 6 extreme southwest counties (see Figure 1).

The topography of the area consists largely of Limestone Valley and Mountain Upland Areas. Most of the intensive crop farming is done in small areas along streams, on heavy textured soils developed over limestone. No-tillage techniques of producing crops have increased the possibilities of expanding acreage of corn and other harvested crops on sloping land (Type II).

Traditionally, the Appalachian Area has been a livestock-producing area or a livestock-burley-tobacco-producing area in the extreme southwest. The production of fluid milk on Grade A dairy farms is profitable for a limited number of farmers. Dairy herds producing milk for manufacturing dairy products are being replaced by beef herds.

PROCEDURES

A personal interview of a sample of 46 beef farmers and non-beef farmers in Virginia and a proportional number of farmers in Tennessee was used to obtain information concerning beef operations in the Appalachian Area of Virginia and Tennessee.[4]

To determine optimum organization for each of five levels of operator's asset equity, 0%, 25%, 50%, 75%, and 100%, linear programming (L.P.) models are used. With a constraint to insure $7,000 returns to operator's labor, management, and equity capital, the objective is to minimize annual costs.

Crop and Beef Cattle System Budgets

The crop and beef budgets are based on information obtained in the regional survey, data from the Department of Agricultural Economics farm record system, and from published materials and conversations with agronomists and animal scientists associated with Virginia Polytechnic Institute and State University. In developing budgets it is assumed that a level of proficiency similar to that carried on by better farmers in the area is used for techniques such as crop planting, culture, and harvesting, and livestock practices such as breeding program, feeding, disease control and marketing.

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[4]Results of survey, for the region as a whole, are published in Southern Cooperative Series Bulletins: Charles H. Butler, Economic and Operational Characteristics of the Southern Beef Cattle Industry and Land Use on Southern Beef-Producing Farms (Southern Cooperative Series Bulletin 176, October 1972, and Bulletin 186, March 1974).

Prices used for investments, production inputs, and product output are based on the 1962-71 historical trend and developed by the S-67 Technical Committee. The beef prices, as well as most other prices, are an average of the 1962-71 prices plus 5% (see Appendix A, Table 1).

Crop budgets.--Farm lands are classified as I, II, III, IV, and V, according to recommended land use, where with conventional tillage land I is suited to continuous row crops; land II is suited for row crops in short rotation with non-row crops; land III is suited for row crops in long rotation with non-row crops; and land IV and land V are suited for pasture only. It is further assumed that by using non-tillage cropping methods row crops may be grown continuously on land II where soil productivity is suitable for row crops. In developing crop budgets it is assumed that the farmer will purchase at least 1 large tractor (75 H.P.), 1 small tractor (35-45 H.P.), a complement of general farm equipment (designated farm bundle), a 2-row forage harvester, and 2 forage wagons with unloading attachments. Resource inputs and related annual costs and crop and pasture yields are summarized in Appendix A, Tables 2A, 2B, and 2C. The annual variable costs of farm machinery are a function of time used for each specified crop and are included as a part of crop budgets. The annual cost for ownership of farm machinery, feeding equipment, fencing, silos, and grain storage are calculated on the basis of expected life with interest at 6% compounded annually on initial investment and paid in equal annual payments. Investments and annual costs are summarized in Appendix A, Table 3. Separate activities permit purchase of silos and equipment.

Livestock budgets.--In this study, the basic livestock enterprises for each beef system considered is the beef brood cow herd. A budget for 32 brood cows, a herd bull, replacement heifers, and raising 29 calves to weaning age (8-1/2 months) is shown in Appendix A, Tables 4A, 4B, and 4C. Feed requirements and performance are based on coefficients given in Nutrient Requirements for Beef Cattle, National Academy of Science (fourth revised edition, 1970). Since it is assumed that the value of the herd does not change from year to year, the cost of raising replacements is included in the budget.

In addition to the sale of weaned steer calves, 502 pounds, and heifer calves, 472 pounds, systems which require additional feeding are listed below, and a summary of budgets is shown in Appendix A, Table 5.

	Beginning		Sale or transfer	
	Date	Wt. lbs.	Date	Wt. lbs.
Beef enterprise				
Yearling feeder				
Steers	Sept. 1	502	Apr. 1	852
Heifers	Sept. 1	472	Apr. 1	800
Slaughter animals				
Light Yearlings				
Steers	Sept. 1	502	Apr. 1	992
Heifers	Sept. 1	472	Mar. 24	882
Heavy Yearlings				
Steers	Apr. 1	852	July 28	1175
Heifers	Apr. 1	800	July 1	1034

On the basis of a 32-brood cow unit, for a year beginning September 1, each beef system would include some multiple of 32 brood cows, a herd bull, 4 replacement heifers 2 years of age, 5 heifer calves 8-1/2 months of age, and 29 calves born in December. In

addition to the animals listed above for the feeder beef system and the light slaughter system, 14 steers and 9 heifers would be fed from September 1 to March-April; and for the yearling heavy slaughter system, the 14 steers and 9 heifers would be fed to the end of June-July.

A budget for the production and sale of 60-pound feeder pigs is summarized in Appendix A, Table 6.

Linear Programming Model

To determine the possibilities of alternative beef systems, a cost minimization linear programming (L.P.) model is used:

The objective is to minimize annual costs.

$$f = C_1X_1 + C_2X_2 + \ldots + C_nX_n$$

Subject to

$$a_{11}X_1 + a_{12}X_2 + \ldots + a_{1n}X_n \underset{>}{\leq} b_1$$

$$a_{21}X_1 + a_{22}X_2 + \ldots + a_{2n}X_n \underset{>}{\overset{=}{\leq}} b_2$$

$$\ldots\ldots\ldots\ldots\ldots\ldots$$

$$a_{m1}X_1 + a_{m2}X_2 + \ldots + a_{mn}X_n \underset{>}{\overset{=}{\leq}} b_m$$

$$X_1 \geq 0$$

where the c_{ij}, a_{ij}, and b_{ij} are known constraints of returns, inputs, and restrictions, respectively. Five of the $b \geq 0$ specify a minimum return for a given operator's asset equity.

The general nature of the L.P. models is explained by a diagram (Figure 2). As shown by the matrix diagram, there are four types of L.P. activities: (1) the beef enterprises represented by the beef-brood cow herd and light slaughters; (2) crop and pasture activities represented by corn silage and bluegrass pasture; (3) activities to transfer feed nutrients--dry matter, total digestible nutrients, and digestible protein from specified crop to livestock, represented by transfer of corn silage and pasture to the cow-calf herd and light slaughters; and (4) buying and selling activities which include investments such as buyland, and production items such as buy corn and sell slaughters. Rows INCOMEA through INCOMEE are used to assure $7,000 return for each of the 5 operator equity assumptions. In abridged matrices in Appendix B, the nature of the model is further outlined.

The L.P. model employed has the following unique features which make it quite useful for analyzing alternative adjustment possibilities for beef production: (1) information concerning beef systems is disaggregated by beef enterprises so that feed requirements for the specified beef enterprise may be accurately studied; (2) feed requirements for specified beef enterprises and transfer of feed nutrients from pasture and crops are specified for 4 seasons of the year; and (3) adjustment of the farm business may be considered with different levels of owner's asset equity.

Disaggregated beef enterprises

The beef brood cow herd is included in each beef system that is developed. The model is designed so that weaned calves can be sold, transferred to a feeder enterprise or to a yearling light slaughter enterprise. The feeders can be sold or transferred to the yearling heavy slaughter beef enterprise.

An objective of this study is to compare farm business adjustment possibilities with alternative beef systems.

Representative items of matrix rows	Activities: Beef enterprises: Brood cow herd	Beef enterprises: Light slaughters	Crop systems: Corn silage	Crop systems: Blue-grass pasture	Transfer activities: To beef cows crm.s.l.	Transfer activities: To beef cows Past.	Buying and selling activities: Buy land	Buying and selling activities: Buy corn	Buying and selling activities: Sell slaughters	Type of constraints	RHS Resources or constraints
Annual costs	XX	XX	XX	XX	XX	XX	XX	XX			
Average investment	XX						XX				
Beef feed requirements by 4 periods of the year	TDNI				TDNI					<	0
	DPROI				DPROI					<	0
	DMATI				DMATI					>	0
	'''				'''	...				..	..
Total digestible nutrients		TDN4				TDN4				<	0
Digestible protein		DPRO4				DPRO4				<	0
Dry matter		DMAT4				DMAT4				>	0
		USE				FURNISH					
Crop dry matter total and pasture dry matter furnished during each of 4 periods of the year			DMATI		DMATI						
			DMATT ...		DMATT ...					<	0
			DMAT4		DMAT4						
			FURNISH		TRANSFER						
Resource requirements: Land, labor, machinery, tractors, buildings, livestock equipment	Resources used by: Livestock		Resources used by: Crops		Resources used by: Feeding		Resources furnished		Resources used livestock sales	<	0
Livestock output, transfer, or sale	Furnish	Use furnish							Livestock sales	<	0
Gross returns, costs, and $7,000 net with equity											
0% (INCOME A)											
50% (INCOME C)	(X)	(X)	-(X)	-(X)	-(X)	-(X)	-(X)	-(X)	(X)	>	$7,000
100% (INCOME E)											

Figure 2.--The Diagrammatic Matrix of Linear Programming Model.

Each system includes the beef cow herd and a specified calf production and sale enterprise, as well as the optimum combination of crops and pastures. Predetermined combinations of feed ingredients are not specified for beef enterprises but kinds and amounts of various pastures and crops are determined simultaneously with the determination of the size of beef enterprises in alternative beef systems. For each beef enterprise, daily feed requirements, based on weight of animal and expected daily gains, are specified in terms of minimum pounds of total digestible nutrients (TDN) and digestible proteins (DPRO) and maximum pounds of dry matter (DMAT). For each beef enterprise feed requirements are specified for each applicable period of the year. Constraint rows of the L.P. model insure that for each period of the year each beef enterprise would receive at least a specified amount of TDN and DPRO and not greater than a specified amount of DMAT.[5] As compared to models where feed constraint rows are aggregated for all beef enterprises, the disaggregated model greatly increases the size of the matrix. Not only are there TDN, DPRO, and DMAT constraint rows for each beef enterprise rather than one, but also it is necessary to include activities to transfer TDN, DPRO, and DMAT to each beef enterprise. The additional size of matrix is justified because L.P. models with aggregated feed nutrient constraint rows may cause the model to indicate less feed needs than the amount required for specified performance. If the $\frac{TDN}{DMAT}$ and $\frac{DPRO}{DMAT}$ feed requirement ratios vary among the beef enterprises, there may be substitution among enterprises which will not permit the 3 feed conditions to be met for specific beef enterprises for each feed requirement.

Feed requirements by period of year

Excess pasture produced in May-June is not available for beef cattle in December-January. To insure that feed is available when needed, the L.P. model is structured so that feed nutrients must be met in each of 4 periods: (1) January-March, (2) April-June, (3) July-September, and (4) October-December. For pasture produced in a designated period up to one-half the amount produced may be transferred to the following period but only one-half of the feed nutrients not utilized will be available in the following period (this assumes that one-half the feed value is lost if not utilized in the designated period).[6]

Operator Equity Levels

An objective of this study is to determine for alternative beef systems the effects of the operator's equity on resources required to produce at minimum annual cost $7,000 returns to operator's labor, management, and equity capital. To facilitate this procedure the model is structured by constraint rows INCOME A-B-C-D-E to include 100%, 75%, 50%, 25%, and 0% of the annual cost of asset ownership for situations where operator ownership is assumed to be 0%, 25%, 50%, 75%, and 100%. Solutions are obtained by parametric L.P. procedures.

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[5] See Nutrient Requirements of Beef Cattle (4th revised edition, 1970), National Academy of Science, also see Appendix B, Abridged Matrix.

[6] If 400,000 pounds of dry matter from pasture is available during April-June but only 200,000 is utilized, 100,000 pounds of dry matter may be utilized in July-September.

Only a limited number of researchable problems relating to the beef farm business are investigated in this study. However, the L.P. model developed for this study can be easily manipulated to provide information concerning alternative hypotheses and/or the effects on the organization and profitability of various beef systems resulting from the use of coefficients different from those used in this analysis.

BEEF INDUSTRY APPALACHIAN AREA OF VIRGINIA

This section is a summary of the structure of the beef production industry in the Appalachian Area of Virginia. The summary is largely based on information obtained by personal interview of a sample of beef farmers in 1968. In the South, the cow-calf systems, producing and selling weaned calves or selling later as feeders or slaughters, are predominant. For this reason, in the Regional Beef Study, farms are grouped according to the number of beef cows (brood cows).[7] Ninety-three and one-half percent of the beef farms in the Appalachian Area of Virginia have beef brood cows. Of the 3,676 beef farms in the Appalachian Area with 10 or more beef cattle above weaning age, 39% have fewer than 20 brood cows, 28% have 20 to 49 brood cows, 22% have 50 to 99 brood cows, and 11% have more than 100 brood cows (see Table 3 and Appendix A, p. 41).

The percentage of farms having specified resources, and differences in averages per farm between the farms having the specified resource and all farms, points up the extreme variation in the structure of beef farms, even within the same size group (numbers of brood cows, see Table 3).

Size group averages of open land acreage suitable for crops and suitable for pasture only, respectively, range from 35 and 60, for farms with less than 20 cows, to 313 and 479, for farms with over 100 cows.

Off-farm income.--Approximately 30% of the operators of farms with less than 50 cows work off the farm 100 or more days per year. The annual non-farm income for operators working off the farm more than 100 days average $7,390 for those with farms with less than 20 cows and over $17,000 for those with farms with 20 to 49 cows.[8] No operators, and 10% of the operators, respectively, for farms with over 100 cows and farms with 50 to 99 cows work off the farm more than 100 days per year.

Investment in farm machinery, livestock equipment, and buildings.--Investment for farm machinery and livestock equipment ranges from $160 to $175 per cow for farms with 20 to 49 and 50 to 99 cows, respectively, and $330 to $360 per cow for the smallest and largest farms. Likewise, the farm machinery and equipment investment per acre of cropland is highest on the largest size group (over 100 cows). Smaller farms may hire custom operators to perform many jobs.

Of the two larger size groups (50 to 99 and over 100 cows) 100% have silos and 30% and 40% of the farms, respectively, have silage unloading equipment such as silo unloaders, bunkline feeders, and/or tractor front-end loaders. Only 30% and 17% of farms with 20 to 49 cows and farms with less than 20 cows, respectively, have silos; and 8%

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[7] Butler, C. H., Economic and Operational Characteristics of the Southern Beef Cattle Industry, Southern Cooperative Series Bulletin 176, October 1972.

[8] Probably one extremely high income and low sampling rate biased the average upward.

Table 3.--Beef Cows and Resources per Farm, Beef Farms Grouped by Size (Number of Brood Cows), Appalachina Area, Virginia, 1969

Items	Unit	Size (brood cows per farm): Less than 20 cows, 1439 farms — Percent of farms	Ave. for farms incl.	Ave. all farms in group	20-49 cows, 1039 farms — Percent of farms	Ave. for farms incl.	Ave. all farms in group	50-99 cows, 799 farms — Percent of farms	Ave. for farms incl.	Ave. all farms in group	100-499 farms, 399 farms — Percent of farms	Ave. for farms incl.	Ave. all farms in group
Beef brood cows[1]	No.	89	12	11	100	31	31	100	65	65	100	104	104
Total open land	Ac.	100	95	95	100	236	236	100	448	448	100	792	792
Cropland[2]	Ac.	94	87	60	92	115	102	100	146	146	100	313	313
Pasture only	Ac.	83	42	35	92	145	134	100	302	302	80	598	479
Woodland	Ac.	56	76	68	77	103	79	100	72	72	100	182	182
Total land[3]	Ac.	100	163	163	100	314	314	100	520	520	100	974	974
Operator worked off-farm													
100-249 days	Da.	0			15	190	29	10	225	23	0		
250 over days	Da.	33	267	89	15	273	42	0			0		
off-farm income													
100-249 days	Dol.	0			15	31000	4769	10	4800	480	0		
250 over days	Dol.	33	7390	2463	15	4900	754	0			0		
Machinery and equip. inv.	Dol.	100	3500	3500	100	5038	5038	100	11550	11550	100	37600	37600
Silos and unloading equip.[3]													
Silo	Farms	17			31			100			100		
Unloading	Farms	0			8			30			40		

[1]To classify as a beef farm, the farm must have 10 or more beef cattle over weaning age but is not required to have brood cows.

[2]Land listed as "in orchards" was included in cropland, total land is total operated not total owned.

[3]Silo unloading equipment included silo self-unloaders, and front-end loaders.

and 0%, respectively, of these farms have silage unloading equipment.

Equity in farm business.--Beef farmers in the Appalachian Area of Virginia have high equity in their businesses--97% for small farms (less than 20 cows) to 93% for farms with 20 to 49 brood cows (see Table 4). Net worth of farm businesses (not including value of residence) ranges from $41,196 for small farms (less than 20 cows) with 148 acres of owned land, of which 60% is open land, to $240,000 for large farms (100 to 499 cows) with 982 acres of owned land, of which 80% is open land. The operators with small size farms (less than 20 cows) value land per acre at a much higher rate than do farmers of any other size group. Also, the estimated value of residence for the smallest farms is higher than estimates made by any group except operators of large farms (100 or more cows, see Table 4).

Land use.--In Table 5 is a summary of cropland use on the Appalachian Area beef farms grouped according to farm size (number of brood cows per farm). The heterogeneous nature of the farms is further exemplified by the relatively small percentage of farms having any one crop. Corn (grain and/or silage) is most consistently grown, and tobacco is also grown on farms in the extreme Southwest. Operations on all farms are quite extensive. Available cropland used for row crops ranges from 9.6% for small farms (less than 20 cows) to 16.4% for farms with 20 to 49 cows. Land used for pastures and hay crops is 77%, 65%, 68%, and 77%, respectively, of total cropland for small to large farms.

Livestock inventory and animals produced.--Farms vary greatly in livestock kept other than the beef cattle (see Table 6). Farms with stockers and fattening animals, in addition to a beef brood cow herd, range from 44.4% of small farms (less than 20 cows) to 80% of large farms (over 100 cows). Seldom does more than 20% of the farms in any group have one or more of the following enterprises: milk cows, feeder pigs, and ewes. Yet, some farms have sizable non-beef livestock enterprises.

Income from beef farms.--In the survey of beef farms, information was not obtained on annual receipts, expenses, and incomes. The size, investment, and income 1970-71 average for beef farmers in the Appalachian Area enrolled in the VPI&SU Farm Record program were:

	Unit	Small farms	Medium farms	Large farms
Beef (animal units)	No.	43	85	230
Crops	Ac.	49	78	145
Pasture	Ac.	122	209	555
Open land	Ac.	171	287	700
Investment				
Land	Dol.	26,161	37,194	105,188
Beef cat.	Dol.	7,605	17,607	56,333
Other	Dol.	7,897	11,734	21,411
Total	Dol.	41,663	66,535	182,932
Returns to operator's				
Labor, mgmt., & equity	Dol.	2,056	5,000	5,700
Labor & mgmt.[9]	Dol.	-55	3,345	-3,445
	Dol.[10]	2,561	7,064	7,073

[9]Not including increase in land value.

[10]Including 10% increase in land value.

Table 4.--Average per Farm Assets, Debts, and Net Worth (1969 and Projected 1975 Land Value) Farms Grouped by Size (Number of Brood Cows) Appalachian Area of Virginia, 1969

Items per farm	Unit	Size (numbers of brood cows per farm) 20 1439 farms	20-49 1039 farms	50-99 799 farms	100-499 399 farms
Land owned	Ac.	148.0	264.0	424.0	982.0
Land operated (including woodland)	Ac.	163.0	314.0	519.8	974.0
Cropland	Ac.	60.2	102.1	146.1	313.0
Pasture only	Ac.	34.9	133.5	302.0	479.0
Total open	Ac.	95.1	235.6	448.1	792.0
Farm assets (1969)					
Land and buildings	Dol.	57,611	46,192	82,000	199,000
All livestock	Dol.	5,474	11,412	18,070	47,600
Machinery and equipment	Dol.	3,500	5,038	11,550	37,600
Total	Dol.	66,585	62,642	111,620	284,200
Value of residence	Dol.	24,111	11,577	14,200	30,000
Total assets less residence	Dol.	42,474	51,065	97,420	254,200
Farm debts					
Real estate mortgage	Dol.	278	1,231	730	6,000
Intermediate term loans	Dol.	1,000	923	3,500	8,000
Short term loan	Dol.	0	1,538	0	0
Total debts	Dol.	1,278	3,692	4,230	14,000
Net worth of farm with residence	Dol.	65,307	58,950	107,390	270,200
Net worth of farm less residence with					
Farm survey 1969	Dol.	41,196	47,373	93,100	240,200
Projected value of land 1975[1]	Dol.	61,296	68,142	133,870	341,600

[1]Projected on basis of land (not including residence) to increase 10 percent per year for 6 years.

Table 5.--Land Use of Cropland Beef Farms Grouped by Size (Number of Brood Cows), Appalachian Area of Virginia, 1969

Items	Unit	Size (brood cows per farm): Less than 20 cows, 1439 farms			20-49 cows, 1039 farms			50-99 cows, 799 farms			100-499 cows, 399 farms		
		Farms % growing	Ave. for farms incl.	Ave. all farms in group	Farms % growing	Ave. for farms incl.	Ave. all farms in group	Farms % growing	Ave. for farms incl.	Ave. all farms in group	Farms % growing	Ave. for farms incl.	Ave. all farms in group
Tobacco[1]	Ac.	28	2	0.4	77	2	1.7	40	3	1.1	40	4	1.4
Corn	Ac.	39	10	3.9	62	11	6.8	40	8	3.3	80	25	20.0
Corn silage	Ac.	11	14	1.5	23	36	8.3	80	19	14.9	80	34	27.2
Total row crops	Ac.		24	5.8		49	16.8		30	19.3		63	48.6
Wheat	Ac.	6	9	0.5				10	2	0.2	20	20	4.0
Barley	Ac.	6	11	0.6									
Oats	Ac.	17	6	1.0	8	2	0.2				20	20	4.0
Other	Ac.	11	6	0.6	23	11	2.6	10	5	0.5	60	17	10.4
Small grain silage	Ac.								30	3.0			
Total small grain	Ac.		32	2.7		13	2.8		37	3.7		57	18.4
Lespedeza	Ac.	6	18	1.0	15	33	5.0	10	15	1.5			
Small grain	Ac.	6	3	0.2	15	9	1.3	30	10	3.1			
Other	Ac.	39	13	4.9	15	31	4.7	40	70	28.0	80	89	71.4
Total annual hay	Ac.		34	6.1		72	11.0		95	32.6		89	71.4
Annual pasture	Ac.	6	52	2.9	15	15	2.2	20	37	7.4			
Alfalfa	Ac.	17	11	1.8	8	11	0.9				20	3	0.6
Tall grass	Ac.	6	15	9.7	62	42	26.0	80	45	35.6	20	55	11.0
Total perennial hay	Ac.		26	11.6		53	26.9		45	35.6		58	11.6
Tall grass	Ac.	11	42	4.7	39	8	3.0	30	78	23.4	40	394	157.6
Bluegrass	Ac.	11	170	18.8	23	102	23.5	10	60	0.6			
Native	Ac.	6	45	2.5									
Tot. perennial past.	Ac.		256	26.0		110	26.5		138	24.0		394	157.6
Idle land	Ac.	22	92	5.1	39	42	16.0	60	37	23.5	20	25	5.0
Total cropland	Ac.	94	87	60.2	92	115	102.1	100	146	146.1	100	313	313.0

[1]Burley tobacco only on farms in six counties in extreme Southwest.

Table 6.--Livestock Inventory and Animals Produced Beef Farm Grouped by Size (Number of Brood Cows) Appalachian Area of Virginia, 1969

Items	Unit	Size (brood cows per farm)											
		Less than 20 cows 1439 farms			20-49 cows 1039 farms			50-99 cows 799 farms			100-499 farms 399 farms		
		Farms % growing	Ave. for farms incl.	Ave. all farms in group	Farms % growing	Ave. for farms incl.	Ave. all farms in group	Farms % growing	Ave. for farms incl.	Ave. all farms in group	Farms % growing	Ave. for farms incl.	Ave. all farms in group
Brood cows	Hd.	89	12	10.6	100	31	30.9	100	65	65.0	100	104	103.8
Calves born	Hd.	78	10	7.7	100	19	19.2	80	60	48.5	100	94	93.8
Replacement heifers	Hd.	44	3	1.4	54	5	2.5	70	17	12.1	40	16	6.2
Stockers and fattening animals	Hd.	44	27	11.8	46	52	23.3	60	53	27.5	80	158	126.2
Replacement bulls	Hd.	28	1	0.3	23	1	0.3	40	7	2.7	20	4	0.8
Herd bulls	Hd.	67	1	0.8	100	1	1.4	100	3	2.6	100	4	3.8
Milk cows	Hd.	39	6	2.5	39	9	3.4	40	18	7.3	80	2	1.8
Brood sows	Hd.	22	9	1.9	23	2	0.4	10	3	0.3	40	8	3.2
Feeder pigs	Hd.	17	145	24.1	8	46	3.5	10	39	3.9	20	25	5.0
Fattening hogs	Hd.	6	3	0.2	23	9	2.2	10	18	1.8	40	67	27.0
Ewes	Hd.	28	56	15.3	8	8	0.6	30	122	36.6	60	223	134.0
Horses[1]	Hd.	22	3	0.7	31	7	2.0	20	10	2.0	60	14	8.4
Layers	No.	0			0			0			20	4000	800.0

[1]Horses include ponies, mules and riding horses.

The low return for operator's labor, management and equity indicate a need for information which may be used by farmers to increase incomes from resources utilized.

OPTIMUM ORGANIZATION TO PRODUCE $7,000 RETURNS TO OPERATOR'S LABOR, MANAGEMENT AND EQUITY CAPITAL

The L.P. model described previously is used to determine for each of 4 beef systems of feeding and selling calves the least annual cost combination of resources to produce $7,000 annual returns to the operator's labor, management, and equity capital when the operator owns 0%, 50%, and 100%, respectively, of resources (investment assets) required.

In this section, first, a general comparison is made of the 4 calf-selling systems, each of which depends on a brood cow herd to furnish calves: (1) sale of weaned calves; (2) sale of stockers (heavy feeders); (3) sale of yearling light slaughters; and (4) sale of yearling heavy slaughters. A comparison is shown among the 4 systems in the requirement of investments, annual costs, brood cows, and acres of open land to produce $7,000 annual returns to the operator's labor, management, and equity capital.

Also, summarized in this section for each beef system and level of operator's asset equity are livestock and crop enterprises, structure of farm businesses, and pastures and crops fed to the specific livestock during various periods of the year.

Resource Inputs for Alternative Cow-Calf Beef Systems

For each situation of operator's asset equity, 0%, 50%, and 100% of the annual cost, investment, and acres of open land for $7,000 return to operator's labor, management, and equity capital are least when weaned calves from the cow-calf herd are fed for a longer time and sold as light yearling slaughters, steers 992 pounds and heifers 882 pounds (see Figures 3, 4, 5, and 6). When calves are fed as feeders and then finished as heavy yearling slaughters, less brood cows but more of all other inputs are required than are required with the light slaughters. As the percent of operator's equity in assets is increased from 0% to 50% and 100%, the resource requirements for beef systems with the production and sale of weaned calves, feeders, or heavy yearling slaughters are less unfavorable, as compared to beef systems with the sale of light slaughters as noted by the following data which rate light slaughters requirement at 100%:

Resource Requirements
(Yearling Light Slaughters 100%)

Resources required	Yearling			
	Light slght.	Heavy slght.	Feed-ers	Weaned calf
	%	%	%	%
Operator's equity in assets, 0%				
Investment	100	115	158	296
Annual cost	100	117	164	281
Brood cows	100	99	174	342
Open land	100	126	158	319
Operator's equity in assets 50%				
Investment	100	106	119	139
Annual cost	100	110	125	132
Brood cows	100	95	139	186
Open land	100	112	112	126
Operator's equity in assets 100%				
Investment	100	105	111	120
Annual cost	100	108	116	118
Brood cows	100	92	129	167
Open land	100	112	104	105

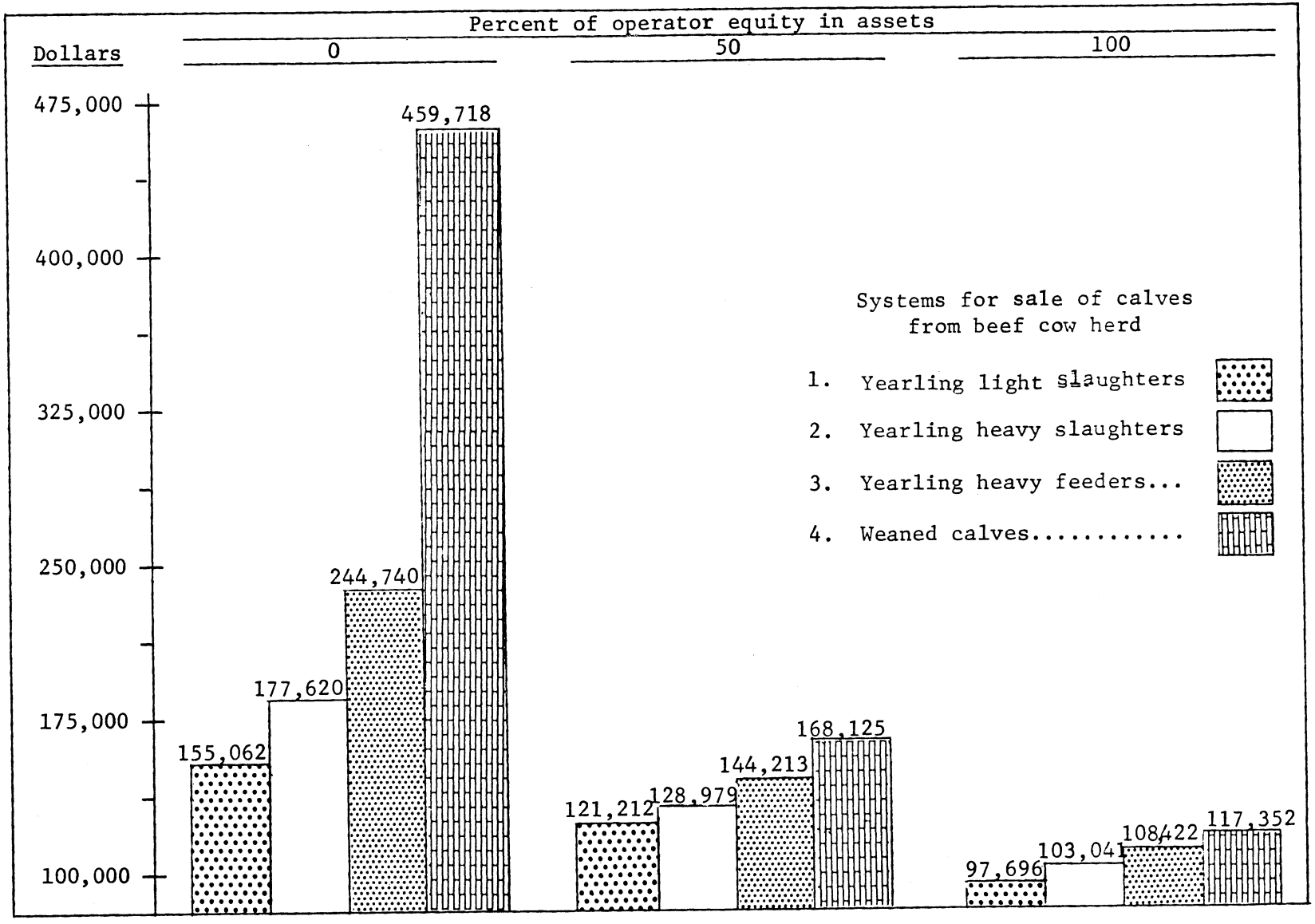

Figure 3.--Average Investment to Produce Annual Returns of 7000 Dollars with Specified Operator Equity and Alternative Beef Calf Sale Systems.

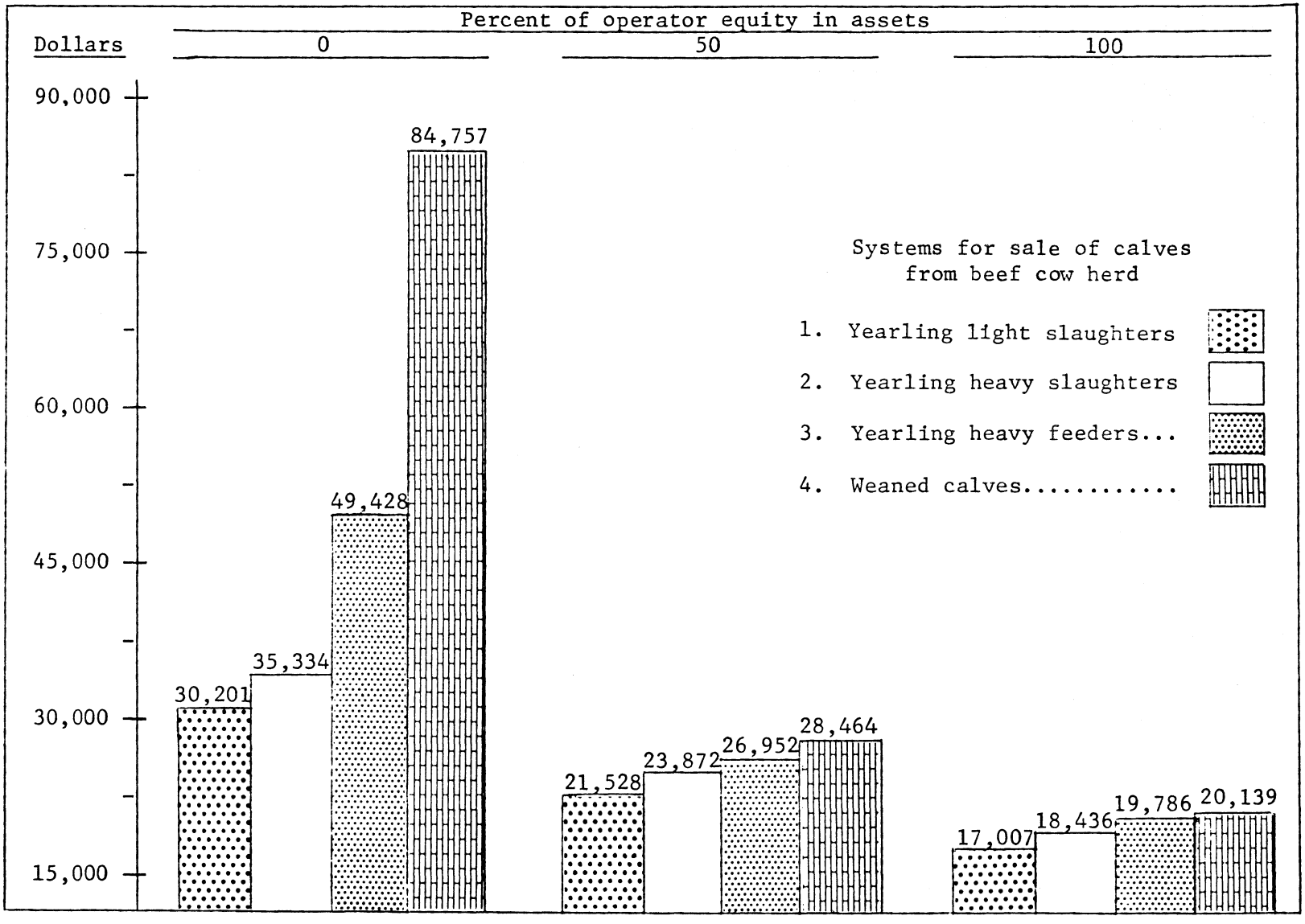

Figure 4.--Annual Costs to Produce Annual Returns of 7000 Dollars with Specified Operator Equity and Alternative Beef Calf Sale Systems.

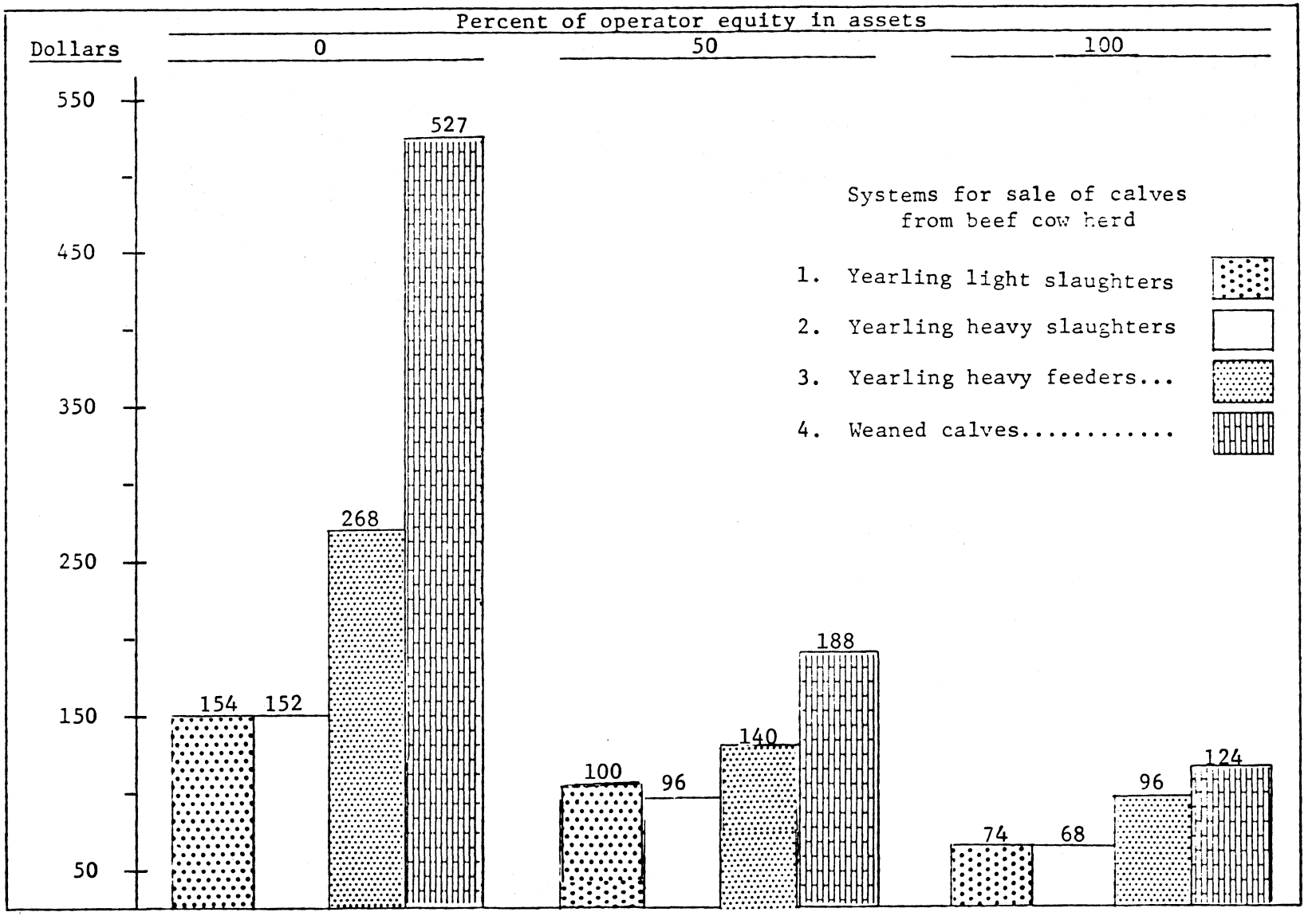

Figure 5.--Number of Brood Cows to Produce Annual Returns of 7000 Dollars with Specified Operator Equity and Alternative Beef Calf Sale Systems.

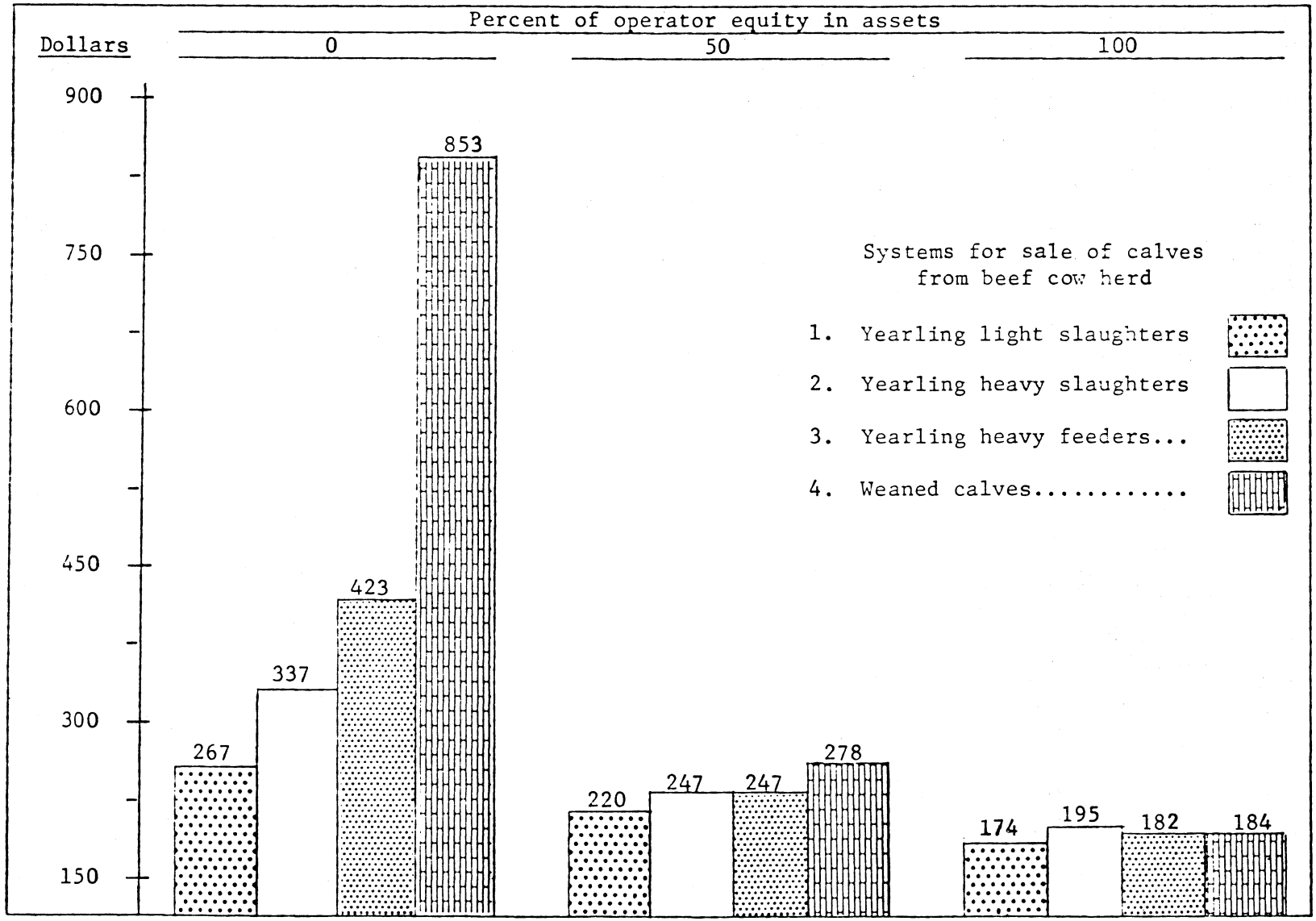

Figure 6 .--Acres of Open Land to Produce Annual Returns of 7000 Dollars with Specified Operator Equity and Alternative Beef Calf Sale Systems.

Whereas when operator's equity is 0%, the investment and annual cost, respectively, of producing $7,000 returns to operator's labor, management, and equity is 196% and 181% higher when selling weaned calves, as compared to additional feeding and selling light slaughters. When operator's equity is 100%, these requirements are only 20% and 18% higher for beef systems with weaned calf sales as compared to light slaughter sales.

Similarly, to attain $7,000 returns when operator must borrow money for all assets, 853 acres of open land is required for the weaned calf system, compared to 267 acres with the light slaughter system, an increase of 219%. When the operator owns (or has funds to purchase) all required assets, 184 acres of open land is required for the weaned calf system, compared to 174 acres with the light slaughter system, an increase of only 5%.

Sell Weaned Calves Cow-Calf Beef System

Enterprise combinations

To obtain operator's returns of at least $7,000 annual cost when selling weaned calves requires beef cattle herd sizes ranging from 124 beef cattle (cattle above weaning age) with 100% operator's asset equity to 527 beef cattle with 0% asset equity (see Table 7). In addition to selling weaned calves and tobacco, operators with 0% and 50% equity sell corn, and operators with 100% equity sell feeder pigs.

The acreage of harvested feed crops ranges from 67 for operators with 100% equity to 253 for operators with 0% equity.

Approximately 42% of the open land in the area is cropland of which 72%, 92%, and 88%, respectively, is planted to harvested crops when operator's equity is 0%, 50%, and 100%. Forty to 50% of the harvested cropland is double-cropped with tall grass-ladino clover pasture and/or sudax pasture. When operator's equity is 100% and 0%, respectively, 55% and 74% of the harvested cropland is planted to row crops. The above factors indicate a much more intensive cropping system than is now practiced by most beef farmers in the area (see Table 5, page 15).

Structure of farm business

Gross receipts to obtain operator's return of $7,000 range from $27,139, when operator's equity is 100%, to $91,757 when operator's equity is 0% (see Table 8). The gross receipts per acre of open land range from $107, with 0% equity, to $147 with 100% equity, as compared to $50 per acre for farms in the Virginia Farm Record Program (1970-71 average). Corn is either sold, or fed to brood sows, for each equity situation. Approximately 90% of the gross receipts are from the sale of beef for each equity situation. Only when the operator's equity is 0% is all operator labor utilized. Land classification, investments, and annual cost associated with $7,000 returns from the weaned-calf beef system to the operator's labor, management, and equity capital are summarized in Table 8.

Sources of feed by period of year

The year is divided into 4 periods for studying pasture output and feed requirements: period 1, January through March; period 2, April through June; period 3, July through September; and period 4, October through December. The calves are born in December, and weaned calves are sold approximately September 1.

Table 7.--Optimum Enterprise Combination to Produce at Least Annual Cost 7000 Dollars Operator's Returns with Weaned Calf Cow-Calf Beef System, Farms Grouped by Operator's Asset Equity, Appalachian Area, Virginia[1]

Livestock and crops	Unit	Percent operator's asset equity 0	50	100
Cow-calf herd				
Brood cows	Hd.	527	188	124
Bulls	Hd.	16	6	4
Replacement heifers	Hd.	82	29	19
Beef sold				
Weaned steers (502 lbs)	Hd.	230	82	54
Weaned heifers (472 lbs)	Hd.	148	53	35
Cull cows and bulls	Hd.	69	25	16
Cull heifers	Hd.	16	6	4
Corn sale pigs				
Brood sows	Hd.			
Corn sold (100 Bu.)	Bu.	87	13	
Main crop				
Corn grain	Ac.	96	14	9
Corn silage	Ac.	94	43	28
Small grain silage	Ac.	64	23	15
Grass-alfalfa silage	Ac.		23	15
Tobacco	Ac.	4	1	1
Total main crop	Ac.	257	103	68
Double-cropped				
Rye pasture	Ac.	124	33	22
Tall grass-ladino clover pasture	Ac.		45	30
Sudax, pasture and silage	Ac.	64		
Total double-cropped	Ac.	189	79	52
Permanent pasture				
Orchard grass-ladino clover	Ac.		14	9
Fescue-ladino clover	Ac.	101		
Bluegrass	Ac.	495	161	107
Total permanent pasture	Ac.	596	175	116

[1]Determined by L. P. model where returns to operator's labor, management, and asset equity is specified at $7000, produced at least annual cost.

[2]Crop rotations when operator's asset equity is 0%, 50%, and 100% are given in Appendix A, pages 41-47.

Table 8.--Structure of Farm Business to Produce at Least Annual Cost 7,000 Dollars Operator's Returns with Weaned Calf Cow-Calf Beef System, Farms Grouped by Operator's Asset Equity, Appalachian Area, Virginia[1]

Items	Unit	Percent operator's asset equity		
		0	50	100
Farm size (brood cows)	Hd.	527	188	124
Receipts, total	Dol.	91,757	30,420	20,098
Non-beef				
Burley tobacco	Dol.	7,148	2,330	1,540
Sale of corn	Dol.	10,428	1,595	
Sale of pigs	Dol.			1,040
Total non-beef	Dol.	17,576	3,925	2,580
Beef	Dol.	74,181	26,495	17,518
Annual cost[2]	Dol.	84,757	28,464	20,139
Annual capital[3]	Dol.	484,035	174,906	122,227
Average investment total	Dol.	459,718	168,125	117,352
Land	Dol.	254,932	83,295	54,922
Buildings and fence	Dol.	5,948	2,645	1,752
Livestock equipment	Dol.	4,355	1,607	1,075
Farm machinery	Dol.	16,737	16,634	16,617
Perennial crop and pasture	Dol.	2,188	301	199
Beef livestock	Dol.	173,863	62,148	41,076
Other livestock	Dol.			16
Farm general	Dol.	1,695	1,695	1,695
Land, total	Ac.	1,103	359	238
Woodland	Ac.	250	81	54
Total open land	Ac.	853	278	184
Suitable for pasture only	Ac.	495	161	107
Cropland	Ac.	358	117	77
Labor, total	Hr.	6,989	2,350	1,542
Operator (available)	Hr.	2,400	2,400	2,400
Operator (used)	Hr.	2,400	2,047	1,513
Hired seasonal	Hr.	4,589	303	29

[1]Determined by L. P. Model where returns to operator's labor, management, and asset equity is specified at $7,000, produced at least annual cost.

[2]Annual cost is the cost of production inputs including interest for part of year used plus annual cost of asset ownership.

[3]Annual capital is investment capital plus production capital prorated according to part of year used.

With the crop and pasture systems now used on many beef cow-calf farms in the Appalachian Area of Virginia, the amounts of pasture during August-October (periods 3 and 4) and the amount of feed available for winter feeding (periods 4 and 1) seriously limit intensive beef operations. With the synthesized beef operations reported, the numbers of animals in any one period are limited only by the total feed that can be economically produced, stored, and fed. When calves are sold at weaning age, for each of the 4 periods of the year the percent of TDN from specified crops and pastures for the brood cow herd are as follows:

Period and feed source	Percent of operator's asset equity 0 % of TDN	50 % of TDN	100 % of TDN
Jan.-March (1)			
Corn sil.	84	92	92
Gr.-lad. cl. past. (March)	9	8	8
Other	7	0	0
April-June (2)			
Gr.-lad. cl. past.	17	18	18
Blgr. past.	79	80	80
Other	4	2	2
July-Sept. (3)			
Blgr. past.	68	58	58
Gr.-lad. cl. past.	3	13	13
Sudax past.	29	0	0
Sm. gr. sil.	0	29	29
Oct.-Dec. (4)			
Corn sil.	26	55	18
Sm. gr. sil.	36	0	36
Gr.-lad. cl. sil.	0	19	20
Gr.-lad. cl. past.	19	8	8
Blgr. past.	11	10	10
Other	8	8	8

Sell Yearling Heavy Feeders, Cow-Calf Beef System

Enterprise combinations

To obtain $7,000 operator's return to labor, management, and asset equity with a beef cow-calf herd when selling heavy feeders requires beef cattle herd sizes (feeders counted 0.58/hd.) of 368, 201, and 138 when operator's asset equity is 0%, 50%, and 100%, respectively (see Table 9). Burley tobacco is produced on farms with tobacco allotment. All other acreage is used for feed production. All corn is produced for silage.

Of land suitable for crops 83%, 87%, and 88%, respectively, is planted to harvested crops; and 65%, 55%, and 55% of the harvested crops, respectively, are corn silage when operator's equity is 0%, 50%, and 100%. The cow-calf system where calves are sold as feeders, steers 882 pounds and heifers 800 pounds, also exemplifies a much more intensive system of beef production than is now practiced in the Appalachian Area of Virginia.

Land suitable for pasture only is maintained as bluegrass pasture, and a small acreage of tall grass-ladino-clover is established as permanent pasture (7-year rotation) on land suitable for harvested crops.

Structure of farm business

The gross receipts per acre of open land, when weaned calves are fed and sold as feeders, are $133, $137, and $139 when operator's asset equity is 0%, 50%, and 100%, respectively (see Table 10).

For each level of operator's asset equity, 0%, 50%, and 100%, the

Table 9.--Optimum Enterprise Combination to Produce at Least Annual Cost 7000 Dollars Operator's Returns with Yearling Heavy Feeder Cow-Calf Beef System, Farms Grouped by Operator's Asset Equity, Appalachian Area, Virginia[1]

Livestock and crops	Unit	Percent operator's asset equity 0	50	100
Cow-calf herd				
Brood cows	Hd.	268	140	96
Bulls	Hd.	8	4	3
Replacement heifers	Hd.	42	22	15
Beef sold				
Heavy feeder steers (852 lbs)	Hd.	117	61	42
Heavy feeder heifers (800 lbs)	Hd.	75	39	27
Cull cows and bulls	Hd.	35	18	13
Cull heifers	Hd.	8	4	3
Main crop[2]				
Corn silage	Ac.	98	50	37
Small grain silage	Ac.	47	20	15
Grass-alfalfa silage	Ac.	3	20	15
Tobacco	Ac.	2	1	1
Total main crop	Ac.	149	91	67
Double-cropped				
Rye pasture	Ac.	50	30	22
Tall grass-ladino clover pasture	Ac.	6	40	30
Sudax, pasture and silage	Ac.	44		
Total double-cropped	Ac.	100	70	52
Permanent pasture				
Tall grass-ladino clover	Ac.	28	12	9
Bluegrass	Ac.	245	143	105
Total permanent pasture	Ac.	273	155	114

[1]Determined by L. P. model where returns to operator's labor, management, and asset equity is specified at $7000, produced at least annual cost.

[2]Crop rotations when operator's asset equity is 0%, 50%, and 100% are given in Appendix A, pages 41-47.

Table 10.--Structure of Farm Business to Produce at Least Annual Cost 7,000 Dollars Operator's Returns with Yearling Heavy Feeder Cow-Calf Beef System, Farms Grouped by Operator's Asset Equity, Appalachian Area, Virginia[1]

Items	Unit	Percent operator's asset equity		
		0	50	100
Farm size (brood cows)	Hd.	268	140	96
Receipts, total	Dol.	56,428	29,625	20,281
Non-beef				
Burley tobacco	Dol.	3,542	2,068	1,523
Total non-beef	Dol.	3,542	2,068	1,523
Beef	Dol.	52,886	27,557	18,758
Annual cost[2]	Dol.	49,428	26,952	19,786
Annual capital[3]	Dol.	275,011	159,314	119,027
Average investment total	Dol.	244,740	144,213	108,422
Land	Dol.	126,338	73,766	54,322
Building and fence	Dol.	5,915	3,074	2,264
Livestock and equipment	Dol.	4,981	2,590	1,765
Farm machinery	Dol.	16,660	16,628	16,617
Perennial crops and pasture	Dol.	614	267	196
Beef livestock	Dol.	88,538	46,193	31,563
Other livestock	Dol.			
Farm general	Dol.	1,695	1,695	1,695
Land, total	Ac.	547	319	235
Woodland	Ac.	124	72	53
Total open land	Ac.	423	247	182
Suitable for pasture only	Ac.	245	143	106
Cropland	Ac.	178	104	76
Labor, total	Hrs.	4,338	2,261	1,571
Operator (available)	Hrs.	2,400	2,400	2,400
Operator (used)	Hrs.	2,400	1,931	1,494
Hired seasonal	Hrs.	1,938	330	77

[1]Determined by L. P. model where returns to operator's labor, management, and asset equity is specified at $7,000, produced at least annual cost.

[2]Annual cost is the cost of production inputs including interest for part of year used plus annual cost of ownership.

[3]Annual capital is investment capital plus production capital prorated according to part of year used.

labor is furnished largely by the operator; however, seasonal labor is hired even if all operator labor is not utilized.

Sources of feed by period of the year

Feed for brood cow herd.--As was described for the weaned-calf system for the yearling heavy feeder system, the breeding herd (including replacements and calves to weaning) requires feed each of the 4 periods of the year. The brood cow herd receives most of the feed nutrient from corn silage in period 1; from bluegrass pasture during period 2; from bluegrass pasture supplemented by various combinations of sudax pasture, grass-ladino clover pasture, and corn, small grain, or grass silage during period 3; and largely corn, small grain, and grass-ladino silage during period 4. For the brood cow herd, the percentages of TDN for specified crops and pastures by periods are:

Period and feed source	Percent of operator's asset equity 0 % of TDN	50 % of TDN	100 % of TDN
Jan.-March (1)			
Corn sil.	100	100	100
April-June (2)			
Gr.-lad. cl. past.	14	11	23
Blgr. past.	85	88	76
Other	1	1	1
July-Sept. (3)			
Corn (green-chopped)	5	--	37
Sm. gr. sil.	--	21	--
Gr.-lad. cl. past.	9	14	8
Sudax past.	33	--	--
Blgr. past.	53	65	55
Oct.-Dec. (4)			
Corn sil.	46	60	28
Sm. gr. sil.	52	16	46
Gr.-lad. cl. sil.	2	24	26

Feed for feeders

Weaned steer and heifer calves are fed from September 1 to April 1 to gain 1.65 and 1.55 pounds per day, respectively. Sources of TDN by periods for specified operator's equity are:

Period and feed source	Percent of operator's asset equity 0 % of TDN	50 % of TDN	100 % of TDN
Sept. (3)			
Corn (green-chopped)	--	--	44
Gr.-lad. cl. past.	--	47	56
Sudax past.	39	--	--
Blgr. past.	61	53	--
Oct.-Dec. (4)			
Corn sil.	62	48	49
Rye past. (Dec.)	16	18	20
Gr.-lad. cl. past.	5	15	16
Blgr. past.	17	19	15
Jan.-March (1)			
Corn sil.	80	77	76
Rye past. (March)	20	23	24

Sell Yearling Light Slaughters Cow-Calf Beef Systems

Enterprise combinations

To produce $7,000 operator return when weaned calves are put in the feed lot--steers fed to 992 pounds and heifers fed to 882 pounds--requires a 119-beef cattle herd (light slaughters counted 0.58/hd.) when operator's asset equity is 100% and a 247-beef cattle herd when operator's asset equity is 0%. For farms with the light slaughter beef system, harvested feed crops range from 64 acres, for farms with operator's asset equity 100%, to 98 acres for operators with 0% equity. Corn for grain, corn silage, small grain silage, and grass-alfalfa silage are main feed crops.

Burley tobacco is produced for each operator's equity situation (see Table 11).

For each operator's asset equity level, 88% of the land suitable for harvested crops is planted to harvested crops. Operator's with 100% and 50% equity have planted to row crops 49% of land suited for crops, and operators with 0% equity have 58% of cropland planted to row crops (see Table 11).

Structure of farm business

Gross receipts associated with operator's return of $7,000 with the yearling light slaughter beef system range from $24,007, when operator's asset equity is 100%, to $37,201 when operator's asset equity is 0% (see Table 12). Except for the sale of tobacco all income is from the sale of beef.

Even for the operator who must borrow for land and all non-land investments, the acreage required for $7,000 disposable income (return to operator's labor, management, and equity capital) is relatively small, 267 acres of open land.

More than 60% of the beef farmers in the Appalachian Area, farms with more than 20 brood cows (see Table 3, page 12) could produce an annual disposable income of $7,000 or more without increasing land acreage. Each farm business which now has more than 20 brood cows could increase investments in livestock, buildings, and equipment and still have more than 50% equity in the farm business (see Table 12 50% equity, and Table 4, page 14).

Operators with more than 0% equity do not have full time farm employment although it is necessary to hire some seasonal labor (see Table 12).

Source of feed by period of year

Feed for brood cows.--For the yearling light slaughter beef cow-calf system, sources of feed for the beef brood cow herd is similar to requirements described previously when weaned calves or feeders were sold. For each of the 4 periods of the year, for the brood cow herd, the percentages of TDN from specified crops are:

Period and feed source	Percent of operator's asset equity 0 % of TDN	50 % of TDN	100 % of TDN
Jan.-March (1)			
Corn sil.	64	79	100
Gr.-lad.	1	12	
Sudax sil.	25		
Other	10	9	11
April-June (2)			
Blgr. past.	87	81	67
Gr.-lad. cl. past.	8	14	28
Rye pasture	5	5	5
July-Sept. (3)			
Blgr. past.	72	75	48
Gr.-lad. cl. past.	2	25	20
Sudax past.	26		
Corn sil.			15
Gr.-lad. cl.			17
Oct.-Dec. (4)			
Sm. gr. sil.	62	53	57
Gr.-lad. cl. sil.		15	11
Sudax sil.	11		
Gr.-lad. cl. past. (Oct.)	9	11	12
Blgr. past. (Oct.)	12	12	9
Other	6	9	11

Feed for yearling light slaughters.--The weaned calves, steers 502 pounds and heifers 472 pounds, are put in the feed lot September 1 and are sold at 992 pounds and 882 pounds, respectively, approximately April 1 and March 24. Sources of TDN for the feeding period are: corn

Table 11.--Optimun Enterprise Combination to Produce at Least Annual Cost 7,000 Dollars Operator's Returns with Yearling Light Slaughter Cow-Calf Beef System, Farms Grouped by Operator's Asset Equity, Appalachian Area, Virginia[1]

Livestock and crops	Unit	Percent operator's asset equity		
		0	50	100
Cow-calf herd				
Brood cows	Hd.	154	101	74
Bulls	Hd.	5	3	2
Replacement heifers	Hd.	24	16	12
Beef sold				
Slaughter steer calves (992 lbs.)	Hd.	67	44	32
Slaughter heifers calves (882 lbs.)	Hd.	43	29	21
Cull cows and bulls	Hd.	20	13	10
Cull heifers	Hd.	5	3	2
Main crop[2]				
Corn grain	Ac.	28	18	13
Corn silage	Ac.	36	26	22
Small grain silage	Ac.	32	18	14
Grass-alfalfa silage	Ac.	1	18	14
Tobacco	Ac.	1	1	1
Total main crop	Ac.	99	81	65
Double cropped				
Rye pasture	Ac.	32	26	21
Orchard grass-ladino clover past.	Ac.	2	36	29
Sudax, pasture and silage	Ac.	15		
Total double cropped	Ac.	50	62	49
Permanent pasture				
Orchard grass-ladino clover	Ac.		11	9
Fescue-ladino clover	Ac.	13		
Bluegrass	Ac.	155	127	101
Total permanent pasture	Ac.	168	138	110

[1]Determined by L. P. model where returns to operator's labor, management, and asset equity is specified at $7,000, produced at least annual cost.

[2]Crop rotation when operator's asset equity is 0%, 50%, and 100%, are given in Appendix A, pages 41-47.

Table 12.--Structure of Farm Business to Produce at Least Annual Cost 7,000 Dollars Operator's Returns with Yearling Light Slaughter Cow-Calf Beef System, Farms Grouped by Operator's Asset Equity, Appalachian Area, Virginia[1]

Items	Unit	Percent operator's asset equity		
		0	50	100
Farm size (brood cows)	Hd.	154	101	74
Receipts, total	Dol.	37,201	24,895	18,145
Non-beef				
Burley tobacco	Dol.	2,236	1,840	1,462
Total non-beef	Dol.	2,236	1,840	1,462
Beef	Dol.	34,965	23,051	16,683
Annual cost[2]	Dol.	30,201	21,528	17,007
Annual capital[3]	Dol.	173,252	132,947	106,139
Average investment total	Dol.	155,062	121,212	97,696
Land	Dol.	79,765	65,638	52,130
Building and fence	Dol.	3,844	2,167	1,760
Livestock equipment	Dol.	2,124	1,393	1,004
Farm machinery	Dol.	16,632	16,624	16,615
Perennial crops and pasture	Dol.	289	237	189
Beef livestock	Dol.	50,713	33,459	24,304
Other livestock	Dol.			
Farm general	Dol.	1,695	1,695	1,695
Land, total	Ac.	345	284	225
Woodland	Ac.	78	64	51
Total open land	Ac.	267	220	174
Suitable for pasture only	Ac.	155	128	101
Cropland	Ac.	112	92	73
Labor, total	Hrs.	2,403	1,623	1,222
Operator (available)	Hrs.	2,400	2,400	2,400
Operator (used)	Hrs.	1,969	1,519	1,191
Hired seasonal	Hrs.	434	104	31

[1]Determined by L. P. model where returns to operator's labor, management, and asset equity is specified at $7,000, produced at least annual cost.

[2]Annual cost is the cost of production inputs including interest for part of year used plus annual cost of ownership.

[3]Annual capital is investment capital plus production capital prorated according to part of year used.

silage (with urea) 55%, corn grain 44%, and soybean oil meal 1%.

Sell Yearling Heavy Slaughters Cow-Calf System

Weaned calves from the cow herd fed and sold as yearling heavy slaughters, steers 1,174 pounds and heifers 1,034 pounds, are first handled as feeders and are then put in dry lot, finished, and sold as slaughters. From weaning age to sale, a steer or a heifer is on the farm 300 and 272 days, respectively, and on a yearly basis this represents 0.82 and 0.74 of an animal. To realize, from the yearling heavy slaughter beef system, $7,000 return to operator's labor management and equity capital when operator's asset equity is 0%, 50%, and 100%, respectively, requires a herd (animals over weaning age) of 268 cattle, 168 cattle, and 120 cattle (see Table 13).

For each operator asset equity situation, 88% of land suitable for crops is planted to harvested crops and 61%, 55%, and 54%, respectively, of harvested cropland is corn or corn silage when operator's asset equity is 0%, 50%, and 100%. Corn silage is utilized by the brood cow herd, the weaned calves during the feeder stage, and by the yearlings slaughters in the feedlot. The corn for grain is used as a supplement to corn silage to finish the yearling heavy slaughters. Tall grass-ladino clover and/or sudax is double cropped for each operator equity situation.

Enterprise Combinations.--Land suitable for pasture only is maintained as permanent bluegrass pasture. In addition, 17 acres, 12 acres, and 10 acres of cropland for farms where operator's asset equity is 0%, 50%, and 100%, respectively, are used for permanent tall grass-ladino clover pasture (re-established each 7 years).

Structure of farm business

The gross receipts per acre of open land are $125, $125, and $130 when operator's asset equity is 0%, 50%, and 100%, respectively (see Table 14). The sale of burley tobacco is the only income other than income from beef cattle.

Annual costs, annual capital requirement, and an itemized account of investment items are summarized in Table 14.

When the operator owns 100% of the investment assets, to attain $7,000 disposable return, he is productively employed only 1,344 hours per year but he must hire 47 hours of seasonal labor for peak periods of labor demands. When the operator's asset equity is 50% and 0%, respectively, larger farm businesses are required to attain $7,000 returns and more operator labor is utilized.

Sources of feed by period of year

Feed for brood cows.--When weaned calves are fed and marketed as yearling heavy slaughters, the sources of feed for the brood cow herd are similar to crop and pasture sources previously described when calves were sold as feeders or light slaughters. The crops and pastures from which the brood cow herd obtains required TDN when operator's equity is 0%, 50%, and 100% are as follows:

Period and feed source	Percent of operator's asset equity 0 % of TDN	50 % of TDN	100 % of TDN
Jan.-March (1)			
Corn sil.	100	100	100

Table 13.--Optimum Enterprise Combination to Produce at Least Annual Cost 7000 Dollars Operator's Returns with Yearling Heavy Slaughter Cow-Calf Beef System, Farms Grouped by Operator's asset Equity, Appalachian Area, Virginia[1]

Livestock and crops	Unit	Percent operator's asset equity 0	50	100
Cow-calf herd				
Brood cows	Hd.	152	96	68
Bulls	Hd.	5	3	2
Replacement heifers	Hd.	24	15	11
Beef sold[2]				
Heavy slaughter steers (1174 lbs)	Hd.	67	42	30
Heavy slaughter heifers (1032 lbs)	Hd.	43	27	19
Cull cows and bulls	Hd.	20	13	9
Cull heifers	Hd.	5	3	2
Main crop[3]				
Corn grain	Ac.	22	14	10
Corn silage	Ac.	54	36	29
Small grain silage	Ac.	35	20	16
Grass-alfalfa silage	Ac.	12	20	16
Tobacco	Ac.	2	1	1
Total main crop	Ac.	125	91	72
Double cropped				
Rye pasture	Ac.	40	30	23
Orchard grass-ladino clover	Ac.	24	40	32
Fescue-ladino clover	Ac.			
Sudax pasture and silage	Ac.	12		
Total double cropped	Ac.	76	70	55
Permanent pasture				
Orchard grass-ladino clover	Ac.		12	10
Fescue-ladino clover	Ac.	17		
Bluegrass	Ac.	195	143	113
Total permanent pasture	Ac.	212	155	123

[1]Determined by L. P. model where returns to operator's labor, management, and asset equity is specified at $7,000, produced at least annual cost.

[2]The number indicated sold as slaughter steers and heifers, respectively, were fed from weaning weights of 502 pounds and 472 pounds to weights of 852 pounds and 800 pounds as feeders.

[3]Crop rotations when operator's asset equity is 0%, 50%, and 100% are given in Appendix A, pages 41-47.

Table 14.--Structure of Farm Business to Produce at Least Annual Cost 7000 Dollars Operator's Returns with Yearling Heavy Slaughter Cow-Calf Beef System, Farms Grouped by Operator's Asset Equity, Appalachian Area, Virginia[1]

Items	Unit	Percent operator's asset equity 0	50	100
Farm size (brood cows)		152	96	68
Receipts, total	Dol.	42,334	27,003	19,254
Non-beef				
Burley tobacco	Dol.	2,823	2,069	1,635
Sale corn	Dol.			
Total non-beef	Dol.	2,823	2,069	1,635
Beef	Dol.	39,511	24,934	17,619
Annual cost[2]	Dol.	35,334	23,872	18,436
Annual capital[3]	Dol.	207,215	147,377	116,239
Average investment total	Dol.	177,620	128,979	103,041
Land	Dol.	100,687	73,790	58,301
Building and fence	Dol.	4,545	2,647	2,125
Livestock equipment	Dol.	3,387	2,152	1,520
Farm machinery	Dol.	16,645	16,628	16,619
Perennial crops and pasture	Dol.	364	267	211
Beef livestock	Dol.	50,297	31,801	22,570
Other livestock	Dol.			
Farm general	Dol.	1,695	1,695	1,695
Land, total	Ac.	436	319	252
Woodland	Ac.	99	72	57
Total open land	Ac.	337	247	195
Suitable for pasture only	Ac.	195	143	113
Cropland	Ac.	142	104	82
Labor, total	Hrs.	2,935	1,879	1,391
Operator (available)	Hrs.	2,400	2,400	2,400
Operator (used)	Hrs.	2,312	1,743	1,344
Hired seasonal	Hrs.	623	136	47

[1]Determined by L. P. model where returns to operator's labor, management, and asset equity is specified at $7,000, produced at least annual cost.

[2]Annual cost is the cost of production inputs including interest for part of year used plus annual cost of ownership.

[3]Annual capital is investment capital plus production capital prorated according to part of year used.

Period and feed source	Percent of operator's asset equity 0 % of TDN	50 % of TDN	100 % of TDN
April-June (2)			
Blgr. past.	80	80	61
Gr.-lad. cl. past.	16	16	16
Rye past. (April)	4	4	4
July-Sept. (3)			
Blgr. past.	80	78	37
Gr.-lad. cl. past.	6	22	17
Sudax past.	14		
Corn (green-chopped)			
Oct.-Dec. (4)			
Corn stover	4	4	4
Sm. gr. sil.	68	62	69
Gr.-lad. cl. sil.		34	27
Sudax sil.	28		

Feed for yearling heavy slaughters.--When weaned calves are fed and sold as yearling heavy slaughters, 502-pound steers and 472-pound heifers are fed approximately 212 days as feeders, so that steers gain 1.65 pounds per day and heifers gain 1.55 pounds per day. The feeders, steers at weights of 852 pounds and heifers at weights 800 pounds, respectively, are put in dry lot and fed to gain 2.70 and 2.45 pounds per day and are sold July 28 and July 1. The crops and pastures from which the weaned calves, sold as yearling heavy slaughters, obtain required TDN when operator's equity is 0%, 50%, and 100% are as follows:

Period and feed source	Percent of operator's asset equity 0 % of TDN	50 % of TDN	100 % of TDN
September (3)			
Blgr. past.	61	52	52
Gr.-lad. cl. past.		48	48
Sudax past.	39		
Oct.-Dec. (4)			
Corn sil.	19	44	29
Gr.-lad. cl. sil.	21	1	18
Blgr. past.	21	20	13
Gr.-lad. cl. past.	23	21	23
Rye past. & other	16	14	17
Jan.-March (1)			
Corn sil.	73	77	73
Rye past. (March)	19	23	27
Gr.-lad. cl. past. (March)	8		
Apr.-July 28 (Feed lot)			
Corn sil.	56	56	56
Corn grain	44	44	44

Summary Cow-Calf Synthesized Beef Systems

Analyses in this study showed the optimum organization, enterprise combnation, size of business (number of brood cows, acres of open land, and total receipts) for four beef cow-calf systems - (1) sale of weaned calves, (2) sale of heavy yearling feeders, (3) sale of light yearling slaughters, and (4) sale of heavy yearling slaughters.

As operator's equity was increased from 0% to 100%, the total receipts, acres of open land, number of beef brood cows and non-land investment required to attain $7000 returns to operator's labor, management, and equity decreased. Also, for each of the four beef cow-calf systems there was differences in farm organization and crop combinations related to the assumed equity.

These analyses generated farm situations ranging in size from beef farm businesses with 68 brood cows and 175

acres of open land to farm businesses with 527 brood cows and 853 acres of open land. These synthesized farm situations generally are in the range of resource situations now existing in the Appalachian Area of Virginia. However, the average farm with less than 20 brood cows would not have sufficient open land to provide $7000 return to operator's equity, labor and management (see Table 4).

IMPLICATIONS OF STUDY AND NEED FOR ADDITIONAL RESEARCH

Important implications for the beef industry of the Appalachian Area of Virginia concern problems that must be solved if the beef industry is to make the expansion that the results of this study indicate are economically feasible. In 1969, on 3,676 beef farms (farms with 10 or more beef cattle beyond weaning age) there were 141,000 beef brood cows and 16,754 replacement heifers. Approximately 16,000 weaned calves were kept as replacements, 65,300 calves were sold at weaning age, 56,000 were sold as feeders and less than 2,500 finished as slaughter animals.[11] This extensive cow-calf system used 7.80 acres of open land (3.08 acres of cropland and 4.72 acres of land suitable for pasture only) per beef brood cow, including acreage for replacement heifers, bull, and calves sold as weaned calves and feeders.

In 1969 the total value of all livestock products sold from all farms in the area was $76 million of which $32 million was from the sale of beef animals. Total value of the sale of all farm products was $100 million.[12]

The non-land investments on beef farms according to the 1969 survey were these: farm buildings approximately $32 million, all livestock $53 million, machinery and equipment $35 million, and total non-land investment $120 million.

A greatly expanded beef cow-calf industry is possible if crop production is intensified and the beef production is vertically integrated. More than 60% of the beef farmers in the Appalachian Area (operations with more than 20 brood cows and 95 acres of open land) could produce an annual disposable income of $7,000 or more without increasing land acreage if they keep weaned calves, feed corn silage and corn, and sell as yearling light slaughters. If the area small farms (farms with less than 20 brood cows) were combined into larger units, the beef industry (aggregate of all beef farms) would include 476,800 brood cows, 75,500 replacement heifers and 14,163 bulls, and 344,600 yearlings sold as light slaughters (steer approximately 990 pounds and heifers 880 pounds). This intensive cow-calf system would require 2.31 acres of open land (0.91 acres of cropland and 1.40 acres of land suitable for pasture only) per brood cow, including acreage for replacement heifers, bulls and calves which would be sold as finished slaughter animals.[13]

Receipts from the expanded beef industry would be $126 million (1961-72 prices) and total farm product sales

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[11] From survey of Virginia Farms.

[12] U.S. Department of Commerce, Bureau of Census, United States Census of Agriculture (Washington, D. C., 1969).

[13] Feed requirement: 1 brood cow, 0.14 heifer, 0.3 bull and 0.9 calf to weaning 5232 TDN; 0.44 steer and 0.28 heifer weaning to slaughter 1610 TDN; total 6842 TDN. Feed production 1.4 acres pasture 1486 TDN/Ac., (utilized 2080 TDN); 0.423 acre corn silage 7558 TDN/A (utilized 3197 TDN); and 0.47 acre corn for grain 3332 TDN/A (utilized 1566 TDN), total 6842 TDN.

from beef farms would be $134 million, $34 million higher than the sale of farm products from all farms of the area in 1969.

The expansion of the beef production industry in the Appalachian Area of Virginia would require $263 million in non-land investment or $143 million more than the $120 million in 1969. The expanded beef industry would require non-land investment as follows: $158 million in breeding livestock, $78 million in farm machinery, $10 million in buildings and fences, $7 million in livestock equipment and $10 million in other items such as perennial crops, non-beef livestock, etc. However, the total non-land investment of $551 per brood cow would be 65% of the non-land investment of $851 per brood cow in 1969.[14] By integrating the beef cow-calf business, feeding weaned calves and selling as yearling slaughters rather than selling weaned calves, less brood cows are required per dollar net receipts. Animals finished for slaughter as compared to brood cows are more economical utilizers of harvested row crops such as corn or corn silage. Since crop harvesting equipment is required to harvest crops for the slaughter animals it permits relative small acreage of corn silage and other harvested forages to be utilized by brood cows with low fixed cost per cow for non-land investment.

Other systems of selling calves from the beef cow-calf herd with intensive crop production would show similar expansion in the beef cow herd and non-land investment needed. To obtain a return of $7,000 to labor, management and equity capital operators with 50% equity would require, 1) 401,000 brood cows and $230 million non-land investment when calves are fed and sold as heavy yearling slaughters, 2) 585,000 brood cows and $294 million non-land investment when calves are sold as heavy yearling feeders, and 3) 698,000 brood cows and $315 million non-land investment if calves are sold at weaning age.

[14] The 1969 non-land investment probably had a higher percentage of investment in non-beef livestock enterprises.

Competitiveness of Integrated Cow-Calf Systems

A recent study, "The Feasibility of Cattle Finishing and Cattle Slaughter in Virginia," has shown that the budgeted returns for finished steers, good and choice, 1,050 lbs. per steer at an average cost of $29.83 per hundredweight marketed (26.4¢/lb. of gain) are competitive with costs in other parts of the country. Although the present study deals with returns to the integrated beef enterprise when the objective is to minimize costs for $7,000 returns, adjustments were made so that costs of present study are on a basis similar to that of the feasibility study. Costs are $23.40 and $23.94 per hundredweight of beef marketed, when weaned calves from cow-calf enterprise are fed and sold as light yearlings (steers 992 lbs., heifers 882 lbs.) and heavy yearlings (steers 1174 lbs., heifers 1032 lbs.), respectively.[15]

Production and sale of weaned calves heavy feeders, and slaughter

[15] Va. Division Indus. Development, Va. Dept. of Agriculture and Commerce, Va. Agric. Extension Service, VPI&SU; Report of a Joint Study, The Feasibility of Cattle Finishing and Cattle Slaughter in Virginia, July 1, 1972. Tables 6-4. Also see Tables 11 and 12, pages 28-29. For present study with 0% equity, estimates were adjusted for a 5% land appreciation; operator labor was charged $2 per hour; and cost and returns to management per cwt. marketed includes weight of cull animals sold.

animals by the integrated cow-calf beef system compares favorably with separate beef systems budgeted in the Virginia feasibility study.

Returns to management per hundredweight marketed would be as follows:

Calves sold as	Va. feasibility study	Integrated cow-calf system
	$	$
Weaned calves	5.29	3.50
Yearling heavy feeders	1.28	2.19
Slaughter animals		
Steers, 1,050 lbs.	1.98	
Steers, 992 lbs.; heifers, 882 lbs.		3.49
Steers, 1,174 lbs.; heifers, 1,174 lbs.		2.88

Future Demand for Slaughter Animals in Virginia

Cattle and calf slaughter in Virgainia has declined from an estimated 280,000 head in 1964 to less than 175,000 head in 1971. Less than 10% of beef consumption in the Middle Atlantic Areas of Virginia, Maryland, Delaware and Washington, D. C. is purchased from local slaughter. Large meat packing plants have closed. One reason indicated for decline of beef slaughter in Virginia is the lack of an even supply of slaughter animals from the local area. Extension Marketing Specialists at VPI&SU estimate that, based on movement of cattle through special slaughter cattle sales, 59% of the slaughter cattle sales are during the five months of January through May and only 41% during the seven months of June through December.[16]

According to the Virginia Feasibility Study, the Middle Atlantic region provided a nearby market with an estimated beef consumption of more than 1,700,000 head of beef slaugher animals in 1970 and a projected consumption of 2,300,000 head by 1980.[17]

Thus, the demand for Virginia beef slaughter animals is available if Virginia slaughter plants can provide the area's beef consumption. This probably will not occur until the Virginia beef production industry gives high priority to furnishing an even supply of finished slaughter animals.

Likely Expansion

The cow-calf beef production in the Appalachian Area of Virginia will likely continue to expand at an increased rate, after some slow-down, because of great variations of beef prices and feed prices during 1973-74. Probably a higher percentage of weaned calves will be fed on the cow-calf farms and sold as heavy yearling feeders or slaughters. An expansion of integrated cow-calf business to the extent indicated feasible in this study will likely not be attained within the next 5 to 8 years. Beef farmers have more than 90% equity in their businesses. With high equity in the farm business and yearly increases in land values, a large number of farmers will continue to look for a satisfactory return above variable cost.

For the present study it is assumed that the operator attempts to attain, at least annual cost, a return of $7,000 annually to his labor, management, and equity. As compared to an integrated cow-calf system where weaned calves are fed and sold as heavy feeders or slaughters, when calves are sold as weaned

[16] Op. cit.

[17] Op. cit.

calves, the lower the operator's equity in the farm business the greater is the disadvantage. Farmers with less than 50% equity in the farm business will usually not be able to obtain sufficient credit to attain returns of $7,000 annually to their labor management and equity if the main sources of income is a cow-calf herd where calves are sold at weaning age.

The indicated large expansion possibilities for heavy feeders and slaughter animals was based on the assumption that much more Type II land that is now used for pasture or row crops in rotation with non-row crops would be utilized for continuous corn silage and/or corn for grain, with a winter rye cover crop. It was assumed that some pasture could be utilized from rye cover. Although there have been in recent years many successful operations with no-tillage continuous corn on land that would not be adaptable to continuous row-crop production with conventional tillage practices, the information concerning expected yields and insect and disease problems is based on a relatively few number of years and acres of operation. Some agronomists raise questions concerning the feasibility of pasturing rye cover crops. Without proper management, fields may be pastured when too wet, causing lower yields for crops in future years.

Future Research

The beef industry will continue to be increasingly important for Virginia, especially the Appalachian Area. New technologies for handling pasture and harvested forages are being developed. The output of these techniques need to be tested in terms of effects on costs and returns to the beef farmer. Agronomists have reported fescue pastures that support one brood cow on less than 2 acres. What is the total weight of beef produced and the cost per pound of beef produced? High moisture corn may be substituted for shelled or corn-and-cob. Balers have been developed with capacity to output bales weighing 1,500 pounds to over 3 tons. How will this affect cost and return for various farm sizes? Will it replace the forage harvester? To what extent will bales allowed to remain in the fields affect yields in subsequent years?

The present study is related to calves born in mid-December, with feeding program described animals available for market as light slaughters approximately April 1, or heavy yearling slaughters July 1 to August 1. Analyses need to be made to determine, for each month of the year, the least cost method of producing finished slaughter animals for the various areas of Virginia.

Alternative methods of integrated cow-calf systems where weaned calves are kept on the farm and sold as heavy feeder or slaughter animals need to be studied to derive coefficients whereby animals are not subject to the shock caused by irregular feeding and setbacks of hauling which is associated with purchased feeder animals.

Possibility of finishing animals on grass (last 60 to 120 days) to continuous feeding supplementary grain on pasture (creep feeding calves before weaning age) and continuing feeding to heavy feeder or slaughter weights need further study. Animal scientists at VPI&SU report results of experimental studies that show steers weighting approximately 600-650 pounds, when fed supplemental grain on pasture to weights of approximately 1,000 pounds, make gains of 2.0 to 2.64 pounds per day using 4.6 to 4.8 pounds of corn and

fat (90% shelled corn and 10% fat) per pound of gain.[18]

Present research indicates that with same TDN per cow and calf, 16.8 pounds, cows can be fed with daily loss of 0.5 pounds and creep fed calves gain 2 pounds per day rather than 1.4 pounds when calves are not creep fed. Information is needed on total feed inputs of cow (feed, total for year) and calves over several-year period).

The general implications of the present study have been stated by Curtis Avery, a Georgia beef farmer who operates an integrated beef farm; he states that most cow-calf beef farm operators in the mid-Atlantic and deep South part of the country are putting all their production costs in a product that is sold before it is ripe.[19]

Concerning finished-feeding, "This breakthrough in finished feeding will come," says Avery, "but it probably will not be the pattern and style we are trying to copy from Western feedlots. With our rainfall, it might have to be on slatted floor confinement lots. As a grain deficit area, it might be we will not feed cattle as long, or we perhaps will extend and sophisticate our present grain on grass practices."

"But the wide opportunity of carrying cattle a bit longer, adding more finish and pounds, does exist, and the days ahead will see us solving some of those situations simply because we have the cattle, and many of them, close at hand."

The model used for the present study is adaptable to use information from agronomic and livestock research to study the possibilities of new technologies with varying prices of inputs and products.

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[18] Livestock Research Report, Research Division Reports 153 and 158, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, July 1973 and 74.

[19] Curtis Avery, "The Wide Grass Patch from Virginia to Texas," Livestock Breeder Journal, July 1974, pages 138 - 144.

Appendix A- Area, Prices, Budgets

The present study is a part of a southern regional farm management project S-67 "Evaluation of Beef Production in the South." Areas in Virginia relating to this study are parts of large economic areas in the United States and include area 10-Applachian Area of Virginia, Tennessee and North Carolina, area 12-Virginia Shenandoah Valley, and area 13-Upper Piedmont of Virginia and North Carolina (Figure 1). The distribution of counties in these areas is somewhat different from type of farming areas which usually have been used when referring to Virginia agriculture.1/

Appendix A, Table 1 gives the prices of inputs and products used in this study. Prices were developed by S-67 Technical Committee and the prices were based on the trend of the 10 year period 1962-71.

Summarized crop budgets are shown in Appendix A, Tables 2A, 2B, and 2C. Investments and related annual ownership costs for farm machinery, feed storage facilities, feeding equipment, and fencing are shown in Appendix A, Table 3.

A budget for the beef brood cow herd (32 cows) is shown in Appendix A, Tables 4A, 4B, 4C, and 4D. Summarized budgets for yearling heavy feeders, yearling light slaughters and yearling heavy slaughters are shown in Appendix A, Table 5. A budget for the production and sale of 60 pound feeder pigs is shown in Appendix A, Table 6.

Table 1- Prices of Products and Inputs

Item	Unit	$/Unit	Item	Unit	$/Unit
Corn, buy	Bu.	1.35	Limestone, spread	Ton	8.50
Corn, sell	Bu.	1.20	Variable cost		
Wheat, sell	Bu.	1.30	Tractor (35-45 H.P.)	Hr.	1.14
Burley tobacco	Lb.	0.75	Tractor (55-75 H.P.)	Hr.	1.92
Soybean meal	Ton	126.00	Cull cows	Cwt.	21.00
Interest			Cull bull	Cwt.	25.00
Operating	$/yr.	0.07	Weaned calves, good		
Investment	$/yr.	0.06	Steer 500 lbs.	Cwt.	31.30
Labor			Heifer 470 lbs.	Cwt.	26.47
Seasonal, hired	Hr.	1.75	Feeders, good		
Full-time	Yr.	4500.00	Steer 852 lb.	Cwt.	28.35
Fertilizer spread			Heifer 800 lb.	Cwt.	25.73
Nitrogen (N)	Lb.	0.10	Light yearling slaughters, good to choice		
Phosporus (P_2O_5)	Lb.	0.096	Steer 992 lbs.	Cwt.	29.43
Potassium (K_2O)	Lb.	0.066	Heifer 882 lbs.	Cwt.	26.99
Herbicides and insecticides			Heavy yearling slaughters, good to choice		
Paraguat	Pint	3.25	Steer 1174 lbs.	Cwt.	29.04
Diazonon	Lb.	0.37	Heifer 1034 lbs.	Cwt.	26.69
Atrazine	Lb.	2.80	Feeder pigs		
2-4-D	Lb.	0.98	60 lbs.	Cwt.	31.00

1/ Aggregate data relating to beef farms is based on a random area sample (USDA Master Sample of Agriculture). The sampling rate was 2.5% of the population.

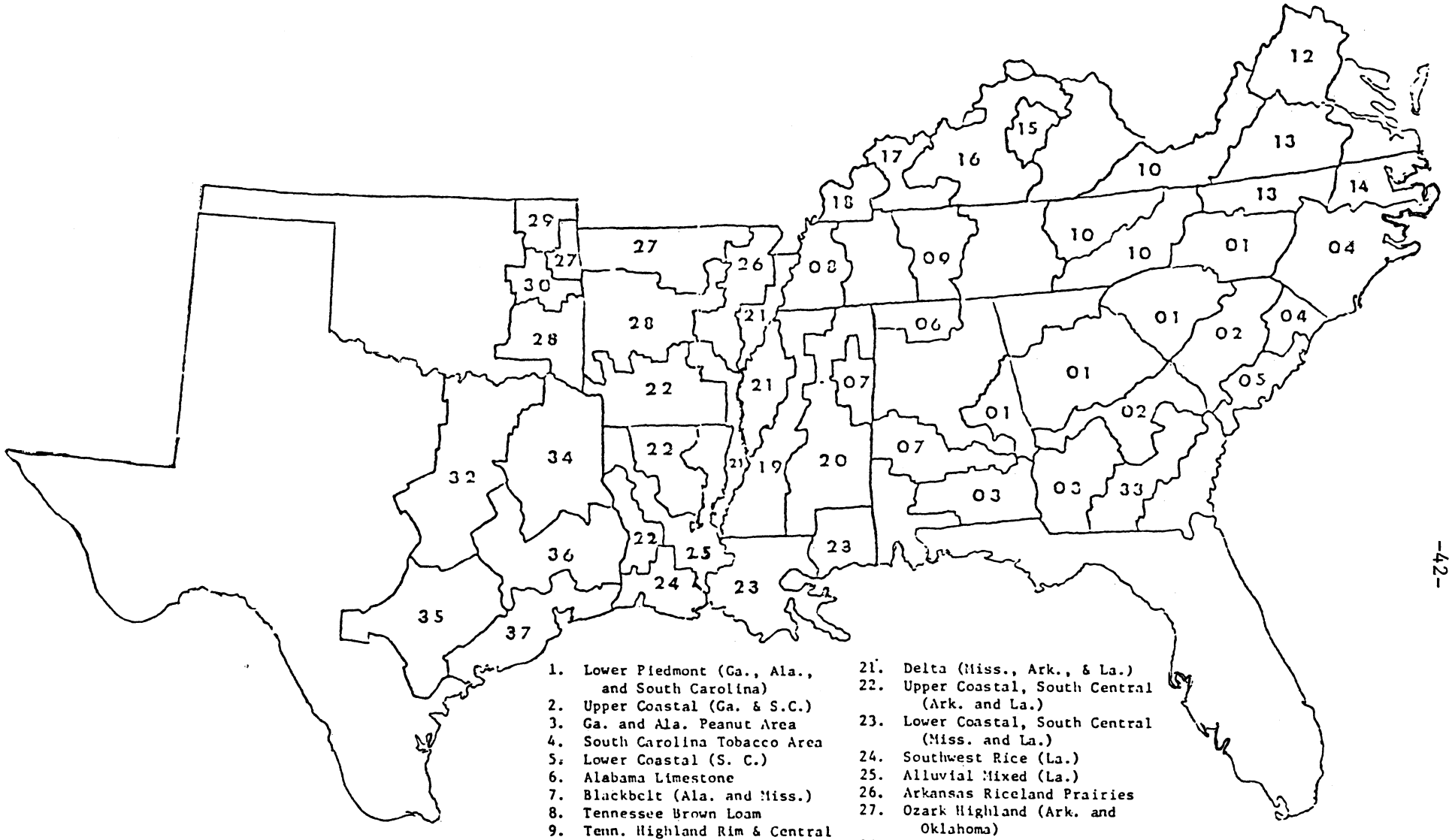

Figure 1.--Subregions included in Southern Regional Beef Cattle Study.

Table 2A.--Summary of Partial Budgets for Crop and Pasture Production, Applachian Area, Virginia

Rotation and/or description code	Past. period	Crop	Fertilizer (Lbs./Acre) N	P_2O_5	K_2O	Output/Acre Unit	Item[2]	Amt.
CCORNRC								
Continous corn		Corn	160	60	60	Bu.	Corn	98.00
with rye cover						Lb.	D.M.	4697.00
on Land I.						Lb.	TDN	4275.00
		Stover				Lb.	TDN4	282.00
Rye-past.								
Jan.-Mar.	1[1]	Rye p.	45	50	50	Lb.	TDN1	335.10
April	2	P.				Lb.	TDN2	374.90
Rye-past. Total		T.p.				Lb.	TDNT	710.00
Total for rotation						Lb.	FTDNTOT	5267.00
Annual cost						$		66.00
CWFYR2								
Continous corn		Corn	160	60	60	Bu.	Corn	70.50
with rye cover						Lb.	D.M.	3381.00
on Land II						Lb.	TDN	3078.00
		Stover				Lb.	TDN4	282.00
Rye-past.								
Jan.-Mar.	1[1]	Rye	45	50	50	Lb.	TDN1	120.60
April	2	P.				Lb.	TDN2	38.00
Rye-past. Total		T.p.				Lb.	TDNT	158.60
Total for rotation						Lb.	FTDNTOT	3518.60
Annual cost						$		66.00
CCRNSRC								
Continuous corn		Corn	200	80	120	Ton.	C. silage	17.19[3]
silage with rye		silage				Lb.	D.M.	12648.00
cover on land I.						Lb.	TDN	8854.00
Urea added 10 lbs. per ton.								
Rye-past.								
Jan.-Mar.	1	Rye p.	45	50	50	Lb.	TDN1	900.00
April	2					Lb.	TDN2	56.50
Dec.	4					Lb.	TDN4	633.00
Rye-past. Total		T.p.				Lb.	TDNT	1589.50
Total for rotation						Lb.	FTDNTOT	10443.00
Annual cost						$		96.60
CSGSYR2								
Continuous corn		Corn	200	80	120	Ton	C. silage	12.00[3]
silage with rye		silage				Lb.	D.M.	8853.00
cover on Land II.						Lb.	TDN	6197.50
Urea added to silage 10 lbs. per ton.								
Rye-past.								
Jan.-Mar.	1	Rye p.	45	50	50	Lb.	TDN1	300.00
April	2					Lb.	TDN2	38.00
Dec.	4					Lb.	TDN4	211.00
Rye-past. Total		T.p.				Lb.	TDNT	549.00
Total for rotation						Lb.	FTDNTOT	6747.00
Annual cost						$		96.00

[1]Pastures are designated: 1 (Jan.-Mar.); 2 (April-June); 3(July-Sept.); 4(Oct.-Dec.).

[2]Items are: TDN--total digestible nutrients, D.M.--dry matter, and FTDNTOT--total digestible nutrients for the rotation.

[3]CCRNSRC (40% dry matter) 18.6 tons yield, 17.19 tons stored, and 15.81 tons utilized.
[3]CSGSYR2 (40% dry matter) 13.02 tons yield, 12.0 tons stored, and 11.07 tons utilized.

Table 2A.--Continued.

Rotation and/or description code	Past. period	Crop	Fertilizer (Lbs./Acre) N	P_2O_5	K_2O	Output/Acre Unit	Item	Amt.
CSGFSY3								
Corn silage-small grain silage-orchard grass, alfalfa, ladino clover silage (aftermath past.);3 yr. rotation land II,		Corn silage	200	80	120	Ton	C. silage	15.14[1]
						Lb.	D.M.	11130.00
						Lb.	TDN	7792.00
		Small grain silage	70	48	40	Ton	Sm. gr. silage	6.00
						Lb.	D.M.	5511.00
							TDN	3241.00
							G.L.	
		Grass-legume silage		80	200	Ton	silage	3.20
						Lb.	D.M.	2952.00
						Lb.	TDN	1816.00
Past. aftermath of small grain silage;	3	Aft. sm. gr. sil				Lb.	TDN3	397.00
past. after first cutting for grass-legume silage	2	Aft. gr.-leg. sil				Lb.	TDN2	973.00
	3	Aft. gr.-leg. sil				Lb.	TDN3	744.00
	4	Aft. gr.-leg. sil				Lb.	TDN4	540.00
Total past. 2A.		T.p.				Lb.	TDNT	2660.00
Total for rotation						Lb.	FTDNTOT	15518.00
Annual cost						$		155.38
CSGSSP2								
Corn silage-small grain silage (sudax pasture double cropped) 2 yr. rotation land II. Small grain silage harvested June, sudax sown June, pastured Aug. and Sept.		Corn silage	200	80	120	Ton	C. silage	15.14[1]
						Lb.	D.M.	11130.00
						Lb.	TDN	7792.00
		Small grain silage	70	48	40	Ton	Sm. gr. silage	6.00
						Lb.	D.M.	5511.00
						Lb.	TDN	3251.00
	3	Sudax p.	60 50 Aug.	70	70	Lb.	TDN3	3195.00
Total past. 1A.		T.p.				Lb.	TDNT	3195.00
Total for rotation						Lb.	FTDNTOT	14238.00
Annual cost						$		166.38
CSGSSY2								
Corn silage-small grain silage (sudax past. 1st, sudax silage double cropped) 2 yr. rotation, land II		Corn silage	200	80	120	Ton	C. silage	15.14[1]
						Lb.	D.M.	11130.00
						Lb.	TDN	7792.00
		Small grain silage				Ton	Sm. gr. silage	6.00
						Lb.	D.M.	5511.00
						Lb.	TDN	3251.00
Silage late Sept. or early Oct.		Sudax silage	60 50 Aug.	70	70	Ton	Sdx. sil.	4.20
						Lb.	D.M.	3869.00
						Lb.	TDN	2283.00
						Lb.	TDN3	1774.60
Sudax past. 1A. Aug. only	3	Sudax p.						
Total for rotation						Lb.	FTDNTOT	15099.00
Annual cost						$		171.49
TGLSPY5								
Orchard grass-ladino cl.-alf., 1st cutting grass silage, followed by pasture, 5 yr. rotation land III.		G. silage				Ton	C. silage	2.41
		Est.[2]	10	175	80	Lb.	D.M.	2240.00
		Maint.		80	200	Lb.	TDN	1299.00
	2					Lb.	TDN2	1059.00
	3					Lb.	TDN3	813.00
	4					Lb.	TDN4	592.00
Total past. 1A.		T.p.				Lb.	TDNT	2464.00
Total for rotation						Lb.	FTDNTOT	3763.00
Annual cost						$		60.00

[1](40% dry matter) 16.36 tons yield, 15.14 tons stored, and 13.91 tons utilized.

[2]Fertilizer for establishing prorated over 5 years.

Table 2A.-Continued.

Rotation and/or description code	Past. period		Fertilizer (Lbs./Acre) N	P_2O_5	K_2O	Output/Acre Unit	Item	Amt.
POGLYR7								
Orchard grass-ladino	2	Orc.-l.	20[5]	100	100	Lb.	TDN2	1728.00
clover pasture, 7	3	p.		80	120	Lb.	TDN3	1103.00
yr. stand, land IV.	4					Lb.	TDN4	256.00
Total pasture 1A.		T.p.				Lb.	TDNT	3086.00
Annual cost						$		31.40
PTFLYRT								
Tall fescue-ladino	1	Fesc.-l.	20[1]	100	100	Lb.	TDN1	627.00
clover pasture, 7	2	p.	70	80	120	Lb.	TDN2	260.00
yr. stand, land IV.			Aug.[2]					
	3					Lb.	TDN3	1228.00
	4					Lb.	TDN4	1066.00
Total pasture 1A.		T.p.				Lb.	TDNT	3182.00
Annual cost						$		38.40
PBGHM								
Bluegrass-clover	2	Blgr.-cl.		95	45	Lb.	TDN2	1570.00
pasture, land IV	3	p.				Lb.	TDN3	1121.00
maintain with high	4					Lb.	TDN4	159.00
fertilization.								
Total pasture 1A.		T.p.				Lb.	TDNT	2850.00
Annual cost						$		21.60
PBGLFLD								
Bluegrass-clover	2	Blgr.-cl.[3]		36	17	Lb.	TDN2	828.00
pasture, land IV	3	p.				Lb.	TDN3	591.00
maintain with low	4					Lb.	TDN4	84.00
fertilization.								
Total pasture 1A.		T.p.				Lb.	TDNT	1503.00
Annual cost								10.84
PBGNFLD								
Bluegrass-clover	2	Blgr.-cl.[4]		10	0	Lb.	TDN2	497.00
pasture, land IV	3	p.				Lb.	TDN3	354.00
maintain with lit-	4					Lb.	TDN4	51.00
tle fertilization.								
Total pasture 1A.		T.p.				Lb.	TDNT	902.00
Annual cost						$		5.00
PBGLFM								
Bluegrass-clover	2	Blgr.cl.[3]		36	17	Lb.	TDN2	799.00
pasture, land V	3	p.				Lb.	TDN3	570.00
maintain with low	4					Lb.	TDN4	81.00
fertilization.								
Total pasture 1A.		T.p.				Lb.	TDNT	1450.00
Annual cost						$		10.84
PBGNFLE								
Bluegrass-clover	2	Blgr.cl.[4]		10	0	Lb.	TDN2	479.00
pasture, land V	3	p.				Lb.	TDN3	342.00
maintain with lit-	4					Lb.	TDN4	49.00
tle fertilization.								
Total pasture 1A.		T.p.				Lb.	TDNT	870.00
Annual cost						$		5.00

[1]Fertilizer for establishg prorated over 7 years.

[2]Added nitrogen for tall fescue in August.

[3]Apply 3 times amount shown every third year.

[4]Apply 6 times amount shown every sixth year.

Table 2B.--Other Inputs for Crops and Pastures/Acre

Inputs		Crops and Pastures				
Item	Unit	CCORNRC contin. corn	CWFYR2 contin. corn	CCRNSRC contin. corn sil.	CSGSYR2 contin. corn sil.	CSGFSY3 3-year sil.
Labor						
April	Hr.	0.83	0.83	0.83	0.83	1.23
May	Hr.	0.86	0.86	0.76	0.76	3.52
September	Hr.			2.10	2.10	2.68
October	Hr.	1.98	1.98	0.58	0.58	
Total	Hr.	3.67	3.67	4.27	4.27	9.73
Machinery						
Small tractor	Hr.	1.86	1.86	1.76	1.76	4.24
Large tractor	Hr.	1.67	1.67	2.27	2.27	5.17
Forage harvester	Hr.			0.80	0.80	2.20
Forage wagon	Hr.			1.30	1.30	3.60
Farm bundle	Hr.	3.45	3.45	2.25	2.25	3.51
Corn picker	Hr.	0.70	0.70			
Farm truck	Hr.			0.40	0.40	1.20
Buildings						
Silo	Ton			17.18F	12.94F	15.14F*
Grain storage	Bu.	98.00				

Inputs		CSGSSP2 2-year sil.	CSGSSY2 2-year sil.	TGLSPY5 sil. & past.	POGLYR7 orch.-lad. past.	PTFLYRT fes.-lad. past.
Item	Unit					
Labor						
April	Hr.	0.83	0.83	0.40		
May	Hr.	0.76	0.76	2.76		
June	Hr.	2.84	2.84			
September	Hr.	3.20	5.36			
Total	Hr.	8.03	9.74	3.56	0.58	0.58
Machinery						
Small tractor	Hr.	3.20	4.00	1.51	0.44	0.44
Large tractor	Hr.	4.01	5.31	1.80	0.08	0.08
Forage harvester	Hr.	1.50	2.30	0.70		
Forage wagon	Hr.	2.40	3.70	1.20		
Farm bundle	Hr.	3.83	3.83	1.31	1.00	1.00
Corn picker	Hr.					
Farm truck	Hr.	0.40	0.40			
Buildings						
Silo (F)	Ton	15.14F	19.34F			
Silo (S)	Ton	6.00S	6.00S	2.41S		

Inputs		PBGHFM bl. grass past.	PBGLFLD b. gr. past.	PBGNFLD b. gr. past.	PBGLFLE b. gr. past.	PBGNFLE b. gr. past.
Item	Unit					
Labor						
Total	Hr.	0.40	0.20	0.10	0.20	0.10
Land						
IV	Ac.	1.00	1.00	1.00		
V	Ac.				1.00	1.00
Machinery						
Small tractor	Hr.	0.35	0.18	0.09	0.18	0.09
Large tractor	Hr.					
Farm bundle	Hr.	0.35	0.18	0.09	0.18	0.09

*9.20S

Table 2C-1.--Burley Tobacco, Estimated Costs and Returns, Large Farm (Four-Row Tractor and Equipment), Virginia Appalachian Area

Item	Description	Unit		Price	Value
				$	$
Production					
Burley tobacco		lbs.	2,682.00	0.727	1,950.00
Variable preharvest cost					
Labor	Regular	hrs.	238.60		
Plants	Prod. costs	acre	1.00	25.000	25.00
Rye	Cover crop	bu.	1.00	3.000	3.00
Fertilizer	N	lbs.	200.00	0.100	20.00
	P_2O_5	lbs.	225.00	0.096	21.60
	K_2O	lbs.	250.00	0.066	16.50
T.D.E. (25% E.C.)		pint	4.00	0.350	1.40
Transplant	Custom	acre	1.00	27.000	27.00
Insurance	Wind and hail	$100	5.00	8.000	40.00
Stick	Replacement	$			7.00
Tractor and equip.	Trac. (35-45 HP)	hr.	3.30	1.230	4.06
	Trac. (55 HP)	hr.	0.91	1.850	1.68
	Equipment	$			10.17
Subtotal					177.41
Int. on 1/2 oper. cost 9 mos. @7% (177.41)		$	66.53	0.070	4.66
Total preharvest					182.07
Variable harvest, storage and marketing cost					
Labor		hr.	150.00		
Hauling	Truck	cwt.	30.00	0.400	12.00
Marketing cost	(3 1/2%)	$	1,950.00	.035	70.25
Annual fixed cost					
Interest on ave. invest.		$			17.46
Depr. and repairs		$			63.16
Taxes		$			0.96
Tot. harv., stor., & mktg.		$			163.83
Tot. variable cost		$			345.90
Returns to mgmt., land, & labor		$			1,604.10

Table 2C-2.--Burley Tobacco, Labor and Tractor Distribution by Months (Hours per Acre), Virginia Appalachian Area

Items	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
Labor - regular	0.2	0.35	21.98	23.25	4.25	48.0	140.58	40.0	110.0	388.61
Small tractor			0.80	1.25	1.25					3.30
Large tractor	0.2	0.35	0.18				0.18			0.91

Table 2C-3.--Burley Tobacco, Estimated Investment and Annual Fixed Cost of Buildings and Equipment, Virginia Appalachian Area

Item	New	Ave.	Years life	Annual cost: Depr.	Int.	Repairs	Taxes	Total
	$			$	$	$	$	$
Plastic	30	15	4	7.50	1.16	1.50	0.06	10.22
Tobacco barn	400	200	15	26.66	14.51	20.00	0.80	61.97
Sticks	40	20	10	4.00	1.43	2.00	0.08	7.51
Press	10	5	10	1.00	0.36	0.50	0.02	1.88
Total	480	240		39.16	17.46	24.00	0.96	81.58

Table 3.--Investment and Annual Cost for Farm Machinery, Livestock Equipment, and Buildings, Virginia

Farm machinery, livestock equipment, buildings, and other general farm investments	Years life	Investment		Annual cost[1]			
		New	Average	Interest	Depreciation	Insurance, taxes, and other	Total
		$	$	$	$	$	$
Forage harvester	10	4,766	2,383	170.95	476.60	17.62	665.17
Forage wagon	10	2,628	1,314	94.26	262.80	9.52	366.58
Truck, 1/2-ton	10	3,389	1,694	121.56	338.90	12.26	472.72
Tractor, 35 H.P.	15	4,883	2,441	177.20	325.53	17.73	520.46
Tractor, 55 H.P.	15	6,930	3,465	251.48	462.00	25.12	738.60
Farm bundle	10	13,961	6,980	500.78	1,396.10	58.92	1,955.80
Grain storage, 500 bu.	15	300	150	10.80	20.00	7.18	37.98
Feed bunks, stationary, 200 hd.	15	650	325	23.58	43.33	15.37	82.28
Feed bunks, fence-line, 450 hd.	12	2,000	1,000	71.92	166.66	47.22	285.80
Creep feeders, 100 hd.	12	300	150	10.78	25.00	7.02	42.80
Trench silo, 100 tons	20	700	350	26.04	35.00	16.52	77.56

[1]The costs of repairs are included in crop budgets for farm machinery, but are included as (other) in budgets for livestock equipment and buildings. Interest and depreciation are calculated according to uniform payment at 6 percent interest for the specified years. Interest is total annual cost minus annual depreciation (new price/years of life). Insurance, taxes, and other is 0.362 percent of initial investment for farm machinery and 2.36 percent for livestock equipment and buildings.

Table 4A.--Beef Cow-Calf: Estimated Non-Feed Cost, Feed Nutrient, Labor, and Fixed Resource Requirements for a 32-Cow Herd, Virginia.[1]

Item	Unit	Quantity	Price	Value	Average per cow Amount	Average per cow Value
			$	$		$
Production						
Steer calves - 14 good @ 502 lbs.	Cwt.	70.28	31.30	2199.76	2.196	68.74
Heifer calves - 9 good @ 472 lbs.	Cwt.	42.48	26.47	1124.45	1.328	35.14
Yearling heifer - 1 good @ 773 lb.	Cwt.	7.73	25.50	197.12	0.242	6.16
Cull cows - 4 cull cows	Cwt.	42.40	21.00	890.40	1.325	27.83
Cull bulls - 0.2	Cwt.	3.10	25.00	77.50	0.097	2.42
Total				4489.23		140.29
Feed requirement (Table 4D)						
32 cows (calves 5-1/2 mon.)	TDN[2]	147,725			4625.14	
29 calves 3 months	TDN	19,704			615.78	
Labor - regular	Hour	224.00			7.00	
Annual cost						
Veterinary and medicine[3]	Hd.	36.00	4.00	144.00		4.50
Salt	Cwt.	4.80	2.00	9.60		0.30
Minerals	Cwt.	9.60	4.50	43.20		1.35
Supplies	Hd.	32.00	0.50	16.00		0.50
Telephone, electricity, etc.	$			8.00		0.25
1/6 replacement bull	$			80.00		2.50
Subtotal to sale	$			300.00		9.40
Interest 6 mos. @ 7% (300.80)	$	150.40	0.07	10.52		0.33
Marketing commissions	Hd.	32.00	2.38	76.16		2.38
Transportation	Hd.	32.00	1.71	54.72		1.71
Annual fixed cost[2]						
Interest (Table 4B)	$			646.55		20.21
Depre. and repair (Table 4B)	$			38.35		1.20
Taxes (Table 4B)	$			42.88		1.34
Total	$			1169.98		36.57
Returns to management, labor and feed	$			3319.25		103.72

Table 4B.--Beef Cow-Calf: Estimated Investment and Annual Fixed Costs of Breeding Herd and Specialized Equipment1/

Item	Investment New	Investment Aver.	Life years	Annual Cost Depre.	Annual Cost Int.	Annual Cost Repr.	Annual Cost Taxes	Annual Cost Total
	$	$		$	$	$	$	$
Livestock								
Brood cows, 32 @ $280	8,960	8,960	--		537.60		35.84	573.44
Rep. heif. 4 1/2 @ $250	1,125	1,125	--		67.50		4.50	72.00
Bulls 1 @ $480	480	480	--		28.80		1.92	30.72
Subtotal	10,565	10,565			633.90		42.26	676.16
Equipment1/								
Corral, load chute, etc.	310	155	20	15.50	11.53	15.35	0.62	43.00
Misc. equipment	30	15	5	6.00	1.12	1.50	0.06	8.68
Subtotal	340	170		21.50	12.65	16.85	0.68	51.68
Total (32-cow herd)	10,905	10,735		21.50	646.55	16.85	42.94	727.78

Table 4C.--Labor Distribution Beef Cow-Calf (32 Cows)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Chores, checking on pasture	11.3	10.2	11.3	11.0	11.3	11.0	11.3	11.3	11.0	11.0	12.8	23.4
Feeding forage	16.6	15.0	16.6								12.0	16.6
Total	27.9	25.2	27.9	11.0	11.3	11.0	11.3	11.3	11.0	11.0	24.8	40.0

Table 4D.--Beef Cow Calf: Feed Nutrient Requirement for 32 Brood Cows and Replacements

Period		Livestock		Pounds fed		
Months	Days	group	No.	Dry matter	Digest. prot.	Total digest. nutr.
Period 1						
Jan.-Mar.	90	Cow and calf	32	66,528.00	3,592.51	37,920
	90	Herd bull	1	2,579.00	183.13	1,470
	90	1 year heifers	5	8,260.00	482.50	4,708
Period 1		Total		77,367.00	4,258.14	44,099
		Brood cow (per cow/day)		23.10	1.25	13
		Total (per cow/day)		27.86	1.48	15
Period 2						
Apr.-May	61	Cow and calf	32	45,091.20	2,434.92	25,701
June	30	Cow only	32	16,128.00	451.58	8,064
Apr.-June	91	Calves, steer	14	3,658.64	299.99	2,714
		Calves, heifer	14	3,459.32	291.37	2,588
Subtotal		Cow and calf	32	68,336.16	3,478.86	39,069
Apr.-June		Herd bull	1	2,608.06	185.17	1,486
Apr.-June		1 year heifers	4	6,829.54	371.20	3,892
Period 2		Total		77,772.76	4,034.23	44,448
		Brood cow (per cow/day)		23.47	1.19	13
		Total		26.70	1.39	15
Period 3						
July	31	Cow only	32	16,665.00	466.64	8,332
Aug. & Sept.	61	Cow only	28	28,694.40	803.44	14,347
		Calves, steer	14	9,745.77	703.58	6,725
		Calves, heifer	14	9,556.33	705.99	6,630
Subtotal		Cow and calf	32	64,660.50	2,679.65	36,035
July-Sept.	92	Herd bull	1	2,637.72	187.21	1,502
July and	31	1 year heifer	5			
Aug.-Sept.	61	Sold 1 cull	4	8,525.35	417.47	4,858
Sept.	30	Heifer calves	5	2,060.55	146.30	1,389
Period 3		Total		77,883.12	3,430.63	43,786
		Brood cow (per cow/day)		24.96	0.99	13
		Total (per cow/day)		26.45	1.17	14
Period 4						
Oct.-Dec. 15	76	Cow only	28	35,750.40	1,001.01	17,875
Dec. 16-31	16	Cow and calf	32	11,827.20	638.67	6,741
Oct.-Dec. 15	76	2 year heifer	4	6,855.16	323.70	3,907
Subtotal	92	Cow and calf	32	54,433.76	1,963.38	28,524
Oct.-Dec.	92	Herd bull	1	2,636.72	184.57	1,502
Oct.-Dec.	92	Heifer calves	5	7,841.86	556.28	5,066
Period 4		Total		64,911.34	2,704.23	35,094
		Brood cow (per cow/day)		18.49	0.67	9
		Total (per cow/day)		22.05	0.92	11

[1]Calves born in December, transferred at 8 1/2 months, steers weighing 502 lbs. and heifers weighing 472 lbs.; 32 cows (old herd kept and replacement heifers) produce 29 calves; 14 steers and 14 heifers are raised; 5 heifers are kept for replacements, 1 is culled; 4 cows minus 0.5% death loss sold as culls; 0.2 bull sold as cull.

[2]Annual costs including variable and prorated fixed cost for producing, storing, and feeding alternative sources of feeds are included in other budgets.

[3]Includes $2 per cow costs for pregnancy test (extra labor plus fees).

Source: Number 4, Nutrient Requirements of Beef Cattle (fourth revised edition, 1970), National Academy of Science. Feed for unweaned cattle is included with beef-cow requirement for 3 1/2 month and calculated separately from 3 1/2 to 5 1/2 months.

Table 5.--Summary Budgets for Feeding Weaned Calves and Selling as Heavy Yearling Feeders and Slaughters.

Item	Unit	Yearling light slaughters		Yearling heavy feeders		Yearling heavy slaughters	
		Steers 5FBCS	Heifers 5FBCH	Steers 3MFEEDS	Heifers 3MFEEDS	Steers 7FHYS	Heifers 7FHYII
Beginning							
Date		Sept. 1	Sept. 1	Sept. 1	Sept. 1	Apr. 1	Apr. 1
Weight	Cwt.	5.02	4.72	5.02	4.72	8.52	8.00
Price[1]	Dol.	31.30	26.47	31.30	26.47	28.35	25.73
Value	Dol.	157	125.6	157	125	241	206
Days fed	Day	205	192	212	212	119	91
Gain	Lb.	490	410	350	328	322	234
Gain/day	Lb	2.39	2.14	1.65	1.54	2.71	2.57
Sale							
Date		Mar. 24	Mar. 11	Apr. 1	Apr. 1	July 28	June 30
Weight	Cwt.	9.92	8.82	8.52	8.00	11.74	10.34
Price	Dol.	29.43	26.99	28.35	25.73	29.04	26.69
Value	Dol.	286	233	237	202	334	270
Fed (TDN)	Lb.	2578	2269	2375	2368	2129	1629
(DPROT)	Lb.	265	239	245	251	211	158
Labor	Hr.	2.11	2.03	2.10	2.20	1.59	1.43
Annual cost							
Vet. & med.	Dol.	2.25	2.25	2.33	2.33	2.16	2.16
Supplies[2]	Dol.	1.60	1.60	1.65	1.65	0.96	0.96
Utilities	Dol.	0.21	0.21	0.22	0.22	0.12	0.12
Marketing	Dol.	3.00	3.00	3.00	3.00	3.00	3.00
Hauling	Dol.	0.88	0.88	0.88	0.88	0.88	0.88
Subtotal	Dol.	7.94	7.94	8.08	8.08	7.12	7.12
Interest[1]	Dol.	6.29	5.07	6.38	5.10	5.80	3.74
Fixed cost	Dol.	1.49	1.49	1.49	1.49	1.49	1.49
Tot. annual cost	Dol.	15.72	14.50	15.95	14.67	14.41	12.35

[1]A 2% death loss is assumed. Since it is assumed that slaughter animals are transferred from feeder groups, the cost of the animals are not included but interest on value of animal for period fed is charged as part of annual cost.

[2]Supplies include salt, minerals and items other than medicine.

Table 6A.--Sow and Pigs (8 Sow Units) Estimated Returns, Operating Costs Excluding Farm-Produced Feed, Total Feed Nutrients, Labor and Fixed Cost.

Items	Unit	Quantity	Price	Value
			$	$
Production				
Cull boar (1/2 @ $60)	Cwt.	16.20	16.02	
Cull sows 3.6 @ 450 lbs.	Cwt.	74.40	31.00	2,306.40
Feeder pigs (124 @ 60 lbs.)				2,611.80
Total receipts				
Feed requirement (see Part C)[1]	TDN	25,945.95		(599.07)
Corn shelled	Cwt.	269.85	(2.22)	
Labor-regular	Hr.	37.50		
Annual cost				
Soybean oil meal	Cwt.	50.91	6.30	320.73
Minerals and supplement	Cwt.	5.35	5.00	26.75
Veterinary and medicine	Hd	8.00	25.00	200.00
Electricity				40.00
Grinding and mixing feed	Cwt.	320.76	0.75	240.57
Replacement boar	Hd.	0.50	100.00	50.00
Tractor (operating cost)	Hr.	10.00	1.23	12.30
Farm equipment	Hr.	10.00	0.12	1.20
Pick-up truck (operating)	Hr.	40.00	1.14	45.60
Subtotal	Dol.			937.15
Interest 6 mos. @ 7% (937.15)	Dol.	468.57	0.07	32.80
Interest farm feed 1/2 year @ 7%	Dol.	299.50	0.07	20.96
Transportation	Dol.			95.04
Marketing commission - 3% sales	Dol.	2,611.80	0.03	78.35
Annual fixed cost				
Interest on average investment	Dol.			85.41
Depreciation and repair	Dol.			120.60
Taxes	Dol.			6.95
Total	Dol.			1,377.26
Returns to manage., labor and feed	Dol.			1,234.54

Table 6B.--Estimated Investment and Annual Fixed Cost

Items	Years life	Investment		Annual Cost				
		New	Average	Depre.[1]	Interest[2]		Taxes[4]	Total
		$	$	$	$	$	$	$
Breeding herd								
Sows 8 @ $70		560	560		33.60		2.03	35.63
Boar one		100	100		6.00		0.36	6.30
Facilities								
Farrowing house	15	960	480	64.00	34.80	9.60	3.48	111.92
Equipment	6	200	10	33.33	7.34	6.00	0.72	47.39
Housing for boar	15	100	50	6.47	3.63	1.00	0.36	11.66
Total		1,920	1,200	104.00	85.41	16.60	6.95	212.96

Table 6C.--Feed Nutrients

Pounds	Total	Per Sow
TDN	25,946	3,243
Crude protein	4,733	592
Dry matter	28,458	3,568
Air dry feed	32,082	4,010

[1]Feed per sow 3,373 lbs. shelled corn, 636 lbs. soybean oil meal, 66.87 lbs. of minerals and supplement additive.

[2]Depreciation and interest--original investment compounded annually at 6%.

[3]Repairs as percent of original investment 2%.

[4]Taxes as percent of original investment 0.362%.

Appendix B - Abridged Matrix

The general nature of the L.P. models was explained by a diagram in Figure 2, page 2.

In abridged matrices Appendix B Figure 1 through Figure 4 the nature of the model is further outlined. The model is so structured that for each beef enterprise where pasture is one source of feed the feed nutrient must be met in each of 4 periods of the year (see Figure 1). For each period the unit of enterprises must obtain at least the amount of total digestible nutrients (TDN) and digestible protein (DPRO) indicated but not more than the amount of dry matter (DMAT) indicated. The herd of 32 brood cows, bull, replacement heifers, and calves up to weaning age are required to receive at least 44,100 and 4250 pounds of total digestible nutrients and digestible protein respectively during period 1. The TDN and DPRO must be provided without exceeding the 77,367 pounds constraint on dry matter. Similar constraints are listed for light feeders. (2LFEEDS and 2LFEEDH) and yearling heavy feeders (3MFEEDS and 3MFEEDH).

It is also noted from Figure 1 that 14 and 9 weaned steer and heifer calves respectively (LFEEDS and LFEEDH) are outputs of the 32 cow herd enterprise (1BFCOW). These calves may be fed as (2LFEEDS and 2LFEEDH) light yearling steer and heifer feeders respectively or they could be finished as yearling light slaughters or sold as weaned calves (activities not shown).

In a similar manner the two yearling light feeder activities show an output of 1 steer (LFDISS) and 1 heifer (LFDISH) which may be transferred to heavy yearling feeder steers and heifers respectively (3MFEEDS and 3MFEEDH).

For each livestock activity the monthly labor requirement not including pasture feeding is shown, ie (LABJAN) 27.29 indicates labor for brood cow herd during January.

The model is structured so that minimization of annual cost (PROF1), or average investment (PROF2), may be used as the objective function subject to $7,000 returns at 5 operator equity levels. This is controlled by rows INCOMEA (0 equity) through INCOMEE (100 percent) equity. With 5 RHS (right-hand sides), the INCOME's make up a sub-matrix with $7,000 being the diagonal RHS figures and all other cells being 0.

Since the calves from the brood cow herd are not sold in activity 1BCOW the figures in INCOMEA-E indicate returns from cull cows, heifers and bull--with 0 (INCOMEA) equity income is $125 and with 100% equity the income is $772.48 (INCOMEE).

The rows IINVTOT, initial total investment through average investment for crop production AINVTOT are representative of the count rows included in the model to summarized various factors.

For crop enterprises, the nature of resource requirements--labor (LABAPR) through total labor (LABTOT), land of specified qualities (LANDA) through (LANDABC), general farm machinery (MCHBHR), truck (TRKHR), small tractor (TRCSHR) . . . fall silo space (SILOF), and grain storage (GRAINS) are shown in an abridged matrix, Figure 2. Also summarized, is the quantity of dry matter made available from various crops such as corn dry matter (CRNDMAT), rye pasture dry matter period 1 (RYDMAT1) and . . . grass-alfalfa silage dry matter (GALSDM). Unlike annual crops, the cost (negative income) for tall grass-alfalfa (TGLSPY5) which is established for 5 years indicates cost according to percent operator equity (INCOMEA-E).

The abridged matrix, Figure 3, shows how 1000 pounds of dry matter from a specific crop such as corn silage is transferred to finishing light yearling slaughters (CSILFBC). The 1000 pounds of corn silage dry matter (row CSILDM) is transferred as 1000 pounds of dry matter (FCDMATT), 81.1 pounds of digestible protein (FCDPROT) and 700 pounds of total digestible nutrients (FCTDNT) to finish the yearlings.

Also shown in Figure 3 is an investment per 1000 pounds of silage dry matter (row PROF2) which includes interest according to length of time silage is stored and pro-rated cost of feeding silage. Labor, machinery, and tractor inputs for feeding 1000 pounds of silage dry matter as well as the feed bunk space that is required are shown in Figure 3. (see row indentification page 58).

Abridged matrix, Figure 4 shows the requirement (furnishing) coefficients for the activities--livestock (1BFCOW), crop (CCRNSRC), feed nutrient (CSILBC1), buying activities (BUYLND), the type of constraint (L, E, AND G), and the right-hand side of the equation (RHS).

Following are definitions of columns and rows shown in abridged matrices of Figure 1 through Figure 4. The constraint symbols used are as follows: E - equality, L - less than, and G - greater than. The N constraint indicates a functional row.

Activities (Columns)

1BFCOW Beef cow-calf brood herd, 32 cows (including herd bull and replacements)

	1BFCOW	2LFEEDS	2LFEEDH	3MFEEDS	3MFEEDH
PROF1	1039.1000	9.30000	8.56000	8.74000	8.27000
PROF2	10905.400	54.99000	44.26000	51.12000	44.46000
BCTDN1	44100.000	.	.	.	.
BCDPRO1	4258.0000	.	.	.	.
BCDMAT1	77367.000	.	.	.	.
BCTDN2	44449.000	.	.	.	.
BCDPRO2	4034.0000	.	.	.	.
BCDMAT2	77773.000	.	.	.	.
BCTDN3	43787.000	.	.	.	.
BCDPRO3	3431.0000	.	.	.	.
BCDMAT3	77883.000	.	.	.	.
BCTDN4	35094.000	.	.	.	.
BCDPRO4	2704.0000	.	.	.	.
BCDMAT4	64911.000	.	.	.	.
LFEEDS	14.00000 -	1.00000	.	.	.
LFEEDH	9.00000 -	.	1.00000	.	.
LFTDN3	.	271.80000	268.75000	.	.
LFDPRO3	.	28.97000	28.59000	.	.
LFDMAT3	.	407.96000	404.95000	.	.
LFTDN4	.	978.16000	972.60000	.	.
LFDPRO4	.	107.64000	106.78000	.	.
LFDMAT4	.	1528.8000	1525.3600	.	.
LFDISS	.	1.00000 -	.	1.00000	.
LFDISH	.	.	1.00000 -	.	1.00000
MFTDN1	.	.	.	1125.0300	1126.9300
MFDPRO1	.	.	.	108.40000	115.53000
MFDMAT1	.	.	.	1705.0000	1734.0000
MFDISS	.	.	.	1.00000 -	.
MFDISH	.	.	.	.	1.00000 -
LABJAN	27.29000	.	.	.54400	.54400
LABFEB	25.20000	.	.	.16800	.16800
LABMAR	27.90000	.	.	.74400	.74400
LABOCT	11.00000	.18600	.18600	.	.
LABNOV	24.80000	.18000	.18000	.	.
LABDEC	40.00000	.74400	.74400	.	.
LABTOT	223.09000	1.63000	1.63000	1.45600	1.45600
INCOMEA	125.92000	9.30000 -	8.56000 -	8.74000 -	8.27000 -
INCOMEB	287.56000	9.30000 -	8.56000 -	8.74000 -	8.27000 -
INCOMEC	449.20000	9.30000 -	8.56000 -	8.74000 -	8.27000 -
INCOMED	610.84000	9.30000 -	8.56000 -	8.74000 -	8.27000 -
INCOMEE	772.48000	9.30000 -	8.56000 -	8.74000 -	8.27000 -
LTDNTOT	167.43000	1.25000	1.24075	1.12503	1.12693
AINVTOT	10735.000	5.35000	5.35000	5.35000	5.35000
AINVLEQ	170.00000	5.35000	5.35000	5.35000	5.35000
AINVBLS	10565.000	.	.	.	.

Figure 1.--Beef Enterprises, Abridged Matrix

	CCORNRC	CCRNSRC	CSGSYR2	CSGFSY3	TGLSPY5
PROF1	65.98000	96.59000	96.59000	155.18000	59.86000
PROF2	30.88000	35.82000	35.82000	77.18000	48.33000
LABAPR	.35000	.83000	.83000	1.23000	.40000
LABMAY	.86000	.86000	.86000	3.52000	2.76000
LABJUN	.	.	.	1.90000	.
LABSEP	.	2.10000	2.10000	2.68000	.
LABOCT	1.98000	.58000	.58000	.	.
LABTOT	3.67000	4.37000	4.37000	9.33000	3.56000
LANDA	1.00000	1.00000	.	.	.
LANDAB	1.00000	1.00000	1.00000	3.00000	.
LANDABC	1.00000	1.00000	1.00000	3.00000	1.00000
RLAND2	.	.	1.54000	.	.
MCHBHR	3.45000	2.25000	2.25000	3.51000	1.31000
MCHBDL	29.02000	27.05000	27.00000	36.68000	9.49000
TRKHR	.20000	.40000	.40000	.40000	.
TRCSHR	1.86000	1.86000	1.86000	4.24000	1.51000
TRCLHR	1.67000	2.27000	2.27000	5.17000	1.80000
FORHHR	.	.80000	.80000	2.20000	.70000
FORWHR	.	1.30000	1.30000	3.60000	1.20000
SILOF	.	15.47100	11.18790	13.18050	.
SILOS	.	.	.	13.27000	3.82000
GRAINS	88.20000	.	.	.	.
CRNDMAT	4227.3000-	.	.	.	.
CSTDMAT	600.00000-	.	.	.	.
RYDMAT1	525.00000-	1350.3000-	470.80000-	.	.
RYDMAT2	629.47500-	84.52500 -	59.40000 -	.	.
RYDMAT4	.	949.20000-	331.10000-	.	.
PGLDM2	.	.	.	1368.0000-	1405.0500-
PGLDM3	.	.	.	1050.3000-	1167.2000-
PGLDM4	.	.	.	767.70000-	744.80000-
PSDXDM3	.	.	.	.	.
CSILDM	.	11383.200-	8233.2900-	9683.1000-	.
SGSDM	.	.	.	5511.0000-	.
GLSDM	.	.	.	2656.8000-	.
SDXSDM	.	.	.	.	.
GALSDM	.	.	.	.	2240.0000-
INCOMEA	65.98000 -	96.59000 -	96.59000 -	155.18000-	59.86000 -
INCOMEB	65.98000 -	96.59000 -	96.59000 -	155.18000-	58.88000 -
INCOMEC	65.98000 -	96.59000 -	96.59000 -	155.18000-	57.90000 -
INCOMED	65.98000 -	96.59000 -	96.59000 -	155.18000-	56.92000 -
INCOMEE	65.98000 -	96.59000 -	96.59000 -	155.18000-	55.94000 -
FTDNTOT	4.87500	9.63721	6.36759	14.05791	3.29355
IINVTOT	.	.	.	.	67.84000
IINVPCP	.	.	.	.	67.84000
AINVTOT	.	.	.	.	33.92000
AINVPCP	.	.	.	.	33.92000

Figure 2.--Crop Enterprises, Abridged Matrix

	CSILFBC	7CSILSP	SGSBC1	SGSMF1
PROF1	.49400	.66800	.74200	.76200
PROF2	1.77500	4.26000	5.32500	5.32500
BCTDN1	.	.	589.90000-	.
BCDPRO1	.	.	55.00000-	.
BCDMAT1	.	.	1000.0000-	.
MFTDN1	.	.	.	589.90000-
MFDPRO1	.	.	.	55.00000-
MFDMAT1	.	.	.	1000.0000-
FCTDNT	700.00000-	.	.	.
FCDPROT	81.10000-	.	.	.
FCDMATT	1000.0000-	.	.	.
LABJAN	.02381	.	.05555	.06940
LABFEB	.02381	.	.05555	.06940
LABMAR	.02381	.	.05555	.06940
LABAPR	.	.	.	.
LABMAY	.	.	.	.
LABJUN	.	.	.	.
LABJUL	.	.04167	.	.
LABAUG	.	.04167	.	.
LABSEP	.02381	.04167	.	.
LABOCT	.02381	.04167	.	.
LABNOV	.02381	.	.	.
LABDEC	.02381	.	.	.
LABTOT	.16666	.16666	.16666	.20832
SPTDNT	.	700.00000-	.	.
SPDPROT	.	81.10000-	.	.
SPDMATT	.	1000.0000-	.	.
MCHBHR	.16666	.16666	.16666	.16666
MCHBDL	4.27000	4.27000	4.27000	4.27000
TRCLHR	.16666	.16666	.16666	.20832
FORWHR	.	.	.	.04166
SILOS	1.00000 -	.62000 -	.125000 -	1.25000 -
CSILDM	1000.0000	1000.0000	.	.
SGSDM	.	.	1000.0000	1000.0000
INCOMEA	.49400 -	.66800 -	.74200 -	.76200 -
INCOMEB	.49400 -	.66800 -	.74200 -	.76200 -
INCOMEC	.49400 -	.66800 -	.74200 -	.76200 -
INCOMED	.49400 -	.66800 -	.74200 -	.76200 -
INCOMEE	.49400 -	.66800 -	.74200 -	.76200 -
FFEED1	.	.	.	1.00000
FBUNKR1	.59000	.	1.10000	.
FBUNKR2	.	.	.	.
FBUNKR3	.59000	.59000	.	.

Figure 3 -- Transfer Feed DMAT to Livestock, Abridged Matrix

	1BFCOW	CCRNSRC	CSILBC1	BUYLND	C	RHS
PROF1	1039.0	96.59	.494 -	27.04	N	0
PROF2	10905.	35.82	1.775	416.0	N	0
BCTDN1	44100.	.	700. -	.	L	0
BCDPRO1	4258.0	.	81.1 -	.	L	0
BCDMAT1	77367.	.	1000.-	.	G	0
LABJAN	27.290	.	.0555	.	L	212
LABFEB	25.20	.	.0555	.	L	193.27
LABMAR	27.90	.	.0555	.	L	212.02
LABOCT	11.0	.58	.	.	L	212.02
LABNOV	24.8	.	.	.	L	205.77
LABDEC	40.0	.	.	.	L	212.02
LABTOT	223.0	4.37	.1666	.	L	2400.
LANDA	.	1.00	.	.18 -	L	0
LANDAB	.	1.00	.	.45 -	L	0
LANDABC	.	1.00	.	.736 -	L	0
LANDPD	.	.	.	.14 -	L	0
LANDPE	.	.	.	.26 -	L	0
MCHBHR	.	2.25	.1666	.	L	0
MCHBDL	.	27.05	4.27	.	L	0
TRKHR	.	.40	.	.	L	00
TRCSHR	.	1.86	.	.	L	0
TRCLHR	.	2.27	.1666	.	L	0
FORHHR	.	.80	.	.	L	0
FORWHR	.	1.3	.	.	L	0
SILOF	.	15.47	.	.	L	0
RYDMAT1	.	1350.3-	.	.	L	0
RYDMAT2	.	84.525-	.	.	L	0
RYDMAT4	.	949.2 -	.	.	L	0
CSILDM	.	11383.-	1000.	.	L	0
INCOMEA	125.92	96.59 -	.490 -	27.04-	E	7000
INCOMEB	287.56	96.59 -	.490 -	20.80-	E	X
INCOMEC	449.20	96.59 -	.490 -	14.56-	E	X
INCOMED	610.84	96.59 -	.490 -	8.32 -	E	X
INCOMEE	772.48	96.59 -	.490 -	2.08 -	E	X
FBUNKR1	.	.	1.1	.	L	0
TRACTLR	.	.	.	.	G	1
IINVTOT	10905.	.	.	.	G	0
IINVLND	.	.	.	.	G	0
AINVTOT	10735.	.	.	.	G	0
AINVLND	.	.	.	.	G	0

Figure 4.--Livestock, Crop, Feed Nutrient and Transfer Activities, Constraint and Right-Hand Side, Abridged Matrix.

Activities Columns, Continued.

2LFEEDS Yearling light feeder steers - pounds (steers 502-704, Sept.-Dec., 122 days @ 1.65 lb/day) gain

2LFEEDH Yearling light feeder heifers - pounds (heifers 472-661, Sept.-Dec., 122 days @ 1.54 lb/day) gain

3MFEEDS Yearling heavy feeder steers - pound (steers 704-852, Jan.-Mar., 90 days @ 1.65 lb/day) gain.

3MFEEDH Yearling heavy feeder heifers - pound (heifers 661-800, Jan.-Mar., 90 days @ 1.54 lb/day) gain

CCORNRC Continuous corn with rye cover, 1 acre on land I (rye pastured Dec. to mid-April).

CCRNSRC Continuous corn silage with rye cover, 1 acre on land I (rye pastured Nov. to mid-April), 1 acre

CSGSYR2 Continuous corn silage with rye cover, no-till on land II (rye pastured Nov. to mid-April), 1 acre

CSGFSY3 Corn silage - small grain silage - orchard grass, alfalfa, clover silage (aftermath pastured) on land II, 3 acres

TGLSPY3 Orchard grass ladino clover, alfalfa, first cutting grass silage followed by pasture, 5-year stand land III, 1 acre

The following are transfers of 1000 lbs. of dry matter from crop to livestock:

CSILBC1 Corn silage to beef cows period 1

CSILFBC Corn silage to light yearling slaughters beef calves (502-992 lbs. S) (472-882 lb. H).

6CSILSP Corn silage to spring purchase yearling steers 704-850 lbs.

SGSBC1 Small grain silage to beef cows period 1

SGSMF1 Small grain silage to yearling heavy feeders period 1

BUYLAND Buy land

RHS Right hand side of matrix equations

Constraints (Rows)

N PROF1 Annual cost, $ (objective function)

N Prof2 Average investment including prorated production cost (objective function)

L BCTDN1 Total digestible nutrients balance row beef cow-calf herd period 1 (Jan. - Mar.)

L BCDPRO1 Digestible protein balance row beef cow-calf herd period 1 (Jan. - Mar.)

G BCDMAT1 Dry matter balance row beef cow-calf herd period 1 (Jan. - Mar.)

L BCTDN2 Total digestible nutrients balance row beef cow-calf herd period 2 (April - June)

L BCDPRO2 Digestible protein balance row beef cow-calf herd period 2 (April - June)

G BCDMAT2 Dry matter balance row beef cow-calf herd period 2 (April - June)

L BCTDN3 Total digestible nutrients balance row beef cow-calf herd period 3 (July-Sept.)

L BCDPRO3 Digestible protein balance row beef cow-calf herd period 3 (July - Sept.)

G BCDMAT3 Dry matter balance row beef cow-calf herd period 3 (July - Sept.)

L BCTDN4 Total digestible nutrients balance row beef cow-calf herd period 4 (Oct. - Dec.)

L BCDORO4 Digestible protein balance row beef cow-calf herd period 4 (Oct. - Dec.)

G BCDMAT4 Dry matter balance row beef cow-calf herd period 4 (Oct. - Dec.)

L LFEEDS Balance row steer calves 502 lbs., No.

L LFEEDH Balance row heifer claves 472 lbs., No.

L LFTDN3 Total digestible nutrients balance row yearling light feeders period 3 (July-Sept.)

L LFDPRO3 Digestible protein balance row yearling light feeders

G LFDMAT3 Dry matter balance row yearling light feeders period 3 (July - Sept.)

L LFTDN4 Total digestible nutrients, balance row yearling light feeders period 4 (Oct. - Dec.)

L LFDPRO4 Digestible protein balance row yearling light feeders period 4 (Oct. - Dec.)

G LFDMAT4 Dry matter balance row yearling light feeders period 4 (Oct. - Dec.)

L LFDISS Balance row yearling light feeder steers 704 lbs., No.

L LFDISH Balance row yearling light feeder heifers 661 lbs. No.

L MFTDN1 Total digestible nutrients balance row yearling heavy feeders period 1 (Jan. - Mar.)

L MFDPRO1 Digestible protein balance row yearling heavy feeders period 1 (Jan. - Mar.)

G MFDMAT1 Dry matter balance row yearling heavy feeders period 1 (Jan. - Mar.)

L MFDISS Balance row yearling heavy feeder steers 852 lbs.

L MFDISH Balance row yearling heavy feeder heifers, 800 lbs.

L FCTDNT Total digestible nutrients balance row finishing yearling light slaughters; total for 205 and 192 days

G FCDMATT Dry matter balance row finishing yearling light slaughters; total for 205 and 192 days

L LABJAN Balance row Jan. labor

L LABFEB Balance row Feb. labor

L LABSEP Balance row Sept. labor

L LABOCT Balance row Oct. labor

L LABNOV Balance row Nov. labor

L LABDEC Balance row Dec. labor

L LABTOT Balance row Total labor for year

L LANDA Balance row, continuous crop land, land I

L LANDAB Balance row, continuous crop land plus rotated crop land, land I plus II

L LANDABC Balance row, continuous crop land plus rotated crop land plus harvested forage crop land, land I, II, plus III

L MCHBHR Bundle of farm machinery (hours)

L MCHBDL Bundle of farm machinery investment

L TRKHR One-half ton truck hours

L TRCSHR Tractor small 35-45 H. P. hours

L TRCLHR Tractor large 65 H. P. hours

L FORHHR Forage harvester, hours

L FORWHR Self-unloading forage wagon, hours

L SILOF Silo space tons, fall

L SILOS Silo space tons, spring

L GRAINS Grain storage, bushel

Dry Matter Balance Rows

L CRNDMAT Corn grain

L CSTDMAT Corn stover

L RYDMAT1 Rye pasture, period 1 (Jan. - Mar.)

L RYDMAT2 Rye pasture, period 2 (April - June)

L RYDMAT4 Rye pasture, period 4 (Oct. - Dec.)

L PGLDM2 Grass-ladino pasture, period 2 (April - June)

L PGLDM3 Grass-ladino pasture, period 3 (July-Sept.)

L PGLDM4 Grass-ladino pssture, period 4 (Oct. - Dec.)

L PSDXDM3 Sudax pasture period 3 (July -Sept.)

L GSILDM Corn silage dry matter

L SGSDM Small grain silage

L GLSEM Grass-ladino silage dry matter

L SDXSDM Sudax silage dry matter

L GALSDM Grass-alfalfa-ladino silage dry matter

G INCOMEA Income no equity capital

G INCOMEB Income 25% equity capital

G INCOMEC Income 50% equity capital

G INCOMED Income 75% equity capital

G INCOMEE Income 100% equity capital

L FFEED1 Fence line feed bunks period 1 (Jan. - Mar.)

L FBUNKR1 Housed feed bunks, animal, period 1

L FBUNKR2 Housed feed bunks, animal, period 2

L FBUNKR3 Housed feed bunks, animal, period 3

Capital Investment (Count rows)

G IINVTOT Initial total

G IINVLD Initial land

G IINVPCP Initial perennial crops and pasture

G AINVTOT Average total

G AINVLND Average land

G AINVPCP Average perennial crops and pasture