APPLICATION OF COMPUTER TECHNIQUES TO FLINT HILLS RANCH PLANNING

by

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Major Professor

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INTRODUCTION

A major agribusiness industry in the Flint Hills Region of the east central tallgrass prairie ecosystem is cattle ranching. A 1969 inventory of the 19 Kansas counties included in the 30-34 inch annual precipitation belt totaled 3,704,647 acres of native range.

Without controlled burning or other weed and brush control methods, trend in species composition of Kansas Flint Hills tallgrass prairie is toward cool-season grasses and woody species (Blan, 1960), (Bragg, 1963), (Wyrill, 1970), (Owensby and Smith, 1972). Kansas ranchers renovate their pastures with various methods which have a wide range in cost to the rancher versus return in animal unit months of forage.

Fifteen commonly used renovation practices or combinations of renovation practices were compared with respect to their cost versus return of forage on the 720 acre Mill Creek Pure-Bred Hereford ranch near Alma, Kansas. Since many conventional methods of alternative evaluation are time consuming, may be numerically inaccurate, and limited in scope, methods of analysis which are more efficient and allow simultaneous consideration of many alternatives should be applied where they have merit. Simultaneous consideration of these fifteen feasible alternatives to renovate ranch owned sub-climax native prairie over a six year period was accomplished with the use of a systems analysis technique, dynamic linear programming (Buller, 1975).

A goal of Mill Creek Ranch was to increase the size of their base cow herd to optimally utilize available forage produced after renovation of their rangeland had occurred. Economic comparisons of the optimum results of the dynamic L-P analysis and a policy of no renovation with two different herd policies and the effect these management policies would have on ranch net income before taxes, interest, and depreciation are calculated was demonstrated using a computerized Internal Rate of Return model (Phillips, et al., 1975).

A method of comparing seasonal ranch pasture forage animal-unit-month production potential with expected increased livestock animal-unit-demand on that forage was needed to help predict if on hand supplies of forage (growing and stored as hay) would be adequate or whether purchase or rental of additional forage producing acreage should be contemplated.

A Fortran IV language computer program was designed to help predict if forage producing lands now being used had the capacity to produce adequate AUM's to support the herd growth policy desired by the ranch (Loper and Halfpap, 1975).

PROJECT ANALYSIS

Firm Goals

Interviews with ranch management personnel identified the priority range management goal as renovation of their brushy native rangeland acres to a high forage producing condition in order to allow possible expansion of existing brood-cow and replacement numbers from the 79, now present, to a maximum of 132 by 1983 (Briener, D. and D. Swanwyck, 1974).

Physical Inventory

A physical inventory of capital improvements such as pasture fences, gates, livestock watering and handling facilities, machinery, equipment and miscellaneous tools, storage facilities, and buildings was gathered by inspection and interviews with ranch personnel. Soil types and range site condition and potential information was gathered with the assistance of the Alma, Kansas, office of the U.S.D.A., Soil Conservation Service. Inventory data were transferred to acetate sheet overlays covering a 1 inch: 330 feet scale aerial photograph.

Forage Projections

Brushy acres having potential for renovation to climax forage producing status were outlined on an acetate overlay. That overlay was placed on top of the base ranch photograph, physical inventory and range site overlays. Potential renovation acres shown to be in conflict with a management goal of livestock shade and winter shelter, important wildlife habitat, or watershed protection were removed from further consideration.

When used, native rangeland burning was on a burn--2 years, no burn--3 years policy at the proper stage of plant development in late April (Owensby and Smith, 1972).

Mechanical treatment of brushy species was to be at the point of lowest carbohydrate reserve level for the target species and chemical treatment when target species were actively storing carbohydrates (Owensby, 1976).

Since each pasture contained varying amounts of each range site and acres of brushy lands to be treated per range site, the yearly animal-unit-months (AUM) available trend and annual total cost were computed for each pasture and renovation possibility (Table 1).

Dynamic Linear Programming Model

Physical Input

Total ranch native range AUM production potentials for each alternative were projected from response to renovation (Figs. 1-3) (Owensby, 1975). The yearly total projected AUM production by alternative was computed by multiplying the number of acres in a range type by its expected production in AUM's for that year (Anderson and Fly, 1955). A six-year sum of these gives the total expected planning period AUM production for each alternative, including the no renovation policy (Figs. 4-7).

Economic Input

The economic input to the dynamic L-P analysis was gathered such that when possible, existing ranch owned equipment would be used to carry out a renovation practice under consideration. Fixed and variable cost data for that equipment were taken from ranch files. Data for fixed and variable cost of rented or purchased items were collected from the item manufacturer. A cost per unit hour or acre was calculated for each item and entered into the analysis only as the item was being used. Economic input for the alternatives which consisted of combinations of the basic seven methods was determined by combining the unit costs for each basic method used in that combination (App. Table 1).

Renovation Alternative Analysis

Out of eight rangeland renovation practices alone and in combination, fifteen alternatives and/or combinations of alternatives were considered feasible on that ranch (Table 1). Those were compared using dynamic L-P (Buller, 1975) with respect to their estimated cost versus return of forage to a no renovation alternative over an initial six-year planning period required to achieve acceptable conversion of these rangeland to near optimum production.

TABLE 1

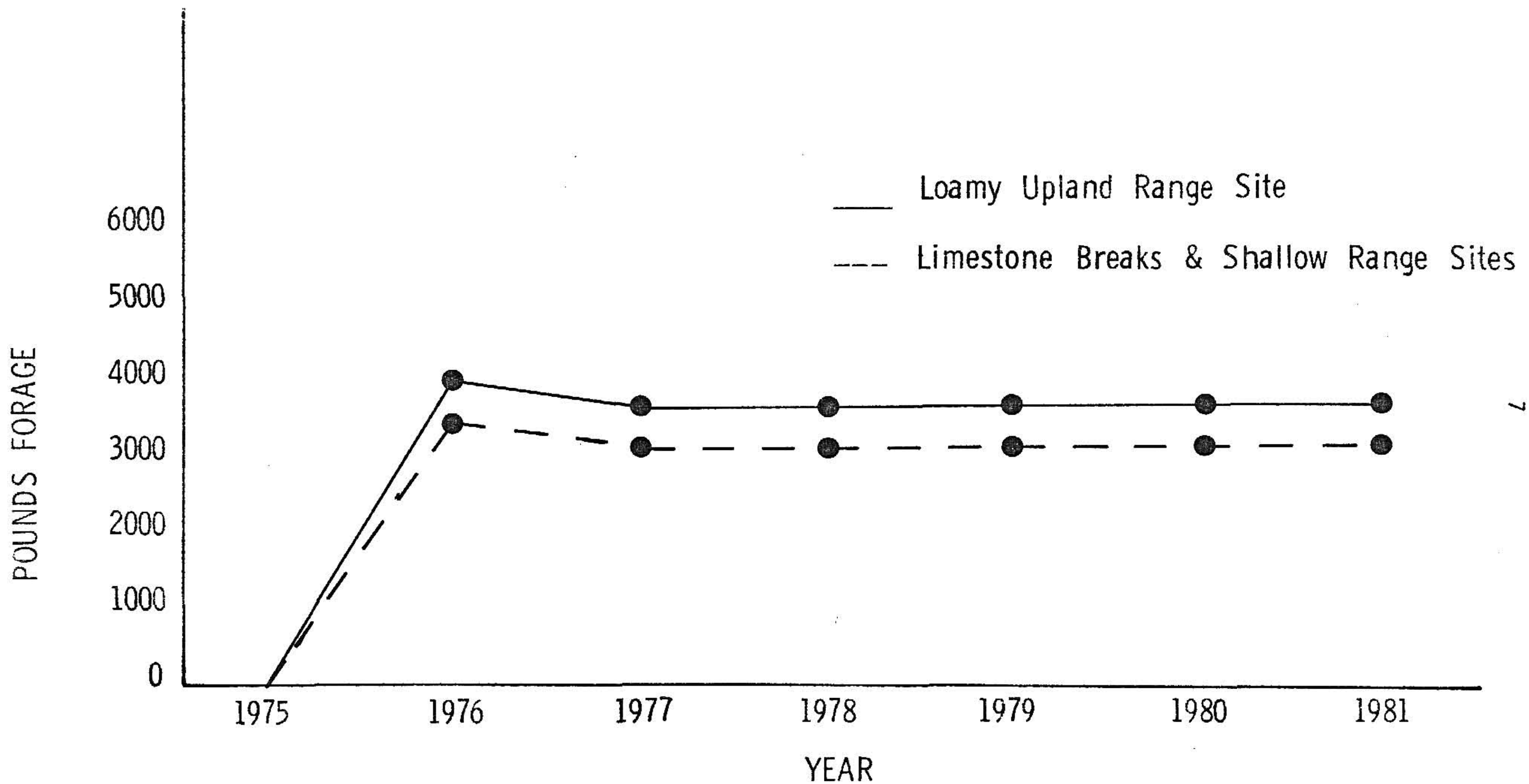
RENOVATION PRACTICE ALTERNATIVES ANALYZED

Practice	Burn	Burn-Hydro Ax	Burn-Mow	Burn-Hand Clear	Burn-Mist Blower	Burn-Aerial Spray	Burn-Hand Spray	No Renovation
Burn	X							
Hydro-ax	X							
Mow	X							
Hand Clear	X	X	X					
Mist Blower	X			X				
Aerial Spray	X			X				
Hand Spray	X	X	X	X		X		
No Renovation								X

Fig. 1. Expected per acre annual forage response to renovation alternatives burn only and burn-mow-hand clear.

THIS BOOK CONTAINS NUMEROUS PAGES WITH DIAGRAMS THAT ARE CROOKED COMPARED TO THE REST OF THE INFORMATION ON THE PAGE.

THIS IS AS RECEIVED FROM CUSTOMER.


Loamy Upland Range Site
Limestone Breaks & Shallow Range Sites
POUNDS FORAGE
6000
5000
4000
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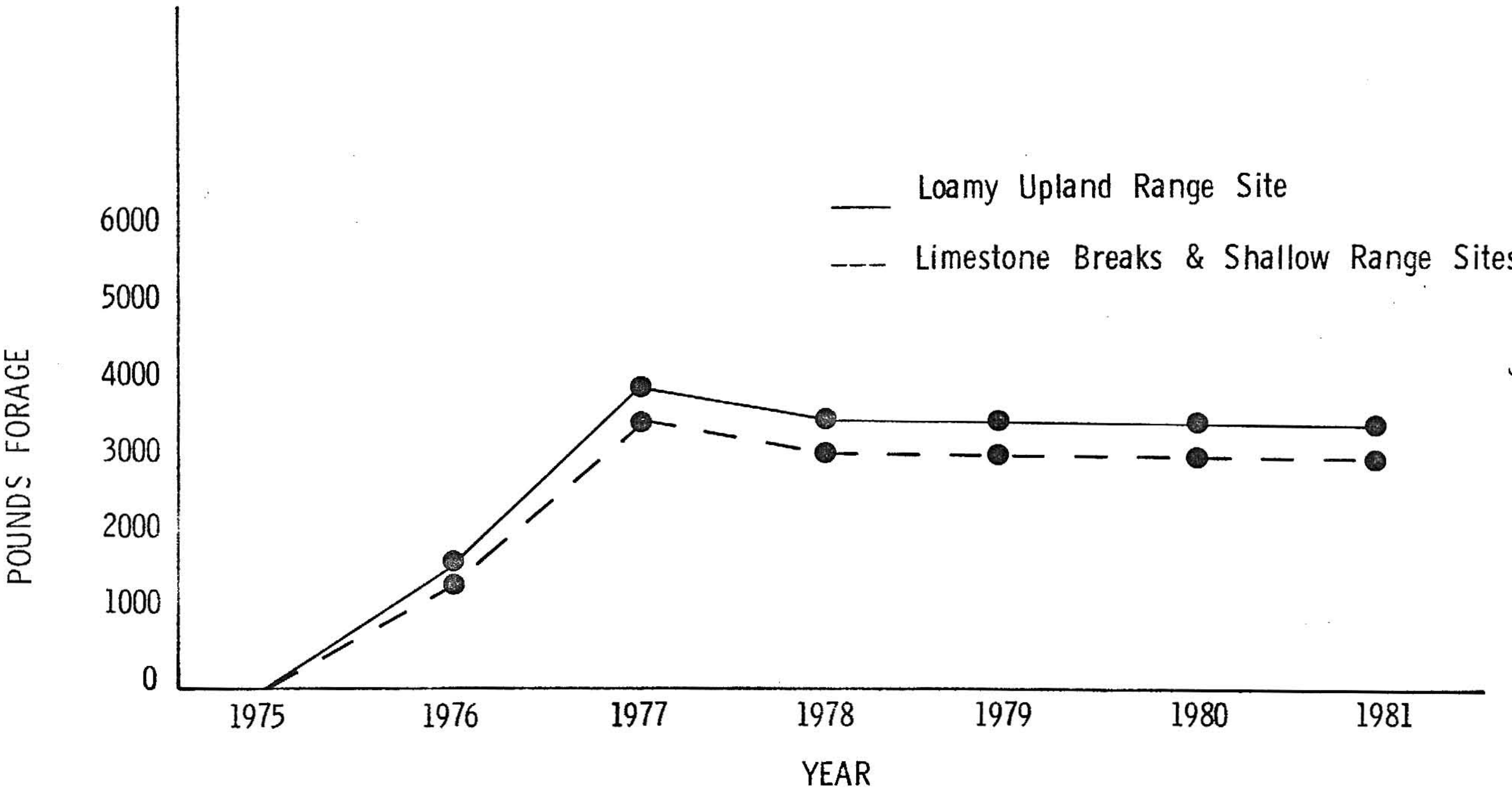
2000
1000
0
1975
1976
1977
1978
1979
1980
1981
YEAR

Fig. 2. Expected per acre forage response to renovation alternatives burn-hydro-ax, burn-mow, burn-hand clear, and burn-hydro-ax-hand clear.


Loamy Upland Range Site
Limestone Breaks & Shallow Range Sites
POUNDS FORAGE
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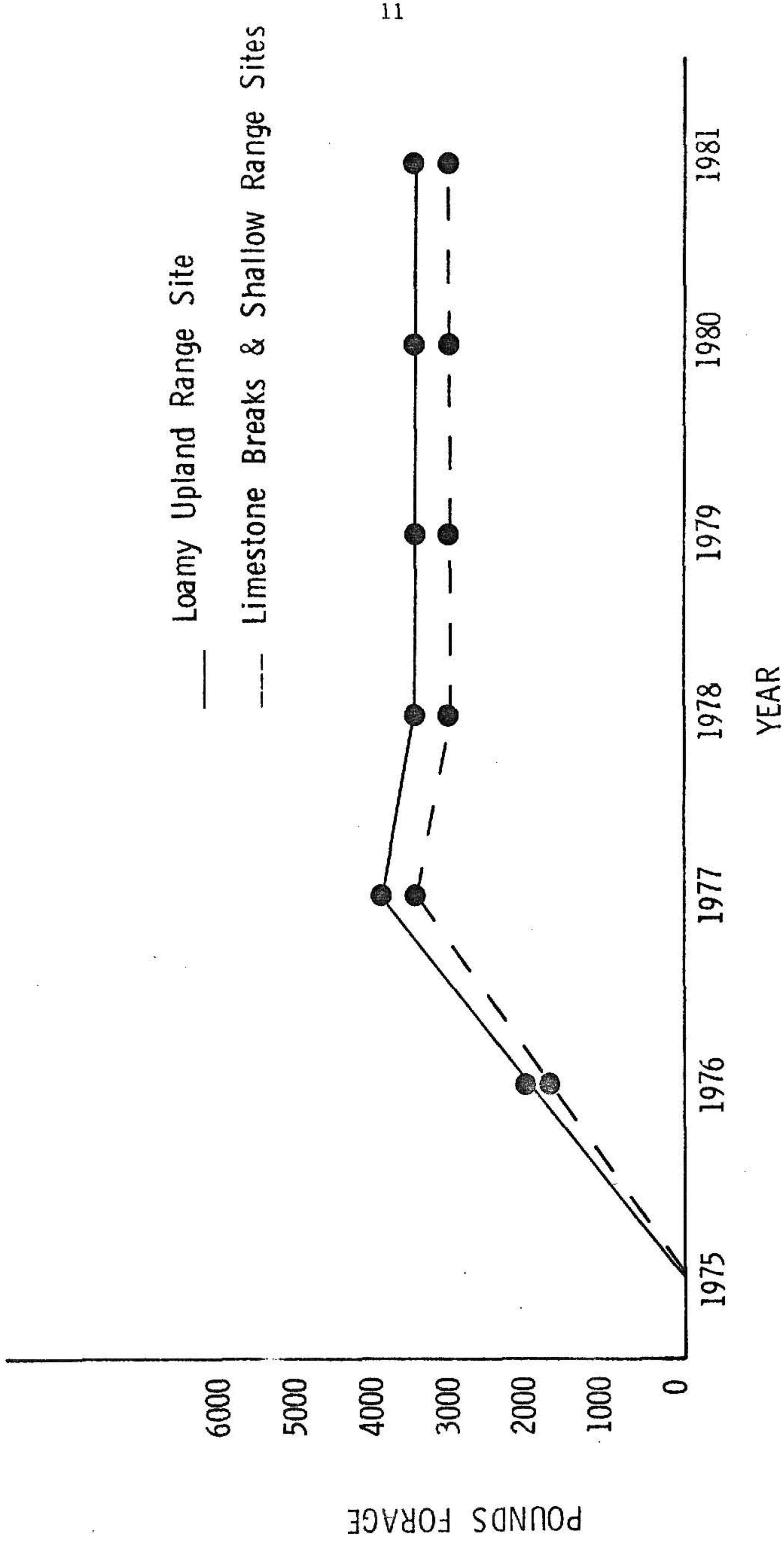
YEAR

Fig. 3. Expected per acre forage response to renovation alternatives burn-mist blow, burn-aerial spray, burn-hand spray, burn-hydro-ax - hand spray, burn-mow-hand spray, burn-hand clear-mist blow, burn-hand clear-aerial spray, burn-hand clear-hand spray, and burn-aerial spray-hand spray.


Loamy Upland Range Site
Limestone Breaks & Shallow Range Sites
POUNDS FORAGE
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1975
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YEAR

Fig. 4. Expected six year total ranch native range AUM production for renovation alternatives burn only, burn-mow, burn-hand clear, and burn-mow-hand clear.

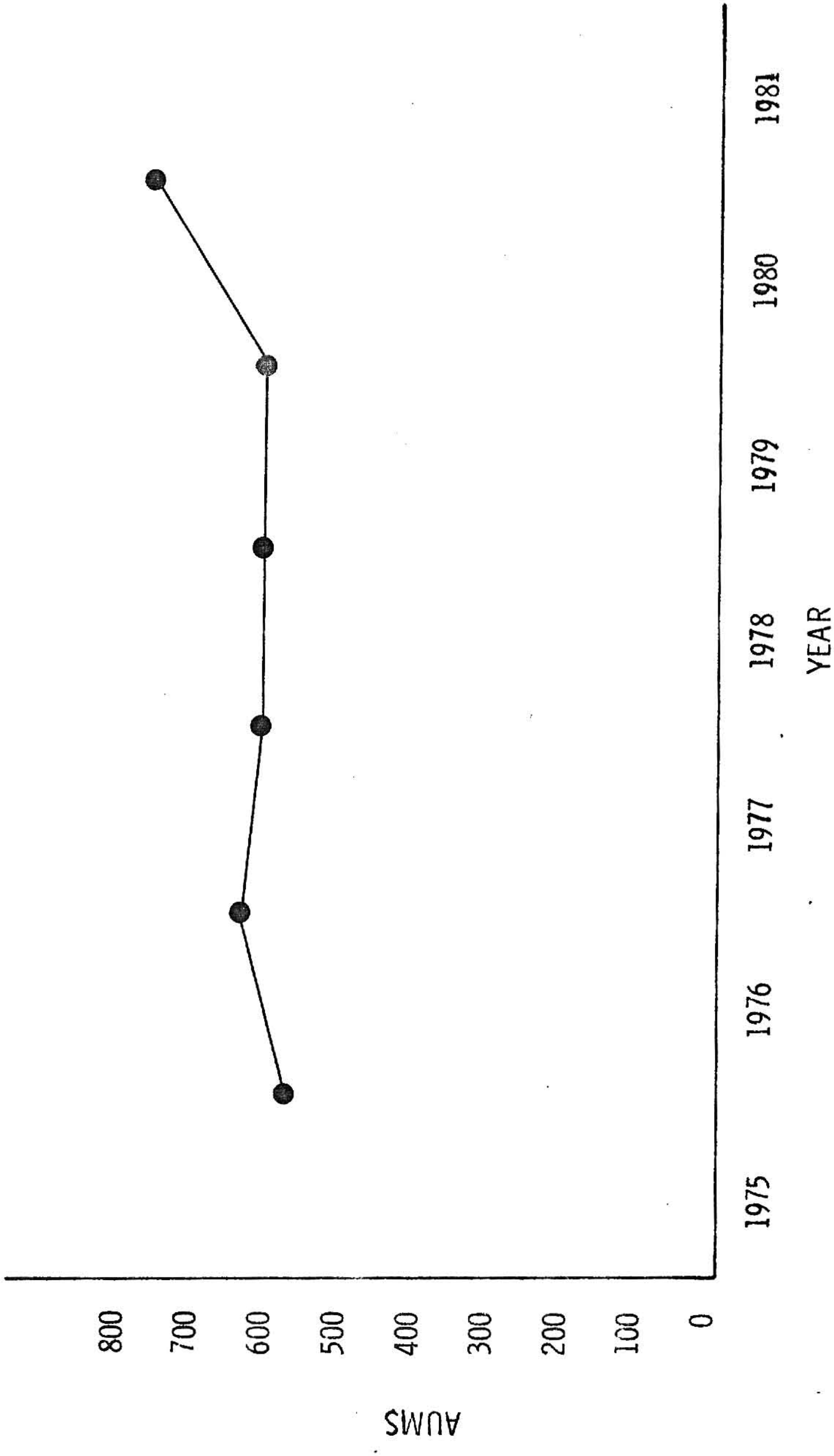
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Fig. 5. Expected six year total native range AUM production for renovation alternatives burn-hydro-ax and burn-hydro-ax-hand clear.

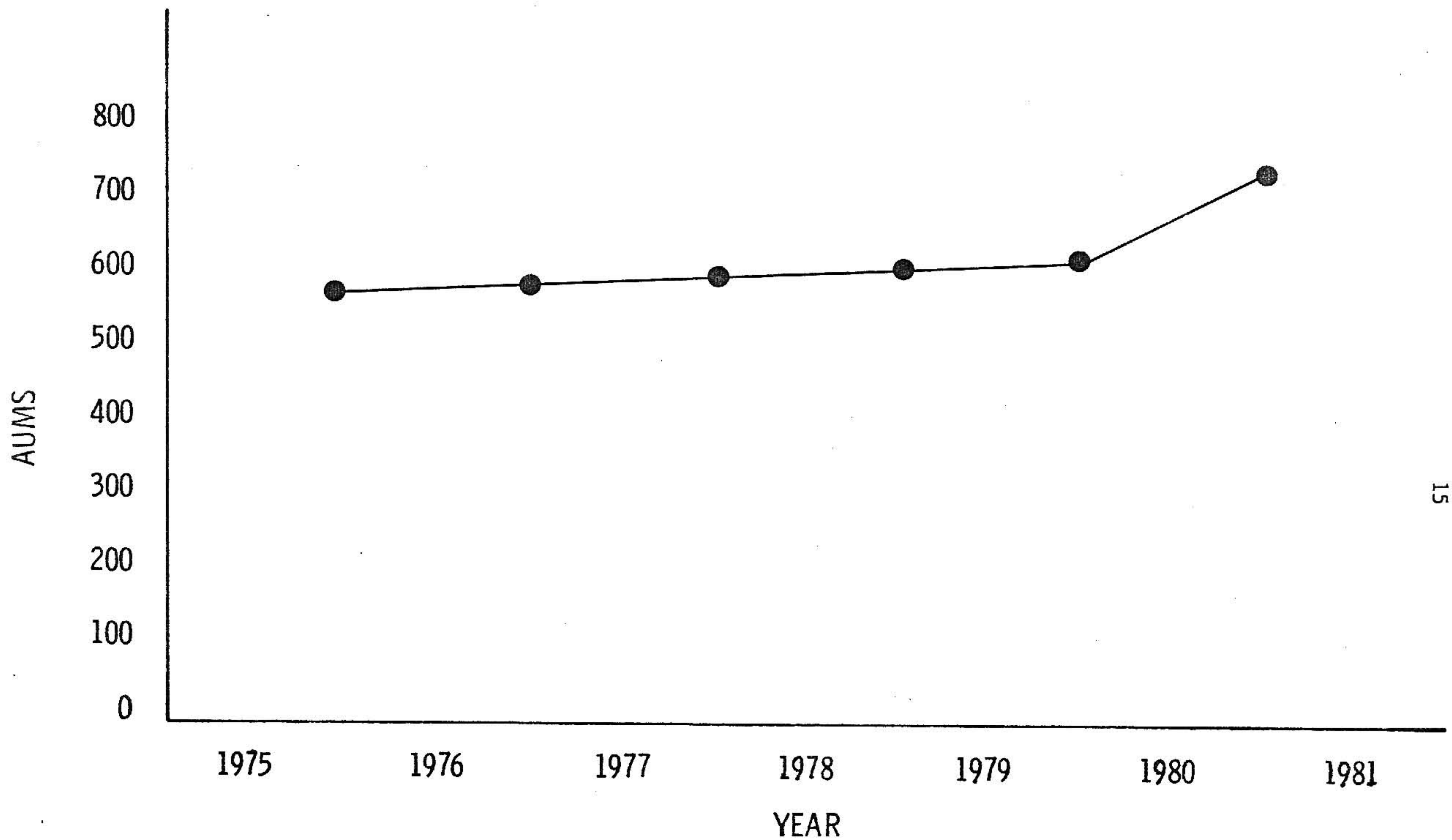
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Fig. 6. Expected six year total ranch native range AUM production for renovation alternatives burn-mist blow, burn-aerial spray, burn-hand spray, burn-hydro-ax-hand spray, burn-mow-hand spray, burn-hand clear-mist blow, burn-hand clear-aerial spray, burn-hand clear - hand spray and burn-aerial spray-hand spray.

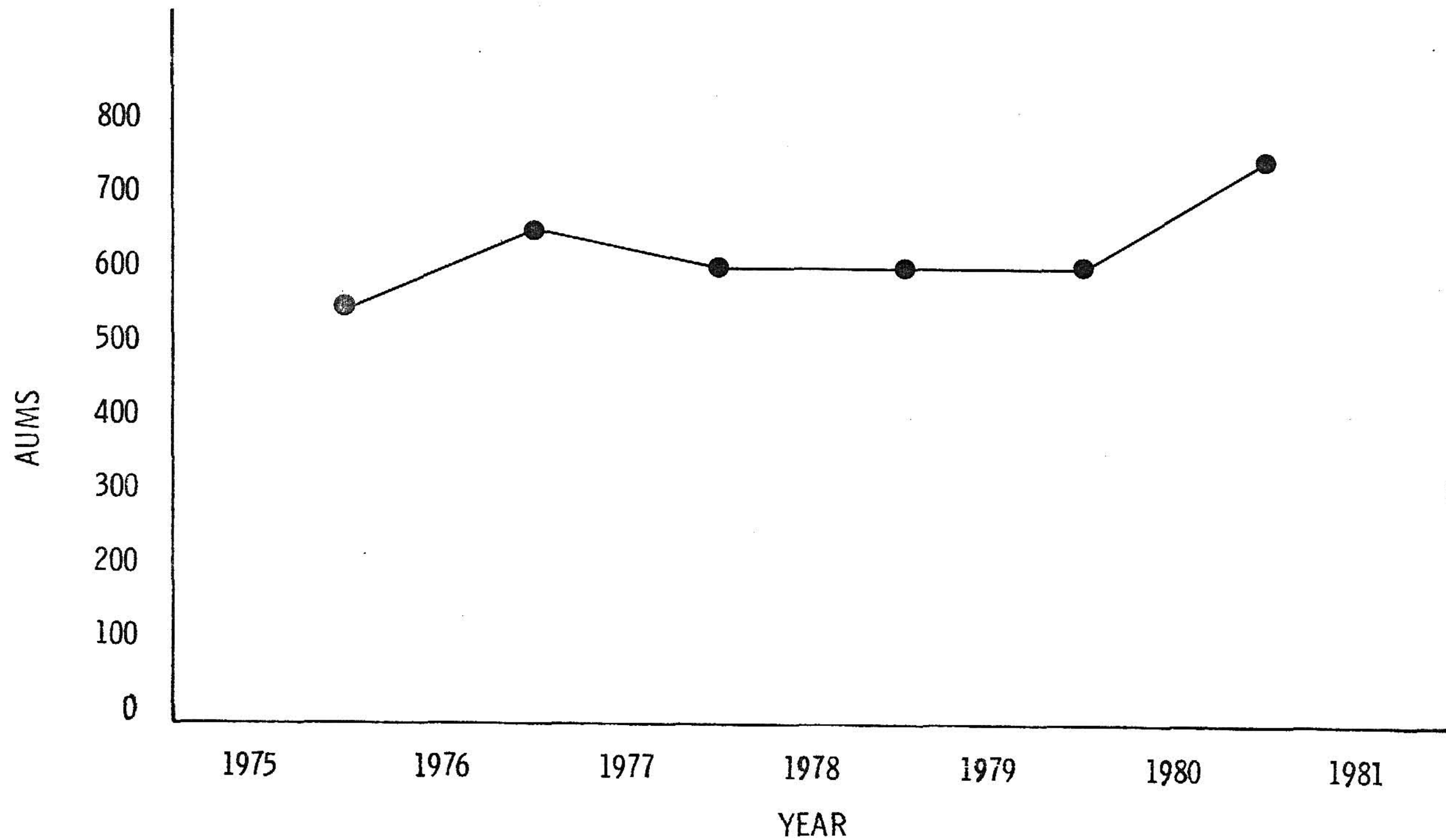
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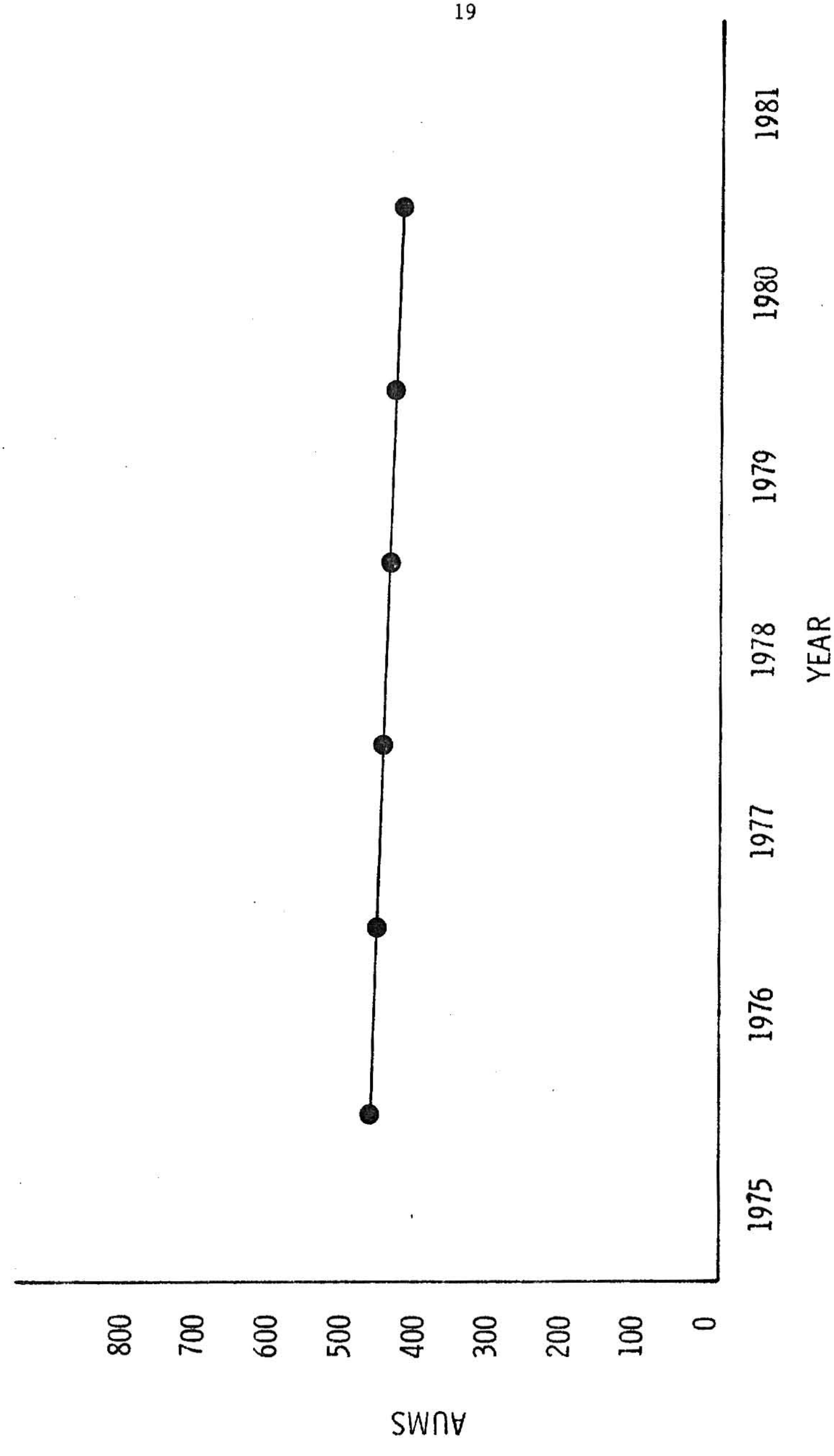
Fig. 7. Expected six year total ranch native range AUM production for no renovation.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The dynamic L-P model objective function was designed to solve for the alternative which gave the least cost per AUM received over a six year renovation planning period. A ranking of the fifteen alternatives from highest to lowest cost per AUM received over this planning period was obtained by continually removing from further analysis the alternative that became least cost in each of the fourteen consecutive runs of the dynamic L-P model (Fig. 10). One renovation alternative was selected by the ranch manager, and AUM production data were projected for that renovation practice (Fig. 8) as well as the extensive management policy of no renovation for a fifteen-year planning period (Fig. 9). That enabled the ranch manager to better see the projected differences in livestock carrying capacity of his native range for these two different policies.

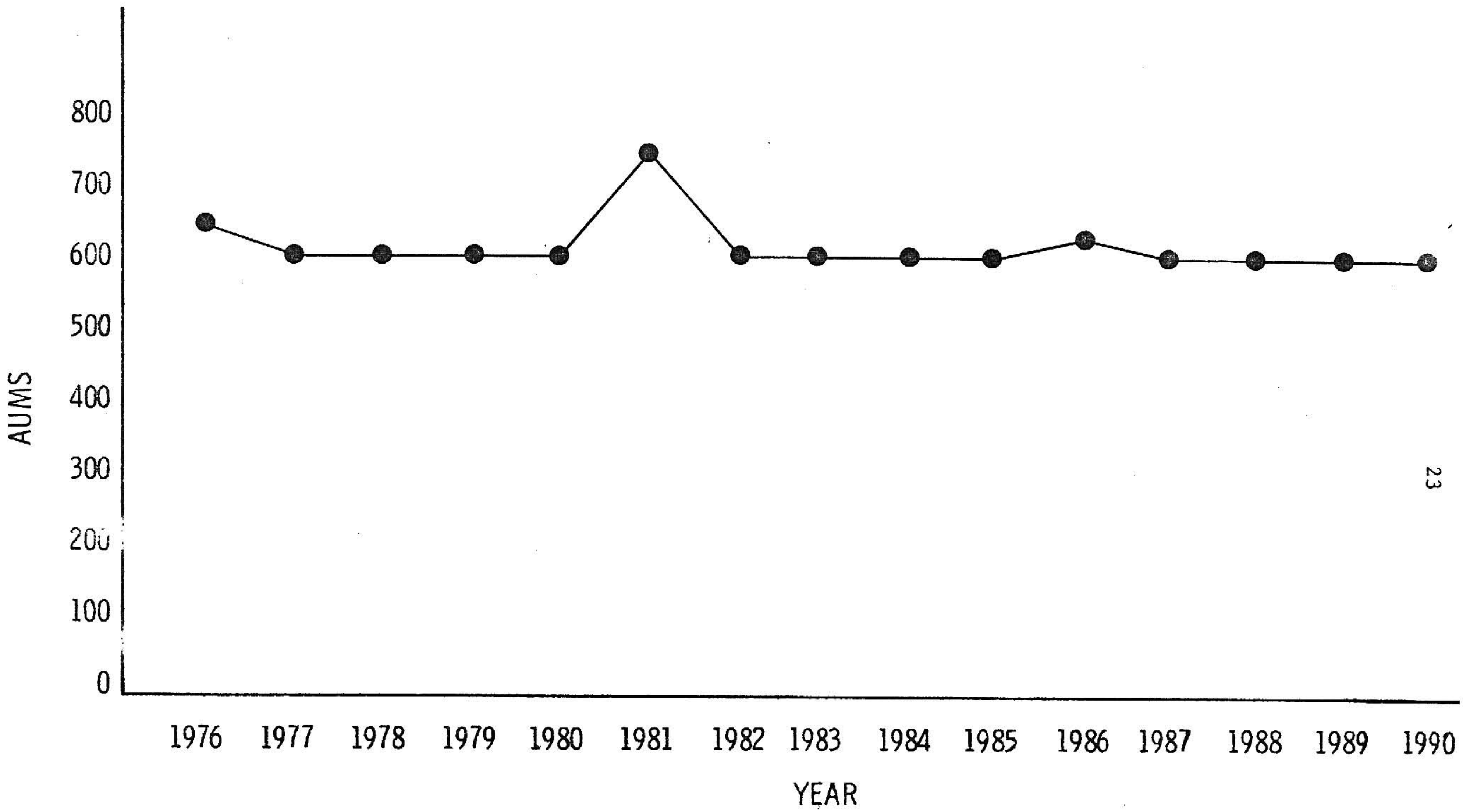
One objective of the ranch was to increase their base cow herd and replacements from 79 to 132 during the six year base planning period. Economic feasibility of building herd numbers of either 1) outright purchase of 30 head of bred cows in 1976 and selective replacement of heifers from within the existing herd until objective numbers are met or 2) the slower policy of a more liberal replacement of heifers produced from existing purebred cows was considered using an economic internal rate of return analysis. Renovate brushy acres and no-renovation to rangelands when combined with the two herd building possibilities produced four distinct combinations of potential management programs.

Economic Internal Rate of Return Model

Initial computer runs for all remaining potential management policies were designed to reflect only the return to total capital investment by the renovation practice, when used, and a base cow herd building program of either buying 30 purebred cows in 1976 or slowly increase brood-cow herd numbers by annually keeping additional replacement heifers produced from within the existing herd (App. Tables 42-49). Livestock herd structures based on purchase plans, culling and selling policies, calving percentages and replacement decisions desired by the ranch were constructed through the time periods needed to reach the pre-determined ranch goal of 70 spring-calving and 30 fall-calving cows (App. Tables 2-17). Unit cost and income for all salable ranch products were tabulated for the fifteen year planning period. Model input tables were constructed for 1) renovate rangelands by burning-increase breeding herd by increased replacement from within (App. Table 42), 2) no renovation of rangelands--increase breeding herd by increased replacement from within (App. Table 44), 3) renovate rangelands by burning-increase breeding herd by adding 30 purebred cows purchased in 1976 (App. Table 46), and 4) no renovation of rangelands--increasing breeding herd by adding 30 purebred cows purchased in 1976 (App. Table 48).

The economic feasibility of these four programs were compared in a computerized internal rate of economic return model (Phillips et al., 1975). Inputs to that model included present day investments in land and capital improvement facilities, yearly totals of anticipated working capital needs, livestock sales, other ranch sales (hay, wheat, etc.), ranch expenses (other than directly for livestock), livestock expenses, and renovation practice fixed and variable costs, if any. Those data were provided by inspection of existing ranch records, projected herd structures (App. Tables 2-17), estimated increased annual ranch cost for the buy-30 or replace from within policies, previously constructed graphs of expected yearly AUM's available under the renovation policy

Fig. 8. Expected 15 year total ranch native AUM production for renovation alternative burn only.


AUMS
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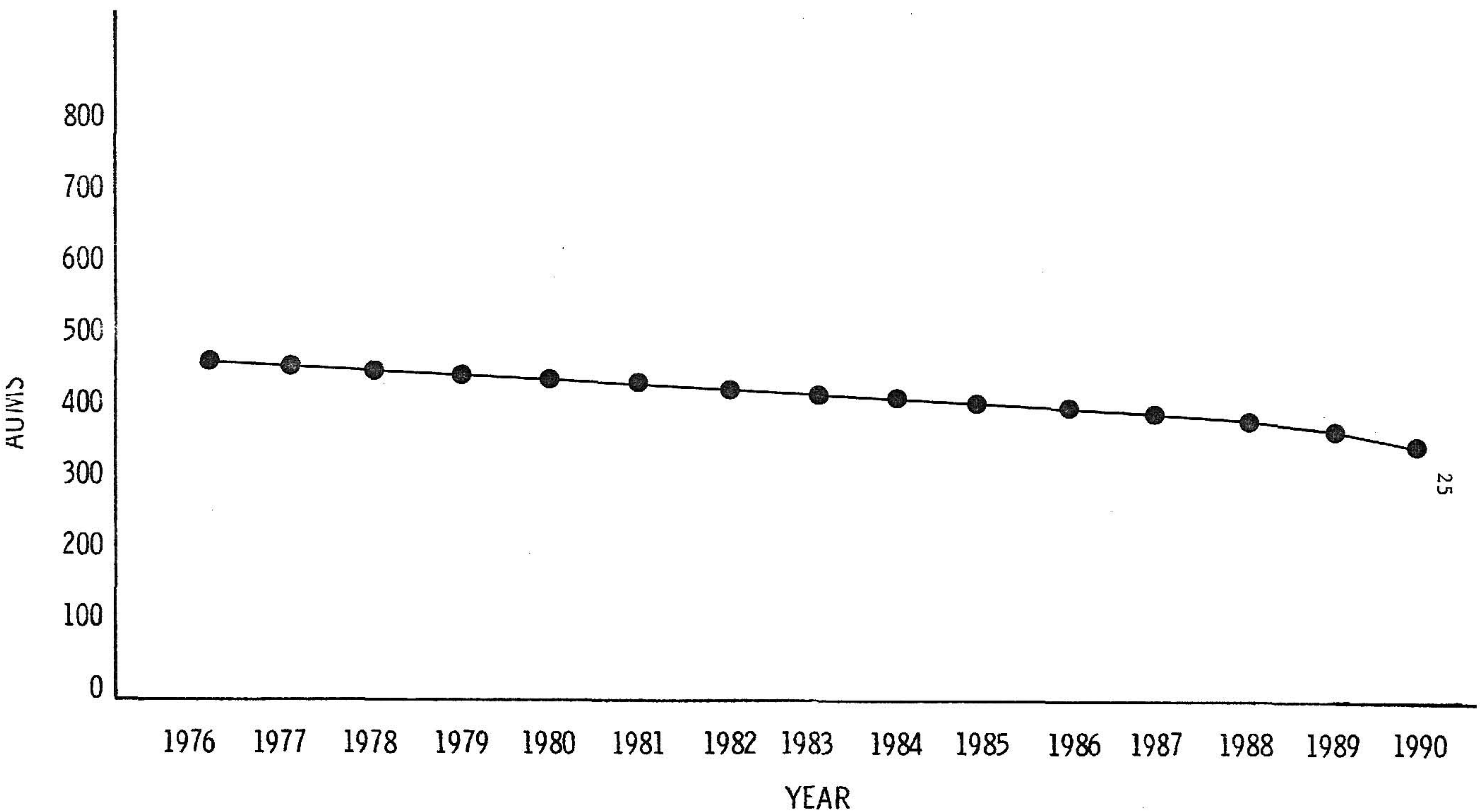
YEAR

Fig. 9. Expected 15 year total ranch native range AUM production for no renovation.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YEAR

accepted or no renovation alternatives (Figs. 8 and 9) and dynamic L-P output which showed total expected renovation project cost (Fig. 10).

Forage/Livestock Model

A computer program was written which calculated and printed in table form, the monthly total of ranch livestock animal-unit forage demand, available animal-unit-months of forage, the positive or negative differences between these two, and the order by which numerically coded forage pastures were used to fill the livestock demand (App. Tables 34-41). This program requires data input from information usually available from area local Soil Conservation Districts, university range extension personnel, and commonly kept ranch records.

Livestock Matrix

The LIVESTOCK ANIMAL-UNIT-DEMAND data input sheets (App. Tables 18-25) required the number of head for each class of animal and their corresponding average weight be entered for each month for each year of the analysis. Numbers and average weights were expected to change constantly due to buying, selling, deaths, births, growth, and other factors. Data for that input came from (App. Tables 2-17). The program converts the average weight of each animal to an animal unit equivalency (Hyder *et al.*, 1975). Livestock weights for 100 through 300 pounds converted to AU equivalents of .1, .2, and .3, respectively. Average animal weights in excess of 1200 pounds were treated as 1.25 animal units. The AUE for each weight class was multiplied by the number of animals in that month for each livestock class and summed to get a monthly livestock AUE forage demand total. This procedure was followed for each month of the analysis and stored in computer memory.

Forage Matrix

The FORAGE PRODUCTION AUM's data input sheets (App. Tables 26-33) allowed the ranch manager to assign numbers to forage pastures and other sources of forage. Forage production available for use by pasture by month was entered on the input sheet as AUM's. Those data were based on interpretation of the physical ranch inventory overlay (Fig. 8) and by K.S.U. range scientists and ranch personnel. Priority numbers of from 1 through 18 were determined by the ranch manager and entered beside each pasture available for that month. The priority numbers may change as the year progresses and should reflect which sources of forage for livestock consumption the ranch manager wished to be used first, second, etc. More than one pasture could have the same priority number. These data were stored in computer memory.

PROJECT RESULTS

Renovation Alternative Assessment

The economic cost versus AUM forage return analysis over a six-year planning period for the fifteen rangeland renovation management alternatives deemed feasible for this ranching situation showed the alternative most expensive per increased available AUM recieved was hand clearing, hand spraying, and burning. Total project cost was projected to be around $5500.00. Total six-year increase in AUM's produced would be $959 units and cost per increased AUM produced would be $4.99. The least expensive alternative was the burn-only policy with a total project cost of $1161.00 and a per AUM cost of $1.30. A comparison of total increased AUM's received over a six-year planning horizon for this ranch ranged from a high of 959 AUM's for the hand clear, hand spray, burn alternatives to a low of 834 AUM's for the hydro-ax, burn, and hydro-ax, hand clear, burn alternatives. These last two alternatives were projected to have an increased AUM cost of $3.52 and $4.06, respectively. The no-renovation alternative was expected to produce only 2900 usable AUM's of forage over the planning period and no increased cost. Projected relative cost per increased AUM of livestock forage, total ranch AUM's produced, and individual renovation practice cost per acre treated is shown in (App. Table 1).

Since the ranch manager was also interested in the yearly AUM production trend, he might wish to implement an alternative other than the least cost, if it provided a more stable yearly forage supply. A graph showed the total project cost for each alternative (Fig. 10). Data for the graph were compiled by continually removing the alternative which proved to be the "least cost" for those remaining in the analysis matrix in fourteen consecutive runs of the program. Forage stability information were provided by (Figs. 4-7).

Management Decision

The ranch manager was then asked to choose a renovation practice for further study. His criteria were 1) cost per increased AUM production (App. Table 4) and 2) yearly AUM production over the six-year planning period (Figs. 4-7).

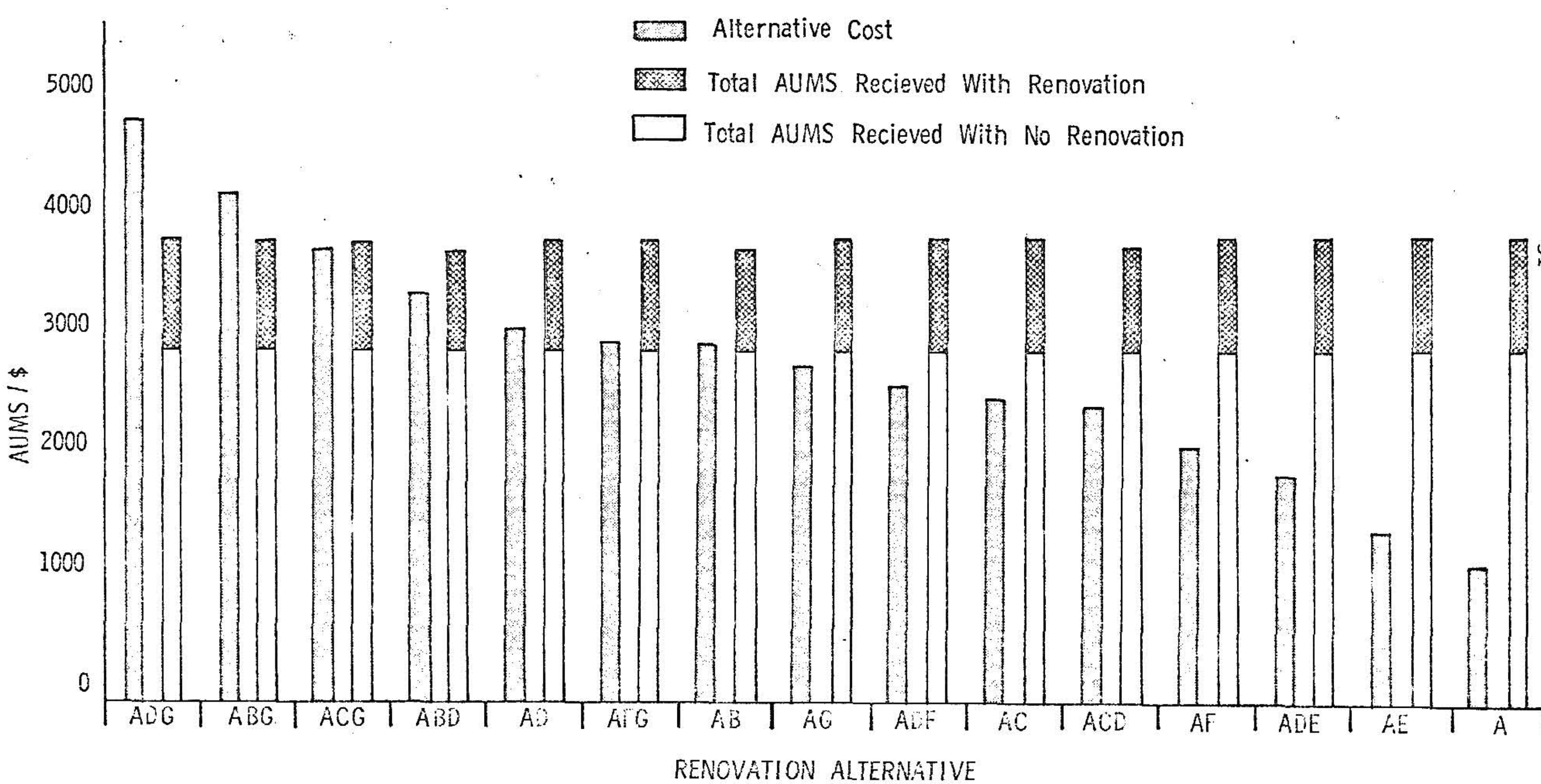
The ranch manager chose burning only as the renovation practice to be compared with the no renovation policy in the economic internal rate of return model.

Economic Internal Rate of Return Model

The IRR for the "burn-replace from within" policy was 1.104 percent. The net revenue for this alternative is only $166,049 for the fifteen-year planning period, an average of $11,070 per year. The first four years operated at a financial loss. The poor net revenue for 1982 can be attributed to fewer livestock available for sale after a large production sale planned for 1981 (Table 2 and App. Table 43). Due to the low IRR and average annual income, this alternative was removed from further consideration by the ranch manager.

The IRR for the "no renovation alternative-replacement from within" policy was .807 percent. The net revenue dropped to $121,748 primarily due to the lack of forage available to feed the increasing breeding cow herd numbers. Additional hay and supplements had to be purchased, and pasture needed to be rented from surrounding areas. The increased cost

Fig. 10. Total cost of renovation alternatives, total AUMs received per renovation alternative, and total AUMs received with no renovation. A-burn, B-hydro-ax, C-mow, D-hand clear, E-mist blow spray, F-aerial spray, and G-hand spray.


Alternative Cost
Total AUMS Recieved With Renovation
Total AUMS Recieved With No Renovation
AUMS / $
5000
4000
3000
2000
1000
0
ADG
ABG
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ABD
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AFG
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ADF
AC
ACD
AF
ADE
AE
A
RENOVATION ALTERNATIVE

to the ranch is reflected in higher working capital demanded and increased ranch and herd expenses (App. Table 45). That alternative was also dropped from further consideration by the ranch manager.

The "burn-buy 30 purebred cows in 1976" option showed an IRR of 4.624 percent, a respectable return for this type of agribusiness firm in Kansas. Total net revenue jumped to $704,662 for the fifteen-year planning period, an average of $46,977 per year. Only the first two years (1976-1977) lost money. Total revenue was higher than the two previous alternatives due to the additional brood cows providing more sellable yearling bulls and replacement heifers. The burn renovation program kept down ranch and herd expenses on a per-brood-cow basis by providing additional forage that was previously not available and removing the need to harvest or purchase supplemental feed supplies, such as hay or forage pasture (Table 3 and App. Table 47). The ranch manager decided to accept that combination of management alternatives as the basic plan for his renovation and herd building program.

The "no renovation, buy 30 purebred cows in 1976" alternative showed an IRR of 4.341 percent. Net revenue dropped $44,301 from the previous alternative to a planning period cumulative of $660,361.00 (Table 2 and App. Table 49). The differences in net revenues between alternatives 3 and 4 can be largely attributed to 1) the lack of forage produced under a no renovation program (alternative 4), and 2) having to cash purchase feed supplies and forage pasture for the increased brood cow herd and production classes of livestock. Management alternative number 4 was removed from further consideration by the ranch manager.

A summary of yearly net income for each alternative is shown in Table 2.

TABLE 2

ALTERNATIVE IRR AND YEARLY NET INCOME COMPARISON

	Management Alternative*			
	1	2	3	4
IRR	1.104	.807	4.642	4.341
Net Income** - 1976	-38501	-39774	-39820	-41093
" " - 1977	- 8225	-10873	-18897	-21545
" " - 1978	-27019	-29839	13762	10942
" " - 1979	- 3046	- 5966	98031	95111
" " - 1980	9857	6837	56367	53347
" " - 1981	30996	27070	105353	101427
" " - 1982	400	- 2228	89723	86795
" " - 1983	34111	30791	62519	59199
" " - 1984	32444	29024	60852	57432
" " - 1985	30742	27222	59150	55630
" " - 1986	28899	24706	57307	53114
" " - 1987	26387	23514	54795	51922
" " - 1988	25425	21605	53833	50013
" " - 1989	23579	19659	51987	48067
Total	166049	121748	704662	660361

* Alternative 1 - burn and replace from within

2 - no renovation and replace from within

3 - burn and purchase 30 purebred cows - 1976

4 - no renovation and purchase 30 purebred cows - 1976

** Dollars net income excluding depreciation, interest, and income tax.

Forage Available/Livestock Demand Model

Seasonal inspections of ranch-owned, native rangeland indicated stocking rates were below optimum carrying capacity. Since the ranch intended to build brood cow herd numbers to the point of balance between AUM production and livestock demand, a computer program was used to supply monthly AUM's available to the monthly AUM livestock demand starting with the forage supply with the highest priority number (Loper and Halfpap, 1975). Excess forage or forage deficiencies and the last priority number used to fill the AUM demand for each month were shown (Table 3 and App. Tables 34-41).

TABLE 3

NET MONTHLY FORAGE AVAILABILITY

	Forage Availability*							
Month	1976	1977	1978	1979	1980	1981	1982	1983
Jan	- 7	- 39	- 62	- 73	- 58	- 66	- 37	- 45
Feb	- 6	- 37	- 59	- 69	- 54	- 63	- 38	- 42
Mar	- 20	- 8	- 17	- 34	- 20	- 24	- 11	- 14
Apr	99	74	43	17	32	29	46	58
May	213	164	151	93	110	100	128	147
Jun	119	65	13	- 24	- 8	- 4	11	38
Jul	47	- 1	- 61	- 95	- 77	- 52	- 59	- 29
Aug	45	2	- 57	- 87	- 72	- 45	- 53	- 24
Sept	41	3	- 61	- 84	- 81	- 43	- 51	- 21
Oct	158	128	75	51	65	68	77	105
Nov	275	248	204	185	198	185	202	229
Dec	2	- 14	-106	- 70	- 58	- 68	- 54	- 32
TOTAL	+966	+585	+ 63	-190	- 23	+ 12	+161	+370

*Forage AUM production minus livestock AUM demand.

Output shows progressively less negative native range AUM's required over what is available due to the increasing amounts of native forage available as the renovation program processes (App. Tables 34-41).

Smooth brome, Bromus inermis (Leyss.) AUM's available are adequate to meet demand and allow some harvest of hay during the early spring grazing season. Fall brome fields provided adequate pasture to meet expected demand through the planning period (Table 3 and App. Tables 34-41). Copies of the Forage Available/Livestock Demand Analysis computer program are available from the authors upon request.

CONCLUSIONS

Livestock ranch management has been defined as "the art of applying economic, business, and scientific principles in organizing and operating a ranch to maximize earnings, or to attain other goals" (Kearl, 1974).

Effective livestock ranch management involves the combination of proper decision-making to balance the environmental needs of both native and introduced pasture ecosystems in order to provide a stable annual forage supply with the demands on those ecosystems made by grazing animals. Field application of selected computer programming techniques to aid the ranch manager in his analysis of potential management alternatives should make his decision-making process more efficient and can be applied to portions of the decision-making process of an operational livestock ranch. Detailed knowledge of computer science is not a prerequisite for the application of this tool to ranch planning (Jamison, 1971), (Bonham, 1971), (Buller, 1975) and (Phillips, 1975). The combination of ranch manager, computer science trained personnel, and rangeland systems analyst, provides an alternative to conventional planning methods which is more efficient and allows simultaneous consideration of the many management alternatives available to the ranch manager.

The dynamic L-P solution to the consideration of fifteen feasible rangeland renovation practices available to the Mill Creek-Hereford Ranch showed burning alone to be the alternative which would best combine least-cost with stable AUM production over a six-year planning period.

Computerized economic comparison of burning to renovate sub-climax native tallgrass prairie with a policy of no renovation strongly suggests that the former will provide the best economic return to capital investment. The purchase of 30 head of purebred herefords in 1976 will provide for an improved economic future for this ranch over a replacement from within existing herd structure decision.

Based on existing rates of stocking and supplemental forage feeding per head, during the non-growing season for native Flint Hills pasture, forage production on existing controlled lands will not have the potential, after renovation, to provide adequate grazing for expected livestock numbers even if weather conditions are within reasonable limits around the averages for this region and a policy of rangeland maintenance is followed by the ranch. Additional supplemental feeding will be required during the winter. This additional feed could be supplied by harvesting some of the excess forage provided by the brome pastures in both the spring and fall grazing seasons (Table 3).

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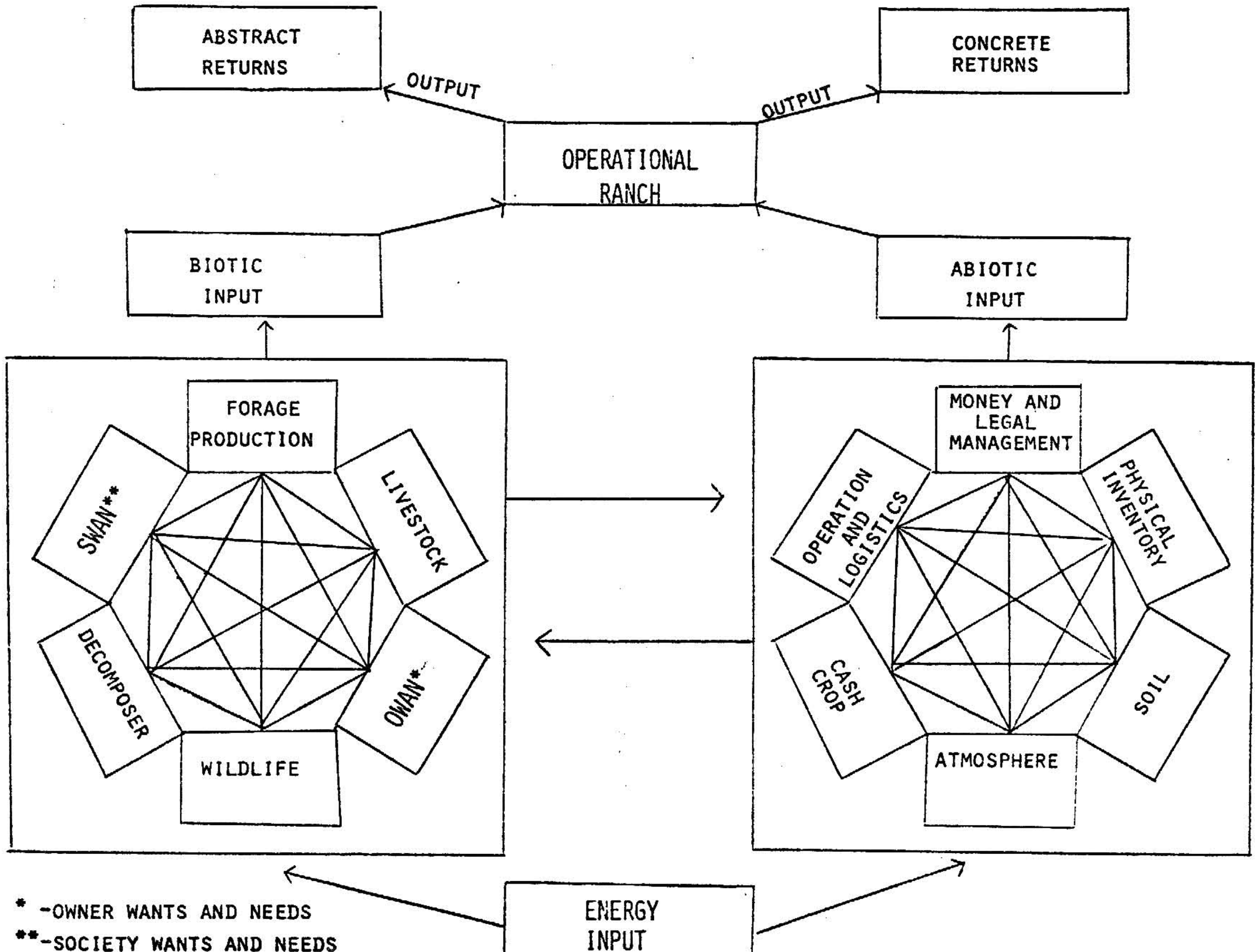
Appendix

LITERATURE REVIEW

A major agribusiness industry in the Flint Hills region of the East Central Kansas tallgrass prairie ecosystem is cattle ranching. A 1969 inventory of the 19 Kansas counties included in the 30-34 inch annual precipitation belt totatled 3,704,647 acres of native range, most of which are stocked with livestock during at least a portion of the year (Anonymous, 1969). The ranching industry for this region is typical of many agribusiness related firms in that each operational ranch must constantly deal with a complex network of physical and economic subsystems (Fig. 1). These subsystems interact with one another towards the usual goal of livestock production for market in either pure-bred or commercial outlets. Due to these complex interactions between subsystems, certain aspects of ranch planning by conventional methods of analysis are time consuming, may be numerically inaccurate, and limited in scope. Methods which are more efficient and allow simultaneous consideration of many alternatives are presently available to aid the ranch manager during his process of practical decision making. One of these methods is called systems analysis. Bartlett and Cook, (1976) describes systems analysis as "an organized thinking process which arranges information into categories for sequential use in arriving at a decision or solution" and they further state that it "provides a logical examination of objectives and the alternative ways of achieving these objectives." Systems analysis is a concept or method of analysis which can be used


ABSTRACT RETURNS
OUTPUT
CONCRETE RETURNS
OUTPUT
OPERATIONAL RANCH
BIOTIC INPUT
ABIOTIC INPUT
FORAGE PRODUCTION
LIVESTOCK
OWAN*
WILDLIFE
DECOMPOSER
SWAN**
MONEY AND LEGAL MANAGEMENT
PHYSICAL INVENTORY
SOIL
ATMOSPHERE
CASH CROP
OPERATION AND LOGISTICS
ENERGY INPUT
* -OWNER WANTS AND NEEDS
**-SOCIETY WANTS AND NEEDS

A-Figure 1.

during the decision making process of industries comprised of interlocked series of subsystems interacting to produce a given product or products.

Some of the tools used in systems analysis are computerized methods of operations research. Operations research is the application of scientific methods, techniques, and tools to problems involving the operation of systems so as to provide the decision maker with feasible solutions to the problem (E. V. Bakuzis, 1974).

Until recently, operations research techniques involving the use of computerized methods of systems analysis have been used as a tool of applied research and little effective effort has been applied to its use as an aid to management decision-making at the agribusiness firm level (Filan, 1972). This is not to imply that operations research methods have application in every phase of a ranching situation. The consultant, extension agent, or ranch manager should consider each situation to be unique and use professional judgment as to where these techniques would or would not apply.

All computerized programs designed for potential or actual application to field management situations can be considered as models of one form or another. Computer models can be considered as abstract representations of real or hypothesized situations. Many are composed of mathematical expressions which are designed to reflect some level of reality. Jamison, (1970) states that "no mathematized model can duplicate the complexity of real systems. Mathematical models, in fact are not intended to duplicate the real system, but rather are intended to provide a useful abstraction." He further states that "experiements that are conducted with the model will introduce responses which are approximations of the actual response to the real system. Nevertheless, these approximations may allow us to make many decisions; particularly they may allow us to delete many possible alternatives from further consideration in a very economical fashion."

Three basic types of models can be used in the planning process and subsequent management of agribusiness enterprises. These are:

1) Planning models

2) Directing models

3) Management-control models

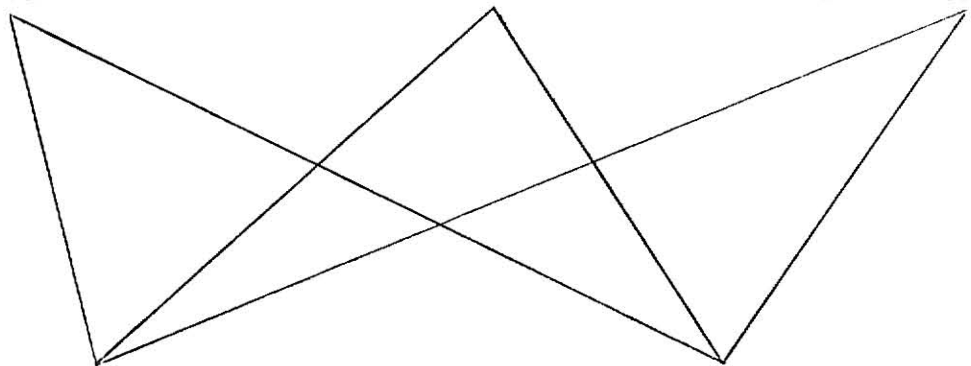
All three basic types are represented by specific function models which may be either predictive or selective in nature (Phillips, 1975).

Predictive models may be further broken down into analytical and simulation models, each with their own function and purpose. Examples of analytical models would include graphic display, data storage and retrieval, statistical analysis, multiple regression, and economic time flow. Examples of simulation models are physical phenomena, biological systems, bio-economic, and economic systems (Filan, 1972).

Selective models can be categorized as either mathematical programming models such as linear, dynamic, quadratic, and goal, or judgment models such as decision trees, sequential processes, and management control.

A search of pertinent literature in available computer programs for potential use as efficient decision-making aids in the planning process of cattle ranches in the 30-34 inch precipitation belt of the Kansas Flint Hills prairie region did not uncover examples which would

PLANNING DIRECTING MANAGEMENT-CONTROL



I. Predictive

A. Analytical Models

1. graphic display
2. data storage and retrieval
3. statistical analysis
4. regression analysis
5. economic time flow

B. Simulation Models

1. physical phenomena
2. biological systems
3. bio-economic systems
4. economic systems

II. Selective

A. Mathematical Programming

1. linear
2. dynamic
3. quadratic
4. goal

B. Judgment Models

1. decision tree
2. sequential
3. management control

fit some of the before mentioned categories. This is not to imply that they do not exist, only that they were not reviewed by this author. Any assistance provided to add to this review will be greatly appreciated. Models such as those developed by Goodall, (1967), Hutchinson, (1972), McKinney, (1972), Sharma, (1973), and Swartzman and Van Dyne, (1972) were considered to have future potential practical application to this region but were not reviewed either because input data representative of this Flint Hills prairie ecosystem is not presently available or the author of the model in question stated that it had not yet been properly validated against field situations.

Models which have as their objective, the analysis of ranching industry firms from a purely economic point of view without direct reference to forage analysis as an integral part of the model will not be included in this review. More complete reviews of systems analysis techniques used in agricultural related industry situations are given by Anderson, (1974) and Armstrong, (1975). The ARID ZONE NEWSLETTER published by CSIRO, Canberra, Australia, is an excellent source of the state of the art of systems research and management application for that part of the world.

PREDICTIVE

Analytical

Most computer centers contain a number of analytical models with statistical or graphic display capabilities but their specific application to forage analysis on rangelands is not evident in the literature. Van Dyne, (1960) reported on the use of IBM cards to record line intercept field data which could then be statistically analyzed. A program which reads pasture composition input from standard IBM data cards and prints out statistical information as well as basal cover expressed as a percent of total hits and percent botanical composition for each of 88 separate forage species and plant categories such as total grasses, forbs, shrubs, and trees was developed by Owensby and Aerheart, (1971). Bonhan, (1971) developed a computer program which maps and graphically displays ecological data.

Simulation

Probably the simulation model most comprehensive in its efforts to simulate components of a rangeland ecosystem and interface these relationships with an economic goal of maximizing the long term profits of a livestock producing firm is given in Swartzman and Van Dyne, (1972). Comprehensive simulation models which include the economic analysis of both farming and ranching activities in the same model have been developed by Schwab, (1974) and Kadlec and Petritz, (1974). Both of these models were designed to find optimum combinations of farm and ranch products and allocate land use.

One of the more practical applications of simulation of agri-business firms is presented by Halter and Dean, (1965). This simulation of a California rangeland-feedlot operation has been well validated against a field situation and the model would seem to have potential application in other range ecosystems without the need for extensive overhaul. Seasonal range condition and cattle price variation were the two main variable inputs to the model which was dynamic in nature. Economic and management goals were a major consideration as decisions were made throughout the yearly operation. Another model which used established management goals in order to estimate prospective results of different management practices is shown by Goodall, (1970). This model uses topography, soil, vegetation, grazing pressure, preference grazing of species by livestock, and degree of forage removal to help determine appropriate stocking practices and indicates the value of proposed capital improvement practices which would aid in livestock distribution over the paddock.

Other examples of bio-economic models are shown by Trebeck, (1972) and Thatcher, (1972). Smith and Williams, (1973) reported on a dynamic bio-economic model which might be used to help predict situations under which early grazing may cause a significant reduction in later pasture growth and livestock performance.

SELECTIVE

Mathematical Programming

Of all the mathematical programming techniques used in the agribusiness industry, linear programming has received the most attention to date. The applications of this technique to agricultural situations in general are described by Heady and Chandler (1958), Throsby (1970), Agrawal and Heady (1972), and Beneke and Winterboer (1973) and rangeland ecosystems in particular by Loper et al., (1972) and Jamison, et al., (1974). Jamison, et al., (1974) states that "linear programming is a method of allocating scarce resources among competing activities in an optimal manner." Since the objective in most ranching situations is to return an economic benefit to the firm in the most efficient manner. The concept of "optimization" seems taylor-made as an aid to its decision-making process.

Static programming models are those who do not consider the movement of time during the analysis period. These can be called "one-shot" programs and have their most relevant application in multi-product situations such as feed mix and management alternative consideration. Woodworth, (1973) used static linear programming to help determine an optimum calf allocation policy between private and government owned grazing lands. D'Aquino, (1974) used the same technique to evaluate optimum seasonal stocking rates for pastures in different range sites in eastern Colorado. Seasonal forage quality and dry matter intake were variable inputs. This model did not allow for possible reuse of a range site if regrowth were to occur later in the grazing season.

CO-PLAN I (Jamison and Child, 1972) used the philosophy that ranch holdings have a dual purpose of livestock operations and real estate investment. The L-P model would evaluate annual operating profit, plus resale value one year hence, minus operating cost, annual debt repayment on improvements, and maximize present sale value for combinations of management alternatives. A second generation CO-PLAN was published by Cook, et al., (1974). This model identifies the feed resources available and the required seasonal nutrient intake for the physiological functions expected of the grazing animal. The authors state that "Intermittent runs of the computer program will aid in the decision for numbers and classes of livestock to be retained from one season to another as it relates to predicted available forage."

A one year forage production model accompanied by a detailed flow chart showing season input-output relationships of the forage crops and animal demand was developed by Tseng and Mears, (1975). Connolly, (1974) looked at livestock carrying capacity and relative management objective trade-offs on rangeland as affected by goals of profit maximization, maximum animal gains, and maximum forage utilization. Overgrazing was not allowed to occur. Jones, (1974) considered the differences between optimum beef-forage farm operations based on three measurements of forage production and beef cattle nutrient requirements. The balanced ration alternative listed seasonally adjusted livestock nutrient requirements and forage production in pounds of TDN, digestible protein, and total dry matter. The second alternative balanced only seasonal TDN forage production and livestock requirements while the animal unit month approach balanced only animal units for each time period. Other practical examples of static period L-P models of livestock-forage systems are represented by Wedin and James, (1974) and Heady, (1968).

An excellent practical application of linear and quadratic programming techniques to study the conversion ratios and economic returns from feeding energy supplements on pastures is provided by Mott et al., (1968). Stocking rate was adjusted as levels of supplement changed in order to maintain a uniform forage removal pattern.

When time-dependent relationships are to be considered, two basic types of analysis may be used when optimality is still the objective. The first is dynamic programming, used when the mathematical relationships between variables are non-linear. Agrawal and Heady, (1972) gave examples of how this approach could be utilized in certain agribusiness firms but due to cost involved in multi-objective analysis, few practical applications of this approach have actually been applied to forage-livestock systems. Throsby, (1964) showed how dynamic programming could be used to allocate land to pasture improvement practices in New South Wales. His model searched for either optimum or sub-optimum where no optimum existed due to risk aversion, capital restrictions, or other factors.

A more popular technique for handling time in forage systems analysis is dynamic-linear programming. This technique involves the simultaneous solving of a series of linear programs based on sequential time series data. Often the optimal output for one time period is used as input in the next time frame analysis. An optimum is obtained for the entire planning period for a given set of management objectives or alternatives.

Throsby, (1962) reviewed the application of a multi-period linear programming model in two examples of farm planning. The study of how sprinkler irrigation systems might affect the growth potential of farm and native pasture ranching activities in the Nebraska Sandhills region was investigated by Anderson, (1970) and a dynamic extension of the D'Aquino static linear programming was published by Bartlett, et al., (1974). Bartlett et al., (1974) employed a series of discrete continuous equations and the parametric programming technique known as "climbing the hill" on available capital tools.

Texas Agricultural Experiment Station, (1967) used dynamic L-P to evaluate investment in mesquite control and alternative beef cattle systems in Texas. Jansen, (1969) used dynamic L-P to develop optimum plans for the total range resource and considers range renovation cost and forage production while meeting prescribed levels of economic, social, legal, technical, and environmental objectives in his RANGE RAM model. An Oklahoma study by Barr and Plaxico, (1961) uses static and dynamic L-P analysis to evaluate potential range improvement practices and optimum livestock systems under varying management goals. A capital rationing model based on the marginal value product theory is also described. Pearse, (1963) states that L-P is a useful tool in analyzing benefits from renovation to seeded pastures if the analysis considered long term effects, differences in financing, alternative management objectives, values of rates of return to capital investment, stability of income, and relationships between marginal value of product of limiting resources. He parametrically varied key matrix coefficients as a means of sensitivity analysis of input variables and as a method of comparing these results to optimum

L-P analysis. His conclusions state that the additional cost, time, and results obtained from using parametric analysis methods were not worth it.

The practical application of computer program techniques involving risk and uncertainty in the forage-livestock sub-systems of a ranching situation have been few. Hunters application of optimum resource allocation through chance-constrained programming could be considered a form of quadratic programming (Hunter, 1974). Percent confidence intervals of risk and uncertainty for individual or groups of management variables such as forage growth or livestock prices were analyzed to determine the combination of management alternatives which would return stated firm goals within those intervals. Another attempt to incorporate management priority goals into the management planning process is shown by Bottoms, (1964). Since true optimum solutions in the analysis of management alternative combinations when each has its own static constraints are often not feasible, goal programming solves for the "as close as possible optimum" (quotes by this author) for each set of management goals in their order or priority. This allows for easy analysis of trade-off values of similar variables between goal priority solutions.

Another program developed by Christain, et al., (1972) searches for an optimum solution using the "hill climbing" technique of stepwise up or down evaluation of variable parameters until an optimum is found. This program will optimize for cost/benefit or rotation versus season long grazing type objectives.

Judgment Models

No practical applications of judgment programming models were reviewed.

In summary, computerized techniques of systems analysis have been applied to segments of the forage-livestock industry. None have been developed to adequately handle a total ranching situation. Possibly the greatest benefits derived from having used a systems approach to aid in the management decision-making process are not in the time conservation, accuracy or expansion of scope categories. The requirements of total resource inventory and objective analysis of economic and physical inputs from the various ranching firm sub-systems allow the ranch manager to better realize and understand some of the interactions between trophic levels and provides him a more complete picture of the total workings of his agribusiness firm.

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A-TABLE 1

RENOVATION ALTERNATIVE ANNUAL COST AND AUM RETURN

·esent ·lue $ ·r Inc. ·M Rec.	Renovation $ Per Ac. Applied	Total	Cost Per Renovation Technique Per Period				Total	Predicted AUMs Produced Per Period						Total	Acres Treated Per Period					Renovation Alternatives
			6	3	2	1		6	5	4	3	2	1		6	3	2	1		
1.30	.57	1161	387		387	387	3809	754	617	617	617	635	569	2034	678	0	678	678	Burn Only	1
3.52	1.28	3480	387	387	387	2319	3750	754	617	617	617	575	570	2712	678	678	678	559	Burn	2
																		119	Hydro-Ax	
2.77	1.14	3060	387	387	985	1301	3820	754	617	617	617	627	588	2692	678	678	658	581	Burn	3
																	22	75	Mow	
3.36	1.46	3906	387	1182	1173	1164	3813	754	617	617	617	635	573	2667	678	663	648	633	Burn	4
																15	15	15	Hand Clear	
1.46	.64	1742	387	387	387	581	3812	754	617	617	617	653	554	2712	678	678	678	498	Burn	5
																		180	Mist Blow	
2.32	.96	2616	387	387	387	1454	3812	754	617	617	617	653	534	2712	678	678	678	498	Burn	6
																		180	Aerial Spray	
3.08	1.21	3282	387	387	387	2120	3812	754	617	617	617	653	554	2712	678	678	678	498	Burn	7
																		180	Hand Spray	
4.06	1.47	3978	387	387	387	2815	3750	754	617	617	617	575	570	2712	678	678	678	559	Burn	8
																		119	Hydro-Ax	
																		10	Hand Clear	
4.76	1.32	3572	387	387	387	1410	3804	754	617	617	617	652	548	2712	687	687	687	498	Burn	9
																		50	Hydro-Ax	
																		130	Hand Spray	
2.75	1.07	2878	387	387	557	1565	3791	754	617	617	617	613	573	2692	678	678	658	571	Burn	10
																	22	75	Mow	
																		10	Hand Clear	
4.25	1.62	4391	387	387	387	3230	3801	754	617	617	617	653	544	2712	678	678	678	505	Burn	11
																		75	Mow	
																		105	Hand Spray	

A-TABLE 1--Continued

2.10	.86	2322	387	387	387	1159	3812	754	617	617	617	653	553	2719	678	678	678	505	Burn	
																		10	Hand Clear	12
																		170	Mist Blow	
3.01	1.18	3212	387	387	387	2050	3812	754	617	617	617	653	554	2729	678	678	678	505	Burn	
																		10	Hand Clear	13
																		180	Aerial Spray	
4.99	2.03	5510	387	387	387	4348	3875	754	617	617	617	653	553	2712	678	678	678	505	Burn	
																		10	Hand Clear	14
																		170	Hand Spray	
3.34	1.31	3638	387	387	1407	1458	3812	754	617	617	617	653	554	2769	678	678	628	505	Burn	
																		180	Aerial Spray	15
																	50		Hand Spray	
N.A.	0	0	0	0	0	0	2916	474	478	482	490	494	498	2712	678	678	678	678	Do Nothing	

nnual cost discounted 10 percent over six year planning period ÷ (Total AUMs received from renovation alternative--nothing AUM production).

A-TABLE 2

1976 LIVESTOCK NET WORTH
Buy 30 Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	24	2170	52080	0			1	250	250	30	1000	30000
3 yr. old	5	1320	6600	0			0			0		
2 yr. old	17	1200	20400	0			0			0		
Yearling heifers	25	525	13125	0			1	225	225	0		
Heifer calves	36	350	12600	15			5	154	770	15	0	0
Bull calves	36	500	1800	29			5	200	1000	15	0	0
Yearling bulls	12	1500	1800	11	1500	16500	0			0		
2 yr. old bulls	4	2000	8000	4	1500	6000	0			0		
FALL												
Mature cows	26	1560	40560	0			1	250	250	0		
3 yr. old	3	1000	3000	0			0			0		
2 yr. old	4	1060	4240	0			0			0		
Yearling heifers	6	1050	6300	0			0			0		
Heifer calves	16	300	4800	0			4	154	616	0		
Bull calves	16	450	7200	0			4	200	800	0		
Yearling bulls	8	1000	8000	8	1500	12000	0			0		
2 yr. old bulls	0	1500	0	0			0			0		
Herd bulls	3	10000	30000	1.5	10000	15000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	246		234505	68.5		59500	21		3911	60		35000

A-TABLE 3

1977 LIVESTOCK NET WORTH
Buy 30 Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	55	2170	119350	0			1	250	250	0		
3 yr. old	16	1320	21120	0			0			0		
2 yr. old	14	1200	16800	0			0			0		
Yearling heifers	31	525	16275	0			0			0		
Heifer calves	40	350	14000	0			5	154	770	0		
Bull calves	40	500	20000	0			5	200	1000	0		
Yearling bulls	17	1500	25500	0			0					
2 yr. old bulls	11	2000	22000	11	2000	44000						
FALL												
Mature cows	32	1560	49920	0			1	250	250	0		
3 yr. old	5	1000	5000	0			0			0		
2 yr. old	7	1060	7420	0			0			0		
Yearling heifers	12	1050	12600	0			0			0		
Heifer calves	21	300	6300	0			5	154	770	0		
Bull calves	21	450	9450	0			5	200	1000	0		
Yearling bulls	12	1000	12000	12	1500	18000	0			0		
2 yr. old bulls	4	1500	6000	4	2000	8000	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	345.5		402735	28		90000	22		4040	1000		5000

A-TABLE 4

1978 LIVESTOCK NET WORTH
Buy 30 Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	65	2170	141050	0			1	250	250	0		
3 yr. old	14	1320	18480	0			0			0		
2 yr. old	29	1200	34800	17	800	13600	0			0		
Yearling heifers	35	525	18375	22	600	13200	0			0		
Heifer calves	51	350	17850	0			3	154		0		
Bull calves	52	500	26000	0			4	200		0		
Yearling bulls	34	1500	51000	16	2000	32000	0			0		
2 yr. old bulls	16	2000	32000	16	2500	40000	0			0		
FALL												
Mature cows	39	1560	60840	0			1	250	250	0		
3 yr. old	7	1000	7000	0			0			0		
2 yr. old	14	1060	14840	8	1000	8000	0			0		
Yearling heifers	16	1050	16800	0			0			0		
Heifer calves	28	300	8400	0			3	154	462	0		
Bull calves	29	450	13050	0			4	200	800	0		
Yearling bulls	17	1000	17000	13	1000	13000	0			0		
2 yr. old bulls	0	1500	0	0			0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	452.5		516485	93		139800	16		1762	1000		5000

A-TABLE 5

1979 LIVESTOCK NET WORTH
Buy 30 Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	73	2170	158410	8	1000	8000	1	250	250	0		
3 yr. old	10	1320	13200	0			0			0		
2 yr. old	10	1200	12000	0			0			0		
Yearling heifers	48	525	25200	35	600	21000	0			0		
Heifer calves	43	350	15050	0			4	154	616	0		
Bull calves	44	500	22000	0			4	200	800	0		
Yearling bulls	48	1500	72000	45	2000	90000	0			0		
2 yr. old bulls	17	2000	34000	17	2500	42500	0			0		
FALL												
Mature cows	48	1560	74880	9	1200	10500	1	250	250	0		
3 yr. old	8	1000	8000	0			0			0		
2 yr. old	18	1060	19080	0			0			0		
Yearling heifers	17	1050	17850	0			0			0		
Heifer calves	35	300	10500	5	300	1500	5	154	770	0		
Bull calves	35	450	15750	4	450	1800	5	200	1000	0		
Yearling bulls	25	1000	25000	22	1000	22000	0			0		
2 yr. old bulls	4	1500	4500	4	2500	10000	0			0		
Herd bulls	2.5	10000	25000	1.0	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	5000	0			0					
TOTAL	490.5		566420	150		227300	20		3686	1000		5000

A-TABLE 6

1980 LIVESTOCK NET WORTH
Buy 30 Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	70	2170	151900	10	1000	1000	1	250	250	0		
3 yr. old	11	1320	14520	0			0			0		
2 yr. old	10	1200	12000	0			0			0		
Yearling heifers	39	525	20475	7	600	4200	0			0		
Heifer calves	13	250	15050	0			4	154	616	0		
Bull calves	43	500	21500	0			4	200	800	0		
Yearling bulls	39	1500	58500	38	2000	76000	0			0		
2 yr. old bulls	3	2000	6000	3	2500	7500	0			0		
FALL												
Mature cows	48	1560	74880	10	1200	12000	1	250	250	0		
3 yr. old	17	1000	17000	0			0			0		
2 yr. old	20	1060	21200	0			0			0		
Yearling heifers	26	1050	27300	17	500	8500	0			0		
Heifer calves	35	300	10500	5	0	0	5	154	770	0		
Bull calves	35	450	15750	5	0	0	5	200	1000	0		
Yearling bulls	26	1000	26000	22	2000	44000	0			0		
2 yr. old bulls	3	1500	4500	3	2500	7500	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	475.5		536075	121		189700	20		3686	1000		5000

A-TABLE 7

1981 LIVESTOCK NET WORTH
Buy 30 Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	69	2170	149730	6	1000	6000	1	250	250	0		
3 yr. old	11	1320	14520	3	900	2700	0			0		
2 yr. old	30	1200	36000	21	800	16800	1	250	250	0		
Yearling heifers	39	525	20475	23	600	13800	2	225	450	0		
Heifer calves	47	350	16450	0			5	154	770	0		
Bull calves	47	500	23500	0			5	200	1000	0		
Yearling bulls	38	1500	57000	32	2000	64000	1	200	200	0		
2 yr. old bulls	0	2000	0	0			0			0		
FALL												
Mature cows	56	1560	87360	42	1200	50400	3	250	750	0		
3 yr. old	19	1000	19000	0			0			0		
2 yr. old	12	1060	12720	7	750	5250	1	250	250	0		
Yearling heifers	25	1050	26250	14	500	7000	1	200	200	0		
Heifer calves	37	300	11100	0			4	154	616	0		
Bull calves	37	450	16650	0			4	200	800	0		
Yearling bulls	25	1000	25000	20	1500	30000	1	200	200	0		
2 yr. old bulls	4	1500	6000	4	2000	8000	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0					
TOTAL	503.5		560755	173		243950	29		5736	1000		5000

A-TABLE 8

1982 LIVESTOCK NET WORTH
Buy 30 Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	70	2170	151900	6	1000	6000	1	250	250	0		
3 yr. old	8	1320	10560	1	900	900	0			0		
2 yr. old	14	1200	16800	5	800	4000	1	250	250	0		
Yearling heifers	42	525	22050	26	600	15600	2	225		0		
Heifer calves	39	350	13650	0			4	154		0		
Bull calves	39	500	19500	0			4	200		0		
Yearling bulls	42	1500	63000	37	2000	74000	0			0		
2 yr. old bulls	4	2000	8000	4	2500	10000	0			0		
FALL												
Mature cows	30	1560	46800	2	1200	2400	1	250	250	0		
3 yr. old	4	1000	4000	1	1100	1100	0			0		
2 yr. old	10	1060	10600	5	750	3750	1	250	250	0		
Yearling heifers	33	1050	34650	22	500	11000	1	200	200	0		
Heifer calves	18	300	5400	0			2	154	154	0		
Bull calves	18	450	8100	0			2	200	200	0		
Yearling bulls	33	1000	33000	28	2000	56000	1	200	200	0		
2 yr. old bulls	4	1500	6000	4	2500	10000	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	415.5		493010	142		214750	20		1754	1000		5000

A-TABLE 9

1983 ANNUAL LIVESTOCK NET WORTH
Buy 30 Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	70	2170	151900	6	1000	6000	1	250	250	0		
3 yr. old	8	1320	10560	8	900	7200	1	250	250	0		
2 yr. old	14	1200	16800	5	800	4000	1	250	250	0		
Yearling heifers	35	525	18375	20	600	12000	1	225	225	0		
Heifer calves	39	350	13650	0			4	154	616	0		
Bull calves	39	500	19500	0			4	200	800	0		
Yearling bulls	35	2000	70000	30	2000	60000	1	200	200	0		
2 yr. old bulls	4	2500	10000	4	2500	10000	0			0		
FALL												
Mature cows	30	1560	46800	2	1200	2400	1	250	250	0		
3 yr. old	4	1000	4000	1	1100	1100	0			0		
2 yr. old	10	1060	10600	5	750	3750	1	250	250	0		
Yearling heifers	16	1050	16800	5	500	2500	1	200	200	0		
Heifer calves	18	300	5400	0			2	154	308	0		
Bull calves	18	450	8100	0			2	200	400	0		
Yearling bulls	16	1500	24000	12	2000	24000	0			0		
2 yr. old bulls	4	2000	8000	4	2500	10000	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	367.5		473485	103		184550	20		3999	1000		5000

A-TABLE 10

1976 LIVESTOCK NET WORTH
Replace From Within Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	24	2170	52080	0			1	250	250	0		
3 yr. old cows	5	1320	6600	0			0			0		
2 yr. old cows	16	1200	19200	0			0			0		
Yearling heifers	16	525	8400	6	500	3000	0			0		
Heifer calves	21	350	7350	2	350	700	1	154	154	0		
Bull calves	21	500	10500	2	500	1000	1	200	200	0		
Yearling bulls	12	1500	18000	11	1500	16500	0			0		
2 yr. old bulls	4	2000	800	4	2000	8000	0			0		
FALL												
Mature cows	25	1560	39000	0			1	250	250	0		
3 yr. old cows	8	1000	8000	0			0			0		
2 yr. old cows	7	1060	7420	0			0			0		
Yearling heifers	8	1050	8400	3	500	1500	0			0		
Heifer calves	16	300	4800	0			1	154	154	0		
Bull calves	16	450	7200	0			1	200	200	0		
Yearling bulls	8	1000	8000	4	1500	3000	0			0		
2 yr. old bulls	0	1500	0	0			0			0		
Herd bulls	3	10000	30000	1.5	10000	15000	0			0		
Seaman	2000	5	10000	2000	5	10000				1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	215		249750	30.5		54500	6		1208	1000		5000

A-TABLE 11

1977 LIVESTOCK NET WORTH
Replace From Within Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	28	2170	60760	0			1	250	250	0		
3 yr. old cows	16	1320	21120	0			1	250	250	0		
2 yr. old cows	10	1200	12000	0			0			0		
Yearling heifers	17	525	8925	7	500	3500	0			0		
Heifer calves	22	350	7700	2	350	700	1	154	154	0		
Bull calves	22	500	11000	2	500	1000	1	200	200	0		
Yearling bulls	17	1500	25500	16	2000	32000	0			0		
2 yr. old bulls	0			0			0			0		
FALL												
Mature cows	31	1560	48360	0			1	250		0		
3 yr. old cows	7	1000	7000	0			0			0		
2 yr. old cows	5	1060	5300	0			0			0		
Yearling heifers	14	1050	14700	6	500	3000	0			0		
Heifer calves	17	300	5100	2	300	600	1	154	154	0		
Bull calves	17	450	7650	2	450	900	1	200	200	0		
Yearling bulls	14	1000	14000	14	1500	21000	0			0		
2 yr. old bulls	4	1500	6000	4	2000	8000	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	248.5		304115	56		90700	7		1208	1000		5000

A-TABLE 12

1978 LIVESTOCK NET WORTH
Replace From Within Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	41	2170	88970	0			1	250	250	0		
3 yr. old cows	10	1320	13200	0			0			0		
2 yr. old cows	10	1200	12000	0			0			0		
Yearling heifers	18	525	9450	6	600	3600	1	225	225	0		
Heifer calves	25	350	8750	3	350	1050	1	154	154	0		
Bull calves	25	500	12500	2	500	1000	1	200	200	0		
Yearling bulls	18	1500	27000	12	2000	24000	0			0		
2 yr. old bulls	0			0			0			0		
FALL												
Mature cows	36	1560	56160	10	1200	12000	1	250	250	0		
3 yr. old cows	5	1000	5000	0			0			0		
2 yr. old cows	8	1060	8480	4	750	3000	0			0		
Yearling heifers	13	1050	13650	3	500	1500	0			0		
Heifer calves	20	300	6000	3	300	900	1	154	154	0		
Bull calves	20	450	9000	3	450	1350	1	200	200	0		
Yearling bulls	13	1000	13000	8	1000	8000	1	250	250	0		
2 yr. old bulls	0			0			0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	269.5		323160	55		76400	8		1683	1000		5000

A-TABLE 13

1979 LIVESTOCK NET WORTH
Replace From Within Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	50	2170	108500	0			1	250	250	0		
3 yr. old cows	10	1320	13200	0			0			0		
2 yr. old cows	11	1200	13200	0			1	250	250	0		
Yearling heifers	21	525	11025	7	600	4200	1	225	225	0		
Heifer calves	30	350	10500	3	350	1050	1	154	154	0		
Bull calves	30	500	15000	2	500	1000	1	200	200	0		
Yearling bulls	21	1500	31500	18	2000	36000	1	250	250	0		
2 yr. old bulls	4	2000	8000	4	2500	10000	0			0		
FALL												
Mature cows	30	1560	46800	1	1200	1200	2	250	500	0		
3 yr. old cows	4	1000	4000	1	1100	1100	0			0		
2 yr. old cows	10	1060	10600	6	750	4500	0			0		
Yearling heifers	16	1050	16800	6	500	3000	0			0		
Heifer calves	18	300	5400	2	300	600	0			0		
Bull calves	18	450	8100	2	450	900	0			0		
Yearling bulls	16	1000	16000	11	1000	31000	1	250	250	0		
2 yr. old bulls	4	1500	6000	4	2500	10000				0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	300.5		363625	68		104550	9		2079	1000		5000

A-TABLE 14

1980 LIVESTOCK NET WORTH
Replace From Within Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	59	2170	128030	0	1000		3	250	750	0		
3 yr. old cows	10	1320	13200	0			0			0		
2 yr. old cows	13	1200	26000	0			1	250	250	0		
Yearling heifers	26	525	13650	9	600	5400	1	225	225	0		
Heifer calves	35	350	12250	3	350	1050	1	154	154	0		
Bull calves	35	500	17500	2	500	1000	1	200	200	0		
Yearling bulls	26	1500	39000	21	2000	42000	1	250	250	0		
2 yr. old bulls	4	2000	8000	4	2500	10000	0			0		
FALL												
Mature cows	30	1560	46800	2	1200	2400	1	250	250	0		
3 yr. old cows	4	1000	4000	1	1100	1100	0			0		
2 yr. old cows	10	1060	10600	5	750	3750	1	250	250	0		
Yearling heifers	16	1050	16800	6	500	3000	0			0		
Heifer calves	18	300	5400	1	300	300	1	154	154	0		
Bull calves	18	450	8100	1	450	450	1	200	200	0		
Yearling bulls	16	1000	16000	11	2000	22000	1	250	250	0		
2 yr. old bulls	4	1500	6000	4	2500	10000	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	331.5		410330	71		122450	13		3183	1000		5000

A-TABLE 15

1981 LIVESTOCK NET WORTH
Replace From Within Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	66	2170	143220	2	1000	2000	6	250	1500	0		
3 yr. old cows	12	1320	15840	0			0			0		
2 yr. old cows	16	1200	19200	7	800	5600	1	250	250	0		
Yearling heifers	31	525	16275	20	600	12000	1	225	225	0		
Heifer calves	40	350	14000	15	350	5250	1	154	154	0		
Bull calves	40	500	20000	14	500	7000	1	200	200	0		
Yearling bulls	31	1500	46500	26	2000	52000	1	250	250	0		
2 yr. old bulls	4	2000	8000	4	2500	10000	0			0		
FALL												
Mature cows	30	1560	46800	2	1200	2400	1	250	250	0		
3 yr. old cows	4	1000	4000	1	1100	1100	0			0		
2 yr. old cows	10	1060	10600	6	750	4500	0			0		
Yearling heifers	16	1050	16800	5	500	2500	1	180	180	0		
Heifer calves	18	300	5400	1	300	300	1	154	154	0		
Bull calves	18	450	8100	1	450	450	1	200	200	0		
Yearling bulls	16	1000	16000	11	1500	16500	1	250	250	0		
2 yr. old bulls	4	1500	6000	4	2000	8000	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	363.5		434735	116		149600	16		3613	1000		5000

A-TABLE 16

1982 LIVESTOCK NET WORTH
Replace From Within Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	70	2170	151900	4	1000	4000	3	250	750	0		
3 yr. old cows	8	1320	10560	1	900	900	0			0		
2 yr. old cows	10	1200	12000	1	800	800	1	250	250	0		
Yearling heifers	24	525	12600	13	600	7800	1	225	225	0		
Heifer calves	37	350	12950	0			4	175	700	0		
Bull calves	37	500	18500	0			4	200	800	0		
Yearling bulls	24	1500	36000	15	2000	30000	1	250	250	0		
2 yr. old bulls	4	2000	8000	4	2500	10000	0			0		
FALL												
Mature cows	30	1560	46800	2	1200	2400	1	250	250	0		
3 yr. old cows	4	1000	4000	1	1100	1100	0			0		
2 yr. old cows	10	1060	10600	6	750	4500	0			0		
Yearling heifers	16	1050	16800	6	500	3000	0			0		
Heifer calves	18	300	5400	1	300	300	1	154	154	0		
Bull calves	18	450	8100	1	450	450	1	200	200	0		
Yearling bulls	16	1000	16000	11	2000	22000	1	250	250	0		
2 yr. old bulls	4	1500	6000	4	2500	10000	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	337.5		445210	71		117250	18		3829	1000		5000

A-TABLE 17

1983 ANNUAL LIVESTOCK NET WORTH
Replace From Within Option

Class	#	Value $/h	T	# Sell	$/head	T	# Cull	$/head	T	# Buy	$/unit	T
SPRING												
Mature cows	70	2170	151900	4	1000	4000	3	250	750	0		
3 yr. old cows	8	1320	10560	1	900	900	0			0		
2 yr. old cows	10	1200	12000	1	800	800	1	250	250	0		
Yearling heifers	33	525	17325	22	600	13200	1	225	225	0		
Heifer calves	37	350	12950	0			4	154	616	0		
Bull calves	37	500	18500	0			4	200	800	0		
Yearling bulls	33	2000	66000	31	2000	62000	1	250	250	0		
2 yr. old bulls	4	2500	10000	4	2500	10000	0			0		
FALL												
Mature cows	30	1560	46800	2	1200	2400	1	250	250	0		
3 yr. old cows	4	1000	4000	1	1100	1100	0			0		
2 yr. old cows	10	1060	10600	6	750	4500	0			0		
Yearling heifers	16	1050	16800	6	500	3000	0			0		
Heifer calves	18	300	5400	1	300	300	1	154	154	0		
Bull calves	18	450	8100	1	450	450	1	200	200	0		
Yearling bulls	16	1500	24000	11	2000	22000	1	250	250	0		
2 yr. old bulls	4	2000	8000	4	2500	10000	0			0		
Herd bulls	2.5	10000	25000	1	10000	10000	0			0		
Seaman	2000	5	10000	2000	5	10000	0			1000	5	5000
Horses	5	800	4000	0			0			0		
TOTAL	355.5		461935	96		154650	18		3745	1000		5000

A-TABLE 18

LIVESTOCK ANIMAL UNIT DEMAND

YEAR 1976

Class of Livestock	Jan		Feb		March		April		May		June		July		Aug		Sept		Oct		Nov		Dec	
	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT
A. Spring Herd																								
old cows (10+)	0																							
4-10 yrs.	24	1.2				1.3		1.2										1.1						1.0
3-4 yrs.	5	1.0								1.1														1.0
2-3 yrs.	17	.9												1.0										
yearling heifers	25	.9																						
heifer calves	0				36	.1										.2		.3		.4		.5		
bull calves	0				36	.1								.2		.3		.4		.5		.6		
B. Fall Herd																								
old cows (10+)	0																							
4-10 yrs.	26	1.2																1.3		1.1				1.0
3-4 yrs.	3	.9																		1.0				
2-3 yrs.	4	.7						.8												.9				
yearling heifers	6	.2				.3		.4						.5						.6				
heifer calves	0																		16	.1				
bull calves	0																		16	.1				
C. Mature bulls																								
herd bulls	3	1.3																						
sp. yearling bulls	12	1.0						1.1												1.2				
D. Stockers																								
Fall yr. bulls	8	.3				.4		.5				.6		.7		.8		.9		1.0				
Fall 2 yr. bulls	0	1.1								1.2														
E. Feeders																								
horses	5	1.3																						
sp. 2 yr. bulls	4	1.2																						
TOTAL																								

A-TABLE 19 LIVESTOCK ANIMAL UNIT DEMAND YEAR 1977

Class of Livestock	Jan N	Jan WT	Feb N	Feb WT	March N	March WT	April N	April WT	May N	May WT	June N	June WT	July N	July WT	Aug N	Aug WT	Sept N	Sept WT	Oct N	Oct WT	Nov N	Nov WT	Dec N	Dec WT
A. Spring Herd																								
old cows (10+)	0																							
4-10 yrs.	55	1.2				1.3		1.2										1.1						1.0
3-4 yrs.	16	1.0								1.1														1.0
2-3 yrs.	14	.9												1.0										
yearling heifers	31	.9																						
heifer calves	0				40	.1										.2		.3		.4		.5		
bull calves	0				40	.1								.2		.3		.4		.4		.6		
B. Fall Herd																								
old cows (10+)	0																							
4-10 yrs.	32	1.2																1.3		1.1				1.0
3-4 yrs.	5	.9																		1.0				
2-3 yrs.	7	.7						.8												.9				
yearling heifers	12	.2				.3		.4						.5						.6				
heifer calves	0																		21	.1				
bull calves	0																		21	.1				
C. Mature bulls																								
herd bulls	3	1.3																						
sp. yearling bulls	17	1.0						1.1												1.2				
D. Stockers																								
Fall yr. bulls	12	.3				.4		.5				.6		.7		.8		.9		1.0				
Fall 2 yr. bulls	4	1.1								1.2														
E. Feeders																								
horses	5	1.3																						
sp. 2 yr. bulls	11	1.2																						
TOTAL																								

A-TABLE 20 LIVESTOCK ANIMAL UNIT DEMAND YEAR 1978

Class of Livestock	Jan N	Jan WT	Feb N	Feb WT	March N	March WT	April N	April WT	May N	May WT	June N	June WT	July N	July WT	Aug N	Aug WT	Sept N	Sept WT	Oct N	Oct WT	Nov N	Nov WT	Dec N	Dec WT
A. Spring Herd																								
old cows (10+)	0																							
4-10 yrs.	65	1.2				1.3		1.2										1.1						1.0
3-4 yrs.	14	1.0								1.1														
2-3 yrs.	29	.9												1.0										
yearling heifers	35	.9																						
heifer calves	0				51	.1										.2		.3		.4		.5		
bull calves	0				52	.1								.2		.3		.4		.5		.6		
B. Fall Herd																								
old cows (10+)	0																							
4-10 yrs.	39	1.2																1.3		1.1				1.0
3-4 yrs.	7	.9																		1.0				
2-3 yrs.	14	.7						.8												.9				
yearling heifers	16	.2				.3		.4						.5						.6				
heifer calves	0																		28	.1				
bull calves	0																		29	.1				
C. Mature bulls																								
herd bulls	3	1.3																						
sp. yearling bulls	34	1.0						1.1												1.2				
D. Stockers																								
Fall yr. bulls	17	.3				.4		.5				.6		.7		.8		.9		1.0				
Fall 2 yr. bulls	0	1.1								1.2														
E. Feeders																								
horses	5	1.3																						
sp. 2 yr. bulls	16	1.2																						
TOTAL																								

A-TABLE 21 LIVESTOCK ANIMAL UNIT DEMAND YEAR 1979

Class of Livestock	Jan N	Jan WT	Feb N	Feb WT	March N	March WT	April N	April WT	May N	May WT	June N	June WT	July N	July WT	Aug N	Aug WT	Sept N	Sept WT	Oct N	Oct WT	Nov N	Nov WT	Dec N	Dec WT
A. Spring Herd																								
old cows (10+)	0																							
4-10 yrs.	73	1.2				1.3		1.2										1.1						1.0
3-4 yrs.	10	1.0								1.1														
2-3 yrs.	10	.9												1.0										
yearling heifers	48	.9																						
heifer calves	0				43	.1										.2		.3		.4		.5		
bull calves	0				44	.1								.2		.3		.4		.5		.6		
B. Fall Herd																								
old cows (10+)	0																							
4-10 yrs.	48	1.2																1.3		1.1				1.0
3-4 yrs.	8	.9																		1.0				
2-3 yrs.	18	.7						.8												.9				
yearling heifers	17	.2				.3		.4				.5								.6				
heifer calves	0																		35	.1				
bull calves	0																		35	.1				
C. Mature bulls																								
herd bulls	3	1.3																						
sp. yearling bulls	48	1.0						1.1												1.2				
D. Stockers																								
Fall yr. bulls	25	.3				.4		.5				.6		.7		.8		.9		1.0				
Fall 2 yr. bulls	4	1.1								1.2														
E. Feeders																								
horses	5	1.3																						
sp. 2 yr. bulls	17	1.2																						
TOTAL																								

A-TABLE 22

LIVESTOCK ANIMAL UNIT DEMAND

YEAR 1980

Class of Livestock	Jan		Feb		March		April		May		June		July		Aug		Sept		Oct		Nov		Dec	
	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT
A. Spring Herd																								
old cows (10+)	0																							
4-10 yrs.	70	1.2				1.3		1.2										1.1						1.0
3-4 yrs.	11	1.0								1.1														
2-3 yrs.	10	.9												1.0										
yearling heifers	39	.9																						
heifer calves	0				43	.1										.2		.3		.4		.5		
bull calves	0				43	.1								.2		.3		.4		.5		.6		
B. Fall Herd																								
old cows (10+)	0																							
4-10 yrs.	48	1.2																1.3		1.1				1.0
3-4 yrs.	17	.9																		1.0				
2-3 yrs.	20	.7						.8												.9				
yearling heifers	26	.2				.3		.4				.5								.6				
heifer calves	0																		35	.1				
bull calves	0																		35	.1				
C. Mature bulls																								
herd bulls	3	1.3																						
sp. yearling bulls	39	1.0						1.1												1.2				
D. Stockers																								
Fall yr. bulls	26	.3				.4		.5				.6		.7		.8		.9		1.0				
Fall 2 yr. bulls	3	1.1								1.2														
E. Feeders																								
horses	5	1.3																						
sp. 2 yr. bulls	3	1.2																						
TOTAL																								

A-TABLE 23 LIVESTOCK ANIMAL UNIT DEMAND YEAR 1981

Class of Livestock	Jan		Feb		March		April		May		June		July		Aug		Sept		Oct		Nov		Dec	
	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT
A. Spring Herd																								
old cows (10+)	0																							
4-10 yrs.	69	1.2				1.3		1.2										1.1						1.0
3-4 yrs.	11	1.0								1.1														
2-3 yrs.	30	.9												1.0										
yearling heifers	39	.9																						
heifer calves	0				47	.1										.2		.3		.4		.5		
bull calves	0				47	.1								.2		.3		.4		.5		.6		
B. Fall Herd																								
old cows (10+)	0																							
4-10 yrs.	56	1.2																1.3		1.1				1.0
3-4 yrs.	19	.9																		1.0				
2-3 yrs.	12	.7						.8												.9				
yearling heifers	25	.2				.3		.4				.5								.6				
heifer calves	0																		37	.1				
bull calves	0																		37	.1				
C. Mature bulls																								
herd bulls	3	1.3																						
sp. yearling bulls	38	1.0						1.1												1.2				
D. Stockers																								
Fall yr. bulls	25	.3				.4		.5				.6		.7		.8		.9		1.0				
Fall 2 yr. bulls	4	1.1								1.2														
E. Feeders																								
horses	5	1.3																						
sp. 2 yr. bulls	0	1.2																						
TOTAL																								

A-TABLE 24

LIVESTOCK ANIMAL UNIT DEMAND

YEAR 1982

Class of Livestock	Jan		Feb		March		April		May		June		July		Aug		Sept		Oct		Nov		Dec	
	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT	N	WT
A. Spring Herd																								
old cows (10+)	0																							
4-10 yrs.	70	1.2				1.3		1.2										1.1						1.0
3-4 yrs.	8	1.0								1.1														
2-3 yrs.	14	.9												1.0										
yearling heifers	42	.9																						
heifer calves	0				39	.1										.2		.3		.4		.5		
bull calves	0				39	.1								.2		.3		.4		.5		.6		
B. Fall Herd																								
old cows (10+)	0																							
4-10 yrs.	30	1.2																1.3		1.1				1.0
3-4 yrs.	4	.9																		1.0				
2-3 yrs.	10	.7						.8												.9				
yearling heifers	33	.2				.3		.4				.5								.6				
heifer calves	0																		18	.1				
bull calves	0																		18	.1				
C. Mature bulls																								
herd bulls	3	1.3																						
sp. yearling bulls	42	1.0						1.1												1.2				
D. Stockers																								
Fall yr. bulls	33	.3				.4		.5				.6		.7		.8		.9		1.0				
Fall 2 yr. bulls	4	1.1								1.2														
E. Feeders																								
horses	5	1.3																						
sp. 2 yr. bulls	4	1.2																						
TOTAL																								

A-TABLE 25

LIVESTOCK ANIMAL UNIT DEMAND

YEAR 1983-1990

Class of Livestock	Jan N	Jan WT	Feb N	Feb WT	March N	March WT	April N	April WT	May N	May WT	June N	June WT	July N	July WT	Aug N	Aug WT	Sept N	Sept WT	Oct N	Oct WT	Nov N	Nov WT	Dec N	Dec WT
A. Spring Herd																								
old cows (10+)	0																							
4-10 yrs.	70	1.2				1.3		1.2										1.1						1.0
3-4 yrs.	8	1.0								1.1														
2-3 yrs.	14	.9												1.0										
yearling heifers	35	.9																						
heifer calves	0				39	.1										.2		.3		.4		.5		
bull calves	0				39	.1								.2		.3		.4		.5		.6		
B. Fall Herd																								
old cows (10+)	0																							
4-10 yrs.	30	1.2																1.3		1.1				1.0
3-4 yrs.	4	.9																		1.0				
2-3 yrs.	10	.7						.8												.9				
yearling heifers	16	.2				.3		.4				.5								.6				
heifer calves	0																		18	.1				
bull calves	0																		18	.1				
C. Mature bulls																								
herd bulls	3	1.3																						
sp. yearling bulls	35	1.0						1.1												1.2				
D. Stockers																								
Fall yr. bulls	16	.3				.4		.5				.6		.7		.8		.9		1.0				
Fall 2 yr. bulls	4	1.1								1.2														
E. Feeders																								
horses	5	1.3																						
sp. 2 yr. bulls	4	1.2																						
TOTAL																								

A-TABLE 26

FORAGE PRODUCTION
AUMS

YEAR 1976

Type	J	P*	F	P	M	P	A	P	M	P	J	P	J	P	A	P	S	P	O	P	N	P	D	P
A. Native Range																								
Pasture 1	44	1	44	1	22	1	22	1			19	2	38	1	38	1	38	1	19	1			44	3
Pasture 2											10	2	20	1	20	1	20	1	10	1				
Pasture 3											9	2	19	1	19	1	19	1	10	1				
Pasture 4											15	2	30	1	30	1	30	1	15	1				
Pasture 5											17	2	35	1	35	1	35	1	18	1				
Pasture 6											14	2	28	1	28	1	28	1	14	1				
B. Cool-Season																								
Pasture 1							54	2	108	1	54	1							54	2	108	1		
Pasture 2							48	2	96	1	48	1							48	2	96	1		
Pasture 3							53	2	105	1	43	1							53	2	105	1		
Pasture 4																			45	3	90	1		
C. Other Grazing																								
Pasture 1																								
Pasture 2																							25	2
Pasture 3																							50	1
Pasture 4																								
D. Hay																								
Native																								
Cool-Season	38	2	25	2	30	2	17	3	8	2	2	3	0		3	2	5	2	10	4	16	3	18	3
Legume	22	3	36	3	40	3	20	4	11	3	3	4	0		3	3	3	3	11	5	17	4	22	4
E. Other Fed Forages																								
TOTAL																								

*Priority 1-18

A-TABLE 27

FORAGE PRODUCTION
AUMS

YEAR 1977

Type	J	P*	F	P	M	P	A	P	M	P	J	P	J	P	A	P	S	P	O	P	N	P	D	P
A. Native Range																								
Pasture 1	44	1	44	1	22	1	22	1			22	2	44	1	44	1	44	1	22	1			44	3
Pasture 2											14	2	28	1	28	1	28	1	14	1				
Pasture 3											9	2	19	1	19	1	19	1	10	1				
Pasture 4											16	2	33	1	33	1	33	1	17	1				
Pasture 5											19	2	38	1	38	1	38	1	19	1				
Pasture 6											15	2	30	1	30	1	30	1	15	1				
B. Cool-Season																								
Pasture 1							54	2	108	1	54	1							54	2	108	1		
Pasture 2							48	2	96	1	48	1							48	2	96	1		
Pasture 3							53	2	105	1	43	1							53	2	105	1		
Pasture 4																			45	3	90	1		
C. Other Grazing																								
Pasture 1																								
Pasture 2																							25	2
Pasture 3																							50	1
Pasture 4																								
D. Hay																								
Native	60	2	40	2	64	2	37	3	18	2	3	3	0		6	2	12	2	24	4	38	3	45	3
Cool-Season	34	3	56	3	85	3	43	4	21	3	6	4	0		6	3	6	3	38	5	41	4	52	4
Legume																								
E. Other Fed Forages																								
TOTAL																								

*Priority 1-18

A-TABLE 28

FORAGE PRODUCTION
AUMS

YEAR 1978

Type	J	P*	F	P	M	P	A	P	M	P	J	P	J	P	A	P	S	P	O	P	N	P	D	P
A. Native Range																								
Pasture 1	44	1	44	1	22	2	22	2			22	2	43	1	43	1	43	1	22	1			44	3
Pasture 2											13	2	26	1	26	1	26	1	13	1				
Pasture 3											9	2	19	1	19	1	19	1	10	1				
Pasture 4											16	2	33	1	33	1	33	1	17	1				
Pasture 5											18	2	36	1	36	1	36	1	18	1				
Pasture 6											15	2	30	1	30	1	30	1	15	1				
B. Cool-Season																								
Pasture 1							54	2	108	1	54	1							54	2	108	1		
Pasture 2							48	2	96	1	48	1							48	2	96	1		
Pasture 3							53	2	105	1	43	1							53	2	105	1		
Pasture 4																			45	3	90	1		
C. Other Grazing																								
Pasture 1																								
Pasture 2																							25	2
Pasture 3																							50	1
Pasture 4																								
D. Hay																								
Native	78	2	52	2	82	2	47	3	23	2	4	3	0		8	2	16	2	31	4	49	3	58	3
Cool-Season	43	3	72	3	109	3	55	4	27	3	8	4	0		8	3	8	3	36	5	54	4	15	4
Legume																								
E. Other Fed Forages																								
TOTAL																								

*Priority 1-18

A-TABLE 29

FORAGE PRODUCTION
AUMS

YEAR 1979

Type	J	P*	F	P	M	P	A	P	M	P	J	P	J	P	A	P	S	P	O	P	N	P	D	P
A. Native Range																								
Pasture 1	44	1	44	1	22	2	22	2			22	2	43	1	43	1	43	1	22	1			44	3
Pasture 2											13	2	26	1	26	1	26	1	13	1				
Pasture 3											9	2	19	1	19	1	19	1	10	1				
Pasture 4											16	2	33	1	33	1	33	1	17	1				
Pasture 5											18	2	36	1	36	1	36	1	18	1				
Pasture 6											15	2	30	1	30	1	30	1	15	1				
B. Cool-Season																								
Pasture 1							54	2	108	1	54	1							54	2	108	1		
Pasture 2							48	2	96	1	48	1							48	2	96	1		
Pasture 3							53	2	105	1	43	1							53	2	105	1		
Pasture 4																			45	3	90	1		
C. Other Grazing																								
Pasture 1																								
Pasture 2																							25	2
Pasture 3																							50	1
Pasture 4																								
D. Hay																								
Native	90	2	60	2	88	2	51	3	25	2	4	3	0		9	2	18	2	34	4	54	1	64	4
Cool-Season	50	3	84	3	118	3	59	4	29	3	9	4	0		9	3	9	3	39	5	59	2	74	5
Legume																								
E. Other Fed Forages																								
TOTAL																								

*Priority 1-18

A-TABLE 30

FORAGE PRODUCTION
AUMS

YEAR 1980

Type	J	P*	F	P	M	P	A	P	M	P	J	P	J	P	A	P	S	P	O	P	N	P	D	P
A. Native Range																								
Pasture 1	44	1	44	1	22	2	22	2			22	2	43	1	43	1	43	1	22	1			44	3
Pasture 2											13	2	26	1	26	1	26	1	13	1				
Pasture 3											9	2	19	1	19	1	19	1	10	1				
Pasture 4											16	2	33	1	33	1	33	1	17	1				
Pasture 5											18	2	36	1	36	1	36	1	18	1				
Pasture 6											15	2	30	1	30	1	30	1	15	1				
B. Cool-Season																								
Pasture 1							54	2	108	1	54	1							54	2	108	1		
Pasture 2							48	2	96	1	48	1							48	2	96	1		
Pasture 3							53	2	105	1	43	1							53	2	105	1		
Pasture 4																			45	3	90	1		
C. Other Grazing																								
Pasture 1																								
Pasture 2																							25	2
Pasture 3																							50	1
Pasture 4																								
D. Hay																								
Native	86	2	58	2	85	2	49	3	24	2	4	3	0		8	2	8	2	33	4	52	3	62	3
Cool-Season	48	3	80	3	114	3	57	4	28	3	8	4	0		8	3	4	3	38	5	57	4	71	4
Legume																								
E. Other Fed Forages																								
TOTAL																								

*Priority 1-18

A-TABLE 31

FORAGE PRODUCTION
AUMS

YEAR 1981

Type	J	P*	F	P	M	P	A	P	M	P	J	P	J	P	A	P	S	P	O	P	N	P	D	P
A. Native Range																								
Pasture 1	44	1	44	1	22	2	22	2			26	2	53	1	53	1	53	1	27	1			44	3
Pasture 2											16	2	32	1	32	1	32	1	16	1				
Pasture 3											12	2	23	1	23	1	23	1	13	1				
Pasture 4											20	2	40	1	40	1	40	1	20	1				
Pasture 5											17	2	45	1	45	1	45	1	18	1				
Pasture 6											18	2	36	1	36	1	36	1	18	1				
B. Cool-Season																								
Pasture 1							54	2	108	1	54	1							54	2	108	1		
Pasture 2							48	2	96	1	48	1							48	2	96	1		
Pasture 3							53	2	105	1	43	1							53	2	105	1		
Pasture 4																			45	3	90	1		
C. Other Grazing																								
Pasture 1																								
Pasture 2																							25	2
Pasture 3																							50	1
Pasture 4																								
D. Hay																								
Native	91	2	60	2	90	2	56	3	26	2	4	3	0		9	2	18	2	35	4	55	2	45	3
Cool-Season	50	3	84	3	120	3	60	4	30	3	9	4	0		9	3	9	3	40	5	60	3	52	4
Legume																								
E. Other Fed Forages																								
TOTAL																								

*Priority 1-18

A-TABLE 32

FORAGE PRODUCTION
AUMS

YEAR 1982

Type	J	P*	F	P	M	P	A	P	M	P	J	P	J	P	A	P	S	P	O	P	N	P	D	P
A. Native Range																								
Pasture 1	44	1	44	1	22	2	22	2			22	2	43	1	43	1	43	1	22	1			44	3
Pasture 2											13	2	26	1	26	1	26	1	13	1				
Pasture 3											9	2	19	1	19	1	19	1	10	1				
Pasture 4											16	2	33	1	33	1	33	1	17	1				
Pasture 5											18	2	36	1	36	1	36	1	18	1				
Pasture 6											15	2	30	1	30	1	30	1	15	1				
B. Cool-Season																								
Pasture 1							54	3	108	1	54	1							54	2	108	1		
Pasture 2							48	3	96	1	48	1							48	2	96	1		
Pasture 3							53	3	105	1	43	1							53	2	105	1		
Pasture 4																			45	3	90	1		
C. Other Grazing																								
Pasture 1																								
Pasture 2																							25	2
Pasture 3																							50	1
Pasture 4																								
D. Hay																								
Native	86	2	54	2	80	2	46	3	23	2	4	3	0		8	2	16	2	29	3	42	2	54	3
Cool-Season	45	3	76	3	106	3	53	4	27	3	8	4	0		8	3	8	3	33	4	50	3	62	4
Legume																								
E. Other Fed Forages																								
TOTAL																								

*Priority 1-18

A-TABLE 33

FORAGE PRODUCTION
AUMS

YEAR 1983

Type	J	P*	F	P	M	P	A	P	M	P	J	P	J	P	A	P	S	P	O	P	N	P	D	P
A. Native Range																								
Pasture 1	44	1	44	1	22	2	22	2			26	2	53	1	53	1	53	1	27	1			44	3
Pasture 2											16	2	32	1	32	1	32	1	16	1				
Pasture 3											12	2	23	1	23	1	23	1	13	1				
Pasture 4											20	2	40	1	40	1	40	1	20	1				
Pasture 5											17	2	45	1	45	1	45	1	18	1				
Pasture 6											18	2	36	1	36	1	36	1	18	1				
B. Cool-Season																								
Pasture 1							54	2	108	1	54	1							54	1				
Pasture 2							48	2	96	1	48	1							48	1				
Pasture 3							53	2	105	1	43	1							53	1				
Pasture 4																			45	1				
C. Other Grazing																								
Pasture 1																								
Pasture 2																							25	2
Pasture 3																							50	1
Pasture 4																								
D. Hay																								
Native	69	2	46	2	70	2	40	3	20	2	3	3	0		7	2	14	2	26	4	40	3	48	3
Cool-Season	38	3	64	3	93	3	46	4	23	3	7	4	0		7	3	7	3	29	5	44	4	55	4
Legume																								
E. Other Fed Forages																								
TOTAL																								

*Priority 1-18

A - TABLE. 34

1976 - BUY 30 OPTION

FORAGE FLOW ANALYSIS

MONTH	AUM DEMAND	AVAILABLE	FROM	SLACK	COMMENTS
JAN	111	104	3	-7	
FEB	111	105	3	-6	
MARCH	112	92	3	-20	
APRIL	115	214	2	99	
MAY	115	328	1	213	
JUNE	115	234	1	119	
JULY	123	170	1	47	
AUG	131	176	1	45	
SEPT	137	178	1	41	
OCT	149	307	2	158	
NOV	157	432	1	275	
DEC	157	159	4	2	
TOTAL	1533	2499	**	966	

A - TABLE.35

1977 - BLY 30 OPTION

FORAGE FLOW ANALYSIS

MONTH	AUM DEMAND	AVAILABLE	FROM	SLACK	COMMENTS
JAN	177	138	3	-39	
FEB	177	140	3	-37	
MARCH	179	171	3	-8	
APRIL	183	257	3	74	
MAY	184	348	1	164	
JUNE	184	249	2	65	
JULY	193	192	1	-1	
AUG	202	204	3	2	
SEPT	207	210	3	3	
OCT	221	349	2	128	
NOV	230	478	1	248	
DEC	230	216	4	-14	
TOTAL	2367	2952	**	585	

A - TABLE. 36

1978 - BLY 30 OPTION

FORAGE FLOW ANALYSIS

MONTH	AUM DEMAND	AVAILABLE	FROM	SLACK	COMMENTS
JAN	227	165	3	-62	
FEB	227	168	3	-59	
MARCH	230	213	3	-17	
APRIL	236	279	4	43	
MAY	236	387	1	151	
JUNE	236	249	2	13	
JULY	248	187	1	-61	
AUG	260	203	3	-57	
SEPT	267	206	3	-61	
OCT	287	362	3	75	
NOV	298	502	1	204	
DEC	298	192	4	-106	
TOTAL	3050	3113	**	63	

A - TABLE. 37

1979 - BUY 30 OPTION

FORAGE FLOW ANALYSIS

MONTH	AUM DEMAND	AVAILABLE	FROM	SLACK	COMMENTS
JAN	257	184	3	-73	
FEB	257	188	3	-69	
MARCH	262	228	3	-34	
APRIL	270	287	4	17	
MAY	270	363	1	93	
JUNE	274	250	4	-24	
JULY	282	187	1	-95	
AUG	292	205	3	-87	
SEPT	298	214	3	-84	
OCT	317	368	4	51	
NOV	327	512	1	185	
DEC	327	257	5	-70	
TOTAL	3433	3243	**	-190	

A - TABLE. 38

1980 - BUY 30 OPTION

FORAGE FLOW ANALYSIS

MONTH	AUM DEMAND	AVAILABLE	FROM	SLACK	COMMENTS
JAN	236	178	3	-58	
FEB	236	182	3	-54	
MARCH	241	221	3	-20	
APRIL	251	283	4	32	
MAY	251	361	1	110	
JUNE	257	249	4	-8	
JULY	264	187	1	-77	
AUG	275	203	3	-72	
SEPT	280	199	3	-81	
OCT	301	366	4	65	
NOV	310	508	1	198	
DEC	310	252	4	-58	
TOTAL	3212	3189	**	-23	

A - TABLE. 39

1981 - BUY 30 OPTION

FORAGE FLOW ANALYSIS

MONTH	AUM DEMAND	AVAILABLE	FROM	SLACK	COMMENTS
JAN	251	185	3	-66	
FEB	251	188	3	-63	
MARCH	256	232	3	-24	
APRIL	265	289	4	24	
MAY	265	365	1	100	
JUNE	271	267	4	-4	
JULY	281	229	1	-52	
AUG	292	247	3	-45	
SEPT	299	256	3	-43	
OCT	319	387	4	68	
NOV	329	514	1	185	
DEC	329	261	5	-68	
TOTAL	3408	3420	**	12	

A - TABLE. 40

1982 - BUY 30 OPTION

FORAGE FLOW ANALYSIS

MONTH	AUM DEMAND	AVAILABLE	FROM	SLACK	COMMENTS
JAN	212	175	3	-37	
FEB	212	174	3	-38	
MARCH	219	208	3	-11	
APRIL	230	276	4	46	
MAY	231	359	1	128	
JUNE	238	249	3	11	
JULY	246	187	1	-59	
AUG	256	203	3	-53	
SEPT	262	211	3	-51	
OCT	280	357	3	77	
NOV	289	491	1	202	
DEC	289	235	4	-54	
TOTAL	2964	3125	**	161	

A - TABLE. 41

1983 - BUY 30 OPTION

FORAGE FLOW ANALYSIS

MONTH	AUM DEMAND	AVAILABLE	FROM	SLACK	COMMENTS
JAN	196	151	3	-45	
FEB	196	154	3	-42	
MARCH	199	185	3	-14	
APRIL	205	263	3	58	
MAY	205	352	1	147	
JUNE	209	247	2	38	
JULY	216	187	1	-29	
AUG	225	201	3	-24	
SEPT	229	208	3	-21	
OCT	245	350	2	105	
NOV	254	483	1	229	
DEC	254	222	4	-32	
TOTAL	2633	3003	**	370	

INVESTMENT FEASIBILITY ANALYSIS

A-TABLE 42. MILL CREEK HERFORD - IRR-C-ALTERNATIVE AA - BUY 30 COWS 1976

INTERNAL RETURN ON TOTAL CAPITAL 4.642 PERCENT

PERIOD NO.	PERIOD IDENT.	INVESTMENT (DOLLARS) FACILITIES	INVESTMENT (DOLLARS) WORKING CAPITAL	INVESTMENT (DOLLARS) TOTAL	OPERATING (DOLLARS) TOTAL REVENUE	OPERATING (DOLLARS) OPERATING EXPENSES **	OPERATING (DOLLARS) NET REVENUE	PRESENT VALUE FACTOR	PRESENT VALUE TOTAL INVESTMENT	PRESENT VALUE NET REVENUE
1	1976	353500.	266356.	619856.	75996.	115816.	-39820.	0.9556	592357.	-38053.
2	1977	0.	201176.	201176.	105625.	125522.	-18897.	0.9132	183722.	-17257.
3	1978	0.	147833.	147833.	154147.	140395.	13762.	0.8727	129017.	12010.
4	1979	0.	84553.	84553.	243571.	145540.	98031.	0.8340	70518.	81759.
5	1980	0.	4744.	4744.	205971.	149604.	56367.	0.7970	3781.	44925.
6	1981	0.	60468.	60468.	262271.	156918.	105353.	0.7616	46055.	80242.
7	1982	0.	-32442.	-32442.	229089.	139666.	89423.	0.7279	-23613.	65087.
8	1983	0.	15804.	15804.	201134.	138615.	62519.	0.6956	10993.	43486.
9	1984	0.	35562.	35562.	201134.	140282.	60852.	0.6647	23638.	40449.
10	1985	0.	35905.	35905.	201134.	141984.	59150.	0.6352	22808.	37573.
11	1986	0.	36211.	36211.	201134.	143827.	57307.	0.6070	21981.	34788.
12	1987	0.	36548.	36548.	201134.	146339.	54795.	0.5801	21202.	31787.
13	1988	0.	36883.	36883.	201134.	147301.	53833.	0.5544	20447.	29843.
14	1989	0.	37222.	37222.	201134.	149147.	51987.	0.5258	19719.	27542.
15	1990	-353500.	-566823.	-1320323.	0.	0.	0.	0.5063	-668445.	0.
	TOTAL	0.	0.	0.	2685608.	1980946.	704662.		474180.	474180.

INTEREST PER CENT	BENEFIT/COST RATIO	PRESENT VALUE IN DOLLARS REVENUE	PRESENT VALUE IN DOLLARS OUTLAY	PRESENT VALUE IN DOLLARS BALANCE
5.000	0.928	460485.	496308.	-35823.
10.000	0.454	310441.	684062.	-373621.
15.000	0.289	214385.	740733.	-526349.
25.000	0.149	107032.	719675.	-612642.
35.000	0.083	54327.	656752.	-602425.
50.000	0.030	16990.	567354.	-550364.

**EXCLUDING DEPRECIATION, INTEREST, AND INCOME TAX

ALTERNATIVE: HERD EXPENSES INCLUDE ANNUAL FORAGE INCREASES FROM ALTERNATIVE

A LISTING OF THE DATA

1241 1 C 0.0

A-TABLE 43. MILL CREEK HERFORD - IRR-C-ALTERNATIVE AA - BUY 30 COWS 1976

PERIOD	FACILITIES	WORK. CAP.	LVSTK SALES	O. SALES	RANCH EXP.	HERD EXP.	ALT. FC	ALT. VC	
11976	353500.	266356.	63411.	12585.	75519.	39910.	171.	216.	0.
21977	0.	201176.	94040.	12585.	76578.	48512.	171.	261.	0.
31978	0.	147833.	141562.	12585.	78066.	62319.	0.	0.	0.
41979	0.	84553.	230986.	12585.	79488.	66052.	0.	0.	0.
51980	0.	4744.	193386.	12585.	80983.	68621.	0.	0.	0.
61981	0.	60468.	249686.	12585.	82653.	73711.	171.	383.	0.
71982	0.	-32442.	216504.	12585.	84230.	54844.	171.	421.	0.
81983	0.	15804.	188549.	12585.	85858.	52757.	0.	0.	0.
91984	0.	35562.	188549.	12585.	87575.	52707.	0.	0.	0.
101985	0.	35905.	188549.	12585.	89327.	52657.	0.	0.	0.
111986	0.	36211.	188549.	12585.	91113.	51927.	171.	616.	0.
121987	0.	36548.	188549.	12585.	92935.	52557.	171.	676.	0.
131988	0.	36883.	188549.	12585.	94794.	52507.	0.	0.	0.
141989	0.	37222.	188549.	12585.	96690.	52457.	0.	0.	0.
151990	-353500.	-966823.	0.	0.	0.	0.	0.	0.	0.

INVESTMENT FEASIBILITY ANALYSIS

A-TABLE 44.- MILL CREEK HEREFORD - IRR-B-ALTERNATIVE 0 - REPLACEMENT FROM WITHIN

INTERNAL RETURN ON TOTAL CAPITAL 0.807 PERCENT

PERIOD NO.	PERIOD IDENT.	INVESTMENT (DOLLARS) FACILITIES	INVESTMENT (DOLLARS) WORKING CAPITAL	INVESTMENT (DOLLARS) TOTAL	OPERATING (DOLLARS) TOTAL REVENUE	OPERATING (DOLLARS) OPERATING EXPENSES **	OPERATING (DOLLARS) NET REVENUE	PRESENT VALUE FACTOR	PRESENT VALUE TOTAL INVESTMENT	PRESENT VALUE NET REVENUE
1	1976	353500.	281601.	635101.	68293.	108067.	-39774.	0.9920	630017.	-39456.
2	1977	0.	87311.	87311.	104493.	115366.	-10873.	0.9841	85919.	-10700.
3	1978	0.	53137.	53137.	90668.	120507.	-29839.	0.9762	51871.	-29128.
4	1979	0.	75083.	75083.	119214.	125180.	-5966.	0.9684	72708.	-5777.
5	1980	0.	81794.	81794.	138218.	131381.	6837.	0.9606	78572.	6568.
6	1981	0.	60203.	60203.	165798.	138728.	27070.	0.9529	57369.	25796.
7	1982	0.	15778.	15778.	133664.	135892.	-2228.	0.9453	14915.	-2106.
8	1983	0.	81964.	81964.	170980.	140189.	30791.	0.9377	76860.	28874.
9	1984	0.	35562.	35562.	170980.	141956.	29024.	0.9302	33081.	26999.
10	1985	0.	35905.	35905.	170980.	143758.	27222.	0.9228	33132.	25120.
11	1986	0.	36211.	36211.	170980.	146274.	24706.	0.9154	33147.	22616.
12	1987	0.	36548.	36548.	170980.	147466.	23514.	0.9081	33188.	21352.
13	1988	0.	36883.	36883.	170980.	149375.	21605.	0.9008	33224.	19462.
14	1989	0.	37222.	37222.	170980.	151321.	19659.	0.8936	33261.	17567.
15	1990	-353500.	-955202.	-1308702.	0.	0.	0.	0.8864	-1160080.	0.
	TOTAL	0.	0.	0.	2017208.	1895460.	121748.		107186.	107186.

INTEREST PER CENT	BENEFIT/COST RATIO	PRESENT VALUE IN DOLLARS REVENUE	PRESENT VALUE IN DOLLARS OUTLAY	PRESENT VALUE IN DOLLARS BALANCE
5.000	0.110	50734.	462767.	-412033.
10.000	0.018	11500.	632286.	-620786.
15.000	-0.015	-10534.	679589.	-690123.
25.000	-0.046	-29855.	653433.	-683289.
35.000	-0.059	-35252.	593393.	-628645.
50.000	-0.069	-35148.	512536.	-547684.

**EXCLUDING DEPRECIATION, INTEREST, AND INCOME TAX

ALTERNATIVE: HERD EXPENSES INCLUDE ANNUAL FORAGE DECREASES FROM NO ALTERNATIVE

A LISTING OF THE DATA

1241 1 0 0.0

A-TABLE 45. MILL CREEK HEREFORD - IRR-B-ALTERNATIVE 0 - REPLACEMENT FROM WITHIN

PERIOD	FACILITIES	WORK. CAP.	LVSTK SALES	C. SALES	RANCH EXP.	HERD EXP.	ALT. FC	ALT. VC	
11976	353500.	281601.	55708.	12585.	75519.	32548.	0.	0.	0.
21977	0.	87311.	91908.	12585.	76578.	38788.	0.	0.	0.
31978	0.	53137.	78083.	12585.	78066.	42441.	0.	0.	0.
41679	0.	75083.	106629.	12585.	79488.	45692.	0.	0.	0.
51980	0.	81794.	125633.	12585.	80983.	50398.	0.	0.	0.
61981	0.	60203.	153213.	12585.	82653.	56075.	0.	0.	0.
71982	0.	15778.	121079.	12585.	84230.	51662.	0.	0.	0.
81983	0.	81964.	158395.	12585.	85858.	54331.	0.	0.	0.
91984	0.	35562.	158395.	12585.	87575.	54381.	0.	0.	0.
101985	0.	35905.	158395.	12585.	89327.	54431.	0.	0.	0.
111986	0.	36211.	158395.	12585.	91113.	55161.	0.	0.	0.
121987	0.	36548.	158395.	12585.	92935.	54531.	0.	0.	0.
131988	0.	36883.	158395.	12585.	94794.	54581.	0.	0.	0.
141989	0.	37222.	158395.	12585.	96690.	54631.	0.	0.	0.
151990	-353500.	-955202.	0.	0.	0.	0.	0.	0.	0.

I N V E S T M E N T   F E A S I B I L I T Y   A N A L Y S I S

A-TABLE 46. MILL CREEK HERFORD - IRR-A-ALTERNATIVE AA - REPLACEMENT FROM WITHIN

INTERNAL RETURN ON TOTAL CAPITAL 1.104 PERCENT

PERIOD		INVESTMENT (DOLLARS)			OPERATING (DOLLARS)			PRESENT	PRESENT VALUE	
NO.	IDENT.	FACILITIES	WORKING CAPITAL	TOTAL	TOTAL REVENUE	OPERATING EXPENSES **	NET REVENUE	VALUE FACTOR	TOTAL INVESTMENT	NET REVENUE
1	1976	353500.	281601.	635101.	68293.	106794.	-38501.	0.9891	628168.	-38081.
2	1977	0.	87311.	87311.	104493.	112718.	-8225.	0.9783	85415.	-8046.
3	1978	0.	53137.	53137.	90668.	117687.	-27019.	0.9676	51416.	-26144.
4	1679	0.	75083.	75083.	119214.	122260.	-3046.	0.9570	71858.	-2915.
5	1980	0.	81794.	81794.	138218.	128361.	9857.	0.9466	77426.	9331.
6	1981	0.	60203.	60203.	165798.	134802.	30996.	0.9363	56366.	29020.
7	1982	0.	15778.	15778.	133664.	133264.	400.	0.9260	14611.	370.
8	1983	0.	81964.	81964.	170980.	136869.	34111.	0.9159	75073.	31243.
9	1984	0.	35562.	35562.	170980.	138536.	32444.	0.9059	32217.	29392.
10	1985	0.	35905.	35905.	170980.	140238.	30742.	0.8960	32172.	27546.
11	1986	0.	36211.	36211.	170980.	142081.	28899.	0.8863	32092.	25612.
12	1987	0.	36548.	36548.	170980.	144593.	26387.	0.8766	32037.	23130.
13	1988	0.	36883.	36883.	170980.	145555.	25425.	0.8670	31978.	22044.
14	1989	0.	37222.	37222.	170980.	147401.	23579.	0.8575	31920.	20220.
15	1990	-353500.	-955202.	-1308702.	0.	0.	0.	0.8482	-1110025.	0.
	TOTAL	0.	0.	0.	2017208.	1851159.	166049.		142723.	142723.

INTEREST PER CENT	BENEFIT/COST RATIO	PRESENT VALUE IN DOLLARS REVENUE	OUTLAY	BALANCE
5.000	0.175	81020.	462767.	-381747.
10.000	0.053	33279.	632286.	-599007.
15.000	0.009	5827.	679589.	-673762.
25.000	-0.030	-19598.	653433.	-673032.
35.000	-0.047	-28112.	593393.	-621506.
50.000	-0.059	-30431.	512536.	-542966.

**EXCLUDING DEPRECIATION, INTEREST, AND INCOME TAX

ALTERNATIVE: HERD EXPENSES INCLUDE ANNUAL FORAGE INCREASES FROM ALTERNATIVE

A LISTING OF THE DATA

11241 1 0 0.C

A-TABLE 47.A MILL CREEK HEREFORD - IRR-A-ALTERNATIVE AA - REPLACEMENT FROM WITHIN

PERIOD	FACILITIES	WORK. CAP.	LVSTK SALES	O. SALES	RANCH EXP.	HERD EXP	ALT. FC	ALT. VC	
11976	353500.	281601.	55708.	12585.	75519.	30888.	171.	216.	0.
21977	0.	87311.	91908.	12585.	76578.	35708.	171.	261.	0.
31978	0.	53137.	78083.	12585.	78066.	39621.	0.	0.	0.
41679	0.	75083.	106629.	12585.	79488.	42772.	0.	0.	0.
51980	0.	81794.	125633.	12585.	80983.	47378.	0.	0.	0.
61981	0.	60203.	153213.	12585.	82653.	51595.	171.	383.	0.
71982	0.	15778.	121079.	12585.	84230.	48442.	171.	421.	0.
81983	0.	81964.	158395.	12585.	85858.	51011.	0.	0.	0.
91984	0.	35562.	158395.	12585.	87575.	50961.	0.	0.	0.
101985	0.	35905.	158395.	12585.	89327.	50911.	0.	0.	0.
111986	0.	36211.	158395.	12585.	91113.	50181.	171.	616.	0.
121987	0.	36548.	158395.	12585.	92935.	50811.	171.	676.	0.
131988	0.	36883.	158395.	12585.	94794.	50761.	0.	0.	0.
141989	0.	37222.	158395.	12585.	96690.	50711.	0.	0.	0.
151990	-353500.	-555202.	0.	0.	0.	0.	0.	0.	0.

INVESTMENT FEASIBILITY ANALYSIS

A-TABLE 48. MILL CREEK HERFORD - IRR-O-ALTERNATIVE 0 - BUY 30 COWS 1976

INTERNAL RETURN ON TOTAL CAPITAL 4.241 PERCENT

PERIOD NO.	PERIOD IDENT.	INVESTMENT (DOLLARS) FACILITIES	INVESTMENT (DOLLARS) WORKING CAPITAL	INVESTMENT (DOLLARS) TOTAL	OPERATING (DOLLARS) TOTAL REVENUE	OPERATING (DOLLARS) OPERATING EXPENSES **	OPERATING (DOLLARS) NET REVENUE	PRESENT VALUE FACTOR	PRESENT VALUE TOTAL INVESTMENT	PRESENT VALUE NET REVENUE
1	1976	353500.	266356.	619856.	75996.	117089.	-41093.	0.9584	594065.	-39383.
2	1977	0.	201176.	201176.	106625.	128170.	-21545.	0.9185	184783.	-19789.
3	1978	0.	147833.	147833.	154147.	143205.	10942.	0.8803	130137.	9632.
4	1979	0.	84553.	84553.	243571.	148460.	95111.	0.8437	71335.	80242.
5	1980	0.	4744.	4744.	205971.	152624.	53347.	0.8086	3836.	43135.
6	1981	0.	60468.	60468.	262271.	160844.	101427.	0.7749	46858.	78598.
7	1982	0.	-32442.	-32442.	229089.	142294.	86795.	0.7427	-24094.	64461.
8	1983	0.	15804.	15804.	201134.	141935.	59199.	0.7118	11249.	42137.
9	1984	0.	35562.	35562.	201134.	143702.	57432.	0.6822	24259.	39178.
10	1985	0.	35905.	35905.	201134.	145504.	55630.	0.6538	23474.	36370.
11	1986	0.	36211.	36211.	201134.	148020.	53114.	0.6266	22689.	33280.
12	1987	0.	36548.	36548.	201134.	149212.	51922.	0.6005	21947.	31180.
13	1988	0.	36883.	36883.	201134.	151121.	50013.	0.5755	21227.	28784.
14	1989	0.	37222.	37222.	201134.	153067.	48067.	0.5516	20531.	26513.
15	1990	-353500.	-966823.	-1320323.	0.	0.	0.	0.5286	-697960.	0.
	TOTAL	0.	0.	0.	2685608.	2025247.	660361.		454337.	454337.

INTEREST PER CENT	BENEFIT/COST RATIO	PRESENT VALUE IN DOLLARS REVENUE	PRESENT VALUE IN DOLLARS OUTLAY	PRESENT VALUE IN DOLLARS BALANCE
5.000	0.867	430199.	496308.	-66109.
10.000	0.422	288663.	684062.	-395399.
15.000	0.267	198024.	740733.	-542709.
25.000	0.134	96776.	719675.	-622899.
35.000	0.072	47188.	656752.	-609564.
50.000	0.022	12272.	567354.	-555082.

*EXCLUDING DEPRECIATION, INTEREST, AND INCOME TAX

LTERNATIVE: HERD EXPENSES INCLUDE ANNUAL FORAGE DECREASES FROM NO ALTERNATIVE

A LISTING OF THE DATA

1241 1 0 0.0

A-TABLE 49.MILL CREEK HERFORD - IRR-C-ALTERNATIVE 0 - BUY 30 COWS 1976

PERIOD	FACILITIES	WORK. CAP.	LVSTK SALES	O. SALES	RANCH EXP.	HERD EXP	ALT. FC	ALT. VC	
11976	353500.	266356.	63411.	12585.	75519.	41570.	0.	0.	0.
21977	0.	201176.	94040.	12585.	76578.	51592.	0.	0.	0.
31978	0.	147833.	141562.	12585.	78066.	65139.	0.	0.	0.
41979	0.	84553.	230986.	12585.	79488.	68972.	0.	0.	0.
51980	0.	4744.	193386.	12585.	80983.	71641.	0.	0.	0.
61981	0.	60468.	249686.	12585.	82653.	78191.	0.	0.	0.
71982	0.	-32442.	216504.	12585.	84230.	58064.	0.	0.	0.
81983	0.	15804.	188549.	12585.	85858.	56077.	0.	0.	0.
91984	0.	35562.	188549.	12585.	87575.	56127.	0.	0.	0.
101985	0.	35905.	188549.	12585.	89327.	56177.	0.	0.	0.
111986	0.	36211.	188549.	12585.	91113.	56907.	0.	0.	0.
121987	0.	36548.	188549.	12585.	92935.	56277.	0.	0.	0.
131988	0.	36883.	188549.	12585.	94794.	56327.	0.	0.	0.
141989	0.	37222.	188549.	12585.	96690.	56377.	0.	0.	0.
151990	-353500.	-966823.	0.	0.	0.	0.	0.	0.	0.

APPLICATION OF COMPUTER TECHNIQUES TO FLINT HILLS RANCH PLANNING

by

RICHARD V. LOPER

B.S., Colorado State University, 1971

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

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A total ranch planning model must be quite large and detailed because inputs from all six ecosystem trophic levels, ENERGY, PRIMARY PRODUCERS, PRIMARY CONSUMERS, SECONDARY CONSUMERS, TERTIARY CONSUMERS, and DECOMPOSERS must be included. This applied research dealt with parts of three of the above six trophic levels: primary producers (forage), primary consumers (livestock), and secondary consumers (man). Under a no-burning, extensive type of management program, percent composition of less desirable cattle forage species such as buckbrush, sumac, dogwood, oak, etc., tend to increase over time. Fifteen commonly used renovation practices or combinations of practices were compared with respect to their cost versus return of forage on native range over an initial six-year planning period on the 720 acre, Mill Creek pure-bred Hereford ranch near Alma, Kansas. All practices included varying amounts of burning native tallgrass prairie under a burn-2-years, no-burn-3-years policy. Pertinent physical and economic inventory information were obtained from ranch personnel interviews and existing files. Rangeland inventory data were supplied by local Soil Conservation Service personnel and range managers from the ranch and Kansas State University.

A 1 inch: 330 feet scale aerial photograph was used as a base map for acetate sheet overlays showing physical inventory and forage resource data. Dynamic linear programming was used to minimize cost per AUM received for the fifteen renovation alternatives feasible for native rangeland forage acres owned by the ranch. The ranch manager was then asked to choose a renovation practice for further analysis.

Management alternatives of renovation and herd replacement policies were analyzed in a computerized Internal Rate of Return model.

A computer program was written which calculated and printed in table form, a monthly total of ranch livestock animal unit forage demand, available animal unit months of forage, the positive or negative differences between these two, and the order by which numerically coded forage pastures were used to fill the livestock demand. This computer program output was used as a guide for adjusting stocking rates to use excess forage or show possible overutilization of existing forage producing lands.