AN ABSTRACT OF THE THESIS OF

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in Agricultural and Resource Economics presented on December 12, 1979

Title: Production and Marketing Strategies for Eastern Oregon Rangeland Cattle Producers, 1968 Through 1978

Abstract approved: ______________________
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Three production systems are typical of rangeland cattle production in the high desert region of Eastern Oregon. These are cow-calf production, cow-yearling production, and cow-long yearling production. A rancher may continuously engage in any one of these systems or he may change production systems over time. A beef-forage-grain simulation model was used to examine each of these production systems over the last cattle cycle, 1968 through 1978.

This model, developed by Sonntag and Klein for Western Canada was adapted to reflect the Pacific Northwest's economic and physical conditions. It was validated both internally (through coefficient verification) and externally (through comparison with other published sources) before being implemented. The model calculated three measures of success: total net farm income, ending equity, and percent return on equity for each production system. Two further simulations were then made allowing the production system to change over time.

Partial budgeting was used to determine the optimal system each year in these two runs. Two sets of prices were used in the partial budgets. Under perfect knowledge it was assumed that all future costs and returns were known. Under the naive approach it was assumed that current period prices would prevail over the production period. The same three measures of success were calculated on the perfect knowledge and naive knowledge system combinations to see if profitability was increased by changing systems over time.

Long yearling production was the most profitable of the three straight systems. Total net farm income of $391,646 for this system was $173,354 greater than a cow-calf operation, and $119,304 greater than a yearling operation. Ending equities were $470,438 for a yearling operation, $423,194 for a cow-calf operation, and a high of $548,258 for a long yearling operation. The long yearlings also generated the highest return to equity, averaging 5.46 percent. The yearling system averaged 4.48 percent, the cow-calf system 3.48 percent.

The optimal combination of systems found through partial budgeting under perfect knowledge was long yearling production from 1968-1972, calf production in 1973 and 1974, long yearlings in 1975, calves in 1976, and long yearling production again from 1977 on. Total net farm income increased $42,222 over the straight long yearlings to $433,868, and ending equity was up $19,024 to $567,282. Average percent return on equity was up .12 percent to 5.58.

When assuming naive knowledge the optimal system combination differs. Now long yearlings are optimal from 1968-1973, and calves from 1974 on. These system combinations produced a total net farm income of $360,416, and ending equity of 537,068 and 5.20 percent return on equity. When comparing these amounts to a straight long yearling operation total net farm income decreased by $31,230, ending equity decreased $11,190, and average percent return on equity fell .26 percent.

The optimal combination of systems obtained through perfect knowledge was analyzed with respect to the cattle cycle. The rangeland cattle producer depicted in this study was better off producing long yearlings during periods of herd building with its accompanying price increases. During periods of herd liquidation and falling prices calf production minimized losses.

Production and Marketing Strategies for
Eastern Oregon Rangeland Cattle
Producers, 1968-1978

by

Carol Elaine Whitely

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Commencement June 1980

APPROVED:

Associate Professor of Agricultural and Resource Economics
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Date thesis is presented December 12, 1979

Typed by Sharon Mosley for Carol Elaine Whitley

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I. INTRODUCTION

Since 1975, beef production declined sharply in the United States. Beef prices had dropped drastically and grain prices escalated in the mid 1970's, causing thousands of dollars in losses to beef producers. In order to cut their losses, individual cattle producers reduced their herd sizes. The number of cattle in the United States fell from a high of 132 million in 1975 to 111 million in January 1979.

Cattle numbers and beef prices rose from 1968 to 1973. During this time the per capita consumption of beef also rose. The cattle producer faced an expanding market and revenue which covered fixed and variable expenses of cattle production. Cattle numbers continued to grow due to producer's expectations of the future. Then in mid 1973, grain exports increased substantially, forcing feed costs up.

To offset the increased production costs, producers needed to receive a higher price for their beef. During this same time the first oil embargo occurred and with increasing oil prices inflation accelerated. As an anti-inflation device, price controls were set on beef. The beef ceiling price was below the price many producers would take for their animals. They reacted by withholding the animals from the market in hopes of obtaining a higher price later. When price controls were lifted, the market was flooded. The quantity of beef slaughtered was greater than the amount consumers demanded at that price, and prices fell as a result. Cattlemen realized a loss on every animal sold. Still optimistic that better prices would return, and beef consumption would continue to rise, cattlemen increased their herds further.

Another blow occurred in 1974 when a drought hit the Western United States. Western producers had two options: to feed the cattle expensive hay, or to sell the animals. Since economic conditions did not warrant keeping the animals, herds were further reduced. This shift in the supply curve caused beef prices to drop further, to the new equilibrium between supply and demand.

As beef prices continued to fall, pessimism replaced optimism. As thousands of cattlemen reduced their herds, prices plunged further. Finally in 1975 slaughter numbers fell due to reduced herds. This herd reduction set beef prices upward once again, with accompanying herd building occurring. After suffering losses since 1973, cattlemen found it difficult to obtain the money to rebuild their herds quickly. This economic restriction plus the biological nature of cattle production restricted the speed of herd growth. The phenomenon of herd growth and herd liquidation perpetuated the cattle cycle with the most recent swing the sharpest on record.

The Relative Importance of Cattle Production in the Pacific Northwest

The economies of the states in the Pacific Northwest (Oregon, Washington, and Idaho) are heavily dependent upon agriculture. Beef cattle generate the greatest cash receipts of any agricultural commodity in Oregon and Idaho. In Washington beef receipts are surpassed only by wheat. However cash receipts for cattle contribute a smaller percentage to total agricultural receipts in this region than the United States as a whole. In 1976, United States cattle receipts contributed 49 percent of total agricultural cash receipts. In Idaho this figure was 36 percent, in Oregon 35 percent, and in Washington 30 percent. Income from cattle and calves make up over one-half of the income received for all livestock in the Pacific Northwest. From 1968 through 1976 the Pacific Northwest region plus Montana marketed five percent of the fed cattle in the United States, and held 18 percent of the beef cows [25, p. 703].

Total costs to produce feeder cattle compare favorably with other regions of the United States. Variable costs of producing calves are greater in this region due to higher hay expenses. This is offset by lower average fixed costs, primarily resulting from lower land costs. Use of public lands and larger herd sizes help keep these average fixed costs below those of other regions [23].

A high desert region extends through Eastern Oregon, Eastern Washington, and a portion of Idaho and Nevada. In this region cattle production plays a larger role than in the total Pacific Northwest area. Seventy-three percent of all ranchers in this region derive 75 percent or more of their income from cattle. Nearly eight percent of ranchers derive 50 to 74 percent of their income from cattle, 12 percent derive 25 to 49 percent, and seven percent derive less than 25 percent of their income from cattle [18, p. 8].

Characteristics of the Pacific Northwest Industry

The Pacific Northwest beef industry is composed of three types of operations. On one type, cattle are a supplemental product. These herds generally number under 100 head. The herd may be kept to utilize a crop residue that would otherwise go to waste, or farmers may use the herd in order to more fully utilize the work force. These herds are kept on land owned by the producer and generally receive supplemental feed.

On the second type of operation, cattle are the main commodity. These operations are generally in the less populated areas of the region, and land is not suited to any other type of agriculture. The operator employs his own land, may rent land, and uses public land. The cattle are generally pastured for the entire year with supplemental feed given during the winter.

The third type of operation is the feedlot. Although the number of cattle on feed has been increasing in the Pacific Northwest, feedlots are still few in number. The existing feedlots are in the feed-producing areas of the region. A large number of calves are shipped out of the region for feeding in other areas of the country.

Cattle production in Eastern Oregon generally falls into the second category, where feeder cattle are the primary product. Eastern Oregon production is typical of high desert production occurring in Oregon, Washington, Idaho, and Nevada. It is this specific geographical area, with its accompanying physical characteristics which are examined in this research. Schmisseur and Holst [18] report cow herd sizes ranging from 20 to over 1000 head. Eighteen percent of herds total 20 to 99 cows, 13 percent 100 to 199 cows, 33 percent 200 to 499 cows, 24 percent 500 to 999 cows, and 12 percent are over 1000 cows.

Two types of operations dominate production in this region: cow-calf production, and cow-yearling or long yearling production. Approximately 35 percent of the producers are in cow-calf production, 59 percent in cow-yearling or long yearling production, four percent buy weaners or stockers, and two percent are in other operations. While only four percent of the ranchers run an exclusive weaner or stocker operation, 23 percent of ranchers buy weaners or stockers to supplement their main operation.

Four types of forage are produced in the high desert region: dryland range, irrigated pasture, dryland and irrigated hay, and grain aftermath. Eighty-eight percent of ranchers produce dryland range, 79 percent produce irrigated pasture, 96 percent produce hay, and 30 percent utilize grain aftermath.

Calving generally occurs in the spring. Only three percent of ranchers calve exclusively in the fall, and 29 percent calve in both the spring and fall.

With winter feed the limiting resource, a rancher may run three-fourths the number of cows under a cow-yearling or long yearling operation as under a cow-calf system.

Problem Statement

Cattle producers in the high desert area of the Pacific Northwest have experienced a pattern of highly volatile revenues and expenses over the last decade. To mitigate the economic effects of these volatile incomes, producers are seeking economic information concerning alternative beef production and marketing strategies.

The producers are attempting to evaluate the effects of feed and feeder market prices on the profitability of cow-calf, cow-yearling, and cow-long yearling operations over time. How does each stage of the cattle cycle effect the optimal production and marketing strategies?

Two methods of analysis are available to examine these concerns. With the first method, case studies of beef firms in the area would be analyzed. With the second method, a model of the typical firm would be constructed and manipulated to determine the optimal strategy. In this study a simulation model was used to evaluate alternative marketing and production strategies.

Objectives of the Study

There were three major objectives to this study. The first one was to adapt a beef-forage-grain simulation model developed for Western Canada to the Pacific Northwest. Production coefficients within the model were examined and changed to reflect Pacific Northwest conditions.

The second objective was to validate the simulation model. Two methods, internal validation, and external validation were used to determine if the model's results were accurate.

The third objective was to examine the profitability of alternative production and marketing strategies available to the Pacific Northwest rangeland cattle producer over the last cattle cycle, 1968-1978. Three systems, a cow-calf operation, a cow-yearling, and a cow-long yearling operation were simulated. Partial budgeting was used to determine the optimal system for each year.

II. LITERATURE REVIEW

Rangeland cattle production is characterized by low investment per unit of land. As a result, beef production alternatives are limited. This limitation increases the importance of good management decisions. Three alternative production systems or a combination of these systems may be implemented as economic conditions warrant. These three systems are: cow-calf, cow-yearling, and cow-long yearling.

The optimal production system may be correlated to different stages of the cattle cycle. In order to better understand the relationship between production alternatives and cattle numbers, cattle cycles will be discussed in greater detail. To facilitate the production decision two common "rule of thumb" ratios have traditionally been used. These measures are the beef steer-corn ratio and the heavy feeder-calf ratio.

To examine beef production alternatives under specified economic conditions, experimentation must occur. Investigating the alternatives would be extremely time-consuming and costly if the researcher utilized actual cattle operations. Due to continuously changing economic conditions, solutions found from real world experimentation may be outdated before ever being implemented. In addition, the cost-benefit ratio may be too low, except for major economic issues. To solve this problem a simulation model of the real system can be substituted. This model is simply a representation of the actual operation. The model can be studied and properties concerning the behavior of the actual system or its subsystem can be inferred [16 p. 2]. Simulation modeling does not determine the optimum production system. Instead this is done for each year through partial budgeting. The general characteristics of simulation modeling and partial budgeting are presented in this chapter.

To compare the different production systems evaluated in this study some standards of success must be used. The measures used are determined by the goals of the producer. Alternative measures that could be used are also presented in this chapter.

Cattle Cycles

Cattle numbers and prices have been extensively studied since the late 19th century. While numbers and prices have not followed a perfectly consistent pattern they have occurred in definite cycles over time. Each cycle can be divided into four phases:

1. rising,
2. high constant,
3. falling, and
4. low constant.

The average length of each cycle has been 12 years, with early cycles being longer, and later cycles shorter.

Three different cycles are frequently measured. The number of animals slaughtered, the total number of cattle on farms, and the price of fat steers. Figure 2.1 illustrates the total cattle on farms cycles since 1938. The graph shows that the last cycle's (1968-1978)

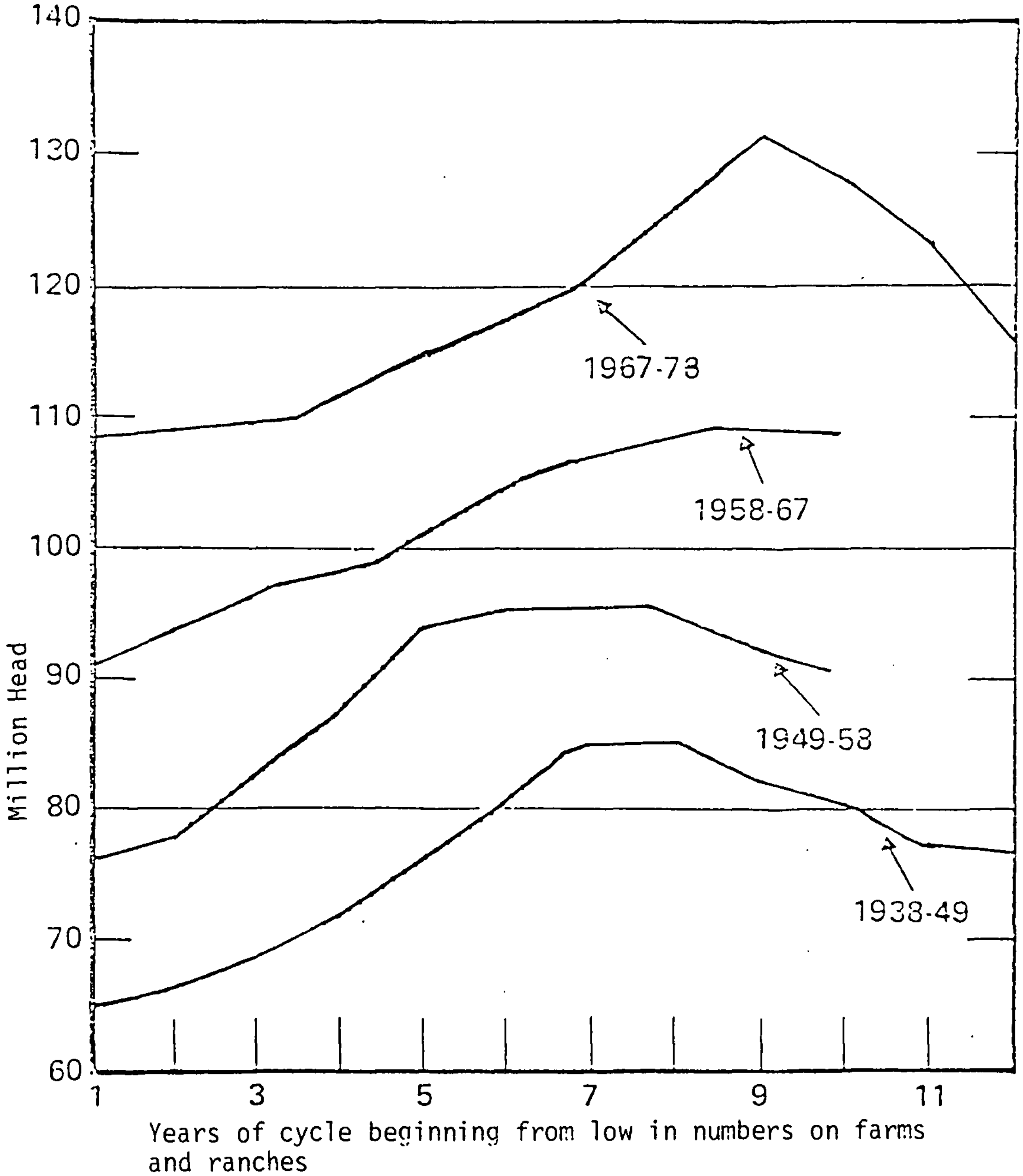


Figure 2.1. Cattle on farms by cycle.

Source: U.S. Department of Agriculture.

duration was 11 years. This was a substantial drop from the earliest cycle (1896-1912) of 17 years.

The duration of the cycle is dependent upon a production lag, currently two to three years, down from three to four years in the earlier periods. The length of each cycle is four times that production lag, making the latest cycle's expected duration eight to 12 years. In fact it was 11 years.

Figure 2.2 illustrates the four phases of the latest cycle (1968-1978). The cycle started in the low constant phase, then rose, remained at a high level, and then fell rather quickly. Experts do not agree if cattle cycles are caused by endogenous or exogenous forces. First, a look at the endogenous theories.

Numerous attempts have been made to explain the cycle in terms of economic behavior. One such attempt uses the cobweb theorem [15 p. 56]. The cobweb theorem attempts to explain how quantities supplied and demanded move around an equilibrium point (the intersection of supply and demand) in response to price changes. Inherent in the model is a time lag in production change to price changes.

Figure 2.3 uses the cobweb theorem to explain the 1968-1978 cattle cycle. In 1968 total cattle numbers were coming out of a low constant phase and just starting to build. Cattle prices were high and slaughter animals were held back to increase herd sizes. The net result was less cattle slaughtered and even higher prices. The market was in disequilibrium corresponding to point A, Figure 2.3. Quantity Q_1 was being supplied by the producers for which the consumer

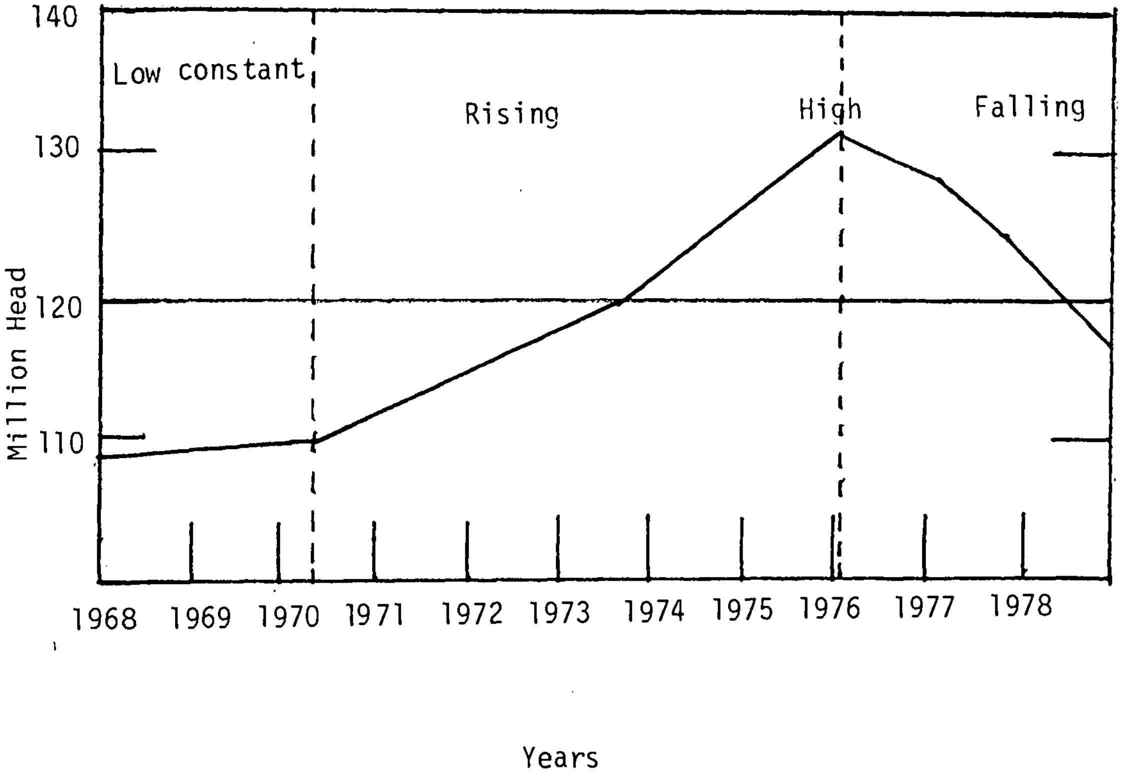


Figure 2.2. Number of cattle on farms, 1968-1978, with the four phases marked.

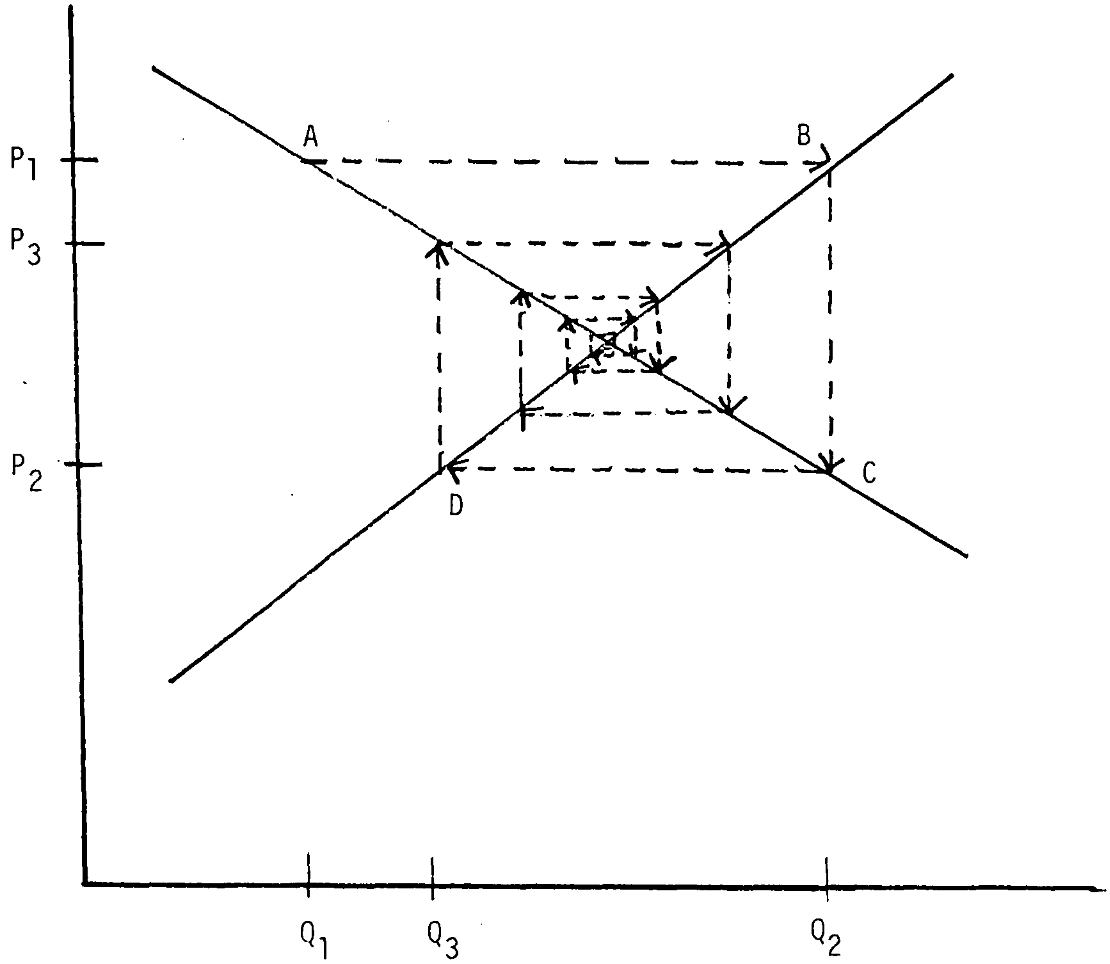


Figure 2.3. Illustration using the cob-web theorem to explain cattle cycles.

was willing to pay price P_1. At price P_1 producers were willing to supply Q_2 units of beef, point B. After a production lag during which cattle inventories were increased supplies were increased to Q_2. Now in 1973 cattle numbers were up, prices remained high and producers were optimistic. When quantity Q_2 hit the market, prices fell to P_2, point C, as consumers were only willing to bid that price for the increased quantity. Producers were thrown off their supply curve and reduced production, point D, to Q_3. Consumers bid up the price on the reduced production to P_3 and producers increased their supply once again. Under the cobweb theorem this adjustment phase continued until the equilibrium point was reached. But, was the equilibrium point ever obtained? The relative elasticities of the supply and demand curves dictate the slopes of these curves. By changing the relative slopes, the movements can be changed to an explosive or divergent system. For the cobweb theorem to be valid depends on the existence of a conventional supply curve in the beef industry [15, p. 56].

Ehrich concludes that the cobweb theorem is an adequate descriptor of the beef industry due to the conventional supply curve restriction. He concludes that

> . . . producers respond incrementally to deviations of price from equilibrium and it serves to deny the existence of a conventional supply function for beef cattle. For, of course, the conventional concept of a supply function presupposes that producers adjust to a new level of planned output which is independent of the present level of output, in response to a change in price levels, rather than seeking to change the rate of planned output from current levels. [15, p. 57]

He suggests that harmonic motion of production and prices is the appropriate model. Harmonic motion involves stimulus, response, and feedback. The feedback acts to alter the stimulus after a fixed delay. He concludes that

> . . . producers respond to prices (stimulus) by changing the rate of planned production (increasing or decreasing the herd incrementally), the change in production is realized after a delay (physical growth limitations), and the price stimulus is altered by realized production (prices are unilaterally affected by predetermined supplies). [15, pp. 56, 57]

Price cycles are the inverse of numbers cycles. However, their turning points do not occur at the same time. This occurs because of producer's price expectations. When cattle numbers are declining and prices rising producers hold heifers in inventory to increase their cow herd. This causes the inventory cycle to start climbing. The number slaughtered decreases by the number of heifers retained and prices go up immediately. At this point the inventory cycle and the price cycle are rising and the slaughter cycle is falling. After cattle inventories are increased,slaughter numbers increase, and prices decrease. A lag of two year has occurred between the inventory cycle and the price cycles movements. This phenomena occurs in reverse when cattle numbers are high.

Availability of feed including range, pasture forage, hay, and grain have been cited as exogenous factors affecting cattle cycles. Some economists contend that cattle cycles are directed by the relationship between fed beef and feed grain prices. This is based on the beef steer-corn ratio defined as the price per cwt. of choice steers (at Omaha) divided by the price per bu. of corn (at Omaha). When this ratio increases more grain feeding occurs, and feedlots bid up the price of calves relative to heavy feeders. The cattle producer is thus encouraged to produce more calves, selling them at lighter weights. When the beef steer-corn ratio drops the reverse is true and producers raise less calves, each to a heavier weight (backgrounding). Total numbers can be expanded in the face of decreasing fed beef prices providing that feed grain prices decrease even faster. Although fed beef prices fall, the beef steer-corn ratio may remain constant or increase. The inventory of cattle develops into a cycle as producers raise calves, or decrease production to background animals depending on the beef steer-corn ratio. When resources shift to backgrounding slaughter numbers increase and a temporary independence between slaughter and production occurs. This acts to extend each movement too far, temporarily hiding the equilibrium relationship between true production and demand, and exaggerates the cycle.

System Modeling and Simulation

Simulation is a descriptive model of the system being studied. It is a two-phase operation involving modeling and experimentation. The abstract system replaces the real system in order to overcome problems of physical experimentation. It describes the behavior of the system under a given set of assumptions. Through experimentation solutions to decision-making problems can be obtained.

Simulation models include mathematical and logical components that describe the structure of a business or economic system over time. A simulation model consists of four elements: components, variables, parameters, and functional relationships.

Components are related to one another by variables within the system. There are three types of variables: exogeneous, status, and endogenous. Exogeneous variables are the independent variables. They are predetermined and given independently of the system being modeled. Status variables change over time. They describe the state of the system or one of its components at a given point in time. Endogenous variables are the output variables; they are dependent upon the exogeneous variables.

A simulation experiment examines the effect different levels of exogenenous variables have on the value of the endogenous variables through a series of computer runs. Using simulation experiments, a number of alternative solutions and decision rules may be examined to determine which ones are more useful in making predictions about the real system's behavior. New policies and decision rules may be pretested on the simulation model before implementation in the real world.

The model building stage is very important in simulation. If the simulated model is not a true representation of the real system, then research results will be erroneous. Advance specification of a well defined and detailed problem will minimize this error. The type of system output required and the method of analysis to be used help to determine the model's form.

Dent and Anderson [3, p. 25] recommend the following starting point for model building:

1. identification of the major subsystems,
2. identification of important components and relationships within each subsystem,
3. identification of the links between subsystems,
4. identification of important environment variables,
5. identification of control points.

The resulting diagrammatic model provides the basis for identification of the type and form of data required.

A major problem of bio-economic models may be the lack of directly suitable biological data. The known data has usually been gathered from small subsystems isolated from the rest of the system. There has been little effort committed to synthesizing this knowledge into the context of the whole system [3, p. 26].

A combination of historical data and primary data will usually be necessary. Historical data can be used to derive production functions and coefficients used within the model. In addition it is often used to detemine exogeneous variables in the model.

Primary data will be necessary in determining any relationships for which secondary data does not exist. The researcher may generate his own primary data,as in price forecasting.

Once the system has been modeled and data collected experimentation takes place. The experimental phase involves many computer runs in which the input data is varied and the output results are compared.

The objectives of experimentation with simulation models in management-oriented studies will usually be of the following types [16, p. 29]:

1. to compare alternative courses of action,
2. to estimate the response of a system to changes in the level of a single input,
3. to explore the response surface generated for different combinations of input levels, and
4. to estimate the input combination required for an optimal or near optimal level of output.

The usual objective will be a general exploration of the optimal region rather than the identification of an optimal point. This generalized optimal region will be of more use for decision making because each individual decision maker's optimal point may differ.

In the same light it is generally illogical to draw blanket recommendations for managerial action from the output. A blanket prescription will generally be suboptimal for any individual manager. If a blanket prescription is made, it represents optimal decisions for the average manager.

Most biological systems have problems of nonnormality and unequal variance. These problems can often be quantified in simulation experiments. Variability is deliberately included in the simulation model. It is both controllable and repeatable. This allows treatments to be compared under exactly identical conditions.

Results obtained from experimentation must be considered in relation to the validity of the model. The simulation model must be verified and validated for the experimental results to be meaningful. In this validation process the model is examined to see how well it represents the real system. It is validated in relation to the purpose for which it was constructed and verified in relation to known parameters.

Verification of the model is important when that model is used to discover facts about a system. The researcher may not be able to establish the model's correctness absolutely, but he can test hypotheses in terms of the probability that they are true or correct. The analysis of results from the model is heavily weighted against the chance of accepting an incorrect hypothesis as being true. The basis for rejecting an incorrect hypothesis is that the model can not be verified within given confidence limits.

The validation of a bioeconomic model relys heavily on subjective judgement. The crucial test is whether the model leads to better decisions than can be obtained by using other techniques.

Once the model has been verified and validated experimental results can be analyzed. The choice of the appropriate test will depend on two main features [3, p. 49]:

1. the experimental objectives of the model, and
2. the extent to which the basic assumptions underlying the test are fulfilled.

With decision-oriented models the standard analysis of variance tests are inappropriate. Instead the best strategy, or some ranking of strategies is required. If accurate input data are missing, then sensitivity analysis is appropriate. It allows the most important parts of the model (those that influence output the most) to be examined with little or no examination of other parts. Sensitivity analysis tests the relative influence of changes in input data and parameters on the relevant outputs of the model. Problems with sensitivity analysis arise when conceptual errors exist in the model. These errors may abstract the importance of certain relations.

The specific simulation model used in this research is discussed in detail in Chapter III. This model is not designed to optimize alternative production systems internally. The optimal system determination is made through budgeting techniques.

Farm budgeting is a technique designed to guide management decisions and future planning [19, p. 21]. It is a written testing of proposed business adjustments based on all available facts. It allows the producer to compare the expected profitability of different production systems before committing any resources. Three types of budgeting are frequently used: total budgeting, partial budgeting, and cash-flow budgeting.

A total budget is used when a new operation is being organized or when evaluating a complete reorganization. It examines all production, income derived from the business, and all variable and fixed costs of the business. It is more concerned with the profitability of the total farm than any one part [13, p. 218].

Partial budgeting is used to adjust production methods, change output levels, or test new techniques that do not affect the total farm plan [13, p. 218]. It only looks at the costs and returns that are expected to change by the proposed business change. The partial budget has two classifications: debits and credits. Total credits equal the additional receipts received for products and services as a result of the change plus reduced expenses which will no longer be incurred due to the change. Total debits equal the reduced receipts from products and services lost due to the change plus additional costs occurring because of the changes. If total credits are greater than total debits then the change should be made [2, p. 110]. In this way the partial budget is used as a decision tool to compare alternative production systems.

The cash flow budget shows the timing of the expected receipts and expenses included in the partial budget. It is useful in planning the timing of cash requirements, and availability of repayment funds [2, p. 92].

Through partial budgeting the optimal production system is determined. Simulation runs can be made with the optimal systems' combinations and with any other systems. Common measures of success are necessary to compare the different production systems simulated.

Choice of these measures is determined by the producer's goals.

Producer's Goals and Measures of Success

Producers goals are many and varied, tangible and intangible. Some of them are income generating and businesslike; others include nonmonetary sources of satisfaction [18, p. 25]. No two producers have the same exact goals. Intangible goals will not be considered in this study.

Most business goals concern size, type, organization and income generation of the ranch. Common goals are: maximizing net farm income, increasing net worth, increasing labor productivity, maintaining herd size, and improving the herd. The goal sought will determine the relevant production systems. Goals involving size and type restrict production system alternatives. Goals involving organization or income maximization offer greater production flexability. Once the producer's goals are determined the appropriate measures of success may be determined.

Specific accounting measures exist to analyze financial goals. These measures can be used in any situation as the source of land, labor, capital or management have no effect on the measurement, and the contributions of the farmer, labor,and capital are all recognized. Eight of these measures are as follows:

1. Net Farm Income--the return to one operator for his labor, management, and investment. It is calculated as receipts minus expenses. Receipts include increases in inventory, profits on sale

of capital items, and all accrued income on sales of this year's products, and sales out of inventory. Expenses include decreases in inventory, losses on sale of capital items, all accrued operating expenses, property taxes, depreciation, and value of unpaid labor except one operator.

2. Labor Income--the return to one operator for his labor and management after all expenses have been met including interest on all capital invested in the business. It is calculated as farm income minus interest on investment.

3. Labor Earnings--the return to one operator for his labor and management both in cash and in kind after all expenses of the business have been met. It is calculated as labor income plus the value of farm privileges.

4. Total Equity--the same as net worth calculated as total assets minus total debt.

5. Return to Capital--the return to all capital invested in the business after all expenses have been made including payment for one operator's labor and management. Calculated as farm income minus management fee.

6. Percentage Return to Capital--the return to capital stated as a proportion of the total value of capital invested in the business. Calculated as the Return to Capital divided by the average investment times 100.

7. Change in Equity--the increase or decrease in equity from the previous year. Calculated as net farm income minus operator's consumption minus taxes.

8. Percent Return to Equity--return to owner's investment. Calculated as the change in equity divided by the beginning year's equity.

In this study three of these eight measures: net farm income, total equity, and percent return to equity were used to evaluate the different production systems, through use of a simulation model.

The Simulation Model

Sonntag and Klein developed a beef-forage-grain simulation model that enables the researcher to examine different cattle production systems under varied economic conditions. The simulation model is not designed to optimize internally the alternative systems, but it simply models any system the researcher desires; he communicates the choice through an input form.

There are six production systems available for use in the model;

1. cow-calf--in which weaned calves are sold,
2. cow-yearling--in which feeder yearlings are sold,
3. cow-calf-feedlot--in which weaned calves go directly to the feedlot and are sold as slaughter cattle,
4. cow-yearling-feedlot--in which weaned calves are placed in a stocker program for the winter, on pasture the next summer, and are sold off-pasture as short-kept feeders,
5. cow-long yearling--in which weaned calves are placed in a stocker program for the winter, on pasture the next summer, and are sold off-pasture as short-kept feeders,

6. cow-long yearling-feedlot--which is the same as 5, except short-kept feeders are placed in the feedlot and finished to slaughter weight.

All of these systems are available to Eastern Oregon cattlemen, however, systems one, two, and five are the most typical and were the systems selected for study.

The specifics of the model are discussed in the next chapter.

III. BEEF-FORAGE PRODUCTION SIMULATION MODEL FOR EASTERN ORGEON

A beef-forage production simulation model which represents beef production alternatives in the high desert area of the Pacific Northwest is outlined in this chapter. This model is a modification of a beef-forage-grain production model developed by Sonntag and Klein for Western Canada [20]. Much of the description of the model which follows was previously published by Sonntag and Klein [20]. However, it is included in this study, along with the description of the appropriate modifications made by this author, so that the reader may have a complete description of the simulation model used in this study.

Beef-Forage-Production Simulation Model

This model is designed to simulate a beef cattle operation in the Burns area of Eastern Oregon. The user of the model communicates all of the relevant information needed through an input form.

It is possible to restrict the number of production alternatives or alter many of the transformation coefficients or prices by making the appropriate insertions in the input form. A completed input form contains the following information (See Appendix A for details):

1. inventories of buildings, livestock, land, machines, products and financial items with detail on type, capacity, amount and age,
2. permanent and seasonal labor supplies on a bi-weekly basis,
3. prices for products and inputs,

4. technical transformation rates, e.g., conception rates, rates of gain, crop yield, etc.,
5. production systems to be evaluated,
6. consumption requirements,
7. values for certain parameters to control operation of the model.

The simulation model's core is a three-dimensional matrix containing transformation coefficients for each production alternative and each relevant job for each bi-weekly time period. Additional matrices permit nonlinear, integer, and stochastic relationships. Input and output price data are contained in additional matrices.

The model allows freedom to choose among six production systems, four breeding methods, three rate-of-gain options for feedlot animals, three types of shelter, and five diet options. A forage enterprise permits choice of pasture types, yields, and seasons of use. A grain enterprise is also available.

The six production systems available are:

1. cow-calf--in which weaned calves are sold,
2. cow-yearling--in which feeder yearlings are sold,
3. cow-calf-feedlot--in which weaned calves go directly to feedlot and are sold as slaughter cattle,
4. cow-yearling-feedlot--where weaned calves are placed in a stocker program for about five months and are then shifted to a feedlot finishing program,
5. cow-long yearling--in which weaned calves are placed in a stocker program for the winter, on pasture the next summer, and are sold off-pasture as shortkeep feeders,

6. cow-long yearling-feedlot--in which weaned calves are placed in a stocker program for the winter, on pasture the next summer, and placed in the feedlot and finished to slaughter weight.

The four breeding methods available are:

1. natural breeding,
2. artificial insemination (AI) once, then natural breeding for non-conceivers,
3. AI twice, then natural breeding for non-conceivers,
4. AI only.

Pregnancy testing is optional for all breeding alternatives.

Feedlot animals may gain weight at a low, medium, or high rate. The breeding herd, stockers, and yearlings on pasture may consume diets ranging from straight pasture to 70 percent grain and 30 percent hay (Tables 3.1 and 3.2).

Shelter requirements are divided into three categories: breeding herd, replacements and stockers, and feeders. Three types of shelter are available for each category:

1. minimal shelter (low capital investment),
2. sheds (medium capital investment),
3. sheds and drylot (high capital investment).

The length of winter feeding period for the cow herd can vary:

1. none,
2. one month (January),
3. two months (January-February),
4. three months (January-March),

Table 3.1. Proportion of digestible energy obtained from each feed source for the breeding herd, by season.

Diet No.	May 7 - Nov. 18			Winter 1/			Early Winter-Early Spring 2/		
	Hay	Grain	Pasture	Hay	Grain	Pasture	Hay	Grain	Pasture
1	-	-	1.0	1.0	-	-	-	-	1.0
2	.1	-	.9	.9	.1	-	.1	-	.9
3	.2	-	.8	.8	.2	-	.2	-	.8
4	.3	-	.7	.7	.3	-	.3	-	.7
5	.4	-	.6	.6	.4	-	.4	-	.6

1/ The length of winter feeding season can vary from zero to six months.

2/ This is the period between mid-November and mid-May which is not required for winter feeding. The timing of this interval is determined by the specified winter period.

Table 3.2. Proportion of digestible energy obtained from each feed source by season, for stockers, replacements, and yearlings on pasture.

Diet No.	Winter			Summer		
	Hay	Grain	Pasture	Hay	Grain	Pasture
1	.7	.3	-	-	-	1.0
2	.6	.4	-	-	.1	.9
3	.5	.5	-	-	.2	.8
4	.4	.6	-	-	.3	.7
5	.3	.7	-	-	.4	.6

5. four months (December-March),
6. five months (December-April),
7. six months (mid November-mid May).

Purchased feeders (calves or yearlings) can be added to the feeder supply produced on the farm. These are handled in the same fashion as farm-produced feeders. Feeder calves can be purchased for all sub-enterprise types except the cow-calf system. Feeder yearlings can be purchased for the cow-yearling or long yearling systems. Herd size can be expanded or contracted over time by specifying the changes in the input form.

Figure 3.1 outlines all combinations of production alternatives for the beef-forage cattle enterprise.

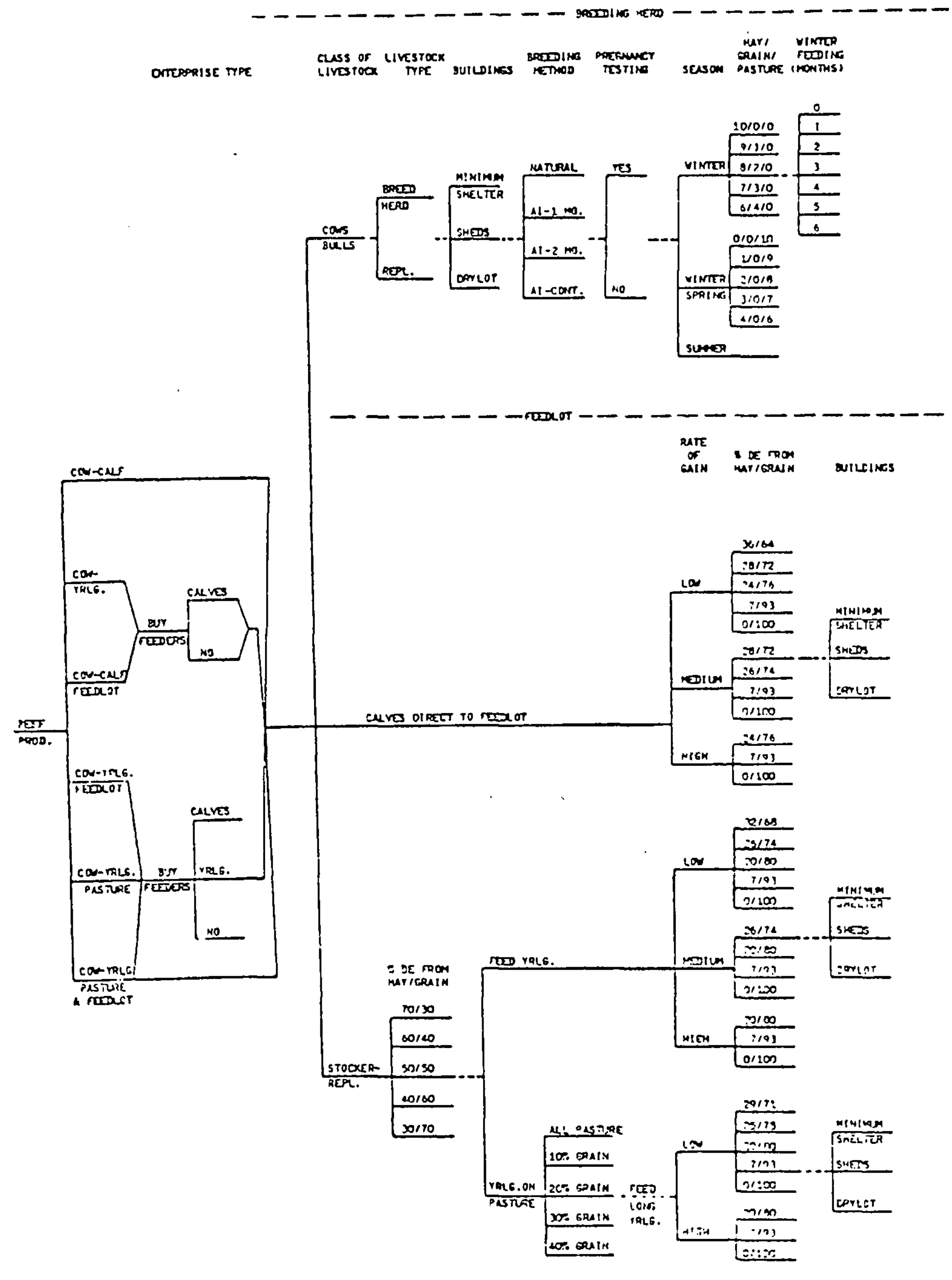
Seven pasture types are available in the model.

1. Native 1 (unimprovable)--represents rough native pastures that are unimprovable because of topography, stones, soil type, etc., and can, therefore, be utilized only in their native state.

2. Native 2 (improvable)--includes pasture that is under native vegetative cover but can be improved through clearing, breaking, re-seeding, etc.

3. Improved (early season)--represents rangeland (Native 2) or cropland seeded to species particularly adapted to early season use. Crested wheatgrass is commonly used in the semi-arid desert areas for this purpose but other species may also be involved.

4. Improved (late season)--represents re-seeded rangeland (Native 2) or cropland where species adapted to grazing over a longer period



NB. REPLACEMENTS ARE CLASSED AS COWS FOR PURPOSES OF DIET COMBINATIONS AFTER THEY ARE BRED.
DASHED LINES CAN BE CONNECTED TO ANY BRANCH OF PREVIOUS SUBSET.

Figure 3.1. Schematic of production alternatives for beef enterprise.

than the early season species permit. Russian wild rye is a common species used for this in the semi-arid desert area.

5. Community pasture (BLM and Forest Service Land)--represents those pasture sources with an administered stocking rate and fixed rental rate per head or animal unit.

6. Stubble--includes cereal stubble available for grazing in fall or winter. It is basically a salvage operation.

7. Aftermath--includes re-growth on perennial hay land that is available for fall or winter grazing.

Figure 3.2 outlines all combinations of production alternatives for the forage enterprise. The acreage of each type of pasture are indicated as inventory items in the input form. All pasture sources can be utilized in a number of ways. Some pasture sources can be grazed all year round in certain areas. Others are available only at certain times of the year. Four annual pasture seasons are identified in the model. The utilization periods available for each of the pasture sources are illustrated in Table 3.3.

Pasture improvement alternatives associated with growth or no growth in the breeding herd are available in the model. Pasture can be improved (within the constraints of the farm situation) to remove the deficit in pasture production for the current herd or for 5, 10, 15, 20, 25, and 30 percent increases in the breeding herd.

There are five methods of improving native rangeland (or increasing the acreage of tame pasture) in the model. They are:

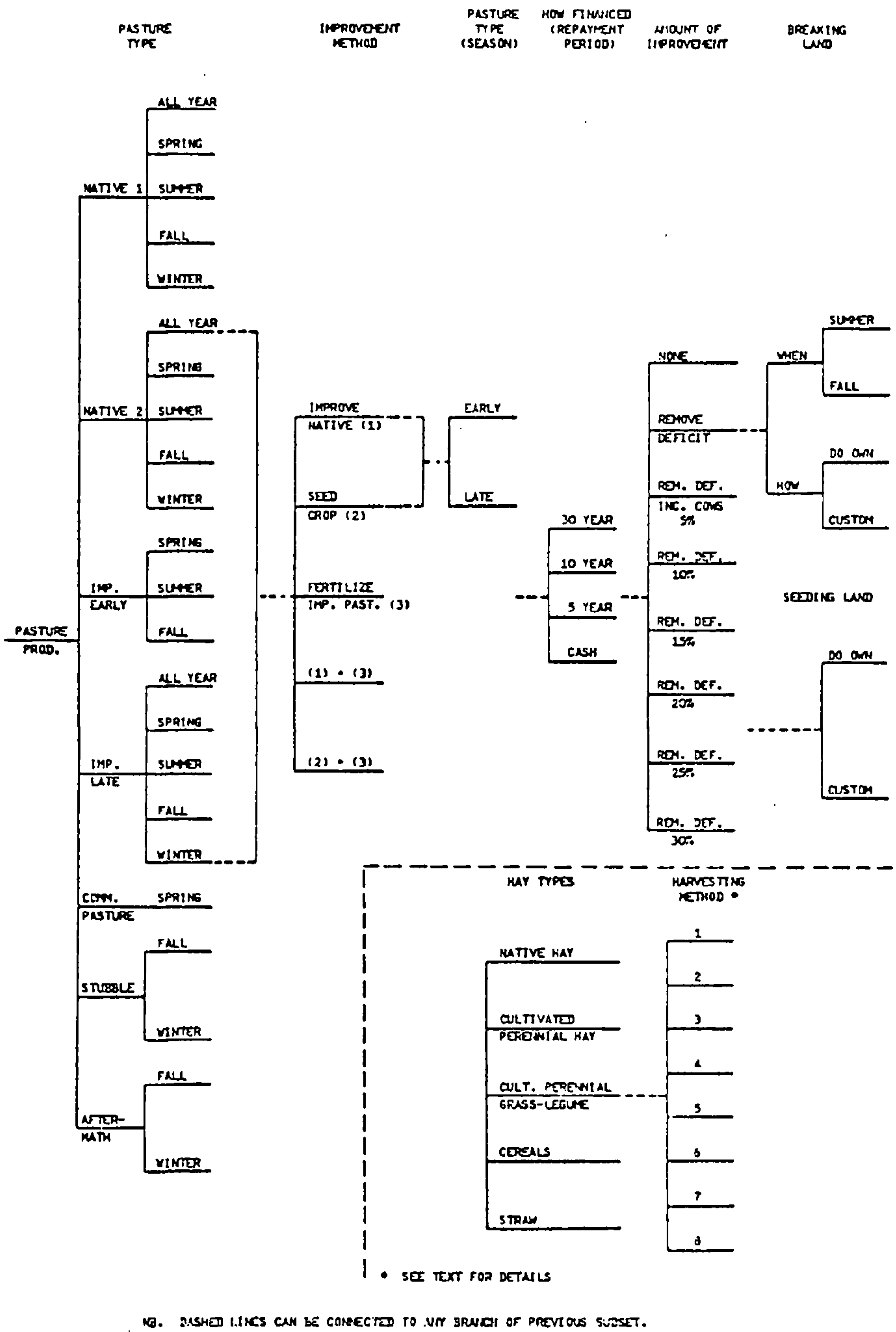


Figure 3.2. Schematic of production alternatives for forage enterprise.

Table 3.3. Utilization periods for pasture sources.

Pasture Sources	Utilization Periods				
	All Year	Spring	Summer	Fall	Winter
Native 1	X[1/]	X	X	X	X
Native 2	X	X	X	X	X
Improved (early)		X	X		
Improved (late)	X	X	X	X	X
Community pasture		X	X		
Cereal stubble				X	X
Hay aftermath				X	X

[1/] An "X" indicates when a pasture source may be used.

1. improve native range through re-seeding with tame grass species,
2. seeding tame grass species on cropland acreage,
3. fertilize present acreage of improved pasture,
4. improve native range and fertilize improved pasture [combination of (1) and (3) above],
5. seed cropland to pasture and fertilize improved pasture [combination of (2) and (3) above].

Breaking can be done in the summer or fall with owned machinery or by custom operators.

Pasture improvement can be financed by:

1. cash,
2. 30-year loan,
3. 10-year loan,
4. 5-year loan.

There are eight methods of harvesting forages available in the model:

1. swath, bale, self-propelled stack wagon, haul at harvest,
2. swath, bale, pull type stack wagon, haul at harvest,
3. swath, bale, stack, haul with loader and trailer at harvest,
4. swath, giant round baler, haul with loader and trailer at harvest,
5. swath, bale, stack, haul with loader and trailer in fall,
6. swath, giant round baler, haul with loader and trailer in fall,
7. swath, loose hay stacker, stack mover,
8. swath, harvest as silage with forage harvester and forage wagon.

Straw can be harvested with any of methods one to seven with the swathing operation deleted. The eighth method is applicable only for perennial and cereal hay crops.

The final sector in the model is grain production. Three crops may be grown: barley, rapeseed, and cereal forage.

There are five machine-purchase options in the model. They include purchasing new or used (1, 2, 3, or 4 year old) machines. Machines are replaced on the basis of hours of their useful life. They can be sold at the end of any year in which their accumulated hours of use reach 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100 percent of their maximum useful life.

Four financing alternatives are available for land purchases. They are:

1. cash,
2. 30-year mortgage,
3. 20-year mortgage,
4. perpetual mortgage.

The quantity of land purchases over time can be specified in the input form.

Production Alternatives Available to Eastern Oregon Beef-Cattle Producers

The rangeland producer may operate an exclusive cow-calf, cow-yearling, or cow-long yearling system. In addition he may switch production systems as economic conditions warrant. The producer has until August 27th each year to decide which system he wants to select, for decisions involving calves. On August 27th his calves are weaned and must be sold or held over the winter. If the calves are kept then the following April he must decide between selling yearlings or holding the animals for long yearlings.

The price structure of this simulation model was modified significantly from the original Sonntag and Klein model. Instead of using average yearly prices for cattle and barley, the model was changed to use bi-weekly prices. Prices of nine classes of cattle are entered: 1) cull cows, 2) fat steers, 3) fat heifers, 4) long yearling steers, 5) long yearling heifers, 6) yearling steers, 7) yearling heifers, 8) male calves, and 9) female calves. All cattle prices are in dollars per hunderdweight at Portland, Oregon as recorded by the Livestock Market News Branch, Oregon State University and the USDA. Prices for yearling and long yearling steers and heifers, prior to 1973, are from the Ontario, Oregon Auction Yard. Barley prices for 1968 through 1978 are dollars per bushel recorded by the Livestock Market News Branch, Oregon State University and the USDA on Thursdays at Portland, Oregon.

Hay prices were originally an internal function in the Sonntag and Klein model, calculated from the price of barley. This section was changed to use actual average yearly legume hay prices. The average yearly farm price for Eastern Oregon alfalfa is used, as recorded by the Livestock Market News Branch, Oregon State University and the USDA.

Personal interviews with Professor Robert J. Raleigh, Superintendent of Eastern Oregon Agricultural Research Center, Squaw Butte at Burns, Oregon provided physical characteristics and production coefficients for the typical operation in that area. This geographical area is classified as a high desert region. Annual precipitation averages 11 inches, two-thirds of it occuring as snow and one-third as rain. Native forage is sagebrush-bunchgrass; crested wheatgrass is the primary improved forage species.

The simulated firm's physical inventory includes 5054 acres of owned rangeland. Forty percent is in Native 1 pasture (see page 34), 53 percent in Native 2 pasture, and seven percent in Improved (early season) pasture. Four hundred acres of forage land produces 800 tons of grass-legume hay each year, which is used to winter the cattle. Average pasture yields are 225 pounds of dry matter for Native 1, 300 pounds for Native 2, and 715 pounds for Improved (early season) pasture. Bureau of Land Management and Forest Service lands are leased in the spring and summer for grazing at $10.68 per animal unit per season utilizing 1976 as a base price. The carrying capacity of the total resources equals 400 cows under a cow-calf system and 300 cows under a yearling or long yearling system.

The production coefficients of the operation are outlined as follows. A conception rate of 94.7 percent, calving rates of 95 percent for mature cows and 87 percent for first time heifers result in an 85 percent calf crop. Calves from mature cows weigh 75 pounds at birth, calves from first time heifers, 70 pounds. Male calves from mature cows gain 1.75 pounds a day until weaning; females gain 1.61 pounds. Male calves from first time heifers gain 1.5 pounds per day until weaning; females gain 1.38 pounds. Stocker steers gain 1.2 pounds per day; heifers 1.08 pounds. Yearling steers on pasture gain 1.5 pounds per day; females 1.275 pounds. The calving season starts March 6th and lasts ten weeks. Cows are bred naturally with a 25:1 cow-bull ratio. Cows are pregnancy-tested in the fall.

The winter feeding season lasts from mid November until mid May. Cows are fed 90 percent hay and ten percent grain during this time. For this same time period stockers receive 70 percent hay and 30 percent grain. During the early winter and early spring cows and stockers receive 80 percent pasture and 20 percent hay; during the summer 100 percent pasture. The pasture yields utilized in the simulation model are calculated using an average yield obtained from prior studies completed by Squaw Butte Experiment Station personnel. An annual index of pasture yields adjusts the average yield for the individual year. These indices for 1968 through 1978 are shown in Table 3.4.

The land values used in the simulation are 1968 land prices. These are $15 per acre for Native pasture, $20 per acre for Native 2 pasture, $30 per acre for Improved (early season) pasture, and $500 per acre for hay land. Annual costs (1976 levels) including taxes are $.02 per acre per year on Native 1 and 2 pastures, $.22 per acre per year on Improved (early season) pasture and $5.15 per acre per year on hay land.

Table 3.4. Annual index of pasture yields, Squaw Butte Experiment Station, 1968-1978.

Year	Index	Year	Index
1968	67	1974	123
1969	123	1975	92
1970	115	1976	85
1971	115	1977	49
1972	104	1978	108
1973	68		

The simulated beef production operation is assumed to be managed by one producer with hired labor available by the hour when needed. It is assumed that the operator has a 30 percent debt on land and 40 percent debt on machinery, and no debt on cattle.

This typical Eastern Oregon cattle operation is simulated using the resource base described above. The specific heuristics for specific sections of the simulation model will now be given in greater detail.

Specific Heuristics

Ten classes of livestock are included in the model:

1. bulls,
2. cows,
3. first calf heifers,
4. replacement heifers,
5. slaughter steers,
6. slaughter heifers,
7. stocker steers,
8. stocker heifers,
9. male calves, and
10. female calves.

The maintenance requirements for each of these classes of cattle are computed for each bi-weekly time period during the year.

The beef sub-enterprise chosen determines which of the classes of cattle will be present on the farm at a given time. The number of animals and their progression through the various stages (depending on the subenterprise chosen) is related in part to normal husbandry assumptions and in part to the rate of gain selected. The major assumptions affecting the number of animals in each class are:

1. the maximum length of breeding season is ten weeks,
2. calves are weaned on August 27th,
3. all cull cows are sold on August 27th if pregnancy testing is selected; otherwise, half the cull cows are maintained over the entire winter,
4. bulls are sold after three breeding seasons,
5. the number of cull cows equals the number of replacements [unless: a) herd growth is specified, or b) one of the response rates and pasture improvement is selected].

Birth weights are assumed to be the same for males and females. Weaning weights depend on birth weight, sex, time of calving, and growth rate. Weights for stockers, yearling feeders, and slaughter animals at any given time depend on weaning weight, sex and rate of gain. Relative rates of gain of steers and heifers change as they get older. The relationships between the rates of growth of males and of females at various stages are summarized in Table 3.5.

Bulls and cows are maintained at their specified weights. Mature cows are assumed to lose twice the birth weight of the calf at calving time. This weight is regained during the pasture season.

Male calves from first calf heifers gain weight at 89 percent of the rate of male calves from mature cows. The rate of gain is specified on the input form. Heifer calves gain weight at 92 percent of the male calf growth rate.

Table 3.5. Proportionate growth rates: females vs. males, various stages.

State of Growth	Female/Male Gain Ratio
Calf - birth to weaning	.92
Stocker	.90
Yearlings on pasture	.85

Weaned heifers gain at a rate of 1.35 lb/.day from weaning to breeding. Bred heifers gain at a rate such that their weight at first calving is 90 percent of the mature cow weight. As with mature cows, they lose twice the birth weight of the calf at calving time. This loss is regained by the time the calf is weaned. Replacements then reach mature weight by the time they have their second calf.

The number of bulls required for breeding purposes depends on the breeding method selected. It is assumed that one bull could adequately service 25 cows under the natural breeding regime.

The following mortality rates are assumed to apply:

1. bulls - zero,
2. cows - 1.5 percent,
3. calves - 2.5 percent,
4. stockers - 1.5 percent,
5. feedlot calves - 3.0 percent,
6. feeder and pasture yearlings - 2.0 percent,
7. long yearling feeders - 1.0 percent.

The various resources required for maintenance and growth of each of the animals are calculated on a bi-weekly basis. They vary with the biological and physical characteristics of the animals and with the production alternative used.

Energy and protein requirements are calculated separately for each of the classes of cattle. Salt, calcium, phosphorus, vitamin A, and other nutritional requirements are purchased and appear as cash costs.

The general form of the energy requirements equation is:

$$DE_{ik} = (a_i W_{ik}^{.75} + b_i W_{ik}^{.75} R_i) E_i \qquad (1)$$

where:

DE_{ik} = digestible energy requirement (kcal) per day for animals of class i (i = 1 for bulls, 2 for cows, 3 and 4 for replacements, 5 and 6 for feeders, 7 and 8 for stockers, 9 and 10 for calves),

a,b = constants,

W_{ik} = weight (lb.) of animals of class i in time period k,

R_i = daily rate of gain (lb.) of animals of class i,

E_i = feed efficiency index of animals of class i.

Weights and, hence, DE requirements change each period for animals that are gaining or losing weight.

The digestible energy requirement of bulls is calculated as:

$$DE_{1k} = 76W_1^{.75}\, E_1 \qquad (2)$$

where:

DE_{1k} = kcal of digestible energy requirement per bull per day in period k,

W_1 = mature weight (lb.) of bulls,

E_1 = feed efficiency index of bulls.

The DE requirement is increased by 15 percent during the breeding season. In the winter season all the DE requirement is obtained from stored forage; in summer it is obtained from pasture. There is no provision for weight gains and losses by bulls.

The digestible energy requirement for cows is divided into a winter and summer season. It is calculated for maintenance and gain only. During the summer time periods (until weaning occurs), the energy requirement of cows is calculated as:

$$DE_{2k} = 98.7W_{2k}^{.75} E_2 + 4534R_2E_2 \tag{3}$$

where:

DE_{2k} = kcal of digestible energy requirement per cow per day in period k,

W_{2k} = the average body weight (lb.) of mature cows in period k,

E_2 = the feed efficiency index of cows, and

R_2 = the daily weight gain (lb.) for matures cows (to recover weight loss during calving).

During the winter time period, the energy requirement for cows is calculated as:

$$DE_{2k} = 76W_{2k}^{.75} P_1E_2 + (76W_{3k}^{.75} + 3484R_3) P_2E_3 \tag{4}$$

where:

W_{3k} = the average body weight (lb.) of first-calf cows in period k,

R_3 = the daily weight gain (lb.) required for first-calf cows to reach full mature weight,

P_1 = the proportion of the herd composed of mature cows,

P_2 = the proportion of the herd composed of first-calf cows,

E_3 = the feed efficiency index of first-calf cows, and all other notations are as defined above.

The digestible energy requirement for cows is increased by 20 percent for the last three time periods (i.e., six weeks) of gestation.

During the winter feeding period, all energy requirements for cows are met by stored feed; during the summer they are met by pasture.

Various combinations of pasture, hay, and grain can be used to satisfy the energy requirements in the late fall and early spring.

The digestible energy requirement of replacement heifers is calculated as:

$$DE_{3k} = 76W_{4k}^{.75}\ E_3(1 + .578R_4) \tag{5}$$

where:

DE_{3k} = kcal of digestible energy requirement per heifer per day in period k,

W_{4k} = average body weight (lb.) of replacement heifers in period k,

E_3 = the feed efficiency index of replacement heifers, and

R_4 = the daily weight gain (lb.) of replacement heifers (R_4 = 1.35 from weaning to breeding; R_4 = 1 from breeding to first calving; R_4 = about 1.8 from calving to weaning of first calf).

The digestible energy requirement for replacement heifers is increased by 20 percent for the three time periods immediately before calving.

The digestible energy requirement for calves and feeders is calculated as:

$$DE_{4k} = 76W_{5k}^{.75}\ E_4(1 + .578R_5) \tag{6}$$

where:

DE_{4k} = kcal of digestible energy required per animal per day in time period k,

W_{5k} = average body weight (lb.) of animals in period k,

E_4 = the feed efficiency index of the appropriate animals, and

R_5 = the daily gain (lb.) of animals.

Crude protein (CPR) requirements depend on weight, rate of gain, and biological function of the animals. CP requirements are calculated as follows:

i) bulls: $CPR_i = .08F_i$

ii) dry, pregnant cows: $CPR_i = .065F_i$

iii) growing animals: $CPR_i = .4566 + .00081W_i + .276R_i$ (7)

where:

CPR_i = crude protein requirements (lb./day) for animals of class i (i=1 for bulls, 2 for cows, 3 and 4 for replacements, 5 and 6 for feeders, 7 and 8 for stockers, 9 and 10 for calves),

F_i = air dry weight (lb.) of all feedstuffs consumed by animals of class i,

W_i = weight (lb.) of animals in class i, and

R_i = rate of gain (lb./day) of animals in class i.

CP consumption (CPC) depends on diet composition and protein content of the component feeds. The CP content of a specific diet is calculated from the proportions of perennial hay, cereal hay, straw, and grain in the diet. CP consumption from these sources is estimated and compared with CPR. If CPR is greater than CPC, a protein supplement is purchased. The cost of 35 percent protein supplement is \$0.08/lb.

The labor requirement for cows and replacements is a function of the herd size. It is calculated as:

$$L_k = ((4.644 + 148/NO)/0.8)\ HP_k \tag{8}$$

where:

L_k = hours of labor required per cow and per replacement for time period k,

NO = the number of cows and replacements in the herd,

HP_k = proportion of annual labor required in period k.

The proportion of annual labor requirements, by time period, is as follows:

Time Periods	Proportion per Period
1 - 8	.075
9 - 12	.035
13 - 24	.010
25 - 26	.075

The labor requirement during the late fall, early spring season is adjusted downward by the proportion of total energy requirements being met by pasture.

The annual labor requirement for bulls is nine hours. It is distributed throughout the year as above.

Labor requirement for feeders is dependent upon the building type selected. They are summarized in Table 3.6. The cost requirements by building type are also detailed in Table 3.6. Since no shelters are provided for the cattle in the modeled operation, the replacement cost for buildings was set at zero. The labor and cost requirements of calving, AI breeding, and pregnancy testing are summarized in Table 3.7.

The pasture utilization methods available in the model represent various combinations of the four seasons. The spring season represents the period when early season species such as crested wheatgrass can be

Table 3.6. Labor and cost requirements by building type.

Class of Animal	Type of Building	Replacement Cost Per Head[1]	Depreciation Rate	Repair Cost (% of Rept. Cost)	Bi-weekly Period Labor	Bi-weekly Period Cash[3]
		$	%	%	Hr.	$
Breeding herd	Min. Shelter	0	5	4	F[2]	.27
	Shed	0	5	3	F	.27
	Drylot	0	5	2	F	.27
Replacements, calves	Min. Shelter	0	5	4	F	.25
	Shed	0	5	3	F	.25
	Drylot	0	5	2	F	.25

[1]This includes feed storage, feeding, water, and handling facilities (1976 levels). These are the default values; their values may be changed through the input form.

[2]The labor requirement for cows and replacements is a function of herd size. Bulls require nine hours labor for the entire year.

[3]These include vitamin A, minerals, veterniary services, and medicine (1976 levels).

Table 3.7. Labor and cost requirements for miscellaneous jobs.

Job	Labor Per Head	Cash Costs Per Head
	Hr.	$
Calving	1.0	2.00
Artificial Insemination	0.8[1]	8.88
Pregnancy Testing	0.25	1.25

[1]There is an additional labor requirement of three hours/day for inspection of the herd during the AI breeding season.

utilized very effectively. It also permits the simulation of delayed grazing on native ranges. The combined spring and summer seasons represent the approximate length of the grazing season in community and other administered pastures. The fall season coincides with the period during which salvage operations on stubble and hay aftermath can occur.

The winter season represents the feeding period in which stored feeds are most often used. In areas where winter grazing is a feasible alternative, this season represents the period when animals are grazed (perhaps with supplemental feeding) on winter range. In areas where winter grazing is not an alternative, some grazing of the salvage type can occur at the beginning and end of the winter season. A feeding period ranging from zero to six months can be specified for the winter season.

The amount of forage that enters the pasture supply in each bi-weekly period depends on the acreage of each type of pasture, the use rate, and the yield.

To maintain pastures in a productive state only part of the total growth can be harvested. The proportion that can be harvested while maintaining such a state depends on the species, the utilization method, quantity and timing of precipitation, pasture condition, and other factors (see Table 3.8). Use rates are lowest when grazing begins near the start of the growing season. When grazing is delayed into the summer season or later the use rates can be increased.

Pasture yields vary widely from year to year, hence, a constant level of carryover is impractical. Use rates can be increased in dry

Table 3.8. Use rates by type of pasture and season of use under average conditions.

Pasture Type	Season of Use: All Year	Spring	Summer	Fall	Winter
Native 1	.55[1]	.55	.55	.55	.75
Native 2	.55	.55	.55	.75	.75
Improved (early)		.75	.75		
Improved (late)	.75	.75	.75	.90	.90

[1]These represent the maximum proportions of total growth that can be consumed without pasture deterioration.

Table 3.9. Adjusted pasture use rates by yield index.

Yield Index (Y_t)	Average Use Rate ($\bar{U}_{ij}$): .55	.75	.90	1.0
.50	.78	.88	.95	1.0
.75	.66	.81	.92	1.0
1.00	.55	.75	.90	1.0
1.25	.44	.69	.88	1.0
1.50	.32	.62	.85	1.0

years without damage to the range if it is compensated by reduced use rates and higher carryovers in wet years. The use rates are adjusted in the model as follows:

$$U_{ih} = \bar{U}_{ij} + (1 - \bar{U}_{ij}) * (1 - Y_t) \qquad (9)$$

where:

U_{ij} = utilization rate of pasture source i in season of use j,

$\bar{U}_{ij}$ = utilization rate for $Y_t = 1.0$, i.e., average rainfall, and

Y_t = pasture yield index in year t (1.0 = average).

When yields (rainfall) are below average ($Y_t < 1.0$) use rates are increased, and vice versa. The same adjustment factor is applied to all utilization rates in the model. Table 3.9 shows how use rates change as the yield index changes through application of equation (9).

Pasture yields depend on species, seasonal precipitation levels, soil fertility, pasture condition, location (soil type and topography), season of use, and other factors. The model recognizes several of these variables. The base yields in the model (Table 3.10) assume average precipitation and a utilization method that allows for maximum growth (grazing delayeduntil the summer season). Yields for each pasture type are adjusted for the season of use (see Table 3.11). Yields are highly variable (Table 3.12) and are strongly correlated (r = 0.8) with growing season rainfall. The pasture yield index in the model is selected each year from a distribution within a range of 75 to 135 percent of acerage yield.

An additional option has been added to the forage enterprize. If actual pasture yields are known, then they may be used through

Table 3.10. Base yields for pasture sources, three zones.

Pasture Type	Zone 1 (Brown Soil)	Zone 2 (Dk. Brown Soil)	Zone 3 (Black Soil)
		lb. dry matter/acre	
Native	350	400	450
Improved (early season)	900	960	1100
Improved (late season)	750	810	1000
Cereal stubble	250	300	300
Hay aftermath	300	385	450

Table 3.11. Effect of season of use on pasture yields.

Pasture Type	Season of Use				
	All Year	Spring	Summer	Fall	Winter
Native 1	.73	.73	1.0	.95	.85
Native 2	.73	.73	1.0	.95	.85
Improved (early)		1.0	.8		
Improved (late)	.90	1.0	1.0	.95	.90
Cereal stubble				1.0	1.0
Hay aftermath				1.0	1.0

Table 3.12. Native pasture yields zones 1 and 2[1].

	Pasture Condition			
	Excellent	Good	Fair	Poor
	lb. dry matter/acre			
Zone 1				
Average yield	425	330	250	165
Range	350-600	250-500	175-400	100-300
Zone 2				
Average yield	525	425	330	230
Range	350-1000	300-750	225-550	175-300

Source: Alberta Agric.

[1]Zone 1 is the "short-grass" area (10-14 inches precipitation, 30 inches evaporation); Zone 2 is the "mid-grass" area (10-14 inches precipitation, 25-30 inches evaporation).

selection of a switch in the input form. An annual yield index of pasture yields adjusts the average yield for the individual year.

A pasture deterioration factor is also incorporated into the forage component of the model to reflect the dry matter losses due to factors other than consumption by cattle. In periods outside the growing season, pasture balance is reduced to account for this.

The base yields in the model (Table 3.9) are meant to reflect average dry matter yields under normal growing conditions. These yields can be adjusted in the input form to suit local conditions (see Appendix A).

The digestible energy (DE) requirements for each type of animal for each bi-weekly time period are converted to quantities of hay, grain, and pasture on the basis of the diet selected and average DE values for these three feed categories (1000 kcal/lb. of air dry feed for hay and pasture and 1550 kcal/lb. for barley). Equations (10), (11), and (12) describe how pasture production and consumption are reconciled in the model.

$$PP_k = \sum_{j=1}^{7} PA_j AY_j \ R \ U_{ij} \ Y_{ij}(1.0 - PD) \tag{10}$$

$$PR_k = \sum_{m=1}^{10} AN_{km} \ DE_{km} \ PPH_m \ / \ 1000. \tag{11}$$

$$P_k = R_{k-1} + (PP_k - PR_k) \ / \ 2000. \tag{12}$$

where:

PP_k = pasture production in period k (lb. DM),

PA_j = acres of pasture source j,

AY_j = average yield (lb. of DM/acre) of pasture source j,

R = rainfall index ($0.75 \leq R \leq 1.35$)

U_{ij} = use rate for pasture source j in season of use i,

Y_{ij} = yield index for pasture source j in season of use i,

PD = pasture deterioration rate,

RP_k = pasture requirements in period k (lb. DM),

AN_{km} = number of animals of type m in period k,

DE_{km} = digestible energy requirement of animal type m in period k (kcal),

PPH_m = proportion of DE from pasture for animal type m, and

P_k = pasture balance at end of period k (T. DM) ($k \geq 10$).

In addition:

AN_{km} = f(enterprise size, breeding system, production system, calving rate, mortality rate),

DE_{km} = f(weight, rate of gain, feed efficiency),

PPH_m = f(diet, feed supply).

If P_k becomes zero, PPH is set to zero and hay is substituted for pasture in the diet. If the hay balance becomes zero, two options are available:

1. hay can be purchased each period in amounts required to make up the pasture deficit, or
2. grain can be substituted for pasture. If the grain balance becomes zero, additonal grain is purchased.

The sources of stored forages are:

1. native hay,
2. cultivated perennial grass,
3. cultivated perennial grass legume mixtures,
4. cereals, and
5. straw.

Maximum acreages of cereal hay and straw are indicated in the input form. These place upper limits on the amount of straw that can be harvested for feed and bedding and on the area of annual crop that can be used for cereal hay. Dietary considerations place further limits on the amount of straw that can be used for feed. The proportion of the forage component of the diet that can be satisfied by straw depends on the class of animal, the forage/grain ratio in the diet, and the source (perennial or cereal hay) of the non-straw part of the diet. For cows, the upper limit on straw is 45 percent of the total digestible energy requirement. Table 3.13 gives the limits for other classes of animals. The elements of the table indicate the maximum straw percentage in the forage portion of the diet given the other sources of forage and the hay/grain ratio. For example, if diet two is being used for stockers and the only other forage source is perennial hay, 15 percent of the forage can be straw. On high grain diets, all of the forage energy can come from straw. When both perennial hay and cereal hay are used, linear combinations of the elements in Table 3.13 define the straw limit.

The production of straw and cereal hay are estimated from the total requirements for forage and bedding subject to the constraints

Table 3.13. Maximum straw content (percent) of diets for stockers, replacements, and heifers.

Diet[1/] No.	Stockers and Replacements Other Forage Source is: Perennial Hay	Cereal Hay	Feeders Other Forage Source is: Perennial Hay	Cereal Hay
1	0	50	0	25
2	15	60	0	50
3	40	70	75	75
4	65	80	100	100
5	100	90	100	100

[1/] See Table 3.2 for composition of diets.

Table 3.14. Digestible energy content and yields of stored forages[1/].

Forage Type	DE (Mcal/lb.)	Yields[2/] (tons/acre) Zone 1 Cut 1	Zone 1 Cut 2	Zone 2 Cut 1	Zone 2 Cut 2	Zone 3 Cut 1	Zone 3 Cut 2
Native	780	0.5	-	0.6	-	0.7	-
Grass	1000	1.0	0.0	1.2	0.0	1.2	0.2
Grass-Legume	940	1.25	0.0	1.3	0.0	1.3	0.2
Cereal Hay	1200	1.5	-	1.75	-	2.0	-
Straw	800	0.5	-	0.6	-	0.7	-

[1/] Zone 1 is the "short-grass" area (10-14 inches of precipitation, 30 inches evaporation); Zone 2 is the "mid-grass" area (10-14 inches precipitation, 25-30 inches evaporation).

[2/] Only the Zone 1 yields are stored as base data in the model. Alterations to these data can be made through the input form.

described above. Bedding requirements are substracted from the straw supply. The feed straw requirement is estimated as the difference between total hay requirements and production from perennial sources. Cereal hay is produced, subject to an acreage constraint, only if perennial hay and straw do not provide sufficient forage. Stored forages from all of the sources described above are converted to a standard stored forage category (1000 kcal DE/lb.) on the basis of average digestible energy (DE) content for each type (Table 3.14).

Yields of forages assume production on dryland. Yields vary annually on the basis of the yield distribution used for pasture and annual crops. The model has provisions for two cuts on perennial cultivated hay crops but the base yields for zones one and two assume only one cut. Yield responses to fertilizer applications can be accommodated through revision of base yields and annual costs associated with hay land.

The protein content of the diet is calculated from the proportion of the various feedstuffs which are included. The crude protein (CP) content of the various feedstuffs is as follows:

1. Barley = 11.5%,
2. Native hay = 5.0%,
3. Grass hay = 8.0%,
4. Grass legume hay = 10.0%,
5. Cereal hay = 8.0%,
6. Straw = 4.0%,
7. Fall and winter pasture = 3.5%,
8. Spring and summer pasture = 12.0%.

Any decline in the protein content of pasture from spring to fall is ignored in the model. It is assumed that crude protein intake during this time is high enough to meet minimum requirements.

The annual cost of land used for pasture and hay production is inserted in the input form by the user of the model. This figure accounts for land taxes and annual maintenance that may be required.

The annual charge for community pasture usage must also be inserted in the input form.

The transformation data for machines used exclusively in the harvesting of hay are detailed in Table 3.15. Tractor and swather data are included in Table 3.16.

Twine costs are assumed to be \$2.50/ton of hay.

The replacement costs of grain storage buildings is assumed to be \$0.50/bushel. The annual repair cost on these buildings was established at two percent of the replacement cost (or \$0.01/bushel).

The transformation data for machines used in the crop enterprise are detailed in Table 3.16.

Machine repair costs are based on annual hours of use, age, and replacement cost of each machine. The repair functions are coded by type of machine (see Tables 3.15 and 3.16); they are presented in equations (13) to (22).

1. $REP_1 = .03767H^{.4003}Y^{.4771}$ (13)
2. $REP_2 = .02732H^{.3995}Y^{.4770}$ (14)
3. $REP_3 = .01654H^{.3992}Y^{.4767}$ (15)
4. $REP_4 = .02014H^{.3982}Y^{.4769}$ (16)
5. $REP_5 = .01618H^{.3982}Y^{.4743}$ (17)

Table 3.15. Transformation data for forage machines.

Machine	Size	Replacement Cost	Draft	Speed	Field Efficiency	Repair Code	Depreciation Code	Maximum Hours of Use
	Tons	$	lbs.	mph	%			Hours
Baler-Conv.	8	3,880		2.8	80	5	4	1800
	9	4,530		3.0	80	5	4	1800
	10	5,470		3.0	80	5	4	1800
Baler-Round	8	6,865		2.8	80	5	4	1800
	9	8,000		2.8	80	5	4	1800
	10	9,500		2.8	80	5	4	1800
SP Bale Stacker	12	23,720		6.0	80	5	3	1800
	14	24,360		6.0	80	5	3	1800
	6	4,850		5.0	75	5	2	1800
	8	8,235		5.5	75	5	2	1800
	10	9,625		6.0	75	5	2	1800
	12	14,995		6.0	75	5	2	1800
For. Harvester	5	4,895	150	3.0	65	6	4	1800
	6	5,865	150	3.0	65	6	4	1800
	7	7,140	150	3.0	64	6	4	1800
	8	8,400	150	3.0	65	6	4	1800
For. Wagon	6	4,865			75	9	4	2400
Loose Stacker	5	7,800	150	3.0	65	4	4	1800
	6	9,200	150	3.0	65	4	4	1800
	7	10,600	150	3.0	65	4	4	1800
	8	18,300	150	3.0	65	4	4	1800
Stackmover	2	1,530	100	6.0	70	4	4	1800
	4	2,580	100	6.0	70	4	4	1800
	6	3,615	100	6.0	70	4	4	1800
	8	5,000	100	6.0	70	4	4	1800
FE Loader	3	1,860	50	5.0	100	4	3	2400
Trailer	3	300	50	5.0	100	4	3	2400

Table 3.15. Cont.

Machine	Size	Replacement Cost	Draft	Speed	Field Efficiency	Repair Code	Depreciation Code	Maximum Hours of Use
	Tons	$	lbs.	mph	%			Hours
	6	450	50	5.0	100	4	3	2400
	9	600	50	5.0	100	4	3	2400
	12	750	50	5.0	100	4	3	2400

Table 3.16. Transformation data for machines.

Machine	Size	Replacement Cost	Draft Per Foot Width	Field Efficiency	Fuel Per Hour	Repair Code	Depreciation Code	Maximum Hours of Use
	ft.	$	lbs.	%	Gal.			Hours
Disc.	24	7,319	179[1]	82		1	2	1800
	28	10,635	179[1]	86		1	2	1800
	30	10,935	179[1]	88		1	2	1800
	32	11,230	179[1]	90		1	2	1800
	36	11,360	179[1]	90		1	2	1800
Harrow	12	310	50	70		1	3	2400
	14	380	50	72		1	3	2400
	16	440	50	74		1	3	2400
	20	545	50	78		1	3	2400
	22	605	50	80		1	3	2400
	24	665	50	82		1	3	2400
	28	770	50	86		1	3	2400
	30	820	50	88		1	3	2400
	32	870	50	90		1	3	2400
	36	975	50	90		1	3	2400
PTO Swather	12	2,450	80	80		4	3	1500
	15	2,850	80	80		4	3	1500
	18	3,250	80	85		4	3	1500
	20	3,520	80	87		4	3	1500
	24	3,870	80	90		4	3	1500
SP Swather	12	6,810		77	2.3	4	2	1500
	14	7,165		82	2.5	4	2	1500
	16	7,260		87	3.0	4	2	1500
	18	7,390		89	3.6	4	2	1500
	20	7,515		90	4.2	4	2	1500

Table 3.16. Cont.

Machine	Size	Replacement Cost	Draft Per Foot Width	Field Efficiency	Fuel Per Hour	Repair Code	Depreciation Code	Maximum Hours of Use
	ft.	$	lbs.	%	Gal.			Hours
PTO Combine	30[2]	12,020	52	65		3	2	1200
	40[2]	13,430	60	70		3	2	1200
	45[2]	18,200	75	75		3	2	1200
	50[2]	20,300	90	80		3	2	1200
SP Combine	30[2]	20,545		65	5.0	3	2	1440
	40[2]	27,040		70	6.6	3	2	1440
	45[2]	28,205		75	8.1	3	2	1440
	50[2]	36,290		80	9.0	3	2	1440
	55[2]	39,000		85	9.4	3	2	1440
	60[2]	41,485		87	9.9	3	2	1440
Sprayer	30	1,710	10	60		6	3	1200
	40	1,870	10	65		6	3	1200
	60	2,010	10	75		6	3	1200
	76	2,415	10	80		6	3	1200
Tractor	40[3]	7,700			2.2	7	1	6000
	50[3]	9,300			2.6	7	1	7500
	75[3]	13,770			3.6	7	1	7500
	100[3]	19,170			4.0	7	1	10500
	110[3]	21,355			4.8	7	1	10500
	120[3]	23,450			5.5	7	1	10500
	135[3]	24,850			6.4	7	1	12000
	150[3]	26,298			7.0	7	1	12000
	165[3]	31,400			7.4	7	1	12000
	185[3]	36,560			8.3	7	1	12000

Table 3.16. Cont.

[1]If a cultivator, discer, or disc is used for the first operation in the spring, the draft requirements are increased by 45 lbs. per foot and the speed of operation is decreased by 0.5 mph.

[2]Combine sizes are specified in inches of cylinder width.

[3]Tractor sizes are specified in terms of rated horsepower.

6. $REP_6 = .02177H^{.4005}Y^{.4762}$ (18)

7. $REP_7 = .00103H^{.5133}Y^{.5912}$ (19)

8. $REP_8 = .00349H^{.3986}Y^{.4740}$ (20)

9. $REP_9 = .01230H^{.3957}Y^{.4772}$ (21)

10. $REP_{10} = .00751H^{.4004}Y^{.4792}$ (22)

where:

REP_i = repair costs ($/hr./$1000 investment for machines of class i

$i = 1, 2, \ldots, 10$,

H = annual hours of use of machine,

Y = age of machine in years.

The remaining farm value of each machine in the inventory is based upon its age and its replacement cost. These values are calculated for beginning and ending inventory values and for the purchase and selling prices of used machinery. The ending remaining farm value is the beginning farm value minus current year depreciation.

The declining balance method is used to determine yearling depreciation. No additional first-year depreciation is taken. Under this depreciation method the largest depreciation deduction is taken the first year, and gradually smaller amounts are taken in subsequent years. Depreciation equals 20 percent of the assets remaining farm value. Salvage value is not subtracted from the purchase price, but depreciation allowances stop when the unrecovered cost equals salvage value (ten percent of purchase price).

Labor, Financial, and Personal Considerations

The labor resource is divided into permanent and temporary categories. Permanent labor includes the operator(s) and any permanent employees on the farm. Temporary labor is purchased on an hourly basis as needed by the farm.

The maximum amount of both types of labor available is specified for each bi-weekly time period through the year. Base figures for permanent labor assume 12 ten-hour days during most time periods and 12 twelve-hour days per two week period during planting and harvesting seasons.

Down payments, interest rates and length of repayment period for various types of loans can be specified in the input form. The base rates of interest range from 6.5 percent for long term loans (15-30 years) to nine percent for short term loans (90 days). In addition, the beginning value of cash and non-farm assets and the current debt situation of the farm is specified in the input form. A cash flow budget keeps track of cash on hand for each period. Whenever cash on hand becomes negative, the necessary cash is borrowed on a short term loan.

Consumption expenditures are withdrawn every two weeks on the basis of the following annual consumption function:

$$C = Ca + cN \tag{27}$$

where:

C = total consumption withdrawal ($),

N = annual net income ($),

Ca = minimum living expenses ($), specified, and

c = proportion of net income withdrawn from consumption ($), specified.

In this study, Ca was assumed to be $5,000 per year and C was ssumed to be zero. Total yearly consumption totaled $5,000.

Social security taxes are paid for one operator. Federal and State income taxes are paid on all taxable income. Taxable income is calculated as net farm income minus half the cull sales (since they are capital items) and minus any changes in inventory. The 1978 federal and state personnal income tax schedules for married couples are used to determine taxes. In this study it was assumed the operator had four dependents.

The annual detailed tables include:

1. beginning inventory (items, age, capacity, remaining value),
2. ending inventory (as above),
3. resource flows by two week periods (cattle labor, crop labor, other labor, pasture production, pasture requirements, pasture balance, forage fed),
4. cash receipt and expense flow by two week periods (cattle and crop receipts, cattle and crop expenses, miscellaneous receipts and expenses, cash balance),
5. grain and hay production, use, purchases, and balance,
6. pasture production (acres, yield, use rate, total use).

The summary tables include for each year of the analysis:

(See Appendix D for samples).

1. farm plan summary (area of grains, oilseeds, hay, number of cows, beef-production options employed),
2. financial summary at year end (assets, debts, net worth, net farm income situation),
3. ending value and change in investment of selected capital items,
4. pasture improvement and herd expansion levels,
5. product sales and selected input use,
6. diets of various classes of animals,
7. receipts and expense summary (receipts, expenses, debt situation, personal expenses),
8. crop options employed.

IV. MODEL VALIDATION, SIMULATION RESULTS AND ECONOMIC IMPLICATIONS

Each alternative beef production system was simulated through the use of the computer model detailed in Chapter III. From these results, then, economic implications can be derived. In order for these results to be meaningful though, the simulation model must be validated. Validation of the model, the simulation results and their economic implications are discussed in this chapter.

Validation of the Model

Validation of the model was done both externally and internally. External validation was done by comparing net farm income generated by a cow-calf system for two years, 1975 and 1977 to net farm income obtained from other sources.

The 1975 comparison utilized a budget created by the Oregon State Extension Service. The data used in this budget was obtained by county extension agents from ranchers in Southeastern Oregon. The resource base in this budget differed from the modeled operation. It was assumed that there was no debt on assets in the Extension Service budget. Therefore there was no interest payment deducted from net farm income. Total net farm income was -$8,966 on the modeled operation, a loss of $22.42 per cow. It was -$5,020 on the Extension Service operation for a loss of $12.55 per cow. If the Extension Service ranch had carried the same debt load as the modeled operation, its total net farm income would drop to -$10,580, a loss of $26.45 per cow.

The total difference of $3,948 equals $9.87 per cow. This difference can be attributed to the different resource base. The Extension

Service budget represents ranches in all of Southeastern, Oregon not just the high desert area. In the high desert area calves are a lighter weight when weaned. In addition winters are harsher forcing grain feeding and its accompanying costs.

The budgets used for this 1975 comparison as well as the 1977 comparison may be found in Appendix B. The 1977 comparison was made to a budget calculated by the U.S.D.A. for cow-calf operations in the Western U.S. [23, p. 38].

This budget differed from the simulation run in that it assumed the rancher also sells some yearlings as well as calves. Although the U.S.D.A. budget encompasses a larger geographical area and the system structure is slightly different it is the best published information available for comparison purposes.

The results of the 1977 simulated operation show total net farm income of $7,958 a profit of $19.89 per cow. The U.S.D.A. budget also produced net farm income of $2,266, for a profit of $5.66 per cow. Comparing the simulation results and the U.S.D.A. budget shows a difference of $14.23 per cow, again attributed to the resource base.

Internal validation was done on several key variables: conception rate, calving rate, replacement rate, birth weight, average daily weight gain, and forage production.

To validate conception rates and calving rates one variable was allowed to change with all others held constant. The number of calves born in the modeled system was compared with the number that should have been born as determined by hand calculation. The equation used for hand calculation was:

$$B = \sum_{L=1}^{2} (CR)(P_i)(C_i)(N) \tag{28}$$

where:

B = Number of calves

CR = Calving Rate

P = Percent of animals in class i (where i = 1 for mature cows, and 2 for first time heifers)

C = Conception rate of animals in class i (where i = 1 for mature cows, and 2 for first time heirfers)

N = Number of cows plus number of first time heifers

With the calving rate held constant at 95 percent for mature cows and 87 percent for first time heifers, the conception rate was changed from 94.7 percent to 50 percent. When a 94.7 percent conception rate is entered into equation (28) 355 calves are born. With a 50 percent conception this number drops to 182 calves. These two conception rates were also entered into the computer simulation model. When the conception rate stood at 94.7 percent 355 calves were born in the modeled system. When the conception rate was entered as 50 percent 182 calves were born.

Calving rates were hand calculated using equation (28), with the conception rate held at 94.7 percent. It was shown that 355 calves were born with a 95 percent calving rate for mature cows and an 87 percent rate for first time heifers. Changing the calving rate to 90 percent for mature cows and 80 percent for first time heifers results in 337 calves born. This number was also obtained using the simulation model.

Replacement rates were checked by changing this rate and finding how many replacements the simulated system kept. This number was then compared to hand calculations with a 15 percent replacement rate. The simulated system kept 60 replacements, with a 30 percent rate it kept 120 replacements. These values were checked by multiplying each replacement rate by the herd size of 400. These calculations generate values of 60 and 120 replacements for 15 and 30 percent replacement rates.

Birth weight of the calf is determined by the classification of its mother. Calves from first time heifers are lighter at birth than calves from mature cows. To find the average birth weight the portion of calves produced by each class of cows was multiplied by their birth weight and then added together.

Two trials were made with different birth weights specified. In the first trial calves from mature cows weighed 100 pounds, calves from first time heifers 90 pounds. In the second trial these weights were 75 pounds and 70 pounds respectively.

The simulation model calculated an average birth weight of 98.50 pounds in the first trial, and 74.25 pounds in the second. To check these results by hand:

$$(.85)(100) + (.15)(90) = 98.50 \tag{29}$$

$$(.85)(75) + (.15)(70) = 74.25 \tag{30}$$

Where 85 percent of the herd are mature cows and 15 percent are first time heifers. Equation (29) shows an average birth weight of 98.50 pounds for the first trial. Equation (30) shows an average birth weight of 74.25 pounds for trial two. This helps verify the model's results.

To check average daily weight gain of calves, yearlings, and long yearlings an output statement was inserted into the model. As weights were calculated for each period they were written out. Then they were checked to see if average daily gain equaled the selected value.

Table 4.1 records the weight of calves from birth until the time they are sold as long yearlings, broken into three time intervals. The first interval is from birth to weaning. The second interval is the yearling stage. It is from weaning until the following spring. The third interval is the long yearling stage. It lasts from spring of their second year until fall, when the animals are sold as long yearlings.

During the first interval calves from first time heifers gain less weight than calves from mature cows. During the second and third intervals there is no difference. Female calves gain 92 percent as much weight as male calves during the first interval. They gain 90 percent as much during the second interval and 85 percent during the third interval.

The average daily gain values used in the actual simulation runs were used for this check. During the first interval male calves from mature cows should gain 1.75 pounds per day, calves from first time heifers 1.50 pounds. During the second and third intervals male animals should gain 1.2 pounds, and 1.5 pounds per day respectively.

Since calves from mature cows gain weight faster than calves from first time heifers during the first interval an additional

Table 4.1. Bi-weekly weight and average daily gain of calves from birth through long yearlings, broken into three time intervals.

Interval	Period	Male Weight	Female Weight
1	6	74.25	74.25
	7	98.22	96.30
	8	122.19	118.35
	9	146.15	140.40
	10	170.12	162.45
	11	194.09	184.50
	12	218.06	206.53
	13	242.03	228.60
	14	266.80	250.65
	15	289.96	272.71
	16	313.93	294.76
	17	337.90	316.81
Average Daily Gain (Pounds per day)		1.71	1.575
2	18	354.70	331.93
	19	371.50	347.05
	20	388.30	362.17
	21	405.10	377.29
	22	421.90	392.41
	23	438.70	407.53
	24	455.50	422.65
	25	472.30	437.77
	26	489.10	452.89
	1	505.90	468.01
	2	522.70	483.13
	3	539.50	498.25
	4	556.30	513.37
	5	573.10	528.49
	6	589.90	543.61
	7	606.70	558.73
	8	623.50	573.85
	9	640.30	588.97
	10	657.10	604.09
Average Daily Gain (Pounds per day)		1.20	1.08

Table 4.1. Cont.

Interval	Period	Male Weight	Female Weight
3	11	678.10	621.94
	12	699.10	639.79
	13	720.10	657.64
	14	741.10	675.49
	15	762.10	693.34
	16	783.10	711.19
Average Daily Gain (Pounds per day)		1.50	1.275

calculation is needed to determine the overall average daily weight gain:

$$(.85)(1.75) + (.15)(1.50) = 1.71 \tag{31}$$

Equation (31) multiplies the proportion of calves from mature cows times their average daily gain, and adds this to the proportion of calves from first time heifers times their average daily weight gain. The resulting 1.71 pounds is the overall average daily weight gain for the first interval.

Comparing the results in Table 4.1 to those obtained by hand verifies the average daily weight gain variable within the model.

The remaining interval validation was done on forage production. To check hay yields, two trials were run. In one trial hay yields were two tons per acre, in the second they were four tons per acre. With 400 acres of producing land 800 tons of hay were produced with a two ton per acre yield. With the four ton per acre yield 1600 tons were produced.

Time constraints limit validation of every variable in the model. Several key variables were checked though and found to work correctly.

Given the set of resources described in Chapter III, the rangeland producer can be in cow-calf production with 400 cows, yearling production with 300 cows, or long yearling production with 300 cows. He may also change production systems over time. Each of the three production systems were simulated over the last cattle cycle, 1968-1978. Three of the standard eight accounting measures: net farm income, total equity, and percent return on equity were used to determine the profitability of each system.

Partial budgeting was then used to determine if and when production system changes should occur to increase profitability. When allowing system changes, the producer must decide on August 27th, the weaning date, whether to sell calves or continue to feed them to heavier weights. If the producer maintains possession of the animals, they must be sold the following April as yearlings or the following August as long yearlings. When partial budgeting these alternatives, two sets of costs and returns were used. One set, the perfect knowledge approach, assumed that all future costs and returns were known. Under perfect knowledge the producer can make the optimal decision between calves, yearlings, and long yearlings at the time of weaning. While perfect knowledge is ideal, it does not exist in the real world. At the other extreme is the second set of costs and returns, the naive approach. This assumes that current prices will prevail over the production period. As time progresses and new price information is received, prior decisions may be reevaluated. Once calves have been sold the decision is irreversible. However, the yearlings versus long yearling decision remains a viable alternative until April when yearlings must be sold. Partial budgeting was utilized twice, once at weaning and again in April with April's prices projected into the future to decide the yearlings versus long yearling alternative.

The relative profitability of the three straight systems and the management option allowing system changes will be analyzed in this chapter. In addition the economic implications of changing systems during 1968 to 1979 will be discussed.

Straight System Results

Given the resource base, optimal herd size differs between alternative production systems. Herd size is adjusted to maximize use of available hay and minimize use of purchased inputs. While 400 cows is the optimal number under the cow-calf system, only 300 cows are kept under a yearling or a long yearling system. Reduction of cows allows the hay to be utilized by the young animals. It is assumed that the resource base is equally suited to any production system which can utilize the resources over the year. Additionally, it is assumed that the producer has equal management skills relative to all systems.

By assuming a 30 percent debt on all land and a 40 percent debt on machinery, the beginning equity differs between a cow-calf, yearling, and long yearling system. With no debt on the cow herd, beginning equity under a cow-calf system equals $325,328. Beginning equity of a yearling or a long yearling system equals $330,784. The difference can be attributed to the reduction of 100 cows and the addition of 211 calves.

Total net farm income is the sum of net farm income for each of the 11 years (1968-1978). It is a measure of the return to the producer for his labor and management. As shown in Table 4.2, total net farm income for the period was $218,292 for the cow-calf operation, $272,342 for the yearling operation, and $391,646 for the long yearling operation. The long yearling operation netted $173,354 over the cow-calf system and $119,304 over the yearling system during the 11 years.

Ending equity for the cow-calf system was $423,194 an increase of $97,366 over the 11 years. The yearling system's total equity increased $139,654 to $470,438. The long yearling system showed the greatest ending equity: $548,258 and the greatest increase: $217,474. Total equity by year is summarized in Table 4.3.

Table 4.4 summarizes the percent return on equity for each year. The long yearling operation averaged 5.46 percent; the yearling operation, 4.48 percent; and the cow-calf operation, 3.48 percent. Computer output forms for these three runs may be found in Appendix D.

Production Systems Under Perfect Knowledge

The operation in 1967 was assumed to be a 400 cow, cow-calf system with a total equity of $325,828. Partial budgeting was used to determine if the operation should change systems over time. Perfect knowledge, the ideal condition, assumes complete foresight as to costs and returns during the next production period. Each year at weaning on,

Table 4.2. Net farm income for alternative production systems, 1968 through 1978.

	Dollars											
Production System	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Total
Cow-Calf (400 cows)	7,383	12,333	15,116	21,038	29,564	60,097	22,354	-8,003	23,954	8,251	26,155	218,292
Yearlings (300 cows)	7,548	19,153	15,493	24,316	36,990	50,170	11,635	3,121	25,526	15,714	62,676	272,342
Long Yearlings (300 cows)	12,511	26,486	22,792	36,519	50,770	75,330	6,427	14,689	32,818	27,534	85,770	391,646

Table 4.3 Total equity for alternative production systems.1968 through 1978.

Production System	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ending
Cow-Calf (400 cows)	328,081	330,284	335,270	346,158	363,846	406,347	418,571	400,438	414,262	412,383	423,194	423,194
Yearlings (300 cows)	333,202	342,225	347,170	361,217	385,686	418,822	419,002	41,992	427,338	432,921	470,438	470,438
Long Yearlings (300 cows)	338,110	352,556	362,382	384,231	416,763	460,175	455,667	460,226	479,825	493,621	548,258	548,258

Table 4.4. Percent return on equity for alternative production systems, 1968 through 1978.

	Percent											
Production System	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Cow-Calf (400 cows)	.69	2.18	2.98	4.59	6.24	11.69	4.12	-3.28	4.54	.76	3.75	3.48
Yearlings (300 cows)	.73	4.10	2.86	5.27	7.64	9.11	1.24	-.49	4.76	2.44	11.62	4.48
Long Yearlings (300 cows)	2.17	5.52	4.09	6.99	9.01	10.52	.11	2.08	5.13	3.81	10.66	5.46

August 27th, the partial budget can be utilized to determine if calves should be sold or maintained over the winter to sell as yearlings or long yearlings the next year.

Once the decision to switch to yearlings or long yearlings is made, the herd must be reduced by 100 cows, due to the resource limitations of the model. Additional income from liquidation of the cows will occur the year of the change. If the producer decides to switch back to the cow-calf production system, the herd may be held at 300 animals or increased to 400 by retaining extra replacement heifers. This rebuilding phase takes three years between the decision to increase herd size and the increased calf production, due to the biological nature of the cow. The extra replacements do not have their calves until they are three years old. Receipts are reduced by the value of each extra replacement heifer the year the decision is made.

When the researcher budgets 1968, he considers two changes: cow-calf to yearling and cow-calf to long yearling. These decisions are made at weaning, August 27th, 1968. The partial budget is broken into four categories: extra receipts due to the change, reduced receipts due to the change, extra expenses due to the change, and reduced expenses due to the change. When one partial budgets the first alternative, cow-calf to yearling, extra receipts include liquidation of 76 cows and three bulls, and yearling sales in 1969. Reduced receipts include those foregone for the calves on August 27th and for 14 fewer cull cows in 1969. Extra expenses include the cost of raising the yearlings, interest on the increased investment in calves minus decreased investment in the herd and interest on the cash foregone by holding animals 17 periods longer, until sale. The second decision, cow-calf versus long yearlings, is budgeted in a similar manner with long yearling receipts and expenses taking the place of yearling. Interest on cash foregone is taken for 25 periods instead of 17. Extra receipts are added to reduced expenses to form total credits due to the change. Total debits are the sum of reduced receipts and extra expenses. If total credits are greater than total debits, then the change in net income due to the change is positive and the change should be made.

In 1968 total credits due to changing to yearlings are $77,547, and total debits are $56,893. The net result is a positive $20,654. Total credits for changing to long yearlings are $90,770, and total debits are $59,977. The net result on income is a positive $30,793. A change to either a yearling or a long yearling operation increases net farm income in 1968, but long yearlings increase it by $10,139 more. Therefore, the operation changes to long yearlings in 1968. The partial budget for these decisions can be examined in Appendix C .

On August 27, 1969 the 1968 calves are sold as long yearlings and the decision concerning the 1969 calves is made through partial budgeting. Now a long yearling versus a cow-calf operation and a long yearling versus a yearling operation are examined. The switch to cow-calf results in reduced income of $7,558, and switching to yearlings reduces income by $6,455. Since both results are negative, the producer should maintain a long yearling operation. In 1970-1972 long yearlings remain the most profitable; $8,591 in 1970, $15,631 in 1971 and $27,747 in 1972 would be lost by switching to cow-calf, and $7,956 in 1970, $11,604 in 1971, and $23,465 in 1972 by switching to yearlings.

Partial budget results in 1973 show an increase in income of $26,975 by changing to cow-calf (keeping the herd at 300) and $7,873 by changing to yearlings. The operation sells calves in 1973. Nineteen-seventy-four partial budgets show decreased income of $14,270 or $6,957 by changing to yearlings or long yearlings respectively. The 1974 operation stays in cow-calf.

In 1975 a long yearling operation shows increased income of $2,533, while a change to yearlings decreases it by $2,529. The operation switches back to long yearlings, holding 1975 calves over. In 1976 partial budgeting shows increased income of $4,879 by switching to cow-calf, and decreased income of $9,959 by switching to yearlings. In 1977 partial budgeting shows increased income of $1,007 by switching to yearlings, and $10,097 by switching back to long yearlings.

All partial budgeting results are summarized in Figure 4.1. The optimal operation under perfect knowledge as determined by partial budgeting is long yearlings in 1968-1972, cow-calf in 1973 and 1974, long yearlings in 1975, cow-calf in 1976, and long yearlings in 1977-1978.

Table 4.5 summarizes net farm income, total equity, and percent return on equity for this selection of production alternatives. Total net farm income is $433,868; ending equity, $567,282, an increase of $241,454; and average return on equity is 5.58 percent. Total net

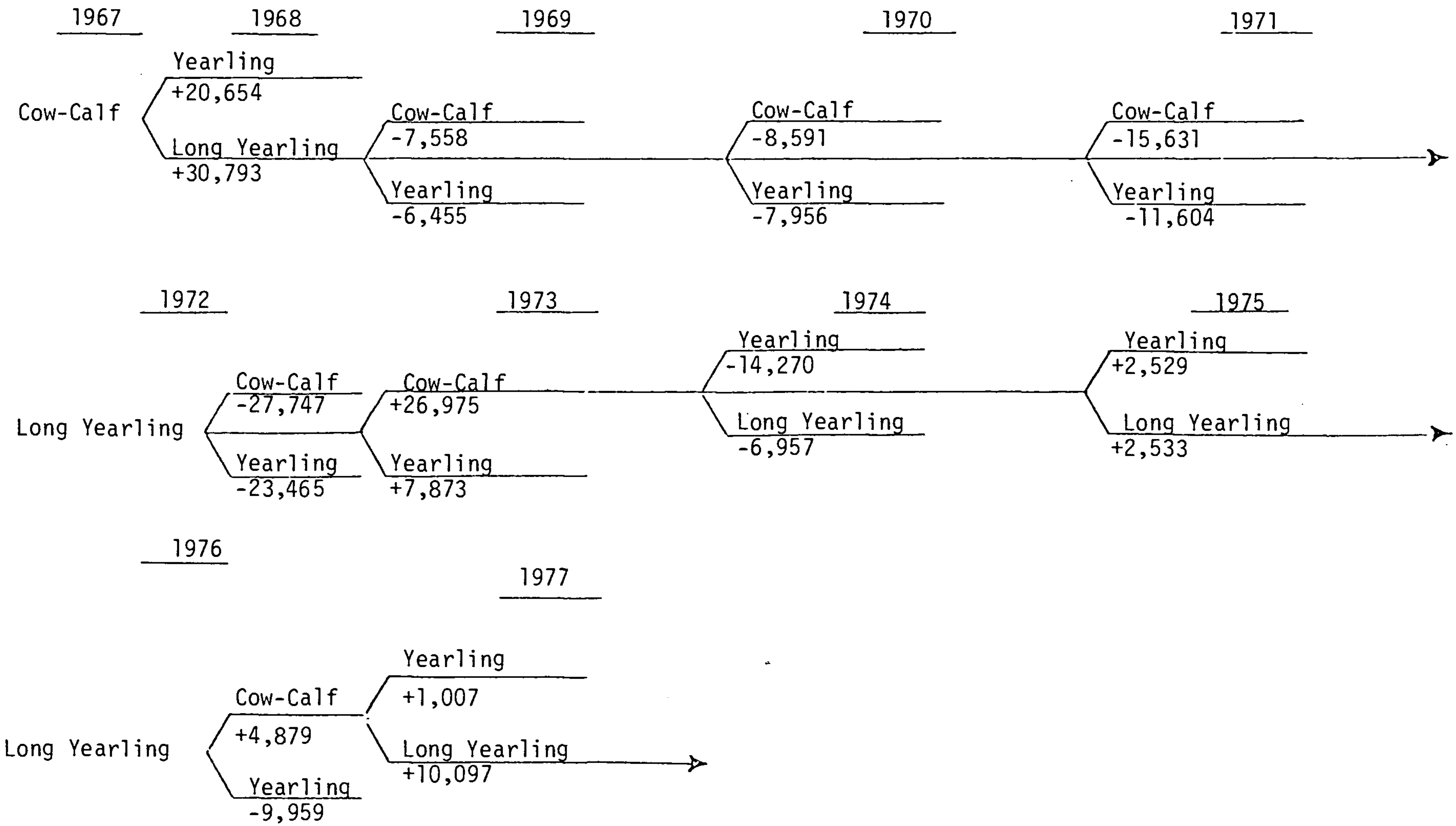


Figure 4.1. Schematic of partial budgeting decisions made at weaning under perfect knowledge.

Table 4.5. Summary of accounting measures for cattle operation systems under perfect knowledge, 1968 through 1978.

Accounting Measure	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Total	Ending	Ave.
Net Farm Income (Dollars)	10,779	26,749	21,915	35,159	49,654	97,745	33,756	14,465	44,383	32,033	67,231	433,868		
Total Equity (Dollars)	331,523	342,197	351,532	372,486	404,333	470,533	475,996	480,349	499,794	527,152	576,282		567,282	
Percent Return on Equity (Percent)	1.73	4.70	4.08	6.97	9.11	9.33	6.01	1.94	4.49	5.10	7.96			5.58

farm income increased $42,222 over the straight long yearling operation, $161,526 over the straight yearling operation, and $215,576 over the straight cow-calf operation. Total ending equity is $19,024 greater than the straight long yearlings, $96,844 greater than the straight yearlings, and $144,088 greater than the straight cow-calves. Average percent return on equity is .12 percent greater than straight long yearlings, 1.10 percent greater than straight yearlings, and 2.10 percent greater than the straight cow-calf system.

Production Systems - The Naive Approach

The same partial budgeting technique was used to determine system changes using the naive approach. The only difference is that August 27th prices are assumed to prevail during the production period. All decisions involving cow-calf must be made on August 27th (weaning). But, price may be updated the following April, when yearlings are sold, if the decision involves yearling versus long yearling. Decisions of these types may be updated using any new information.

The same assumptions were made about the resource base in the naive approach as under perfect knowledge. In 1967 the operation was a 400 cow-calf system with ending equity of $325,828. In partial budgeting 1968 extra receipts are received for herd liquidation. Partial budget results show an increase in income of $18,707 if yearlings are produced, and $26,293 if long yearlings are produced rather than calves.

In 1969 through 1973 the operation stays in long yearlings. Partial budgeting shows a decrease in income of $4,642 in 1969, $4,573 in 1970, $5,839 in 1971, $8,264 in 1972, and $1,328 in 1973 if the change to cow-calf is made. A reduction in income of $6,291 in 1969, $7,001 in 1970, $6,889 in 1971, $12,362 in 1972, and $5,027 in 1973 occurs if a change to yearlings is made.

In April 1974 prices are still holding and selling yearlings shows profits decreased by $21,639 compared to holding the animals until August. By August, 1974 prices have fallen and partial budgeting shows increased income of $12,308 by changing to a cow-calf system. In August, 1974, then, the 1973 calves are sold as long yearlings and the 1974 calves are sold at weaning.

Partial budgeting for 1975, 1976, and 1977 shows decreased income of $16,305, $11,294, and $20,312 respectively by changing to yearlings. Decreases of $4,800, $7,681, and $15,458 respectively are budgeted for a change to long yearlings in 1975, 1976 and 1977. Figure 4.2 summarizes all the partial budgeting results.

Table 4.6 summarizes net farm income, total equity, and percent return on equity for the production alternatives chosen. Total net farm income equals $360,416 for the 11 years. This is $73,452 less than under perfect knowledge and $31,230 less than straight long yearlings, $88,074 more than straight yearlings, and $142,124 more than straight calves.

Total ending equity is $537,068 an increase of $211,240 over the 11 years. The ending equity is $30,214 less than under perfect knowledge, $11,190 less than straight long yearlings, $66,630 greater

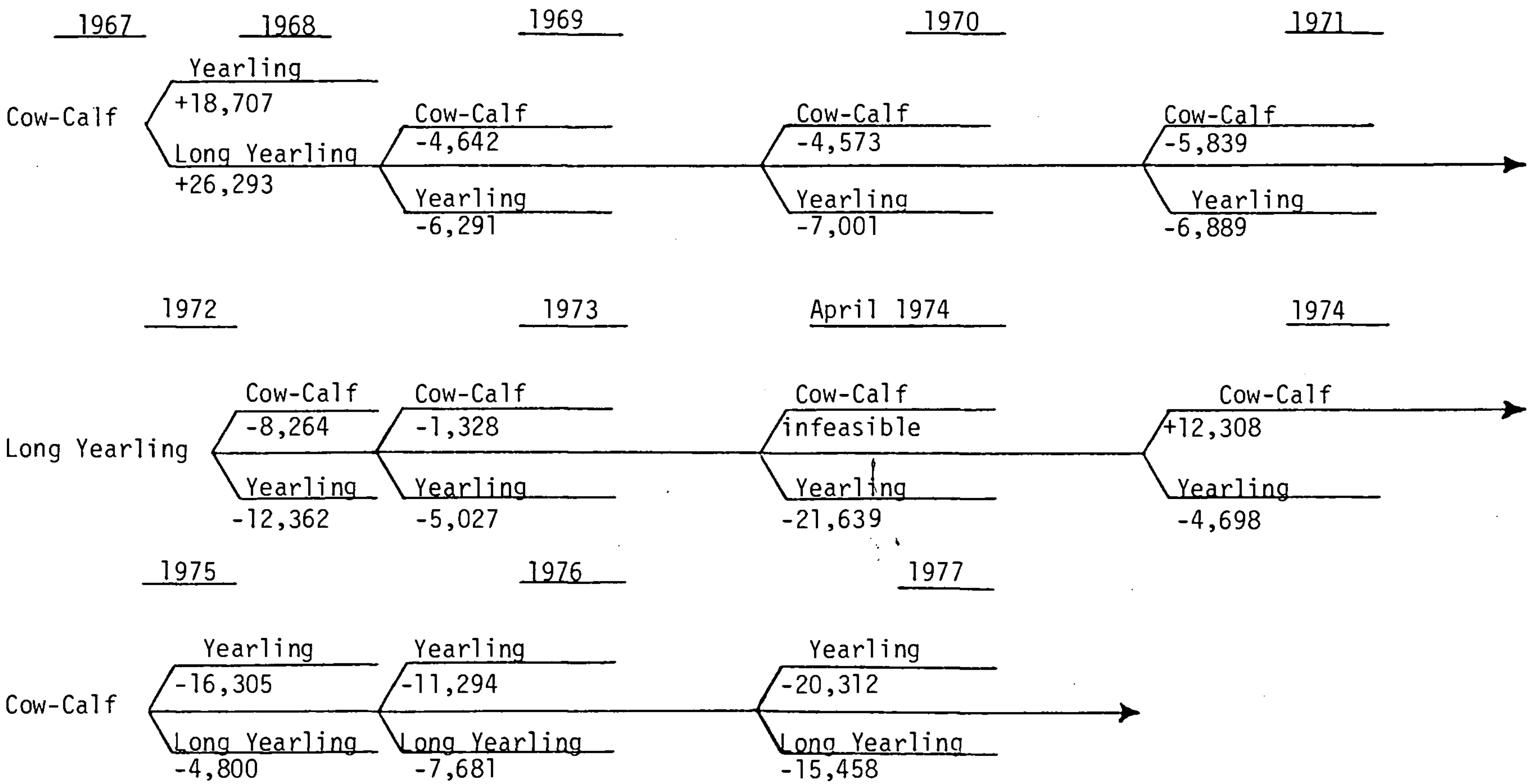


Figure 4.2. Sehematic of partial budgeting decisions made at weaning, except as noted under the naive approach.

Table 4.6. Summary of accounting measures for cattle operation systems using the naive approach, 1968 through 1978.

Accounting Measure	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Total	Ending	Ave.
Net Farm Income (Dollars)	10,779	26,748	21,915	35,159	49,654	73,154	28,409	12,760	39,258	31,354	31,226	360,416		
Total Equity (Dollars)	331,523	342,197	351,532	372,486	404,333	446,250	459,462	471,137	500,265	521,489	537,068		537,068	
Percent Return on Equity (Percent)	1.73	4.70	4.08	6.97	9.11	10.51	2.78	1.62	6.82	5.03	3.83			5.20

than straight yearlings, and $113,874 greater than straight calves.

The average percent return on equity over the 11 years is 5.20, .38 percent lower than under perfect knowledge, .26 percent lower than the straight long yearlings, .72 percent greater than straight yearlings, and 1.72 percent greater than straight calves.

Summary of Results

When comparing the results of the three straight systems and the optimal system combinations under perfect knowledge and naive knowledge, it is important to keep the producer's goals in mind. If his goal is simply to maximize income, then total net farm income is the appropriate measure. Of the three straight systems the long yearling operation with total net farm income of $391,646 far surpassed the cow-calf operation's net farm income of $218,292 and the yearling operation's net farm income of $272,342. With perfect knowledge, total net farm income of $433,868 could be realized by the optimal system combination. In actuality the producer does not have perfect knowledge but he does have all the information used in the naive approach. The total net farm income for the optimal system combination under naive knowledge was $360,416.

By comparing the total net farm income figures it can be seen that the producer is better off by changing system under perfect knowledge. When only naive knowledge is known the producer is better off producing long yearlings for the entire 11 years.

If the producer's goal includes increasing his net worth in addition to maximizing income, then the total ending equity measure is examined. Total ending equity is highest for the optimal system combinations under perfect knowledge: $567,282. It is $537,068 for the naive system, $548,258 for straight long yearlings, $470,438 for straight yearlings, and $423,194 for the straight cow-calf operation. If maximizing net worth is the goal, then a straight long yearling operation is better if only naive information is known. If any additional information is known, then system changes will increase equity as shown by the perfect knowledge results.

The average percent return on equity measures the return to owner's investment. If the producer's goal is to return a fair share on his investment, then the average percent return on equity can be compared to the return he would receive from an alternative investment. The highest return to equity was 5.58 percent return under the perfect knowledge system. The naive system combination returned 5.20 percent; straight long yearlings, 5.46 percent; straight yearlings, 4.48 percent; and straight calves, 3.48 percent. All of these returns are consistent with the returns that could have been received from an alternative investment.

Economic Implications

Production Systems and the Cattle Cycle

In 1968 cattle numbers were down and herd building was occurring. As heifers were held for herd expansion, fewer cattle went to slaughter and prices rose. Between 1968 and 1973 herd expansion occurred and prices rose. During this time it paid to add weight on the ranch by being in long yearling production. Prices rose over the year the animals were held. Due to heavier animals and increased prices, profits were greater.

Herd growth had peaked by 1973 and slaughter numbers were up. Prices fell due to increased production. At this point the producer should shift to calf production. Prices were expected to fall over the next production period so he'd receive a smaller price for added weight. When prices fell in 1973, herd liquidation quickly followed in 1974. Again, the producer should sell calves as prices were expected to fall more during the next year. In 1975 herd size was reduced once again and rising prices reflected the reduced numbers slaughtered. The producer should now switch to long yearling production to take advantage of increased prices on greater weight. Over the cattle cycle the producer depicted in this study should raise long yearlings during the building phase and calves during the liquidation phase. The cow-calf system should be utilized only during periods of falling prices.

Figures 4.3 and 4.4 show the prices of steer calves at Portland and feeder steers at Portland respectively. The vertical lines designate the optimal production system for each period. Prices are rising from 1968 to mid 1973, and in 1975 and 1977. During this period long yearling production is more profitable. When prices are falling from mid 1973-1974, and during 1976, calf production minimizes losses.

Limitations

The results obtained in this study are meaningful only for an Eastern Oregon rangeland cattle producer. As the resource base, physical characteristics, and production coefficients differ in other geographical areas, the optimal system may vary. The optimal decisions and the economic conclusions reached from them are based on costs and returns during the 1968-1978 cycle and may differ in another cycle.

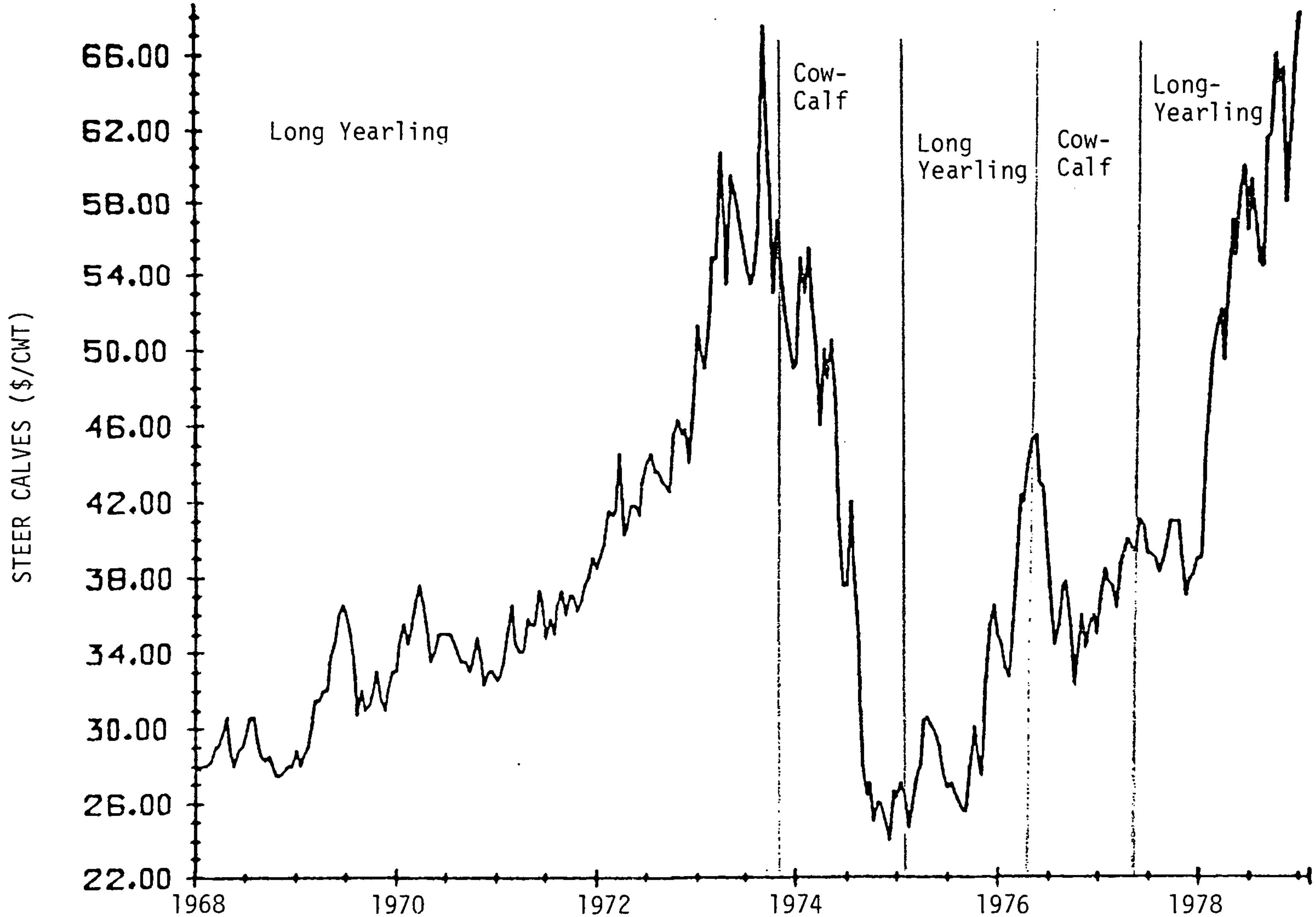


Figure 4.3. Price of Steer Calves.

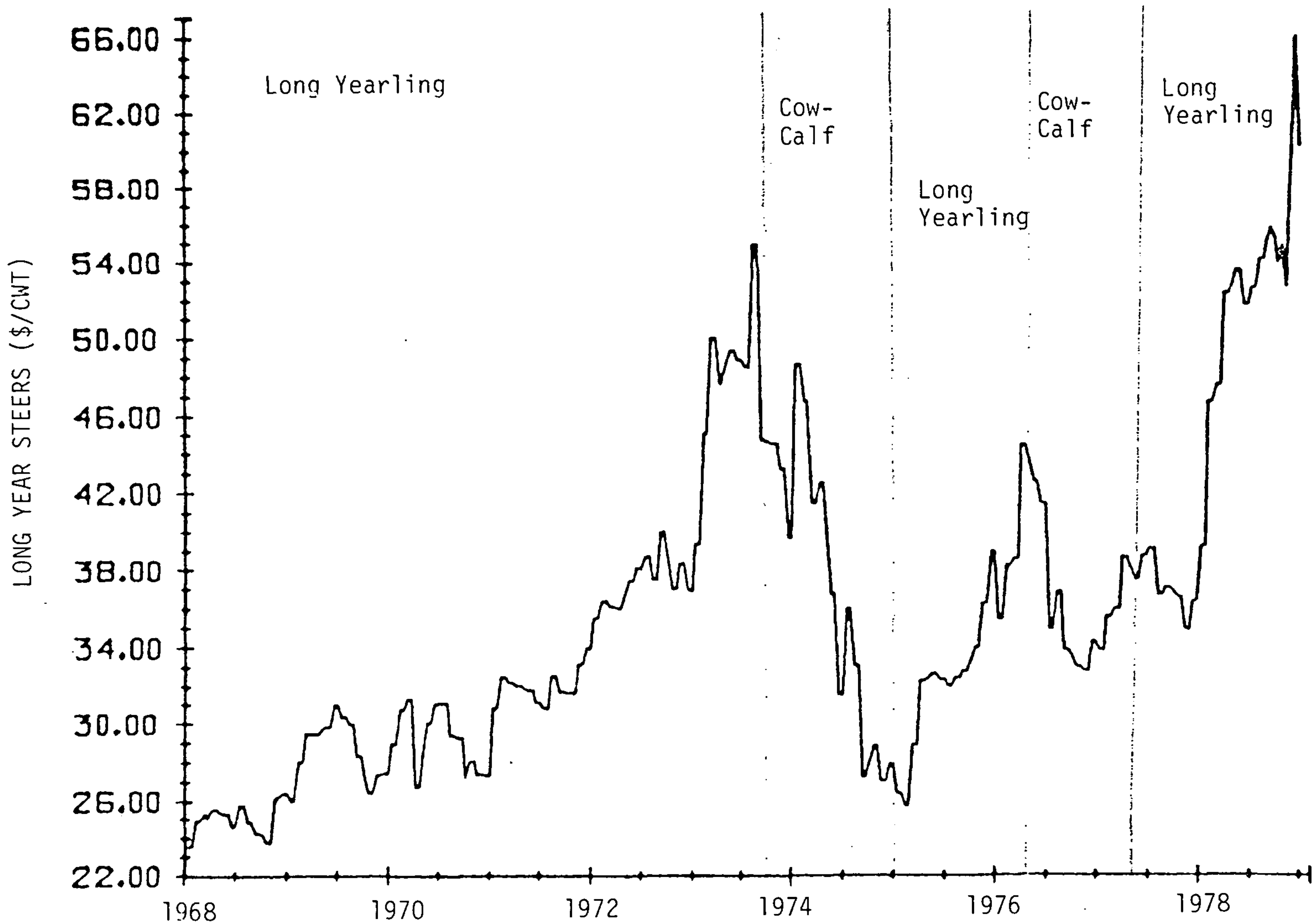


Figure 4.4. Price of Long Yearling Feeders.

V. SUMMARY AND CONCLUSIONS

Summary

Three cattle production systems: cow-calf production, cow-yearling production, and cow-long yearling production are available to the Eastern Oregon rangeland cattle producer. To examine each production system over the last cattle cycle, 1968-1978, a beef-forage-grain simulation model was used.

This model, developed by Sonntag and Klein [20] for Western Canada wad adapted to reflect the Pacific Northwest's economic and physical conditions. Major production assumptions changed within the model include a shortening of the breeding season. This was changed from 12 weeks to ten. Weaning dates of the calves were changed from November 4th to August 27th.

Prices received for cattle and prices paid for grain were changed from a yearly average to bi-weekly prices. An additional dimension was added to forage production. Through the use of a control switch the operator can choose to use average pasture yields or actual pasture yields for each year. Depreciation was changed to the declining balance method, utilizing a ten percent salvage value. One further modification was a U.S. tax package.

Validation of the model was done both internally and externally. Internal coefficients including: conception rate, replacement rate, birth weight, average daily gain, and forage yields were verified.

Through comparison with Oregon State University Extension Service and U.S.D.A. budgets the simulation results were verified externally.

Each of the three production systems were simulated over the last cattle cycle, 1968 through 1978. Three measures of success: total net farm income, ending equity, and percent return on equity were used to compare the profitability of each system. Two further simulations were then made allowing the production system to change over time.

Partial budgeting was used to determine the optimal system each year. Two sets of prices were used in the partial budgets. Under the perfect knowledge approach it was assumed that all costs and returns for the production period are known. At the other extreme the naive approach was used. Here it was assumed that no indications of future costs or returns are known, but that current period prices will prevail over the production period. The same three measures of success were calculated on the perfect knowledge and naive knowledge system combinations to see if profitability was increased by changing production systems over time.

Conclusions

Long yearling production was the most profitable as measured by total net farm income, ending equity, and percent return on equity of the three straight production systems. Total net farm income of $391,646 for the long yearlings was $173,354 greater than a cow-calf operation, and $119,304 greater than a yearling operation. Ending equities were $470,438 for a yearling operation, $423,194 for a cow-calf operation, and a high of $548,258 for a long yearling operation.

The long yearling system's average return was 5.46 percent; the yearling system returned 4.48 percent, the cow-calf system 3.38 percent.

The optimal combination of systems found through partial budgeting assuming perfect knowledge was: long yearling production from 1968 through 1972, calf production in 1973 and 1974, long yearling production in 1975, calf production in 1976, and long yearlings again in 1977 through 1978. Total net farm income increased $42,222 over the straight long yearling operation to $433,868. Ending equity was up $19,024 over straight long yearlings to $550,393. Percent return on equity was up .12 percent to 5.58.

When assuming only naive knowledge about future conditions the optimal combination of systems differs. Long yearlings are optimal from 1968 through 1973, calves from 1974 on. This system combination produced a total net farm income of $360,416, an ending equity of $537,068, and 5.20 percent return on equity. When comparing these amounts to a straight long yearling operation total net farm income decreased by $31,230, the ending equity decreased by $11,190, and percent return on equity decreased by .26 percent.

Allowing system changes increases profitability of the resources if perfect knowledge is known. If only naive knowledge is known then a straight long yearling system is superior. In actuality the producer's information is in between these two extremes. These results reveal the value of timely economic information to the cattle producer.

The optimal combination of systems obtained through perfect knowledge budgeting can be analyzed with respect to the cattle cycle.

Long yearling production was the most profitable when cattle numbers were building and prices rising from 1968 to 1972. When cattle numbers peaked and prices fell in 1974 switching to calf production minimized losses. After liquidation occurred and cattle numbers were down again in 1975, prices rose. At this point long yearling production became superior again.

The Eastern Oregon rangeland cattle producer depicted in this study is better off producing long yearlings during periods of herd building with is accompanying price increases. During periods of herd liquidation and falling prices calf production minimizes losses.

Recommendations for Future Research

The different incomes generated from optimal system combinations under perfect knowledge and naive knowledge point out the value of information. Additional work could be done updating the decision choice as new information becomes available throughout the year.

This study only examined optimal production systems in the high desert area of the Pacific Northwest. Other geographical areas could be examined in this same manner to determine their optimal production systems. These other geographical areas as well as Eastern Oregon could also be simulated over other cattle cycles. It would be interesting to determine if the optimum production system recommendations determined in this study are optimal historically.

In addition the simulation model could be used to research other issues. Examining various tax strategies would be one use. Another one would be to vary to debt-equity ratio and determine its effects on the operation.

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APPENDICES

APPENDIX A

INPUT FORM

WESTERN BEEF-FORAGE-GRAIN MODEL

MODIFIED FOR THE PACIFIC NORTHWEST

Developed by
AGRICULTURE CANADA RESEARCH STATION

Agriculture Centre
Lethbridge, Alberta
May 1978

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Farm Identification

Your	Name ______________________________	
Return	Address ______________________________	
Address:	City ______________ State ________ Zip Code ______	

Plan	Enter some identifying information
Identification:	(farm names, owner's or operator's name, etc.) in the space provided below. This information will appear on your computer print out.
	Please print - capital letters only

Format (I2,10A4)

Card 01 ______________________________

____

Introduction

This beef-forage-grain computer model can assist farmers in making long range plans concerning the organization and growth of their farm business. The model can be used for specialized beef farms, specialized grain farms, or for mixed enterprise farms.

This computer model can be used to simulate the results of particular production alternatives over a period of up to 10 years. It is also possible to let the computer model find the best production plan for your farm, given your resources.

To complete this input form you must:

i) decide which beef production systems, rations, breeding method, building type, pasturing and haying methods, and grain production methods you wish to consider,

ii) describe the resources you have available for the production of beef and grain (land, buildings, machinery, labor),

iii) indicate the prices you expect to receive for beef and grain over the number of years you wish to consider,

iv) indicate the prices you expect to pay for the various inputs required for production of beef and grain,

v) check (and modify if necessary) various production coefficients, labor requirements, yields, interest rates, etc.

With this information the computer will simulate one or more plans for your farm. Reports are generated for the best of these plans. They show changes in net worth, annual net farm income, beginning and ending inventories, cash flow, labor use, grain and forage production and use, receipts and expenditures, and many other items of interest in your farm business.

Many of the data required for the computations are listed in the input form as <u>base data</u>. These were largely developed from research projects. They are intended as guides. If you agree with these data, you need not insert any values of your own in these spaces.

Input Form Format

The input form is arranged in such a manner that the explanatory notes to assist you in completing the form will appear on the page proceeding the item.

NOTES TO KEYPUNCHERS

There are five keypunching formats used in the model. All reserve the first two columns for the card number.

Card No.	Format
01	(I2,10A4)
06, 07, 23, 26	(I2,72I1)
24, 25	(I2,11F7.0)
37, 38	(I2,26I3)
All others, including inventory items	(I2, 10F7.0)

NOTE TO OPERATORS

There are three data files read by the program:

1) The Base Data: These are the default values. They are entered in a file named NEWDATA
2) Input Data: except prices. This is the data entered on this form. It may be entered under any file name.
3) Price Data: Bi-weekly livestock and barley prices. It is entered in a file named PRICES.

Information for Completing Page 117

1) Product prices are entered for each year hence inflation of product prices can be handled explicitly through the input form. Input prices are fixed for the duration of the model run unless they are indexed through an entry in this space.

2) This space should be 0.0 or blank if input costs are th be indexed. A value $\neq$ 0. overrides the entry in the previous space in which case constant prices prevail for the duration of the run.

3) If blank, year 1 in the model is 1978. The number in this space is added to the base year value to determine the starting year for the run.

4) Indicate the number of feeder steers purchased, if any. These steers are managed in a manner identical to those produced on the farm.

5) Enter as 7.0 if you want to save the ending inventory on a separate file named ENDATA.

6) Enter 7.0 if your entering pasture yields as determined by their percent of average yield. If this space is not equal to 7 then the pasture condition index will be used to determine yield.

7) If a number of alternatives are left open on the succeeding pages several plans will need to be budgeted to find a good plan. If the production plan is completely specified the appropriate entry is 1.0.

8) These switches are operative only when switch 4 results in a call to the output routine.

9) You can increase or decrease your herd size during each of the years if you wish. If you insert a positive number in any of these spaces, additional replacements will be saved in that year. The opposite occurs for a negative number.

10) You can also add crop acreage for each year of the plan if you wish. The computer will add or subtract the number of <u>acres</u> you insert in these blanks.

Operator Control Cards

PARAMETERS (PARAM) — Card 02

1		______ (1)
2	Rate of inflation on input costs (%/yr)[1]	______ (2)
3	Input prices (0.0 = nominal \$, > 0. = constant)[2]	______ (3)
4	Input unit for base data (5=cards, 8=disk)	______ (4)
5	Starting year increment (base = 1977)[3]	______ (5)
6	Number of feeder steers purchased per year[4]	______ (6)
7	Saving ending inventory? (yes = 7, no ≠ 7)[5]	______ (7)
8	Number of years for evaluating farm plan (≤ 10)	______ (8)
9	Pasture yields (7 = % of average yield, ≠ 7 = pasture condition index)[6]	______ (9)
10	Number of observations or solutions [7]	______ (10)

SWITCHES (SWTCH) — Card 03

1	Yield index (0. = variable, >0 = average)	______ (1)
2	Beef and crop job matrices (≠6. = omit, = 6. = write) [8]	______ (2)
3	Pasture table (0 = omit, > 0 = write)[8]	______ (3)
4	Output call (0 = best plan, 1 = last year and best plan, 2 = every year of every plan)	______ (4)
5	Inventory tables (≠ 1. = omit, = 1. = write)[8]	______ (5)
6	Detail tables (≠ 1. = omit, = 1. = write)[8]	______ (6)
7	Farm location (0. = prairie, > 0 = parkland)	______ (7)
8	Inventory and detail tables (0. = omit, 1. = write)[8]	______ (8)
9	Pasture zone (1.=brown soil zone, 2.=dark brown, 3.=black)	______ (9)
		______ (10)

	Card 04		Card 05	
1	Cow herd increment year 1	______ (1)[9]	Crop acreage increment year 1[10]	______ (1)
2	year 2	______ (2)	year 2	______ (2)
3	year 3	______ (3)	year 3	______ (3)
4	year 4	______ (4)	year 4	______ (4)
5	year 5	______ (5)	year 5	______ (5)
6	year 6	______ (6)	year 6	______ (6)
7	year 7	______ (7)	year 7	______ (7)
8	year 8	______ (8)	year 8	______ (8)
9	year 9	______ (9)	year 9	______ (9)
10	year 10	______ (10)	year 10	______ (10)

Information for Completing Page 119

1) On this and the next two pages appear the beef production alternatives which the computer model can handle. If you wish to consider any of these, leave them blank. <u>If you wish to exclude any of these alternatives, mark a "7" in the appropriate blank.</u> The computer will ignore all of the production alternatives marked with a "7".

2) The computer will only consider one beef production system at a time. It is not possible therefore, to have both a cow-calf-sell calves system and a feedlot system.

3) If you place a "7" in the seventh space, no feeders will be purchased. If you place a "7" in the eighth space, the number of feeders you specified on the previous page will be purchased.

4) If this alternative is chosen, the number of feeders to be purchased will be calculated by the computer. The number will be dependent on your available feed supply. This option is currently not available.

5) The type of feeders to be purchased must correspond to the cow-calf production system chosen above (either by you or by the computer). No feeders can be purchased with the system where calves are sold at weaning. Calves only can be purchased if the second or third cow-calf systems are chosen. Calves or yearlings can be purchased with the last 3 cow-calf systems.

I Beef Production[1] Format (I2,72I1) Card 06

1. Beef Production Systems[2]

(a) Breeding herd

Cow-calf - sell calves at weaning	____(1)
Cow-calf - sell feeders in spring as stockers	____(2)
Cow-calf - direct to feedlot at weaning	____(3)
Cow-calf - stocker - into feedlot in spring	____(4)
Cow-calf - stocker-pasture-sell long yrlg feeders in fall	____(5)
Cow-calf - stocker-pasture-put long yrlg. in feedlot	____(6)

(b) Purchased feeder steers

Buy feeders[3] - Yes?	____(7)
- No?	____(8)
Number - Specified?	____(9)
- Based on feed supply?[4]	7 (10)
Type[5] - Buy calves	____(11)
- Buy yearlings	____(12)

2. Feeding Methods - Cows, Stockers and Replacements

(a) Breeding herd

		Portion of Energy Req't. From			
Early Winter-Early Spring		Hay	Grain	Pasture	
(i)	All pasture	0	0	1.0	____(13)
(ii)	Hay and pasture	.1	0	.9	____(14)
(iii)	Hay and pasture	.2	0	.8	____(15)
(iv)	Hay and pasture	.3	0	.7	____(16)
(v)	Hay and pasture	.4	0	.6	____(17)
Winter					
(i)	High forage	1.0	-	-	____(18)
(ii)		.9	.1	-	____(19)
(iii)	Med. forage	.8	.2	-	____(20)
(iv)		.7	.3	-	____(21)
(v)	Low forage	.6	.4	-	____(22)
Summer					
(i)	All pasture	-	-	1.0	____(23)
(ii)	Drylot - Hay	1.0	-	-	____(24)
(iii)	Drylot - Hay & Grain	.8	.2	-	____(25)
(iv)	Drylot - Hay & Grain	.6	.4	-	____(26)
(v)	Drylot - Hay & Grain	.4	.6	-	____(27)
(b)	Stockers and replacement heifers				
(i)	70/30 hay:grain	.7	.3	-	____(28)
(ii)	60/40 hay:grain	.6	.4	-	____(29)
(iii)	50/50 hay:grain	.5	.5	-	____(30)
(iv)	40/60 hay:grain	.4	.6	-	____(31)
(v)	30/70 hay:grain	.3	.7	-	____(32)
(c)	Yearlings on pasture				
(i)	All pasture	-	-	1.0	____(33)
(ii)	10% grain	-	.1	.9	____(34)
(iii)	20% grain	-	.2	.8	____(35)
(iv)	30% grain	-	.3	.7	____(36)
(v)	40% grain	-	.4	.6	____(37)

Information for Completing Page 121

1) The rates of gain selected for feedlot animals partly determines their feed requirements, finished weights and time of sale. The rates given are those for steers. The corresponding gains for heifers are scaled down by the computer. They range from 75 percent of steer gains for long yearlings in the feedlot to 92 percent of steer gains for nursing calves.

3. Rates of Gain - Feedlot Steers[1] Card 07

(a)	Calves direct to feedlot	- 2.0 lbs./day	______(1)
		- 2.25 "	______(2)
		- 2.5 "	______(3)
(b)	Yearlings in feedlot	- 2.2 "	______(4)
		- 2.5 "	______(5)
		- 2.8 "	______(6)
(c)	Long yearlings in feedlot	- 2.5 "	______(7)
		- 3.0 "	______(8)
		-	7 (9)

4. Feeder Diets

	Portion of Energy Req't. From: Hay	Grain	
(a) Diets for calves - Low gain	.36	.64	______(10)
	.28	.72	______(11)
	.24	.76	______(12)
	.07	.93	______(13)
	-	1.0	______(14)
- Med. gain	.28	.72	______(15)
	.24	.76	______(16)
	.07	.93	______(17)
	-	1.0	______(18)
- High gain	.24	.76	______(19)
	.07	.93	______(20)
	-	1.0	______(21)
(b) Diets for yearlings - Low gain	.32	.68	______(22)
	.26	.74	______(23)
	.20	.80	______(24)
	.07	.93	______(25)
	-	1.0	______(26)
- Med. gain	.26	.74	______(27)
	.20	.80	______(28)
	.07	.93	______(29)
	-	1.0	______(30)
- High gain	.20	.80	______(31)
	.07	.93	______(32)
	-	1.0	______(33)
(c) Diets for long yearlings-Low gain	.29	.71	______(34)
	.25	.75	______(35)
	.20	.80	______(36)
	.07	.93	______(37)
	-	1.0	______(38)
-High gain	.20	.80	______(39)
	.07	.93	______(40)
	-	1.0	______(41)

Information for Completing Page 123

1) Natural breeding requires 1 bull for every 30 cows. AI - one month requires 1 bull for every 45 cows. AI - two months requires 1 bull for every 65 cows. If the bull requirements exceed the number of bulls specified in the inventory (see page 146), additional bulls will be purchased. Excess bulls are sold.

2) If space 55 is filled with a "7", pregnancy testing will be applied to all cows and bred heifers in the herd. All cull cows (including those presumed to be open) will be sold in the fall.

   If no pregnancy testing is done (a"7" appears in space 56), then one-half of the cull cows will be maintained in the herd until spring. This represents the lack of knowledge concerning their pregnancy.

3) If the diets specified or chosen result in pasture requirements greater than available supplies the deficit is supplied from hay. If hay supplies are depleted additional hay is purchased or hay is replaced by grain in the diet depending on the choice made here.

4) If hay output exceeds hay requirements the surplus can be left to accumulate in inventory or supplies in excess of one year's requirements can be sold.

Card 07 cont.

5. Breeding Methods[1]

Natural	______(42)
AI - one month, bulls for clean-up	______(43)
AI - Two months, bulls for clean-up	______(44)
AI - continuous	______(45)

6. Buildings

(a) Breeding herd - Minimal shelter	______(46)
- Sheds	______(47)
- Drylot	______(48)
(b) Replacements - Minimal shelter	______(49)
- Sheds	______(50)
- Drylot	______(51)
(c) Feeders - Minimal shelter	______(52)
- Sheds	______(53)
- Sheds & paved lot	______(54)

7. Pregnancy Testing[2] - No	______(55)
- Yes	______(56)

8. Feed Deficits and Surpluses

(a) Deficits[3] - Buy hay	______(57)
- Feed grain	______(58)
(b) Surpluses[4] - Accumulate in inventory	______(59)
- Sell	______(60)

Information for Completing Page 125

This page contains several items of data required to analyze your farm. You may change any of these data by inserting your figure in the appropriate space.

1) Feed requirements for each of the classes of animals are calculated from a complicated formula which was derived from research data. For example, the following quantities of feed are required per day, using maximum forage diets. The digestible energy content of hay and grain is assumed to be 1.0 and 1.55 Mcal/pound air dry basis, respectively.

	Daily Feed Requirements Hay
	lbs
Bulls (1500 lbs)	23.6
Cows (1000 lbs) - dry, pregnant	13.8
- late gestation	16.5
- calving to weaning	19.5
- average	17.9
Heifer - first calf	18.7
Replacement heifer	15.9

Energy requirements for calves are estimated directly from calf weight and rate of gain. Hence, energy requirements for cows from calving to weaning exclude lactation requirements.

2) Labor requirements depend on the size of the herd and the time of year. For example, the annual labor requirement per cow is:

Size of Herd	Labor Requirement per Cow
25 Cows	13.2 hours
50 Cows	9.5 hours
75 Cows	8.3 hours
100 Cows	7.7 hours

Replacements require the same amount of labor as cows. Bulls require 9 hours of labor per head annually. Feedlot animals require between .3 - .4 hours per head every two weeks. There are also labor requirements for calving, artificial insemination and pregnancy testing. If your labor requirements are 10% higher, insert 1.1 in space 9.

3) Operating costs are approximately $6.75 per head per year for the breeding herd. Feedlot animals have operating costs of $.30 - .50 per head every two weeks. This covers Vitamin A, minerals, veterinary services, and medicine. There are also cash costs associated with calving, artificial insemination and pregnancy testing. The level of these costs can be adjusted by changing the index in space 10 of Card 08.

4) In the model the year is divided into 26 two week periods (e.g., Jan. 1-14 is period 1). Period 6 is March 12-25. The calving period is assumed to be 10 weeks long, i.e., 5 periods.

5) The model can accommodate winter feeding periods from 0 to 6 months duration.

9. Management Factors

	Base Figure	Your Figure
		Card 08
Conception Rate - AI (per season)	0.90	________(1)
- Natural (per season)	0.95	________(2)
Replacement Rate	0.15	________(3)
Feed Requirements[1] - Cows & Bulls	1.0	________(4)
- Replacements	1.0	________(5)
- Feeders	1.0	________(6)
- Stockers	1.0	________(7)
- Calves	1.0	________(8)
Labor Requirements[2]	1.0	________(9)
Operating Costs[3]	1.0	________(10)
		Card 09
Calving Rates - Cows	.97	________(1)
- Heifers	.90	________(2)
Calf Birth Weight - Mature Cows (lbs)	75.	________(3)
- Heifers (lbs)	70.	________(4)
Ave. Gain/Day - Calves from mature cows (lbs)	1.75	________(5)
- Calves from heifers (lbs)	1.5	________(6)
- Stocker steers (lbs)	1.2	________(7)
- Replacement heifers (lbs)	1.35	________(8)
- Bred heifers to calving (lbs)	1.0	________(9)
- Bred second calf heifers to weaning (lbs)	.75	________(10)
		Card 10
- Yearling steers on pasture (lbs)	1.5	________(1)
Heifer weight at first weaning (% of mature cow)	90.	________(2)
Feedlot labor efficiency index	1.0	________(3)
Starting period for calving[4]	6.0	________(4)
Selling costs ($/head)	5.0	________(5)
35% Protein Supplement costs ($/lb)	.08	________(6)
Crude Protein - Barley	.115	________(7)
- Fall & winter pasture	.035	________(8)
- Spring & summer pasture	.12	________(9)
Length of winter feeding period (mo)[5]	0.0	________(10)

Information for Completing Page 127

1) Insert the expected prices for oilseed and alfalfa for each year you wish the computer to use in your plan. An eleventh year may be inserted if the simulation will be extended past ten years.

2) This if the on farm price of grass legume hay ($/ton). If hay is purchased $10. per ton is added to this price.

3) When the beef enterprise requires extra buildings, they will be purchased at the unit prices shown, unless changed by you.

10. Oilseed and Hay Prices[1]

Year	Card No.	Oilseed Price (1)	Hay Price (2)[2]
1	11	________	________
2	12	________	________
3	13	________	________
4	14	________	________
5	15	________	________
6	16	________	________
7	17	________	________
8	18	________	________
9	19	________	________
10	20	________	________
11	21	________	________

11. Building Replacement	Base Figure	Your Figure	
		Card 22	
Average weight of mature cows (lbs)	1000.	________	(1)
Replacement costs for new buildings ($/head)[3]			
Cow herd - Minimal shelter	0.	________	(2)
- Open sheds	0.	________	(3)
- Drylot with sheds	0.	________	(4)
Replacements and calves - minimal shelter	0.	________	(5)
- Open sheds	0.	________	(6)
- Drylot with sheds	0.	________	(7)
Feedlot - Minimal shelter	60.	________	(8)
- Fenced lot and sheds	110.	________	(9)
- Paved lot and sheds	135.	________	(10)

Information for Completing Page 129

1) The following pasture types are available:

   1. Native 1 - This category includes native pasture that is unimproved due to topography, stones, soils, etc.
   2. Native 2 - This category is used for native pasture that could be improved through re-seeding and fertilization.
   3. Improved (early season) - This is improved pasture seeded to species particularly adapted to early season growth and use. In the Brown and Dark Brown soil zones this would likely be crested wheat grass.
   4. Improved (late season) - Improved pasture seeded to species suited to summer, fall and winter grazing. e.g., Russian wild rye.
   5. Community pasture - This includes administered pastures with specified grazing season and grazing fee. e.g., grazing reserves, community pastures.
   6. Stubble - Cereal stubble suitable for fall grazing.
   7. Aftermath - Re-growth on perennial hay crops.

   The season when they can be used are identified as:

   Spring (SP) - May 7 - June 3
   Summer (S) - June 4 - Sept. 23
   Fall (F) - Sept. 24 - Nov. 18
   Winter (W) - Nov. 19 - May 6

   If some of these seasons are not applicable for your farm, put a "7" in the appropriate space.

2) If pasture is improved this year it can be used at a higher stocking rate during the spring or summer. You may exclude one of these alternatives with a "7".

3) Pasture improvement to remove any existing pasture deficit or to increase the size of the breeding herd may be done. All pasture improvements begin in the second year. The herd is increased as soon as the extra pasture becomes available. All herd increases occur by saving extra heifers for replacement and, if required, a lower culling rate for cows. If not enough pasture is available after improvement, supplementary hay or grain will be used.

   If you do not wish to consider pasture improvement, put "7's" in spaces 30 through 36.

II Crop and Forage Production Format (I2,72I1) Card 23[1]

1. Pasture Production

a) Pasture Utilization Methods by Pasture Types[1]

Native 1 - All Year	________(1)
- Spring	________(2)
- Summer	________(3)
- Fall	________(4)
- Winter	________(5)
Native 2 - All year	________(6)
- Spring	________(7)
- Summer	________(8)
- Fall	________(9)
- Winter	________(10)
Improved (Early Season)	
- Spring	________(11)
- Summer	________(12)
- Fall	________(13)
Improved (Late Season)	
- All Year	________(14)
- Spring	________(15)
- Summer	________(16)
- Fall	________(17)
- Winter	________(18)
Community Pasture - Spring	________(19)
Stubble - Fall	________(20)
- Winter	________(21)
Aftermath - Fall	________(22)
- Winter	________(23)
Improved This Year[2] - Spring	________(24)
- Summer	________(25)
	________(26)
	________(27)
	________(28)

b) Pasture Improvement[3]

(i) How much? - None	________(29)
- Remove pasture deficit	________(30)
- Remove deficit and increase cows 5%	________(31)
- Remove deficit and increase cows 10%	________(32)
- Remove deficit and increase cows 15%	________(33)
- Remove deficit and increase cows 20%	________(34)
- Remove deficit and increase cows 25%	________(35)
- Remove deficit and increase cows 30%	________(36)

Information for Completing Page 131

1) The method chosen for pasture improvement determines when the extra replacements can be added and the amount of increased pasture that will be forthcoming. The following notes briefly indicate the differences in improvement methods:

   i) Method 1 permits late fall grazing in the second year after improvement and normal grazing in the third year in zone 3. In zones 1 and 2, grazing and, hence, the herd expansion is delayed by one year.

   ii) Method 2 removes cropland from the crop enterprise. There is no short term reduction in the pasture supply. Replacements can be added in the second year after improvement in all zones.

   iii) There is no short term reduction in pasture supply with Method 3. The fertilization rates and yield increases for each zone are shown below:

	Zone 1	Zone 2	Zone 3
Lbs. N per acre - first year	120	135	150
Lbs. N per acre annually	50	60	70
Yield increase (multiple)	2	3	3

   Replacements are added in the second year in all zones.

   iv) Nitrogen fertilizer is added as above. If this doesn't supply enough additional pasture, some native land is broken and improved.

   v) Nitrogen fertilizer is added as above. If more pasture is required, cropland is converted to tame hayland.

2) Yields are based on Smoliak, S., et al., Guide to Range Conditions and Stocking Rates for Alberta 1976, Alberta Energy and Natural Resources, Edmonton. Base yields for native pasture assume good range condition. Actual yields harvested depend on range condition, season of use, and use rate. Base figures used in the model depend on value of SWTCH(9) on Card 03.

3) Base figures used in the model depend on value of SWTCH(9) on Card 03.

4) The base yields assume good range condition. Yields of native pasture are affected as follows by range condition:

Zone	Condition Code 1	2	3	4
1	1.2	1.0	0.8	0.6
2	1.25	1.0	0.75	0.5
3	1.25	1.0	0.75	0.5

	Card 23 cont.
(ii) Type of improved pasture - early season species	________(37)
- late season species	________(38)
(iii) Method[1] - 1 - Improve native	________(39)
- 2 - Seed cropland	________(40)
- 3 - Fertilize present improved pasture	________(41)
- 4 - Fertilize imp. pasture & improve native	________(42)
- 5 - Fertilize imp. pasture & seed cropland	________(43)
(iv) When is breaking done? summer	________(44)
fall	________(45)
(v) How is breaking done? custom	________(46)
own machine	________(47)
(vi) How is seeding done? custom	________(48)
own machine	________(49)
(vii) How is improvement financed? cash	________(50)
30 year loan	________(51)
10 year loan	________(52)
5 year loan	________(53)

c) Pasture Yields[2] Format (I2,11F7.0)

	Base Yields by zone			Card 24 Your Figure
	- lbs. DM/acre -			
	Zone 1	Zone 2	Zone 3	
Native 1	500.	800.	1300.	________(1)
Native 2	500.	800.	1300.	________(2)
Improved (early season)	715.	1070.	2680.	________(3)
Improved (late season)	533.	1070.	2680.	________(4)
Grain stubble	200.	400.	600.	________(5)
Hay aftermath	300.	600.	900.	________(6)

d) Pasture Improvement Costs[3]

	Base Costs by Zone			
	- $/acre -			
	Zone 1	Zone 2	Zone 3	
Clearing, breaking, cultivation	16.00	20.00	50.00	________(7)
Seeding	3.00	3.00	5.00	________(8)
Fence & water development	5.00	5.00	5.00	________(9)
Seed cost	3.20	4.00	5.00	________(10)

e) Native Range Condition Code[4]

Excellent = 1, Good = 2, Fair = 3, Poor = 4 ________(11)

Information for Completing Page 133

1) If PARAM (9) (Page 117) equals 7. then the pasture yields will be determined as a percent of average yields. Insert the percent of average yield to be used for each year. An eleventh year may be inserted if the simulation will be extended passed 10 years. The native range condition code will be ignored if percent yields are used.

Information for Completing the Grain System

In this section you can select a cropping system and change some of the data currently used in the computer model.

The model contains both grain and oilseed crops. These are called barley and rapeseed but should be considered as representative crops. If you grow other crops, consider them as barley and/or rapeseed when you complete this section.

2) The cropping alternatives that are available are listed on this and the next page. If you permit the computer to pick a seeding, spraying, swathing, or combining method for which you do not have the appropriate machine, one will be purchased for you.

f) Native Range - % of average yield[1]

Card 25

year 1	________	(1)	year 6	________	(6)	year 11	________	(11)
2	________	(2)	7	________	(7)			
3	________	(3)	8	________	(8)			
4	________	(4)	9	________	(9)			
5	________	(5)	10	________	(10)			

2. Grain Production

Format (I2,72I1)

Card 26

a) Cropping Alternatives[1]

(i) Cropping Program

1/2 crop - 1/2 summerfallow	________	(1)
2/3 crop - 1/3 summerfallow	________	(2)
3/4 crop - 1/4 summerfallow	________	(3)
Continuous cropping	________	(4)

(ii) Seeding Method

Discer	________	(5)
Press drill	________	(6)
Hoe drill	________	(7)

(iii) Spraying

Do your own	________	(8)
Custom	________	(9)
	7	(10)

(iv) Swathing

PTO	________	(11)
SP	________	(12)
Custom	________	(13)

(v) Combining

PTO	________	(14)
SP	________	(15)
Custom	________	(16)

Information for Completing Page 135

1) All machines are purchased new. They are replaced when they reach the specified or selected percentage of useful life.

2) The first column indicates that from 0 to 100 percent of the summerfallow crop acreage may be planted to oilseeds in the 2/3 - 1/3 or in the 3/4 - 1/4 rotations. The second column indicates that up to 50 percent of the total acres planted may be in oilseeds under the 1/2 - 1/2 or the continuous cropping rotation. If you have selected a rotation on page 21, you can then select or leave open the proportion of oilseed acreage. If you did not select a rotation, the number of acres planted to oilseeds will be determined firstly by the rotation selected for you by the computer and secondly by the spaces left open number 38 to 43.

3) Cereal forage is limited to 50 percent of the crop acreage. However, even if 50 percent cereal forage is selected by you or by the computer, only the amount needed for feed requirements will be produced.

	Card 26 cont.
(vii) Machine Replacement[1]	
Purchase - New	______(19)
	7 (20)
	7 (21)
	7 (22)
	7 (23)
Sell at - 10% of maximum useful life	______(24)
- 20% of maximum useful life	______(25)
- 30% of maximum useful life	______(26)
- 40% of maximum useful life	______(27)
- 50% of maximum useful life	______(28)
- 60% of maximum useful life	______(29)
- 70% of maximum useful life	______(30)
- 80% of maximum useful life	______(31)
- 90% of maximum useful life	______(32)
- 100% of maximum useful life	______(33)

(viii) Land Purchase Options

Cash	______(34)
30 year mortgage	______(35)
10 year mortgage	______(36)
Perpetual	______(37)

(ix) Oilseed[2]

% of smf. crop acres in 2/3 & 3/4 rotations	% of crop acres in cont. and 1/2 rotations	
0%	0%	______(38)
20%	10%	______(39)
40%	20%	______(40)
60%	30%	______(41)
80%	40%	______(42)
100%	50%	______(43)

(x) Cereal Forage (maximum % of crop acreage)[3]

0%	______(44)
10%	______(45)
20%	______(46)
30%	______(47)
40%	______(48)
50%	______(49)

Information for Completing Page 137

1) Insert the market value (year one) of each of the land sources in this column.

2) Annual costs per acre refer to real estate taxes (in the case of owned land) and to land maintenance charges. For cash rented land, enter the annual lease fee per acre. For share rented land the assumed share rental arrangement is the 1/3:2/3 crop share with fertilizer costs shared on the same basis.

b) Land Values and Annual Costs

	Land Value[1]	% Owned	Annual Cost[2] Owned	Annual Cost[2] Leased
	$/ac.		- $/ac.-	
	Card 27			Card 29
Pasture				
Native 1	______(1)	______(8)	______(3)	______(1)
Native 2	______(2)	______(9)	______(4)	______(2)
Improved	______(3)	______(10)	______(5)	______(3)
Community Pasture Rental ($/AU)				______(4)
Crop Land				
Owned - Cultivated	______(4)		______(6)	
Owned - Other	______(5)		______(7)	
Cash Rented				______(5)
		Card 28		
Hay Land				
Native	______(6)	______(1)	______(8)	______(6)
Improved	______(7)	______(2)	______(9)	______(7)

Information for Completing Page 139

1) No fertilizer is used unless you so specify. However, if you insert a fertilizer cost per acre, all crop acres will be fertilized at that rate, including cereal forage. Therefore, if you have some land that might not require fertilizer, adjust the fertilizer cost to reflect the average fertilizer cost per crop acre on your farm.

2) As with fertilizer, all crop acres are assumed to be sprayed. If fewer acres are sprayed on your farm, adjust the cost per acre to reflect this.

   Base figures for chemical costs ($/ac) are as follows:

	Rotation			
	1/2	2/3	3/4	Continuous
Grain - Fallow	.94	.94	.94	
- Stubble		1.50	1.50	1.50
Oilseed - Fallow	.52	.52	.52	
- Stubble				1.00

3) The computer calculates draft requirements for all field operations. The base soil draft index of 1.0 assumes a medium textured soil. If your land is heavier adjust the index upwards, if lighter adjust the index downwards. For a 10 percent increase in draft, insert 1.1 in the space provided.

e. Cropping Inputs

	Rotation 1/2	2/3	3/4	Continuous
	Card 30		Card 31	
(i) Fertilizer ($/ac)[1]				
Grain - Fallow	______(1)	______(5)	______(1)	
- Stubble		______(6)	______(2)	______(7)
Oilseed - Fallow	______(2)	______(7)	______(3)	
- Stubble				______(8)
(ii) Chemicals ($/ac)[2]				
Grain - Fallow	______(3)	______(8)	______(4)	
- Stubble		______(9)	______(5)	______(9)
Oilseed - Fallow	______(4)	______(10)	______(6)	
- Stubble				______(10)

	Base Figure	Your Figure
(iii) Seed ($/ac)		Card 32
Grain	4.50	______(1)
Oilseed	2.40	______(2)
(iv) Custom rates		
Spraying ($/ac)	1.80	______(3)
Combining ($/ac)	5.50	______(4)
Hauling grain ($/bu)	.05	______(5)
Spreading fertilizer ($/ac)	1.25	______(6)
(v) Fertilizer - forage crops		
Perennial hay ($/ac)	0.0	______(7)
Improved pasture ($/ac)	0.0	______(8)
(vi) Index numbers		
Soil draft[3]	1.0	______(9)
Field time availability	1.0	______(10)

Information for Completing Page 141

1) There are 8 haying methods in the model. Method 5 will be used unless you indicate a different method by number. A different method can be used for each type of hay. The methods are:

No.	Method
1	Swath, bale, self-propelled stack wagon, haul at harvest
2	Swath, bale, pull type stack wagon, haul at harvest
3	Swath, bale, stack, haul with loader and trailer at harvest
4	Swath, giant round baler, haul with loader and trailer at harvest
5	Swath, bale, stack, haul with loader and trailer in fall
6	Swath, giant round baler, haul with loader and trailer in fall
7	Swath, loose hay stacker, stack mover
8	Silage, forage harvester, forage wagon (this method can only be used for permanent and cereal hay crops - not native hay and not straw).

2) Yields are based on air dry weights (90% dry matter). Yields are converted to a "standard hay" on the basis of average digestible energy (DE) values for the various types of forage.

Feed	DE Content
	Mcal/lb air dry
Native hay	0.78
Grass hay	1.00
Grass-Legume hay	0.94
Cereal hay	1.20
Straw	0.80

f. Grain and Oilseed Yields (bu/ac)

	Barley		Oilseed	
	Base Figure	Your Figure	Base Figure	Your Figure
Rotation		Card 33		Card 34
1/2 crop	28.	________(1)	14.	________(1)
2/3 crop - Fallow	28.	________(2)	14.	________(2)
- Stubble	20.	________(3)		XXX
3/4 crop - Fallow	28.	________(4)	14.	________(3)
- Stubble 1	20.	________(5)		XXX
- Stubble 2	15.	________(6)		XXX
Continuous	15.	________(7)	8.	________(4)

3. Hay Production

a. Haying Methods and Protein Content by Types of Forage[1]

	Haying Methods		Protein Content	
	Base Figure	Your Figure	Base Figure	Your Figure
		Card 35		
Native Hay	5.	________(1)	.05	________(6)
Grass Hay	5.	________(2)	.08	________(7)
Grass Legume Hay	5.	________(3)	.10	________(8)
Cereal Hay	5.	________(4)	.08	________(9)
Straw	5.	________(5)	.04	________(10)

b. Hay Yield (T/acre)[2]

	Base Figures		Your Figures	
	Cut 1	Cut 2	Cut 1	Cut 2
			Card 36	
Native	0.5	-	________(1)	
Grass	0.75	-	________(2)	________(6)
Grass Legume	0.9	-	________(3)	________(7)
Cereal	1.25	-	________(4)	
Straw	0.5	-	________(5)	

Information for Completing Page 143

1) In this section you indicate your present labor force, the additional labor you would be willing to hire, and wage rates. Present labor consists of that supplied by the operator(s), family, and permanent employees. Additional labor is hired by the hour. The year is divided into 26 biweekly time periods. You must specify the amount of present and additional labor available in each two-week period.

2) The base figures assume one operator plus a small amount of family labor.

3) Enter your figures here. Remember present labor will be fixed and additional labor will be variable from zero to your indicated maximum. Subtract vacation time from present labor where appropriate.

Sample Calculation

Period 11: May 21 - June 3

Operator:	10 hours/day x 12 days	=	120 hours
Family	2 hours/day x 12 days	=	24 hours
Permanent employee:	0 hours/day x 12 days	=	0 hours
Total present labor			144 hours

4) If this simulation run is a continuation of a previous run, enter the value of the first year of the original run. Where 1968=1., 1969=2., ..., and 1978 = 11. This enables the model to calculate the correct inventory value for the breeding herd. Leave this space blank (or = 0.) if this is not a continuation run.

III Labor Supply and Wage Rates[1]

1. Labor Availability (I2,26I3)

Period	Calendar Date	Available Field Time	Base Figures[2] Present Labor/ Period	Maximum Additional Labor/Period	Your Figures[3] Present Labor/ Period	Maximum Additional Labor/Period
				--- Hours ---		
					Card 37	Card 38
1	Jan. 1	0	120	0	(1)	(1)
2	Jan. 15	0	120	0	(2)	(2)
3	Jan. 29	0	120	0	(3)	(3)
4	Feb. 12	0	120	0	(4)	(4)
5	Feb. 26	0	120	0	(5)	(5)
6	Mar. 12	0	120	0	(6)	(6)
7	Mar. 26	0	120	0	(7)	(7)
8	Apr. 9	0	120	0	(8)	(8)
9	Apr. 23	53	144	0	(9)	(9)
10	May 7	92	144	0	(10)	(10)
11	May 21	124	144	0	(11)	(11)
12	June 4	124	120	0	(12)	(12)
13	June 18	124	120	0	(13)	(13)
14	July 2	124	120	0	(14)	(14)
15	July 16	124	120	0	(15)	(15)
16	July 30	124	120	0	(16)	(16)
17	Aug. 13	124	120	0	(17)	(17)
18	Aug. 27	124	144	0	(18)	(18)
19	Sept. 10	124	144	0	(19)	(19)
20	Sept. 24	122	144	0	(20)	(20)
21	Oct. 8	120	144	0	(21)	(21)
22	Oct. 22	104	120	0	(22)	(22)
23	Nov. 5	88	120	0	(23)	(23)
24	Nov. 19	88	120	0	(24)	(24)
25	Dec. 3	0	120	0	(25)	(25)
26	Dec. 17	0	120	0	(26)	(26)

Card 39

IV. Value of the starting year[4] ______ (1)

Information for Completing Page 145

1) When specifying amount paid to present labor, <u>do not include the operator</u>. His compensation will be provided in family living expenses below. Specify wages you expect to pay in the near future.

2) Taxable income is divided by the number of operators before calculating the amount of the tax.

3) The first two items permit you to specify the amount you wish to withdraw from the income of the farm each year for living expenses. The amount you enter as minimum living expenses will be withdrawn each year regardless of income. If you wish to withdraw some portion of net income after taxes, you can enter that proportion in space 6. If you enter 0.5 for example, the amount that will be withdrawn would be your specified minimum plus half of the net income produced during that year. If there is not enough income to cover your specified minimum withdrawal, the balance will be borrowed.

4) Interest rates must be specified as percentages, e.g., 7.5%. Down payments must be specified as proportions, e.g., 0.10.

5) If you wish to change the type of loan to be used for buildings, machinery, or breeding stock, simply select a type from the following list:

Loan Type	Code
30 year	4
20 year	5
15 year	6
10 year	7
5 year	8
3 year	9

If some assets will be purchased for cash you can indicate a 1.0 down payment for that type of loan.

2. Wage Rates[1]

Card 39

Salary for permanent hired labor ($/year)	________(1)
Wage rate for additional labor ($/hour)	________(2)

IV Consumption and Income Tax

1. Tax Base[2]

Among how many operators is income divided before tax	________(3)

2. Other Income

Annual net income from other enterprises and off-farm sources ($/year)	________(4)

3. Consumption Withdrawals and Tax Exemptions[3]

Minimum living expenses ($)	________(5)
Portion of positive net income consumed (decimal)	________(6)
Total No. of exemptions for Income Tax Purposes	________(7)

V Financial Considerations

In this section you will provide information on the cost of additional capital, the amount you are willing to borrow, and the like. Current debts are specified later as part of the farm inventory. For debts incurred in the process of developing a farm plan for your situation you need only to specify the interest rate, the down payment, and the type of loan to be used.

1. Interest Rates and Down Payments[4] (I2,10F7.0)

	Base Figures		Your Figures (Card 40)	Your Figures (Card 41)
Type of Loan	Interest Rate	Down Payment	Interest Rate	Down Payment
	%	(decimal)	%	(decimal)
4 30 year	6.5	0.	________(1)	________(1)
5 20 year	6.5	0.	________(2)	________(2)
6 15 year	6.5	0.	________(3)	________(3)
7 10 year	8.0	0.	________(4)	________(4)
8 5 year	8.0	0.	________(5)	________(5)
9 3 year	7.5	0.	________(6)	________(6)
Short term capital	9.0	XXX	________(7)	

2. Repayment Period for Loans[5]

Loan Purpose	Loan Type	Base Type	Your Type
Buildings	10 year	7	________(7)
Machinery	5 year	8	________(8)
Breeding Stock	3 year	9	________(9)

VI Inventory

1. Buildings

NOTE: For buildings indicate the year new and capacity for each type of beef building you now use for beef cattle. Capacity is in terms of number of head.

Item	Type Code	Item Code	Year New	Number or Capacity
Cow - Minimal shelter	1	21	______	______
- Shed	2	21	______	______
- Drylot	3	21	______	______
Calf - Minimal shelter	1	22	______	______
- Shed	2	22	______	______
- Drylot	3	22	______	______
Feeders- Minimal shelter	1	23	______	______
- Shed & fenced lot	2	23	______	______
- Shed & paved lot	3	23	______	______
Grain Storage (Bushels)	1	24	______	______

2. Livestock

Item	Type Code	Item Code	Year New	Number or Capacity
Bulls	1	25	XXX	______
Cows	2	25	XXX	______
Bred Heifers	3	25	XXX	______
Replacement Heifers	4	25	XXX	______
Long yearling steers on feed	5	25	XXX	______
Long yearling heifers on feed	6	25	XXX	______
Stocker steers	7	25	XXX	______
Stocker heifers	8	25	XXX	______
Steer calves on feed	9	25	XXX	______
Heifer calves on feed	10	25	XXX	______
	Field 1	Field 2	Field 3	Field 4

Information for Completing Pages 148-149.

1) Identify each item of machinery you have on your farm. If you have more than one of a particular item, enter the number of such items in the column headed No. You must also enter the year each item was new in the column Years New. For example, you might have two 16 foot cultivators. Make the entry as:

Item	Size	No.	Size Code	Item Code	Years New
Cultivator	16'	2	3	1	1966,1972

2) Machines are purchased if:

   i) current machines become too old (see machine replacement policy),

   ii) machines in the inventory are not compatible with the production method selected (e.g., press drill in the inventory when hoe drill was selected),

   iii) machines required for particular jobs are not in the inventory (e.g., manure spreader or front end loader).

   The size of machine purchased is related to farm size. The largest size of each machine that will be purchased is indicated below (see size codes on pages 33, 34 & 35.

	Cultivated Acres		
Type of Machine	Less than 800	800 to 1200	More than 1200
Cultivator, rod weeder packers, discer, disc, harrow, tractor	4	7	10
Drills	3	5	7
Sprayer, PTO Combine	2	3	4
Swathers	2	4	5
SP Combine	2	4	6

If the machine purchased are too large for the largest tractor in the inventory, they are considered not to be purchased and smaller machines are substituted.

3. Tillage and Planting Machinery[1]

Item	Size	No.	Size Code[2]	Item Code	Years New
Cultivator	12'	______	1	1	______
	14'	______	2	1	______
	16'	______	3	1	______
	20'	______	4	1	______
	22'	______	5	1	______
	24'	______	6	1	______
	28'	______	7	1	______
	30'	______	8	1	______
	32'	______	9	1	______
	36'	______	10	1	______
Rod Weeder	12'	______	1	2	______
	14'	______	2	2	______
	16'	______	3	2	______
	20'	______	4	2	______
	22'	______	5	2	______
	24'	______	6	2	______
	28'	______	7	2	______
	30'	______	8	2	______
	32'	______	9	2	______
	36'	______	10	2	______
Packers	12'	______	1	3	______
	14'	______	2	3	______
	16'	______	3	3	______
	20'	______	4	3	______
	22'	______	5	3	______
	24'	______	6	3	______
	28'	______	7	3	______
	30'	______	8	3	______
	32'	______	9	3	______
	36'	______	10	3	______
Discer	12'	______	1	4	______
	14'	______	2	4	______
	16'	______	3	4	______
	20'	______	4	4	______
	22'	______	5	4	______
	24'	______	6	4	______
	28'	______	7	4	______
	30'	______	8	4	______
	32'	______	9	4	______
	36'	______	10	4	______
Hoe Drill	12'	______	1	5	______
	14'	______	2	5	______
	16'	______	3	5	______
	18'	______	4	5	______
	21'	______	5	5	______
	24'	______	6	5	______
	28'	______	7	5	______
	32'	______	8	5	______
	36'	______	9	5	______

Item	Size	No.	Size Code	Item Code	Years New
Press Drill	12'	______	1	6	______
	14'	______	2	6	______
	16'	______	3	6	______
	18'	______	4	6	______
	21'	______	5	6	______
	24'	______	6	6	______
	28'	______	7	6	______
	32'	______	8	6	______
	36'	______	9	6	______
Sprayer	30'	______	1	13	______
	40'	______	2	13	______
	60'	______	3	13	______
	76'	______	4	13	______
Harrow	12'	______	1	8	______
	14'	______	2	8	______
	16'	______	3	8	______
	20'	______	4	8	______
	22'	______	5	8	______
	24'	______	6	8	______
	28'	______	7	8	______
	30'	______	8	8	______
	32'	______	9	8	______
	36'	______	10	8	______
4. Harvest Machinery					
PTO Swather	12'	______	1	9	______
	15'	______	2	9	______
	18'	______	3	9	______
	20'	______	4	9	______
	24'	______	5	9	______
SP Swather	12'	______	1	10	______
	14'	______	2	10	______
	16'	______	3	10	______
	18'	______	4	10	______
	20'	______	5	10	______
PTO Combine	30"	______	1	11	______
	40"	______	2	11	______
	45"	______	3	11	______
	50"	______	4	11	______
SP Combine	30"	______	1	12	______
	40"	______	2	12	______
	45"	______	3	12	______
	50"	______	4	12	______
	55"	______	5	12	______
	60"	______	6	12	______
			Field 1	Field 2	Field 3

Information for Completing Page 151

1) For each field operation the smallest tractor in the inventory with the capacity to pull that machine is used. If the largest tractor available cannot pull the machine for a particular operation a smaller machine is purchased and the large one is sold. When tractors are replaced the new tractor has a maximum size that corresponds to farm size (see page 143). The horsepower figures are maximum rated horsepower. The effective horsepower under field conditions is assumed to be 3/4 of rated horsepower.

Item	Size	No.	Size Code	Item Code	Years New
SP Bale Stacker	12T	______	1	14	______
	14T	______	2	14	______
Pt Bale Stacker	6T	______	6	14	______
	8T	______	7	14	______
	10T	______	8	14	______
Baler - Conventional	8T	______	1	15	______
	9T	______	2	15	______
	10T	______	3	15	______
Baler-Giant Round	8T	______	6	15	______
	9T	______	7	15	______
	10T	______	8	15	______
Forage Harvester	5T	______	1	16	______
	6T	______	2	16	______
Forage Wagon	6T	______	6	16	______
	8T	______	7	16	______
Loose Hay Stacker	1	______	1	17	______
	3	______	2	17	______
Stack Mover	3	______	6	17	______
	6	______	7	17	______
FE Loader		______	1	18	______
Trailer		______	6	18	______
Manure Spreader	100 ft^3	______	1	19	______
	130 ft^3	______	2	19	______
	160 ft^3	______	3	19	______
	200 ft^3	______	4	19	______
	240 ft^3	______	5	19	______
5. Tractors[1]					
	40 HP	______	1	20	______
	50 HP	______	2	20	______
	75 HP	______	3	20	______
	90 HP	______	4	20	______
	110 HP	______	5	20	______
	120 HP	______	6	20	______
	135 HP	______	7	20	______
	150 HP	______	8	20	______
	165 HP	______	9	20	______
	185 HP	______	10	20	______

Information for Completing Page 153

1) Land is divided into categories for pasture, grain, and hay. Enter only the acreages used for each of these purposes. Acreage for building sites and waste land can be entered in the Owned-Other category.

2) Entries here establish the maximum acreage of stubble and aftermath pastures and the maximum acreage from which straw may be collected. If these spaces are left blank no grazing will be permitted on grain stubble or hay aftermath and no straw will be collected for bedding or feed. If the entries here are greater than the acreages of cereal and hay land all of the cereal and hay acreage are available for fall and winter grazing and harvesting of straw for feed and bedding.

3) Indicate the cash value of machinery, buildings, off-farm assets, etc. which are not listed above.

4) A list of your outstanding loans is required to complete the financial picture of your farm. Indicate your debt situation as closely as possible in the loan categories provided. Indicate the year the loan was made, the original amount, and the interest rate. The computer assumes equal annual payments to cover principal and interest.

5) The last card in the input must have 999. in field 1.

6. Grain and Hay Inventory

					Amount
Barley	bus.	1	30	XXX	______
Oilseed	bus.	2	30	XXX	______
Native Hay	T.	3	30	XXX	______
Grass Hay	T.	4	30	XXX	______
Grass Legume Hay	T.	5	30	XXX	______
Cereal Hay	T.	6	30	XXX	______
Straw	T.	7	30	XXX	______
Silage	T.	8	30	XXX	______

7. Land[1]

Pasture					
- Native 1	acres	1	26	XXX	______
Native 2	acres	2	26	XXX	______
Improved 1	acres	3	26	XXX	______
Improved 2	acres	4	26	XXX	______
Community	A.U.	5	26	XXX	______
Stubble[2]	acres	6	26	XXX	______
Aftermath[2]	acres	7	26	XXX	______
Grain					
Owned-Cult.	ac.	1	28	XXX	______
-Other	ac.	2	28	XXX	______
Cash Rented-Cult.	ac.	3	28	XXX	______
Share Rented-Cult.	ac.	4	28	XXX	______
Hay-Native	ac.	5	28	XXX	______
Grass	ac.	6	23	XXX	______
Grass Legume	ac.	7	28	XXX	______
Straw[2]	ac.	9	28	XXX	______

8. Financial Items

				Year of Loan	Original Amount	Interest Rate (%)
Cash on Hand	$	1	29	XXX	______	
Other Assets[3]	$	2	29	XXX	______	
30 year Debt[4]	$	4	29	______	______	______
20 year Debt[4]	$	5	29	______	______	______
15 year Debt[4]	$	6	29	______	______	______
10 year Debt[4]	$	7	29	______	______	______
5 year Debt[4]	$	8	29	______	______	______
3 year Debt[4]	$	9	29	______	______	______
Last Card[5]		999.				
		Field 1	Field 2	Field 3	Field 4	Field 5

APPENDIX B

Budgets Used for Model Validation

Appendix Table B.1. 1975 budgets used for model validation.

Receipts (Per Cow)	Simulation Model	Budgeting[1]
Calves	48.73	68.85
Cull Cows	26.18	18.25
Bulls	6.19	3.45
TOTAL RECEIPTS	81.10	90.55
Expenses (Per Cow)		
Hay	27.12	30.00
Grain	9.66	
Pasture	9.42	9.00
Bull Purchase	12.50	6.00
Veterinary and Medicine, Vitamins and Minerals	6.41	5.50
Gas and Oil	3.74	6.00
Hired Labor	12.32	12.00
Overhead Expenses[2]		19.00
Property Taxes	5.30	5.60
Interest on Loans	13.90	
Depreciation	3.14	10.00
TOTAL EXPENSES	124.82	103.10
NET FARM INCOME (Per Cow)	-22.41	-12.55

[1]Source: Oregon State University Extension Service

[2]Overhead expenses are included in other expense classifications for the simulation model.

Appendix Table B.2. 1977 budgets used for model validation.

Receipts (Per Cow)	Simulation Model	Budgeting[1]
Calves	75.90	120.80
Cull Cows	32.06	34.39
Bulls	8.14	
TOTAL RECEIPTS	116.10	155.19
Expenses (Per Cow)		
Hay	21.26	75.32
Grain and Protein Suppl.	12.51	4.92
Pasture	6.49	12.53
Bull Purchase	12.50	
Veterinary and Medicine, Vitamins and Minerals	6.95	4.79
Gas and Oil	1.72	7.37
Hired Labor	12.61	9.67
Overhead Expenses[2]		14.14
Property Taxes	5.75	14.80
Interest on Loans	14.96	3.93
Depreciation	1.46	2.06
TOTAL EXPENSES	110.44	149.53
NET FARM INCOME (Per Cow)	19.89	5.66

[1]Source: USDA, Economics, Statistics, and Cooperative Service. Costs of Producing Feeder Cattle in the United States-Final 1977, Preliminary 1978, and Projections for 1979.

[2]Overhead expenses are included in other expense classifications for the simulation model.

APPENDIX C

Examples of Partial Budgeting Used to Determine Optimal System, 1968

Appendix Table C.1. Partial budgeting to determine the optimal production system under perfect knowledge, cow-calf to yearling, 1968, in dollars.

Debits		Credits	
Reduced Receipts		Extra Receipts	
Calves	22,161	Yearlings	43,931
Cull Cows	2,550	Dispersal of:	
		3 Bulls	1,312
		76 Cows	13,092
		15 B. Heifers	3,257
		15 R. Heifers	1,533
TOTAL	24,711	TOTAL	63,125
Extra Expenses		Reduced Expenses	
Maintain Cows and Yearlings	20,749	Maintaining Cows	14,422
6% Interest on change in investment	750		
6% Interest on cash	116		
Labor	1,836		
Hay	8,731		
TOTAL	28,609	TOTAL	14,422
TOTAL DEBITS	56,893	TOTAL CREDITS	77,547
Change in Net income =	$20,654		

Appendix Table C.2. Partial budgeting to determine the optimal production system under perfect knowledge, cow-calf to long yearling, 1968, in dollars.

Debits		Credits	
Reduced Receipts		Extra Receipts	
Calves	22,161	Long Yearlings	57,154
Cull Cows	2,550	Dispersal of:	
		3 Bulls	1,312
		76 Cows	13,092
		15 B. Heifers	3,257
		15 R. Heifers	1,533
TOTAL	24,711	TOTAL	76,348
Extra Expenses		Reduced Expenses	
Maintain Cows and Long Yearlings	708	Maintaining Cows	14,422
6% Interest on change in investment	750		
6% Interest on cash	171		
Labor	3,244		
Hay	3,841		
TOTAL	35,266	TOTAL	14,422
TOTAL DEBITS	59,977	TOTAL CREDITS	90,770

Change in Net Income = 30,793

Appendix Table C.3. Partial budgeting to determin the optimal production system under naive knowledge, cow-calf to yearling, 1968, in dollars.

Debits		Credits	
Reduced Receipts		Extra Receipts	
Calves	22,161	Yearlings	36,778
Culls	2,412	Dispersal of:	
		3 Bulls	1,312
		76 Cows	13,092
		15 Bred Heifers	3,257
		15 Replacement Heifers	1,533
TOTAL	24,573	TOTAL	55,972
Extra Expenses		Reduced Expenses	
Maintain Cows and Yearlings	14,438	Maintaining Cows and Calves	14,432
6% Interest on change in investment	2,016		
6% Interest on cash	116		
Labor	1,848		
Hay	8,706		
TOTAL	27,124	TOTAL	14,432
TOTAL DEBITS	51,697	TOTAL CREDITS	70,409

Change in Net income = $18,707

Appendix Table C.4. Partial budgeting to determine the optimal production system under naive knowledge, cow-calf to long yearling, 1968, in dollars.

Debits		Credits	
Reduced Receipts		Added Receipts	
Calves	22,161	Long Yearling	46,028
Culls	2,412	Dispersal of:	
		3 Bulls	1,312
		76 Cows	13,092
		15 Bred Heifers	3,257
		15 Replacement Heifers	1,533
TOTAL	24,573	TOTAL	65,222
Extra Expenses		Reduced Expenses	
Maintain Cows and Long Yearlings	18,689	Maintaining Cows and Calves	14,432
6% Interest on change in investment	2,016		
6% Interest on cash	171		
Labor	2,267		
Hay	5,645		
TOTAL	28,768	TOTAL	14,432
TOTAL DEBITS	53,361	TOTAL CREDITS	79,654

Change in Net income = 26,293

APPENDIX D

Computer Output Forms for the three straight runs: cow-calf, yearlings, and long-yearlings, 1968 through 1978.

Appendix Table D.1. Computer Print-out for the Straight Cow-Calf Operation

OUTPUT SUMMARY
WESTERN BEEF-FORAGE-GRAIN PRODUCTION MODEL-MAY/78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
FARM PLAN SUMMARY											
ACRES OF CROPLAND	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACRES OF GRAIN	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACRES OF OILSEED	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACRES OF CEREAL HAY	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NO. OF COWS	400.	400.	400.	400.	400.	400.	400.	400.	400.	400.	400.
BEEF SYSTEM SELLS FEEDER CALVES											
WINTER FEEDING PERIOD 6 MONTHS											
BREEDING METHOD - NATURAL											
COWS ARE PREGNANCY TESTED											
FINANCIAL SUMMARY-YEAR END											
TOTAL ASSETS	425906.	424760.	426182.	433276.	448908.	488547.	498821.	476613.	490230.	486003.	494813.
TOTAL DEBT	97824.	94476.	90912.	87110.	85062.	82200.	80250.	73175.	75965.	73620.	71619.
TOTAL EQUITY	328081.	330284.	335270.	346155.	363846.	406347.	418571.	403438.	414262.	412383.	423194.
CHANGE IN NET WORTH	2253.	7203.	9985.	15083.	22689.	47500.	17224.	-13133.	16624.	3121.	15868.
RETURN ON EQUITY(%)	.69	2.16	2.98	4.39	6.24	11.69	4.12	-3.25	4.54	.76	3.75
DEPRECIATION	4194.	4190.	3352.	2552.	2210.	2141.	1620.	1257.	779.	433.	214.
NET FARM INCOME	7383.	12333.	15116.	21635.	29564.	60097.	22354.	-8003.	23954.	3251.	26195.
TAXABLE INCOME	0.	0.	3694.	4593.	12334.	27184.	0.	0.	0.	0.	22281.
OPERATING RECEIPTS											
CATTLE RECEIPTS	33699.	36447.	40483.	41919.	50589.	70600.	35295.	32440.	45271.	46443.	73014.
BULLS	2236.	2392.	2833.	2510.	2922.	4076.	4056.	2476.	3554.	3256.	4069.
CULL COWS	9302.	9836.	10576.	11046.	13193.	18638.	10441.	10473.	14645.	12825.	19645.
CALVES	22161.	24219.	27076.	28263.	34469.	47886.	20798.	19491.	27077.	30362.	49100.
CROP RECEIPTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OTHER RECEIPTS	0.	0.	0.	0.	0.	1136.	1831.	915.	126.	0.	462.
TOTAL RECEIPTS	33699.	36447.	40483.	41919.	50589.	71736.	37126.	33355.	45396.	46443.	73476.
OPERATING EXPENSES											
CATTLE EXPENSES	14432.	14666.	14328.	15148.	15587.	18466.	22063.	23272.	23095.	22571.	22492.
CROP EXPENSES	3589.	3796.	3398.	4122.	4227.	4758.	5604.	6059.	7259.	7362.	7459.
WAGES AND SALARIES	3513.	3641.	3641.	3760.	3960.	4535.	5301.	6063.	6367.	6387.	6367.
TOTAL EXPENSES	21533.	22102.	21366.	23038.	23774.	27771.	32969.	35393.	36736.	36620.	36338.
DEBT SITUATION											
NEW LOANS	4433.	0.	0.	0.	1933.	0.	0.	0.	0.	0.	0.
DEBT PAYMENTS	8196.	9306.	9306.	9306.	9306.	8026.	6915.	6915.	6915.	6915.	6419.
CHANGE IN DEBT	1987.	-3346.	-3564.	-3794.	-2056.	-2862.	-1950.	-2075.	-2207.	-2343.	[illegible]
INTEREST PAYMENT	6223.	6490.	6282.	5964.	5672.	5321.	4965.	4841.	4576.	4527.	[illegible]
PERSONAL EXPENSES											
FAMILY LIVING	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.
US AND SS TAXES	130.	130.	130.	130.	1490.	6139.	130.	130.	130.	130.	4255.
OREGON INCOME TAX	0.	0.	0.	21.	385.	1456.	0.	0.	0.	0.	1035.
TOTAL TAXES OWED	130.	130.	130.	151.	1875.	7597.	130.	130.	130.	130.	5289.

Appendix Table D.1. continued

PRODUCT SALES AND INPUT USE

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
LIVESTOCK SALES											
CULL COWS	54.	54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
FED STEERS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FED HEIFERS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FEEDER STEERS	173.	173.	173.	173.	173.	173.	173.	173.	173.	173.	173.
FEEDER HEIFERS	114.	114.	114.	114.	114.	114.	114.	114.	114.	114.	114.
CROP PRODUCTION AND SALES											
BARLEY SOLD(FEED)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OILSEED SOLD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HAY SOLD(T.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GRAIN OUTPUT(BU.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FORAGE OUTPUT(T)	800.	800.	830.	800.	800.	800.	800.	830.	630.	830.	600.
PASTURE PRODUCED(T)	1162.	1357.	1332.	1332.	1297.	1165.	1357.	1263.	1236.	1125.	1253.
SELECTED INPUTS											
PURCHASED CALVES	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PURCHASED STEERS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FUEL AND OIL	387.	400.	400.	414.	426.	449.	490.	534.	650.	690.	690.
CHEMICALS AND FERT.	460.	471.	433.	452.	489.	527.	666.	904.	941.	941.	941.
LABOR(HRS.)	5094.	5094.	5094.	5094.	5094.	5094.	5094.	5094.	5094.	5094.	5094.
GRAIN FED(BU.)	2605.	2605.	2605.	2605.	2605.	2605.	2605.	2605.	2605.	2605.	2605.
FORAGE FED(T)	752.	729.	729.	725.	729.	760.	729.	733.	745.	821.	729.
PROTEIN SUPP.(S)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PASTURE REQUIRED(T)	1164.	1164.	1154.	1164.	1154.	1164.	1164.	1164.	1164.	1154.	1164.

DIETS FOR	FEED SOURCES HAY	GRAIN	PASTURE
COWS-LATE FALL+SPR.	.20	0.00	.80
COWS-WINTER	.90	.10	0.00
COWS-SUMMER	0.00	0.00	1.00
REPTS AND STOCKERS	.70	.30	0.00

CROP PROGRAM

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
GRAIN YLD-% OF AVE.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
NO.SMF.OPERATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

MACHINES PURCHASED AT AGE 0YRS.
MACHINES ARE SOLD+ 39 % OF USEFUL LIFE

CHANGES IN PASTURE AND COW HERD

RESPONSE LEVEL(%) 0.
RESPONSE METHOD---IMPROVE NATIVE

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
PAST.SEEDED(AC)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PAST.FERTILIZED(AC)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EXTRA REPT ADDED	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Appendix Table D.2. Computer Print-out for the Straight Yearling Operation

OUTPUT SUMMARY
WESTERN BEEF-FORAGE-GRAIN PRODUCTION MODEL-4Y/76

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
FARM PLAN SUMMARY											
ACRES OF CROPLAND	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACRES OF GRAIN	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACRES OF OILSEED	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACRES OF CEREAL HAY	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NO. OF COWS	300.	300.	300.	300.	300.	300.	300.	300.	300.	300.	300.
BEEF SYSTEM SELLS FEEDER YEARLINGS											
WINTER FEEDING PERIOD 6 MONTHS											
BREEDING METHOD - NATURAL											
COWS ARE PREGNANCY TESTED											
FINANCIAL SUMMARY-YEAR END											
TOTAL ASSETS	431027.	430701.	438383.	443335.	470747.	531022.	499251.	490167.	504549.	507573.	542059.
TOTAL DEBT	97824.	94476.	90912.	87118.	85062.	62200.	80250.	73175.	77213.	74651.	72621.
TOTAL EQUITY	333202.	342225.	347170.	351217.	385686.	416022.	419002.	416992.	427336.	432921.	473433.
CHANGE IN NET WORTH	2416.	14623.	9345.	19047.	29469.	30136.	5165.	-2009.	20346.	10564.	[illegible]
RETURN ON EQUITY(%)	.73	4.16	2.65	5.27	7.64	9.11	1.24	-.49	4.76	2.44	[illegible]
DEPRECIATION	4194.	4193.	3352.	2632.	2210.	2141.	1626.	1257.	876.	750.	454.
NET FARM INCOME	7548.	19153.	15493.	24316.	36990.	50170.	11635.	3121.	25525.	15714.	62675.
TAXABLE INCOME	0.	4191.	7226.	5452.	13931.	25803.	10350.	0.	5356.	395.	26976.
OPERATING RECEIPTS											
CATTLE RECEIPTS	36754.	42186.	43817.	43364.	51469.	69611.	56954.	41319.	55145.	48963.	75330.
BULLS	1759.	1914.	2264.	2088.	2336.	3251.	3246.	1961.	2643.	2635.	3355.
CULL COWS	6890.	7286.	7834.	5162.	9776.	13808.	7734.	7755.	10403.	9500.	14700.
YEARLINGS	28105.	32986.	33719.	33094.	39356.	52544.	45974.	31530.	41902.	36555.	57975.
CROP RECEIPTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OTHER RECEIPTS	0.	117.	512.	828.	1572.	3082.	3857.	3364.	3347.	3331.	4673.
TOTAL RECEIPTS	36784.	42303.	44329.	44192.	53041.	72693.	60811.	44784.	58493.	52291.	80603.
OPERATING EXPENSES											
CATTLE EXPENSES	15945.	16023.	15747.	16722.	17665.	22366.	27912.	28263.	27378.	26626.	26094.
CROP EXPENSES	3696.	3917.	4032.	4269.	4386.	4942.	5307.	6907.	7406.	7535.	7652.
WAGES AND SALARIES	4162.	4313.	4313.	4465.	4692.	5373.	6281.	7199.	7567.	7567.	7567.
TOTAL EXPENSES	23804.	24254.	24092.	25456.	26745.	32681.	39499.	42355.	42352.	41729.	41313.
DEBT SITUATION											
NEW LOANS	4433.	0.	0.	0.	1983.	0.	0.	0.	1243.	0.	0.
DEBT PAYMENTS	8196.	9306.	9306.	9306.	9306.	8026.	6915.	6915.	6915.	7227.	6730.
CHANGE IN DEBT	1337.	-3343.	-3504.	-3794.	-2056.	-2862.	-1950.	-2375.	-984.	-2560.	-2436.
INTEREST PAYMENT	5773.	6026.	5742.	5512.	5267.	5154.	4365.	4341.	4763.	4607.	4562.
PERSONAL EXPENSES											
FAMILY LIVING	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.
US AND SS TAXES	130.	130.	412.	162.	2061.	5713.	1176.	130.	133.	130.	6072.
OREGON INCOME TAX	0.	0.	136.	104.	460.	1320.	279.	0.	51.	0.	1436.
TOTAL TAXES OWED	130.	130.	548.	259.	2521.	7033.	1456.	130.	161.	130.	7510.

Appendix Table D.2. continued

PRODUCT SALES AND INPUT USE

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
LIVESTOCK SALES											
CULL COWS	40.	40.	40.	40.	40.	40.	40.	40.	40.	40.	40.
FED STEERS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FED HEIFERS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FEEDER STEERS	128.	128.	128.	128.	128.	128.	128.	128.	128.	128.	128.
FEEDER HEIFERS	83.	83.	83.	83.	83.	83.	83.	83.	83.	83.	83.
CROP PRODUCTION AND SALES											
BARLEY SOLD(FEED)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OILSEED SOLD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HAY SOLD(T.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GRAIN OUTPUT(BU.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FORAGE OUTPUT(T)	800.	800.	800.	800.	800.	800.	800.	800.	800.	800.	800.
PASTURE PRODUCED(T)	1162.	1357.	1332.	1332.	1297.	1165.	1357.	1260.	1238.	1125.	1260.
SELECTED INPUTS											
PURCHASED CALVES	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PURCHASED STEERS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FUEL AND OIL	427.	442.	442.	457.	472.	495.	541.	655.	762.	762.	762.
CHEMICALS AND FERT.	480.	471.	433.	452.	489.	527.	605.	804.	941.	941.	941.
LABOR(HRS.)	5982.	5982.	5982.	5982.	5982.	5982.	5982.	5982.	5982.	5982.	5982.
GRAIN FED(BU.)	4687.	4687.	4687.	4687.	4687.	4687.	4687.	4687.	4687.	4687.	4687.
FORAGE FED(T)	786.	786.	786.	786.	786.	786.	786.	786.	786.	786.	786.
PROTEIN SUPP.($)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PASTURE REQUIRED(T)	875.	875.	875.	875.	875.	875.	875.	875.	875.	875.	875.

DIETS FOR	FEED SOURCES HAY	GRAIN	PASTURE
COWS-LATE FALL+SPR.	.20	0.00	.80
COWS-WINTER	.90	.10	0.00
COWS-SUMMER	0.00	0.00	1.00
REPTS AND STOCKERS	.70	.30	0.00

CROP PROGRAM

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
GRAIN YLD-% OF AVE.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
NO.SMF.OPERATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

MACHINES PURCHASED AT AGE 0YRS.

MACHINES ARE SOLD+ 89 % OF USEFUL LIFE

CHANGES IN PASTURE AND COW HERD

RESPONSE LEVEL(%) 0.

RESPONSE METHOD---IMPROVE NATIVE

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
PAST.SEEDED(AC)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PAST.FERTILIZED(AC)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EXTRA REPT ADDED	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Appendix Table D.3. Computer Print-out for the Straight Long-Yearling Operation

OUTPUT SUMMARY
WESTERN BEEF-FORAGE-GRAIN PRODUCTION MODEL-MAY/78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
FARM PLAN SUMMARY											
ACRES OF CROPLAND	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACRES OF GRAIN	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACRES OF OILSEED	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACRES OF CEREAL HAY	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NO. OF COWS	300.	300.	300.	300.	300.	300.	300.	300.	300.	300.	300.
BEEF SYSTEM SELLS LONG YRLG.FEEDERS											
WINTER FEEDING PERIOD 6 MONTHS											
BREEDING METHOD - NATURAL											
COWS ARE PREGNANCY TESTED											
FINANCIAL SUMMARY-YEAR END											
TOTAL ASSETS	435935.	447033.	453294.	471349.	501825.	542375.	535917.	538401.	555793.	568484.	620965.
TOTAL DEBT	97824.	94476.	90912.	87118.	85062.	82200.	80250.	78175.	75960.	74363.	72650.
TOTAL EQUITY	338110.	352556.	362382.	384231.	416763.	460175.	455667.	460226.	479625.	493621.	548258.
CHANGE IN NET WORTH	7326.	19446.	14825.	25849.	37532.	46411.	493.	9559.	24559.	13795.	63563.
RETURN ON EQUITY(%)	2.17	5.52	4.09	6.99	9.01	10.52	.11	2.38	5.13	3.81	11.52
DEPRECIATION	4194.	4193.	3352.	2682.	2210.	2141.	1620.	1257.	779.	535.	526.
NET FARM INCOME	12511.	26430.	22796.	36519.	50770.	75330.	6427.	14039.	32613.	27534.	65770.
TAXABLE INCOME	5422.	12155.	15006.	19576.	28709.	54624.	8592.	3639.	15951.	17287.	40440.
OPERATING RECEIPTS											
CATTLE RECEIPTS	44282.	51371.	52626.	57036.	66036.	97464.	54199.	51643.	64101.	63132.	93697.
BULLS	1759.	1914.	2264.	2588.	2338.	3251.	3246.	1931.	2643.	2605.	3255.
CULL COWS	6890.	7236.	7834.	8182.	9776.	13066.	7734.	7753.	10400.	9500.	14700.
LONG YEARLING	35633.	42071.	42528.	46266.	53922.	80397.	43219.	41909.	50858.	51027.	75742.
CROP RECEIPTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OTHER RECEIPTS	0.	0.	725.	1625.	2927.	5191.	6297.	6501.	7072.	7948.	10077.
TOTAL RECEIPTS	44282.	51371.	53351.	58662.	68963.	102655.	60497.	58149.	71173.	71030.	103774.
OPERATING EXPENSES											
CATTLE EXPENSES	16732.	16691.	16410.	17682.	18404.	23043.	28822.	29613.	28772.	28205.	29077.
CROP EXPENSES	3685.	3904.	4018.	4254.	4371.	4924.	5786.	6082.	7516.	7488.	7609.
WAGES AND SALARIES	4536.	4701.	4701.	4366.	5113.	5656.	6845.	7635.	8247.	8247.	8247.
TOTAL EXPENSES	24953.	25497.	25129.	25801.	27889.	33823.	41453.	44334.	44535.	43940.	44934.
DEBT SITUATION											
NEW LOANS	4433.	0.	0.	0.	1983.	0.	0.	0.	0.	1243.	0.
DEBT PAYMENTS	8196.	9306.	9306.	9306.	9306.	6026.	6915.	6915.	6915.	6915.	6730.
CHANGE IN DEBT	1957.	-3346.	-3564.	-3794.	-2056.	-2862.	-1950.	-2075.	-2207.	-1105.	-2213.
INTEREST PAYMENT	6266.	6386.	5943.	5512.	5267.	5164.	4965.	4841.	4703.	4567.	4517.
PERSONAL EXPENSES											
FAMILY LIVING	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.	5000.
US AND SS TAXES	130.	1661.	2456.	3853.	6627.	>17716.	735.	130.	2636.	3075.	13703.
OREGON INCOME TAX	55.	359.	515.	812.	1611.	4202.	196.	0.	583.	664.	3365.
TOTAL TAXES OWED	185.	2040.	2971.	4670.	8233.	21918.	934.	130.	3219.	3739.	17066.

Appendix Table D.3. continued

PRODUCT SALES AND INPUT USE

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
LIVESTOCK SALES											
CULL COWS	40.	40.	40.	40.	40.	40.	40.	40.	40.	40.	40.
FED STEERS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FED HEIFERS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FEEDER STEERS	125.	125.	125.	125.	125.	125.	125.	125.	125.	125.	125.
FEEDER HEIFERS	81.	81.	81.	81.	81.	81.	81.	81.	81.	81.	81.
CROP PRODUCTION AND SALES											
BARLEY SOLD(FEED)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OILSEED SOLD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HAY SOLD(T.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GRAIN OUTPUT(BU.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FORAGE OUTPUT(T)	800.	800.	800.	800.	800.	800.	800.	800.	800.	800.	800.
PASTURE PRODUCED(T)	1182.	1357.	1332.	1332.	1297.	1165.	1357.	1263.	1238.	1125.	1260.
SELECTED INPUTS											
PURCHASED CALVES	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PURCHASED STEERS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FUEL AND OIL	423.	436.	439.	453.	468.	491.	536.	650.	755.	755.	755.
CHEMICALS AND FERT.	430.	471.	433.	452.	439.	527.	666.	904.	941.	941.	941.
LABOR(HRS.)	6154.	6154.	6154.	6154.	6154.	6154.	6154.	6154.	6154.	6154.	6154.
GRAIN FED(BU.)	4916.	4916.	4916.	4916.	4916.	4916.	4916.	4916.	4916.	4916.	4916.
FORAGE FED(T)	821.	805.	805.	805.	805.	819.	805.	805.	805.	353.	805.
PROTEIN SUPP.($)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PASTURE REQUIRED(T)	1121.	1121.	1121.	1121.	1121.	1121.	1121.	1121.	1121.	1121.	1121.

	FEED SOURCES		
DIETS FOR	HAY	GRAIN	PASTURE
COWS-LATE FALL+SPR.	.20	0.00	.80
COWS-WINTER	.90	.10	0.00
COWS-SUMMER	0.00	0.00	1.00
REPTS AND STOCKERS	.70	.30	0.00
YRLGS ON PASTURE	0.00	0.00	1.00

CROP PROGRAM

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
GRAIN YLD-% OF AVE.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
NO.SMF.OPERATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

MACHINES PURCHASED AT AGE 0YRS.

MACHINES ARE SOLD+ 89 % OF USEFUL LIFE

CHANGES IN PASTURE AND COW HERD

RESPONSE LEVEL(%) 0.

RESPONSE METHOD---IMPROVE NATIVE

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
PAST.SEEDED(AC)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PAST.FERTILIZED(AC)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EXTRA REPT ADDED	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.