# EVALUATING THE GROWTH POTENTIAL OF IRRIGATED FARMS WITH DIMINISHING WATER SUPPLIES: A MULTIPLE GOALS APPROACH TO DECISION-MAKING

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TABLE OF CONTENTS

Chapter | Page

Chapter | Page

LIST OF TABLES

Tables | Page

| Tables | | Page |
|---|---|---|

## LIST OF FIGURES

# CHAPTER I

# INTRODUCTION

Firm growth and resource adjustments over time are topics of primary concern in evaluating the economic viability of firms. Numerous studies have been concerned with identifying and evaluating the factors responsible for the success or failure of these firms. In agricultural analyses the emphasis has been directed toward evaluating the effects of various financial and resource conditions, levels of managerial expertise, price and yield variability, family consumption patterns, capital financing opportunities and tax management alternatives. External factors such as technological advances, commodity programs and monetary market conditions have also been evaluated.

This study evaluates the effects of several factors on the growth potential of irrigated farms in the South Central Plains. While the effects of various water supply conditions are of primary interest, the effect of the beginning scale of the firm, the extent of initial land ownership and the family consumption patterns associated with various ages of operators are also of concern.

## Statement of the Problem

Two factors are of primary importance in evaluating the growth potential of irrigated firms using a stock underground water supply. First, the initial thickness and specific capacity of water bearing materials determine the physical volume of water available for irrigation. Second, the initial depth to water or static water level influences both the present and future cost of irrigation. If the rate of withdrawal depletes the aquifer, the cost per unit of water pumped can be expected to increase as the depth to water increases. The increasing cost structure diminishes the stream of net farm income over time.

Continual pumping at a rate in excess of natural recharge will eventually increase the pumping cost beyond the point of profitability. The time period in which this occurs is referred to as the "breakover" to dryland farming. The interval of time in which irrigation produces profits in excess of alternative dryland returns is defined as the "economic life" of the water supply. It is distinguished from the "physical life" of the stock resource since the water stored in the aquifer may not be physically depleted at the time of "breakover." At this point in time, the alternative dryland use for resources such as capital and labor is more profitable than continuing their use in irrigation activity.

Declining net farm income over time influences capital accumulation and the potential growth of firms. The impact on net farm income and the growth potential depends on the saturated thickness of the aquifer and the depth to water. These factors coupled with various family consumption requirements, land equity positions and size of firms may affect the ultimate growth potential over a specified planning period.

Inherent in the intertemporal process of capital accumulation is a decision framework involving alternatives such as intensifying production on the farm, enlarging the scale of operation or increasing the standard of living to mention a few. Necessarily, some strategies are incompatible with others. For example, diverting capital to increase the family's living standard may prevent expansion of the operation in the short term.

Decisions are functions of the relative importance of specific goals as well as the availability of resources such as land, labor and capital to accomplish selected goals. The periodic availability of resources may vary and, in turn, affect the priority placed on certain goals. For example, if short-term family living needs are currently exhausting the cash reserves, increasing the size of operation or intensifying production may not be possible under the circumstances. Basing future decisions on the single goal of increasing family living needs may result in a sacrifice in the ultimate growth potential. However, if the goals are allowed to shift in relative importance as family needs decrease or as the financial position improves, future decisions to enlarge or intensify may be made. Thus, a decision process involving several goals over time may not result in the same periodic decisions as one which utilizes only one goal over the planning horizon.

Research efforts involving multiple goals and their influence on decision-making have not been thorough because of difficulties in quantifying the relative importance of several goals and the problems of simultaneously incorporating them into analytical models. It has also been difficult to specify how they are used in making decisions. The difficulties in addition to the proper identification of relevant goals have restrained progress in research efforts utilizing multiple goals in the decision-making framework.

The current problem is to evaluate the effects of various water resource conditions, land equity positions, sizes of operation and ages of operator on the growth potential of irrigated farms. The selected factors affect the beginning and intertemporal characteristics of the firm. Goals may alternate in importance as varying financial and family characteristics evolve over time. Basing periodic decisions on multiple goals may result in quite different growth potentials for selected situations. Thus, an appraisal of the relative growth over the planning horizon can be related to a decision process based on alternating goals which are, in turn, functionally related to the evolving characteristics of the family and firm.

## Objectives of the Analysis

The primary objective of the analysis is to evaluate the growth potential of irrigated farms with diminishing water supply conditions in the South Central Plains. In addition, the effects of various factors such as the size of operation, land equity position and age of operator are to be evaluated. Since alternative goals may influence the decisions over time, a multiple goal decision process is also formulated.

Specifically, the objectives are to:

A. Develop a method of establishing a hierarchy of goals including a concept for identifying the currently relevant decision-making goals;

B. Develop an analytical technique in which a multiple goal structure is incorporated into the decision-making process over time; and

C. Evaluate the growth potential of selected representative firms for specific water and land resource conditions, initial land ownership patterns and operator ages.

The discussion of this thesis generally follows the order of the objectives. However, the remainder of this chapter provides additional background by reviewing previous research efforts involving firm growth and introducing the geographical, physiological and economic characteristics of the study area.

## Review of Firm-Growth Studies

The following review of firm growth analyses includes selected efforts using dynamic or multiperiod linear programming and simulation. Particular studies are selected to provide both an historical sketch of the advancement and progress of economic research toward evaluating the intertemporal behavior of agricultural firms and the effects of selected factors on the growth of the firm.

### Dynamic Linear Programming Studies

Swanson,[1] Loftsgard and Heady[2] were the pioneers in conceptualizing economic studies of firms involving time. Swanson began by evaluating a five year period with year-to-year income transfers and a yearly minimum consumption level for the family. The model was designed to select the optimum combination of enterprises for maximizing the present value of accumulated income from the farm plan. Loftsgard and Heady then conceived a more sophisticated model whereby expansion of pork production activities could be added to a fixed size of farm. If surplus funds were generated in excess of family consumption and fixed costs, they were transferred to the next period. A total of eight years was evaluated in this study which assumed maximization of the discounted sum of net income.

Even more sophistication with regard to the cash flow of a farm was developed by Irwin and Baker.[3] Although only one year was evaluated, cash transactions were developed for quarterly periods within the year to cope with the seasonal capital requirements and sales. In addition, explicit consideration was given to external capital sources. The objective function reflected maximum net returns with periodic interest charges deducted.

The use of several objectives and a comparison of using alternative goals over time in a firm growth study of southwestern Oklahoma farms was conducted by J. Rod Martin and James S. Plaxico.[4] The theoretical framework posited by this study was based on the dynamic processes of meeting family consumption requirements while accumulating capital for reinvestment in the firm. Several goals were compared with respect to their effect on the capital accumulation process of the firm.

The results indicated that maximum capital accumulation and growth occurred by maximizing the present value of the stream of net returns. Various measures of growth including ending owned capital, undiscounted net returns, discounted gross sales and total acres operated were used and found to result in the same growth over time. The objective of maximizing the present value of land investments resulted in a slower rate of growth since the strategy of renting land was instrumental in maximizing firm growth. An additional objective of maximizing the present value of consumption discounted at six percent resulted in a similar capital accumulation and growth process as maximizing the discounted net returns. The rate of discount was insufficient to draw capital away from the firm growth purposes to be consumed by the family.

Another recent study by Boehlje[5] maximized both ending net worth and disposable income objectives. He found the choice of objective influenced the method of capital accumulation. Maximizing disposable income favored internal generation of capital whereas the net worth criterion utilized external means of generating capital to maximize the criterion function.

These studies utilized either a single goal or one in conjunction with others as constraints for the total planning horizon rather than allowing the objective to change over time. However, they did compare the effects of using alternative objectives.

## Simulation Studies

In contrast to the previous firm growth analyses utilizing linear programming, a mathematical optimizing procedure, simulation models do not necessarily use optimization techniques. Thus, the decision criteria may be developed in a more flexible manner and under conditions of greater complexity. The interrelated activities of a firm growth model are necessarily complex depending on past, current and expected events. With simulation procedures, the range of alternative situations and decision rules used to evaluate the effects on firm growth is broad and can be as complex as the analyst designs them.

Eisgruber[6] was instrumental in developing simulation procedures of farm operations. An outgrowth of his efforts was completed by Patrick[7] in which four objectives of the operator were included. They concerned (1) the living standard as measured by the adequacy of current consumption; (2) farm ownership reflected by the ability to own land and accumulate net worth; (3) leisure time available for family activities and (4) the extensive uses of credit and willingness to bear risk.

Recognizing that the relative importance of objectives may change over time due to age or physical and financial resources available, a set of weights summing to one were attached to each goal representing the "average farmer." The living standard goal bore a weight of .40, farm ownership .25, leisure .10 and the risk-bearing goal was weighted by .25. The results of alternative plans were evaluated and rated subjectively from unsatisfactory to highly satisfactory. The plan having the highest satisfaction value was selected and implemented. Thus, instead of pursuing a specific goal such as maximizing progits, the entrepreneuer seeks a plan among the available alternatives which best satisfies the composite goal structure.

The results indicated after successive periods in which land was purchased, the farm ownership objective declined in importance. Similarly the objective of more leisure time decreased and did not increase until cash income increased in latter years. On the other hand, the standard of living goal became relatively more important when there was little money available for consumption. The aversion to bear risk and use credit extensively decreased in relative importance as net worth increased.

The previous approach to using multiple goals was limited by the subjective nature of the weights attached to the goals. A second study by Harshbarger[8] utilized a comparative framework of two objectives: making the most net farm income and increasing net worth while maintaining an adequate standard of living. The latter dual objective was assigned aspiration levels based on a periodic $5,000 increase above current net worth and an expectation of net farm income being 130 percent of the planned family consumption as estimated by a function developed by Patrick.

The results indicated that few changes in the farm organization's livestock program occurred when the level of satisfaction of the dual objectives was high. However, since livestock programs were of secondary importance in the firm growth process, no significant changes were expected while the firm was operating successfully. When the net income was maximized, the livestock enterprises indicated a higher degree of fluctuation because of the competitive uses for capital and labor in operating additional land. Land rental activities were actively engaged to aid in maximizing profits.

Bostwick[9] used simulation to evaluate five land control strategies over thirty years. The strategies were designed to increase land equity, increase the scale of operation by refinancing followed by purchasing land to increase equity, increase scale by renting and then purchasing land, increase scale by a perpetual land mortgage on purchases and increase scale by renting only. The latter two resulted in the highest amounts of income. The results indicated that growth in equity is best achieved by increasing the scale of operation. Thus, strategies which rapidly increased the size of the unit operated were inclined toward relatively more growth in equity than immediately pursuing the equity objective.

An analysis emphasizing growth by land acquisition was completed by George Flaskerud.[10] A sophisticated simulation of the monthly cash flows from small grain, forage and beef cattle production is included for 25 years. Four variables including alternative land acquisition methods, production plans, financial arrangements and levels of beginning equity were analyzed. The results indicated that security levels on assets for obtaining credit was the most important aspect of financing. Land purchase and growth in net worth resulted from production plans including cows, feeders and crops whereas consumption levels were highest with plans including only crops and feeder cattle. Rental and rent-purchase land acquisition strategies required 35 percent land equity to grow over time.

A more general simulation technique for computer use was developed by Hutton and Hinman.[11] It is flexible regarding the planning period, farm organization, deterministic or stochastic prices and yields, security levels, consumption levels, interest rates, and complements of machinery. However, unlike the previous analyses, neither decision rules nor optimization criteria are included. It provides a basis for comparing several situations when key variables are altered. The input data and other specifications are numerous because of the extreme degree of complexity in itemizing resource and machinery inventories, production by enterprise and the detailed financial characteristics of the firm.

These studies indicate both simulation analyses and dynamic linear programming studies have evaluated the effects of key variables on growth of the firm. The simulation technique is more flexible and permits incorporating relatively complex relationships such as those required when multiple goals are important. Regradless of the technique of analysis, a measure of growth such as wealth or gain in net worth is needed as a criterion to compare alternative strategies. Thus, the definition of growth and the differentiation between growth and expansion in the current analysis is important.

## Growth Versus Expansion

Penrose[12] indicates that the term growth is used with two connotations: (1) as an increase in the amount of something and (2) as a process of development such as the biological process of maturing in which a series of internal changes lead to size and characteristic alterations. The previous discussion of the Martin and Plaxico firm growth study indicated several measures of growth such as maximum undiscounted and discounted net returns, ending owned capital, gross sales and acres of land operated. Bostwick, on the other hand, used net worth as a measure of growth by pursuing increases in farm equity (the ratio of total resources controlled to the investment plus accumulated capital gains in land) and the size of farm by renting or purchasing.

The current analysis also uses net worth as the measure of growth. Net worth provides a common basis for comparing the various situations and evaluating the effects of selected factors on growth. Since the opportunity of accumulating capital by alternative investments other than in the farm operation is available, increases in size (expansion), sales, or other measures are not considered applicable. Consequently, the terms growth and expansion are differentiated in the present analysis in the following manner. Firm growth is defined as an increase in the net worth position as a result of strategies adopted by the operator while firm expansion relates only to increasing the scale of operations by renting or purchasing additional land.

Since the present analysis is also concerned with the use of multiple goals in selecting among expansionary and non-expansionary strategies, the effect of these decision can be evaluated by a common measure such as net worth rather than physical measures directly influenced by the type of strategy selected such as the size of operation, gross sales or others. Thus, net worth is used as the common yardstick of growth for three primary reasons:

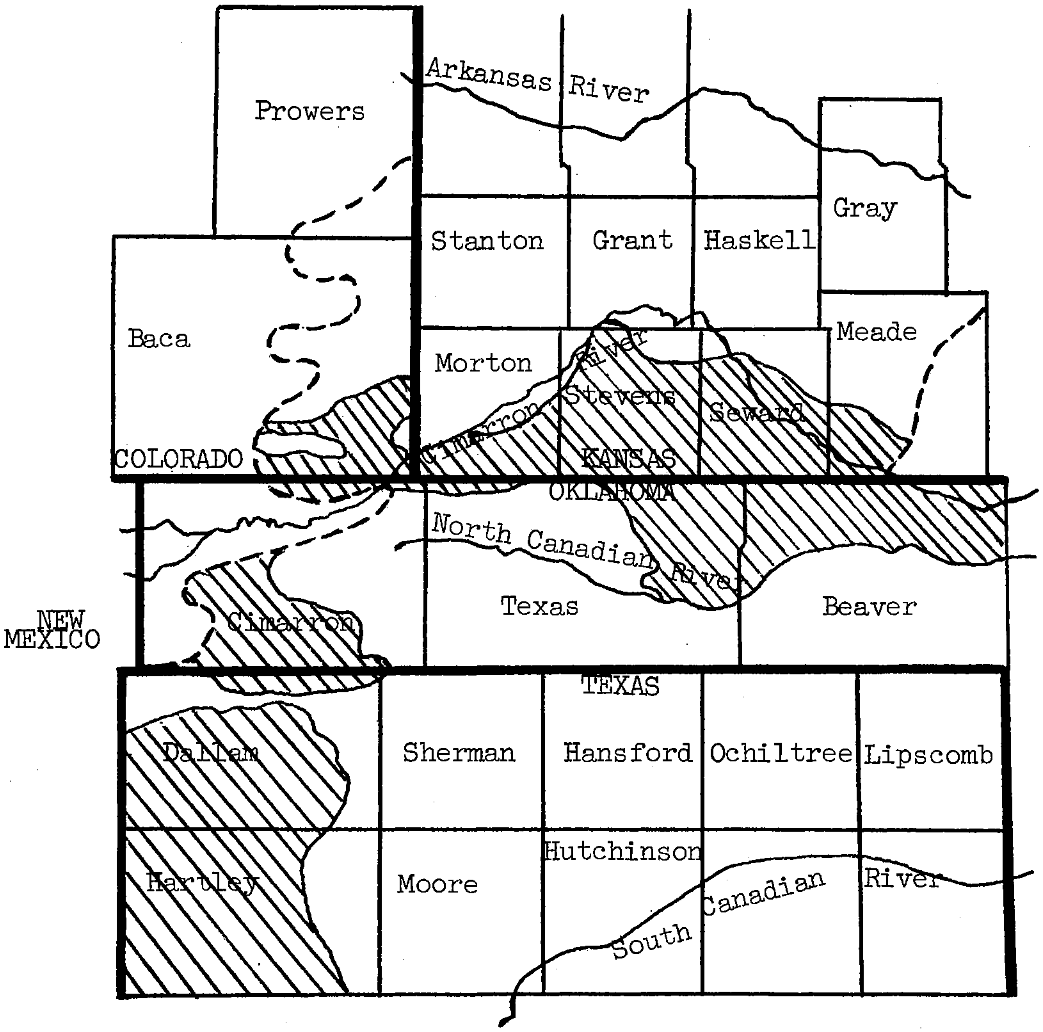
1. Two of the four alternative strategies available to the operator do not involve expansion of land resources;
2. The net worth statement reflects the economic viability of a firm; and
3. The representative situations under consideration vary by land and water resources, land equity position and operator characteristics requiring a common measure for evaluating the comparative changes in net worth over time.

Net worth also provides a measure of the salvage value of business. A major limitation in using net worth is that it does not directly indicate the earning potential of the business. Nevertheless, net worth is considered as a satisfactory measure of growth since increases in net worth generally result from increases in earning capacity.

## The Study Area

### Climatological and Physical Characteristics

The area of concern includes portions of the northern Texas panhandle, the Oklahoma panhandle, southwestern Kansas and southeastern Colorado. Figure 1 indicates the twenty-one counties included in the




Approximate Boundary of the Ogallala Formation
State Lines
County Lines
Sandy Loam Soils
Clay Loam Soils

Figure 1. The Study Area

study area. Bekure[13] describes the study area as one of relatively low precipitation and humidity, a high degree of seasonal temperature variation and relatively high wind velocities particularly in early spring. The average annual precipitation is about 19 inches but ranges from a low of approximately eight to over 30 inches. Most of the precipitation falls in the late spring and early summer. Temperatures in the summer reach about 100 degrees and winter temperatures fall to zero. The growing season is generally less than 190 days with the last killing frost occurring in latter April and the first in latter October.

The major soil types are clay loam and loam with just over 20 percent being sandy loam soils. Figure 1 indicates the distribution of these soil types. Most of the clay loam is furrow irrigated with sprinkler irrigation being the most prominant on sandy loam soils. The soils are generally deep, productive and well drained responding to intensive cultivation practices and fertilization.

The area is underlain by a saturated aquifer which yields irrigation water of satisfactory quality for intensive agricultural production practices. The Ogallala formation is an unconsolidated aquifer composed of sediments believed to have been eroded from the Rocky Mountains and deposited by streams in the area. The formation has a slight gradient to the east as a result of shifting and depositing of the unconsolidated materials over time. It extends throughout most of the Great Plains region: from southern South Dakota to southern Texas.

Streams and rivers have since developed and presently the North Platt, Arkansas and Canadian rivers separate the formation into sectors.[14] This study involves most of the area between the Arkansas River on the north and the Canadian River on the south (Figure 1). The area overlying this sector of the Ogallala is about 11 million acres or 17,500 square miles.[15] However, the total county area is somewhat larger; 14,671,780 acres as reported in the 1969 census of agriculture.[16]

## Economic Factors

Crops and Livestock. The study area is reliant on agriculture as the major industry. Wheat, grain sorghum, corn and beef production are the major enterprises. The 1969 census data, Table I, indicate the importance of wheat and grain sorghum as the principal cash crops. In 1964, over 93 percent of the total irrigated acreage of the five primary irrigated crops and nearly 99 percent of the five primary dryland crops was accounted for by wheat and grain sorghum.[17] In 1969, less than 80 percent of the irrigated acres are represented by sorghum and wheat with an offsetting increase comprised mostly of corn for grain. Some increase is also noted for corn silage, sorghum silage and alfalfa hay. These recent shifts toward corn grain, silage and hay are effects of the recent expansion in feeder cattle activity in the area.

The rapid development of large-scale commercial cattle feeding activities is reflected by a three-fold increase of nearly 270,000 head between the 1966-1967 and the 1969-1970 production periods for the Oklahoma Panhandle area.[18] Preliminary estimates by Purcell indicate fed cattle marketing will be about 584,000 head by 1990 for the panhandle area.[19] The effects of the rapidly increasing feeder cattle industry are localized but have apparently exerted sufficient influence on the overall demand for feed grain, silage and hay production to be reflected in the area statistics.

TABLE I

SUMMARY OF MAJOR CROPS AND THE IRRIGATED DRYLAND DISTRIBUTION BY STATE SECTORS OF THE STUDY AREA[a]

| State Sector | Grain Sorghum | Wheat | Corn Grain | Silage[b] | Alfalfa | Total |
|---|---|---|---|---|---|---|
| | - - - - - - - - acres - - - - - - - - | | | | | |
| Colorado: | | | | | | |
| Irrigated | 44,844 | 22,848 | 20,847 | 7,042 | 36,346 | 131,927 |
| Dryland | 94,447 | 132,121 | 2,999 | 1,459 | 4,072 | 235,098 |
| Kansas: | | | | | | |
| Irrigated | 243,821 | 158,134 | 96,463 | 25,167 | 14,330 | 537,915 |
| Dryland | 253,400 | 591,973 | 3,837 | 4,524 | 11,540 | 865,274 |
| Oklahoma: | | | | | | |
| Irrigated | 116,917 | 57,407 | 17,782 | 19,797 | 3,881 | 215,784 |
| Dryland | 134,775 | 240,527 | 2,210 | 2,584 | 1,323 | 381,419 |
| Texas: | | | | | | |
| Irrigated | 358,250 | 266,062 | 60,340 | 26,390 | 5,916 | 716,958 |
| Dryland | 90,522 | 381,733 | 1,888 | 2,008 | 1,604 | 477,755 |
| Subtotals: | | | | | | |
| Irrigated | 763,832 | 504,451 | 195,432 | 78,396 | 60,473 | 1,602,584 |
| Dryland | 573,144 | 1,346,354 | 10,934 | 10,575 | 18,539 | 1,959,546 |
| Grand Total: | 1,336,976 | 1,850,805 | 206,366 | 88,971 | 79,012 | 3,562,130 |
| Percentages: | | | | | | |
| Irrigated | 47.66 | 31.48 | 12.20 | 4.89 | 3.77 | 100.0 |
| Dryland | 29.25 | 68.70 | .56 | .54 | .95 | 100.0 |
| Total Distribution | 37.54 | 51.95 | 5.79 | 2.50 | 2.22 | 100.0 |

[a] Source: U.S. Department of Commerce, Bureau of the Census, 1969 Census of Agriculture, Volume 1, Parts 21, 36, 37 and 41, (U.S. Government Printing Office, Washington, D.C., 1972).

[b] Includes corn and sorghum silage.

Irrigation Development. Development of an underground water-bearing formation has been one of the most recent and significant economic factors. Wells were drilled into the Ogallala formation as early as 1932 in Oklahoma.[20] Drilling activities did not begin until 1940 in the Kansas and Colorado portions of the area.[21] The rate of development was slow until about 1950 when larger and more efficient pumping systems were developed. Advent of the vertical turbine pump and the drouth in the mid-fifties accelerated the rate of irrigation development.

Of the state sectors in the study area, the northern part of Texas has experienced the most rapid rate of development with the momentum increasing steadily since 1962. From 1950 to 1965, the number of irrigated acres increased from 17,000 to 1,003,000 in Texas, from 43,000 to 408,000 in Kansas and Colorado and from 1,000 to 117,000 in the Oklahoma panhandle. Approximately 14 percent of the area overlying the Ogallala was irrigated by 1965 comprising only 19 percent of the irrigable acres.[22]

As a measure of the continuing trend in irrigation development since 1965, the 1969 census indicates an increase of over 70 percent in irrigated land since the 1964 census year. Distributed by state sectors of the study area, northern Texas accounted for 45 percent of the increase and southwestern Kansas nearly 30 percent. The Oklahoma Panhandle shared almost 22 percent of the increase leaving Colorado with only about three percent.[23]

The continual and intense development of the underground aquifer over time has caused withdrawals in excess of the available recharge. Recharge is estimated to be approximately .27 million acre feet per year while recent annual withdrawals have exceeded two million acre feet. Bekure[24] estimated the first overdraft of the aquifer occurred about 1954 and by 1965 the overdraft exceeded 2.7 million acre feet per year. With the continued development since 1965, the overdraft continues to increase and will eventually be an important economic factor in the profitability of irrigated operations.

The economic significance of a continued withdrawal rate in excess of recharge is realized by a reduction in the saturated thickness of water-bearing materials and an increase in the pumping lift. The economic consequences of the overdraft will be an increase in the cost per unit of water pumped and an eventual decline in well capacity when pumps are lowered to the bottom of the aquifer. Accelerated declines in farm profits can be expected at this point since the irrigated acreage per well is expected to diminish and additional wells must be drilled if irrigated acrea are to be maintained.

The extent of the overdraft in Kansas between 1942 and 1960 in the older and more intensely developed counties resulted in nearly four feet decline per year in the static water level. Northern Texas estimates were over one and one-half feet average annual decline from 1956-1965.[24] The declines have not been as serious in the Oklahoma panhandle and Colorado portions of the study area but as irrigation development intensifies, the annual decline rates in these areas are expected to increase significantly.

The study area can be characterized as relatively homogeneous in farming activities with wheat, grain sorghum and beef production as the dominant enterprises. Corn grain, silages and hay production are increasing in importance as feeder cattle operations expand. Extensive irrigation development is occurring throughout the area causing depletion of the underground aquifer.

The underground water resource conditions vary by depth-to-water and the saturated thickness. Thus, the area is less homogeneous than readily apparent from a surface appraisal. The depth-to-water varies from less than 50 feet to over 350 feet and the thickness of the water bearing formation ranges from less than 50 feet to over 500 feet in some areas. Approximately 73 percent of the area has less than 300 feet of formation with most of the water being between 50 and 200 feet deep. The numerous combinations of the depth-to-water and saturated thickness deem it impractical to evaluate each in the current analysis. Consequently, selected water resource situations will be evaluated to estimate the effects of various water supply conditions on resource adjustments and firm growth.

## Organization of Thesis Discussion

Before discussing the water resources analysis, Chapter II addresses the theory of the firm, the multi-dimensional utility theory of decision-making and the present decision process using multiple goals. The third chapter reports the logic of the simulation program used for the analysis. Prior to evaluating the growth potentials of representative operations, the effects of selected declining water resource conditions on the farm organization and net income are assessed in Chapter IV for the purpose of delineating the present and future representative farm organizations. The representative firms and their initial status of land and water resources, land ownership patterns and operator ages are developed in the fifth chapter. The growth potential of the representative situations and discussion of the impact of a multiple goals decision process will be presented in Chapter VI with the seventh chapter evaluating the multiple goals decision technique. Chapter VIII summarizes the results and indicates needs for extended research efforts.

FOOTNOTES

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[18]Bekure, p. 7.

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## CHAPTER II

## THEORETICAL ASPECTS OF THE ANALYSIS

The analysis has two dimensions: the evaluation of resource adjustments with diminishing water supplies and estimation of the growth potential of irrigated firms. The relevant theoretical aspects are the theory of the firm and multidimensional utility analysis. The first aspect concerns resource adjustments over time as a function of a single goal; maximizing profits. The latter theory is the basis for incorporating multiple goals into the firm growth decision process for selecting among alternative strategies. The following discussion also includes applications of the theoretical aspects in relation to the current problem.

### Theory of the Firm

Theory of the firm provides the framework to analyze resource adjustment problems over time. The dynamic process of resource adjustments in the current analysis may be viewed as a series of sequential static positions of the firm over time. Thus, the decision process of adjusting to a diminishing water supply can be portrayed as a comparative static rather than a dynamic decision process.

The peculiar problems of analyzing resource adjustments of irrigated firms using a stock water supply are based on the physical characteristics of the underlying water-bearing strata. Three characteristics are of primary importance: (1) the initial thickness and specific capacity of water bearing materials determines the physical volume of water available for irrigation, (2) the initial depth to water or static water level influences the cost of irrigation, and (3) if the rate of withdrawal depletes the aquifer, the cost per unit of water pumped can be expected to increase over time as the depth to water increases. Eventually, the returns to resources with irrigation reach the point of equivalent returns in dryland production activities.

Figure 2 depicts the theoretical evaluation of the adjustments to a diminishing water supply. For purposes of simplification, two resources are used: irrigable land on the vertical axis and water on the horizontal axis. Considering the price of the product is constant, $MVP_L$ and $MVP_W$ represent the marginal value productivity of irrigable land and water respectively. $P_W$ represents the unit price of water and $P_L$ the opportunity dryland return of using land in alternative dryland production activities. Other resources such as labor and capital are also diverted to dryland production activities when the opportunity dryland returns exceed the returns from irrigation.

The theory of the firm indicates that the expansion path O P gives the optimum or least cost combinations of land and water to produce various levels of output $0_1$, $0_2$, . . . , $0_7$. The points A, B and C along O P are the points of tangency equating the ratio of the marginal physical products to the price ratio of the inputs.

The pseudo-scale line MP represents the points at which the $MVP_L = P_L$ and NP the points where $MVP_W = P_W$. The ridge lines denoted by XZ and YZ represent the points where the marginal physical products of land and water, $MPP_L$ and $MPP_W$, respectively are equal to zero.

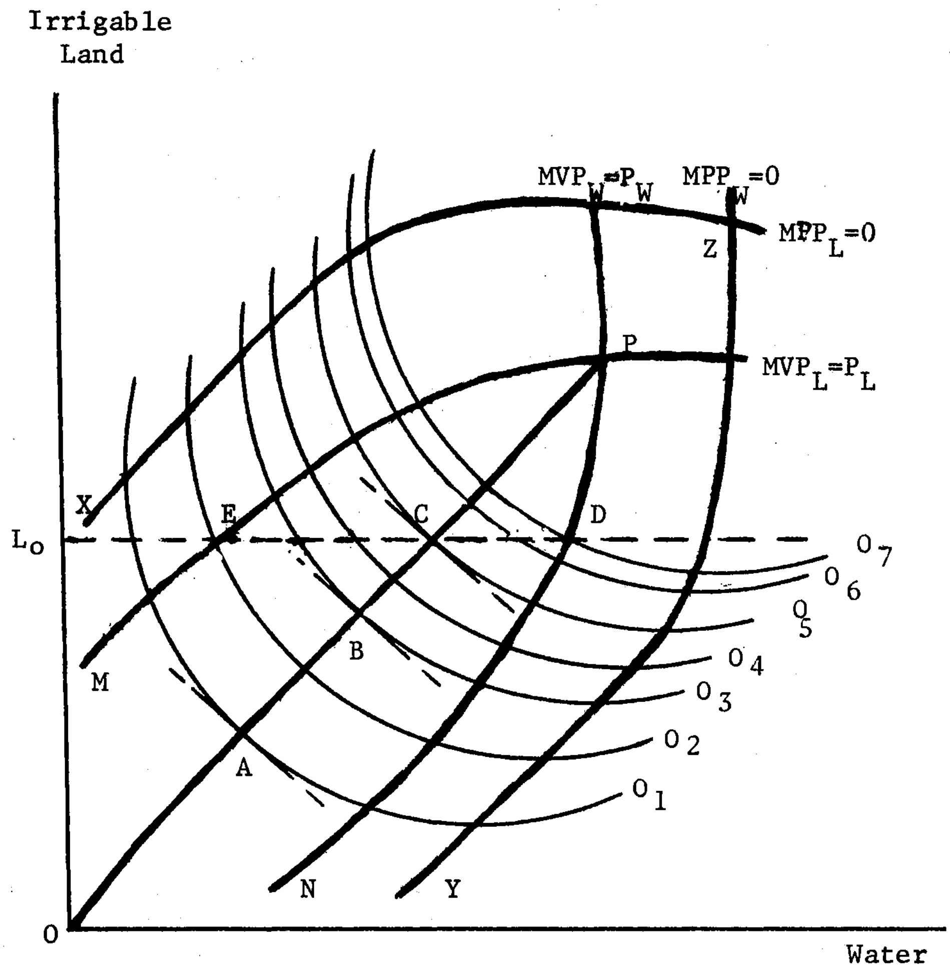


Figure 2. Theoretical Depiction of the Path of Adjustment With Diminishing Water Conditions

Assuming $L_o$ is the maximum amount of irrigable land on the farm, the portion of the expansion path above point C is not attainable. Thus, the expansion path is OABCD with profits being maximized as additional water is used beyond point C by moving as far as possible toward point D. However, the economically rational firm would not apply more water than the amount required at D since the price of water, $P_W$, would be greater than its marginal value product, $MVP_W$.

Assume sufficient water exists to operate at point D producing $O_7$ during the initial stage of the planning horizon. As the water level declines, the variable cost per unit of water pumped is expected to increase over time causing NDP and OP to shift to the left. The shifts are caused by successive increases in $P_W$ tracing the adjustment path DCEM. In practice many farmers attempt to maintain irrigation activity on the available irrigable land by drilling more wells. The additional wells hastens the increase in the cost of water, but does provide enough water per production period to adjust along DCEM.

This path of adjustment maintains the level of irrigable land until returns from irrigation are less than opportunity dryland returns. However, when enough additional wells are not drilled to supplement the diminishing water supply as well capacities decline, the optimum adjustment path is DCBAO. In practice, it appears many farmers attempt to maintain irrigation activity on the available irrigable land even though they cannot apply the same amount of water. That is, it appears these farmers also adjust along DCEM instead of the economically rational adjustment along DCBAO.

The theoretical agrument above assumes a single objective of profit maximization. As was pointed out earlier, other goals may be important in the decision-making process. The following discussion presents the theory of multidimensional utility analysis and the mode in which multiple goals can be applied to the firm growth portion of the analysis.

The Theory of Multidimensional Utility Analysis

The theory of multidimensional utility delineates a model of making decisions when several goals are under consideration.[1] A lexicographic system is used for ranking the objectives into an ordered hierarchy. The lexicographic or multidimensional ordering is based on the premise that the decision-maker has a hierarchy of desires in which the components are not of equal importance. Let $x = (x_1, x_2, x_3, \ldots, x_n)$ be a vector of the components in the hierarchy where $x_1$ is more important than $x_2$ and $x_2$ is in turn more important than $x_3$ and continue until all n components are ranked. Also, consider two alternative courses of action a and b, are available for attaining the levels of desires such that the two vectors $x^a$ and $x^b$ exist. Defining u as a preference index function, the lexicographic system of ordering defines alternative a as preferred to alternative b or $u(x^a) > u(x^b)$ if $x_1^a > x_1^b$ without regard to the relationships of lower ranked components $x_k^a$ and $x_k^b$ where $k = 2, 3, \ldots, n$ and  is defined as "preferred to." This is in contrast to a regular ordering which considers $u(x^a) > u(x^b)$ if, and only if, $x_i^a \geq x_i^b$ for all i and the inequality holds for at least one i.

In the case of a tie between the alternatives such that $x_1^a = x_1^b$, the second ranked component is compared. Thus, $u(x^a) > u(x^b)$ if $x_1^a = x_1^b$ and $x_2^a > x_2^b$. The situation could exist where several components are tied in which case the successively lower ranked components are considered until a selection between alternatives a and b is made. One suggested method of using multiple goals is to pursue one objective subject to satisfying constraints on others. In a static situation, Baumol argues that firms may establish pricing and production goals in such a manner as to maximize total sales subject to the constraint that a satisfactory level of profit is attained.[2]

C. E. Ferguson[3] combines the Baumol thesis of constrained goals with the multidimensional ordering of goals such that the decision-maker is assumed to have a hierarchy of objectives and a minimum achievement or satisficing level for each. Considering the profit maximization objective as the dominant goal and sales maximization of secondary importance, there are two possibilities. First, if the alternatives under consideration fall short of the satisficing level for profits, the secondary goal is ignored and the alternative which maximizes profits is selected. Secondly, if two or more alternatives meet or exceed the minimum level of profits, the secondary goal of sales maximization determines the course of action since no additional utility is derived from profits in excess of the minimum level.

Figure 3 illustrates the decision process with two objectives to be maximized and the results of several alternative courses of action A, B, C, D and E. This example asserts that the entreprenuer is maximizing leisure time subject to a satisfactory level of net income. Letting the dominant goal be net income (horizontal axis) and the second ranked objective be hours of leisure time (vertical axis) with the minimum satisficing levels of each indicated by $I_m$ and $L_m$ respectively, alternative B is superior to A because it has a higher net income than A. However, if alternative C is also considered, C is superior

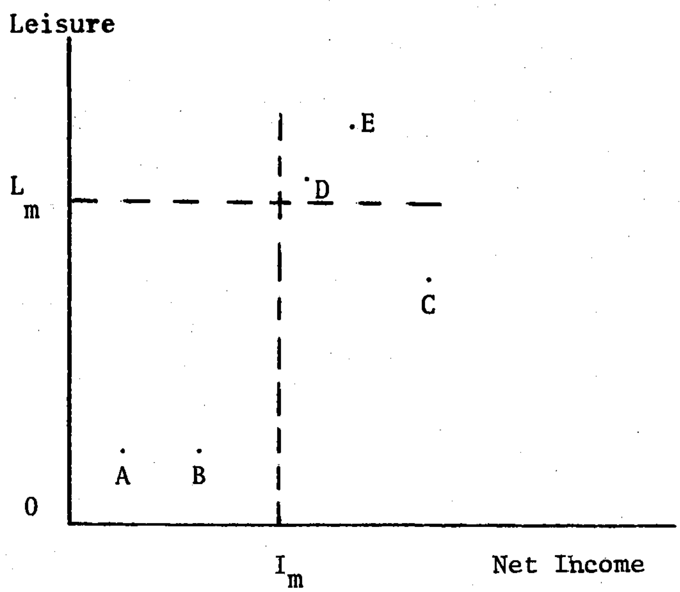


Figure 3. Hypothetical Combinations of Income and Leisure Resulting from Alternative Plans

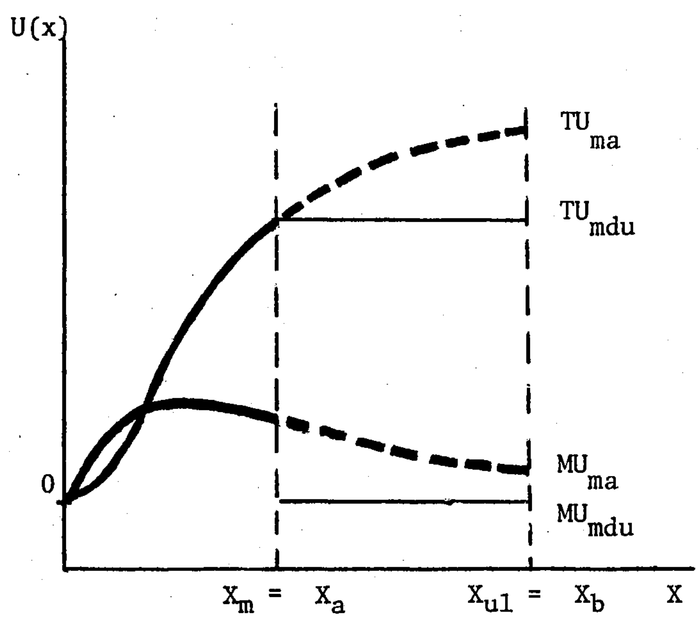


Figure 4. Theoretical Depiction of the Types of Utility Functions Used in the Multidimensional Utility Analysis and the Modified Approach

to both A and B since the minimum level of net income is satisfied.

Expanding the alternatives to include D, alternative C is inferior to D since the former does not meet the satisficing level of the secondary goal, $L_m$. Further extension of alternatives to include E indicates both D and E are superior to C but no clear decision can be made between D and E. These alternatives are equally preferred by the decision-maker even though E results in, both, more income and leisure than D. The indifference arises because the marginal utility of additional units of income and leisure is assumed to be zero beyond the minimum satisficing levels. This assumption, when placed in an analytical framework, causes an inadequacy in the decision process. Some means of selecting alternative D or E needs to be devised. The following discussion proposes a modification of the multidimensional utility approach for making a distinct decision in such cases.

## A Modified Multidimensional Utility Approach

A modified multidimensional utility approach is used in this thesis in an effort to improve the decision-making process in an analytical framework. Specifically, the modification avoids the possibility of equal preferences between alternative courses of action. The basic assumption of zero marginal utility for units beyond the minimum satisficing level is the underlying cause of the equal preference decision.

Figure 4 depicts the types of utility functions used in the multidimensional utility analysis, $Tu_{mdu}$, and the modified approach, $TU_{ma}$. The respective marginal utility functions are indicated by $MU_{mdu}$ and $MU_{ma}$. Letting X be the level of attainment (horizontal axis) by some alternative course of action, the vertical axis denotes the utility of

$X^4$. The minimum satisficing level of X is $X_m$, the point at which the marginal utility of additional units of X, $MU_{mdu}$, is zero in the multidimensional utility analysis (solid horizontal line). Although it is depicted as a disjoint function for comparison purposes, the function would be continuous if $MU_{mdu} \rightarrow 0$ in the neighborhood of $X_m$. The dashed line, at levels greater than $X_m$, represents the type of utility function used in the current modified approach. Considering that $X_{ul}$ indicates the upper limit of X attained by the course of action, $TU_{ma}$ does not reach a mazimum over the range of $X_m$ to $X_{ul}$ whereas $TU_{mdu}$ reached a maximum at $X_m$. The marginal utility functions then have the respective characteristics of

$$MU_{mdu} = \left.\frac{du}{dx}\right]_{X_m} \leq X \leq X_{ul} = 0$$

and $$MU_{ma} = \left.\frac{du}{dx}\right]_{X_m} \leq X \leq X_{ul} > 0$$

where the latter marginal utility of the modified approach $MU_{ma}$ reflects additional utility gain from units of X above $X_m$ and the former, $MU_{mdu}$ indicates no marginal utility beyond $X_m$.

The modification of the type of utility function allows a definite choice of two alternative courses of action A and B. Let the levels of X attained by the alternatives be $X_a$ and $X_b$. Again in Figure 4, let $X_a = X_m$, the minimum satisficing level, and $X_b = X_{ul}$, the upper limit of X attained by the alternatives. The alternatives are equally preferred by multidimensional utility analysis but with the modified approach B is superior to A since u(X) at $X_b$ is greater than at $X_a$. Thus, the modification results in an operational decision-making process which can be indorporated into an analytical framework.

Decision Process of the Modified Approach

In contrast to the decision process of the multidimensional utility approach, the modified procedure utilizes the minimum satisficing levels of the objectives as decision criteria for selecting the superior alternative courses of action while screening the inferior alternatives. The multidimensional utility approach assumes all alternatives are feasible choices. In the case of all alternatives being infeasible, the modified approach continues with the present operation until the decision-maker chooses to evaluate the courses of action again.

The previous example in Figure 3 can be used to explain the modified decision process. Considering only the dominant goal, net income, alternative C is superior to A, B, D and E but does not meet the minimum satisficing level of the second-ranked objective, leisure time, denoted by $L_m$. Consequently, alternatives A, B, and C are not feasible alternatives. Alternatives D and E are the only courses of action meeting the minimum levels of both goals, $L_m$ and $I_m$. Again, by the selection criterion of choosing the alternative which best meets the dominant goal, E is preferred to D since it produces more net income. Incidentally, it also produces more leisure than D but this is of no consequence in the decision process unless the two alternatives are tied with respect to the dominant goal.

In tied situations, the next non-tied successively lower ranked goal is used as the decision criterion. In Figure 5, a tie with respect to net income is depicted for alternatives D and E. The process of selection again starts with alternative C and finding it inadequate with respect to the minimum leisure hours, alternatives A, B, E and D are evaluated. Alternatives A and B are also found to be infeasible leaving alternatives D and E under consideration. Alternative E is ultimately selected because it provides more of the second-ranked goal, leisure time, than D. Multi-dimensional utility analysis would find the decision-maker indifferent between D and E since no additional utility is gained from E having more leisure time than D.

The previous examples assume that the goals are successively ordered and relevant to the decision maker but the modified procedure also allows flexibility with respect to the relevancy of goals. In Figure 6, assume that some prevailing circumstance deems the leisure time goal as an irrelevant objective with only one minimum satisficing level required on net income, $I_m$. Again, the selection process begins with the alternative which best meets the dominant goal and C is found to be superior to A, B, D and E. The multidimensional utility approach, however, would result in D, E and C being equally preferred by the decision-maker.

## Common Limitations of the Multidimensional and Modified Approaches

Some common limitations of each of the approaches using multiple goals in the decision-making process are:

1. Both assume an established hierarchy of goals and a satisficing level for each prior to the decision process and
2. No specific trade-off criteria are provided for alternative goals in the hierarchy.

Trade-off criteria are difficult to quantify and are probably highly personal. For example, in Figure 6 alternatives C, D, and E provide varying amounts of leisure. Alternative C provides more net

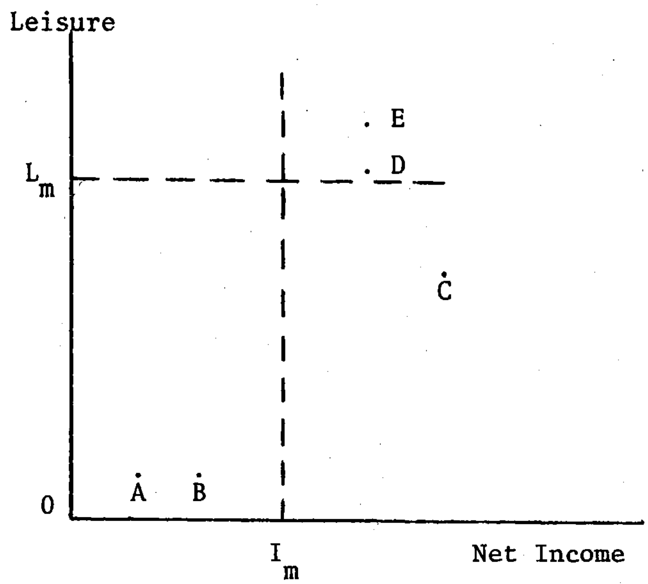


Figure 5. Depiction of Tied Alternatives with Multiple Goals

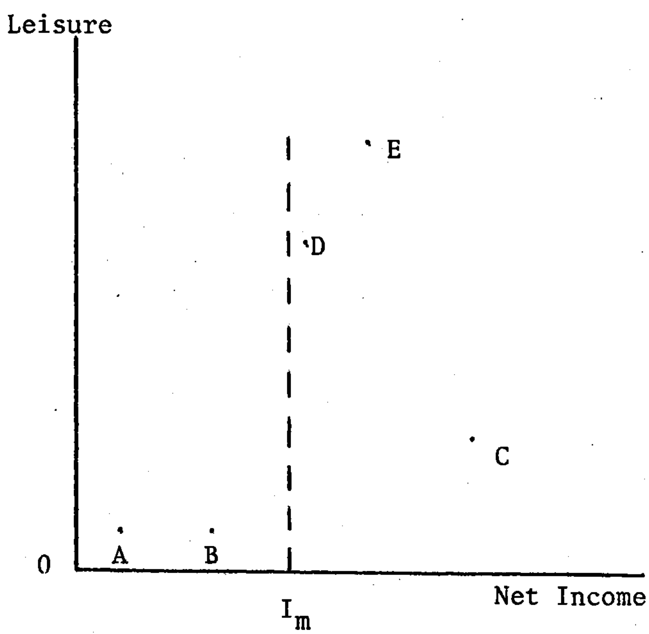


Figure 6. Depiction of the Use of One Goal

income than either D or E but choosing C requires sacrificing leisure time relative to D and E. It is conceivable that the increased leisure of D or E would offset the increased income of C for some individuals but not for others. Reflecting individual trade-off preferences and their complicating dimensions in analytical models would be extremely difficult and require development of individual utility functions. However, the imposition of satisficing levels on each goal inherently affords some reflection of trade-off conditions by rejecting the infeasible alternatives in the decision process.

The modified multidimensional utility approach requires establishing a hierarchy of goals and their minimum satisficing levels. The goals considered in this study, the method of establishing the hierarchy and the means of estimating differences in the hierarchy over time are discussed in detail in the following chapter.

FOOTNOTES

[1]C. E. Ferguson, "The Theory of Multidimensional Utility Analysis in Relation to Multiple-Goal Business Behavior: A Synthesis," Southern Economic Journal, Vol. 32 (1965), pp. 169-175.

[2]William J. Baumol, Economic Theory and Operations Analysis, 2nd Edition (New Jersey: 1965), pp. 295-310.

[3]C. E. Ferguson, pp. 169-175.

[4]Note that disutility from excessive units or super-saturation is not possible in either approach.

# CHAPTER III

## DEVELOPMENT OF THE ANALYTICAL TECHNIQUE

Linear programming is a valuable tool in farm management and firm growth analyses. However, it is limited in cases where multiple goal evaluations are of primary concern. In addition, the complete certainty of events such as yields reduces its desirability when uncertainty is an important aspect of the analysis.

In contrast to the mathematical optimizing techniques such as linear programming, simulation programs are considered more flexible when (a) distinct individibilities or lumpiness features are required, (b) decisions within production periods must be made, (c) non-linearities are encountered, (d) several goals are important both within a period and over the planning horizon and (e) external or non-economic factors are involved in the decision processes of the firm.[1] The additional flexibility of simulation increases the realm of possibilities to evaluate the causes and effects of growth factors. Therefore, it provides more information in regard to the behavioral patterns of firms over time. The added complexities of simulation can also be viewed as disadvantageous since many interrelated variables may provide difficulties in isolating the cause-effect relationships. Although, ambiguous as the interrelationships may be, the additional dimensions that can be incorporated may permit more realistic analyses.

## Simulation

An analytical and operational technique that incorporates the theoretical aspects discussed in the previous chapter should:

(1) include multiple goals in the decision-making process over time and allow the rank of the goals to change over the planning period,

(2) include alternative strategies by which the firm may grow over time, and

(3) provide a decision-making environment consistent with current agricultural conditions.

These three features are required to meet the shortcomings of many of the earlier analyses which evaluated resource adjustments and firm growth over time. Some of the studies and their shortcomings were reviewed in Chapter I.

The advanatages of flexibility and ease of adaptation to individual problems afforded by simulation prompted the use of the general agricultural firm simulator by Hutton and Hinman.[2] It has the essential element of a multiple period capability for accounting purposes. However, it is not a decision model, but is a technique by which instrumental changes in farm characteristics can be made and comparative analyses evaluated. Several adaptations of the basic Hutton-Hinman simulator for use in this study are discussed in the remainder of this chapter. The primary adaptation concerns the multiple goals decision process.

## Selection of Multiple Goals

An objective of this analysis, as indicated earlier, is to develop a framework utilizing multiple goals which may vary in importance as circumstances change over time and to incorporate them into the decision-making process of the firm. While multiple goals are commonly recognized as being important in making business decisions,[3] the use of singular goals such as maximizing profits, net worth or minimizing costs, for example, has been predominant since they are conveniently operational and theoretically consistent. Some objectives have been suggested such as reducing income variability, providing an acceptable family living standard and increasing leisure time.[4] Multiple goals have been incorporated by maximizing or minimizing one of the objectives subject to constraints on others.[5] Utility functions have also been estimated for incorporating expected farm income and the variability of income.[6]

Recent research established a means of ranking eight economically-based goals as a function of farm and operator characteristics.[7] The 1972 study was based on a survey of about 150 farm operators randomly sampled throughout the present study area. The analysis considered goals suggested by previous research efforts and consultation with extension specialists in the area. Pretesting the schedule with farmers in the area aided in reducing a list of twelve sociologic, economic, and agronomic goals to eight economic objectives. The goals eliminated were either difficult to quantify or judged to be of lesser importance. Also, some statements were combined. The resulting goal statements given as choices in the survey were:

1. Control more acreage by renting or buying;
2. Avoid being forced out of business;
3. Maintain or improve family's standard of living;
4. Avoid years of low profits or losses;

5. Increase time off from farming (leisure time);

6. Increase net worth from farm or off-farm investments;

7. Reduce borrowing needs; and

8. Make the most profit each year (net above farm costs).

These goals were selected because they were amenable to quantification in firm growth studies, i.e., each of them could be identified with respect to units of measure such as dollars, acres or hours.

The paired-comparison method[8] was used to rank and scale the goals of each individual after screening the inconsistent responses. The general results indicated "controlling more acres" and "increasing time off from farming" were the least perferred goals by the combined group of respondents. "Making the most profits," "maintaining or increasing family living standards" and "avoiding years of low profits or losses" were the most preferred objectives.

The purpose of the analysis was to identify the farm and operator characteristics associated with differences in the goal hierarchy. The statistical test of the paired-comparison technique did not isolate significant causal factors but another statistical test[9] indicated that age, educational level, years of farming experience, dependents, off-farm income and acres of cropland were highly significant factors associated with hierarchial differences. Other factors such as assets, net worth, size of farm, and livestock production experience were somewhat less significant.

The significant factors were then used as independent variables in developing a regression equation for predicting a scalar value for each objective. The dependent variable in the stepdown regression procedure was the respondent's hierarchy of goals scaled from 0 to 100 for his lowest to highest ranking goals respectively. Seven of the eight equations had F-values significant at the one percent level and the other was significant at the five percent level. The coefficients of multiple determination, $R^2$, varied from 0.173 to 0.561

The analysis indicates that no one of the eight objectives was preferred by a majority of the respondents. However, the goal of "increasing time off from farming" was the one most frequently ranked last of the eight. Thus, the study emphasizes the existence and importance of multiple goals among operators.

Even though a procedure explaining more of the variation in ranking would be desirable, the equations do provide a method of ordering the goals and, more importantly, a perspective of their relative importance by the use of scalar values.[10] The latter feature is important for delineating the primary and secondary groups of decision goals.

### Development of Dominant, Primary, and Secondary Goals

The modified multidimensional utility approach is described in Chapter II. The approach requires delineating a dominant goal and dividing the eight goals into primary and secondary groups. Goals in the primary group are relevant for current decisions whereas the secondary group consists of those goals which are not considered in making decisions at the current time. The goal hierarchy and hence the components of each group are allowed to change based on the firm and family situation in each decision period.

The development of the primary and secondary group is based on both the ordinal ranking and the scalar values. An hypothetical example using four objectives is given in Table II. In this example the objectives are ordinally ranked as follows: #1. maximize profits; #2. increase family consumption; #3. reduce borrowing needs; and #4. increase leisure time. The hypothetical scalar values in column 3 are developed by the regression equations and converted to a common scale of zero to one in the fourth column. The differences in the common scale values are given in column five and the classification of each goal is given in the sixth column.

The headings are self-explanatory except for the predicted and common scalar values. The predicted values in column 3 are obtained from four regression equations utilizing current farm and operator characteristics. These values are converted to a common scale of zero to one in column 4 by the following mathematical expression for k=1,2, ...n goals.

$$CSV_k = \frac{(PSV_k - PSV_n)}{(PSV_1 - PSV_n)} \tag{1}$$

where $CSV_k$ is the common scalar value of the kth goal, $PSV_k$ is the predicted scalar value of each of the $k = 1,2,...n$ regression equations and $PSV_1$ and $PSV_n$ represent the highest and lowest predicted scalar values, respectively.

The goals are grouped into primary or secondary groups by determining the differences between the common scalar values derived by equation (2).

$$\begin{aligned} SD_j &= CSV_k - CSV_{k+1} \\ \text{Subject to: } CSV_k &\geq CSV_{k+1} \\ \text{and } SD_j &\geq 0 \end{aligned} \tag{2}$$

where $SD_j$ is the scalar difference between any two goals for $j = 1,2,$ $\ldots(n-1)$ differences. The common scalar values, $CSV_k$ for $k = 1,2,\ldots n$ goals are ranked such that the k+1 scalar value represents a lower ranked goal than the goal associated with the kth scalar value.

The two largest scalar differences are isolated dividing the list of goals into three parts. Goals ranked in the upper two parts are placed in the primary group and those in the lower part are assigned to the secondary group. In Table II, the two largest absolute differences are 0.471 and 0.353 (column 5). The only goal ranked below the difference of 0.353 is "increase leisure time." Thus it is the only one of secondary importance. Consequently, the hours of leisure afforded by alternative growth strategies are of no consideration in the decision process of selecting among strategies. That is, it has no effect on the choice between alternatives.

## Incorporating Multiple Goals Into the Decision Process

The method of implementing multiple goals in the decision process is based on the premise that alternative strategies for firm growth are available to an entreprenuer at various times over some relevant long-term planning horizon. However, the specific frequency and timeliness of decision periods is unknown and possibly quite variable between entreprenuers.

The basic problems of implementing a decision-making procedure of the previously described nature are twofold: (1) developing logical strategies including an alternative for continuing the current operation, and (2) developing the necessary decision rules for selecting among the alternatives.

TABLE II

HYPOTHETICAL EXAMPLE OF THE SCALAR VALUES, ORDINAL RANK, AND GROUPING OF FOUR OBJECTIVES

| Goal | Ordinal Rank | Scalar Values Predicted (PSV) | Scalar Values Common (CVS) | Scale Difference (SD) | Group Classification |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Maximize Profits | 1 | 95 | 1.0 | -- | Dominant, Primary |
| Increase Family Consumption | 2 | 80 | 0.824 | 0.176 | Primary |
| Reduce Borrowing Needs | 3 | 40 | 0.353 | 0.471 | Primary |
| Increase Leisure Time | 4 | 10 | 0.0 | 0.353 | Secondary |

Generally, alternatives can be categorized as intensive or extensive in nature. Intensive alternatives are considered to be courses of action which may enhance capital accumulation by intensifying the current farm organization but exclude extension of ownership or control of land resources. Intensifying actions may be the development of irrigation, adoption of integrated livestock enterprises utilizing intermediate products or other such strategies. Extensive strategies are then defined as those which extend the entreprenuer's control of additional land resources either by expanding the physical size or by attaining additional land ownership in the current operation.

In the current study, alternatives of purchasing and renting additional acreage as well as releasing rented acreage for purchasing more land are considered to be extensive in nature. Specifically, the four alternatives as numbered in the analysis are:

#1. Continue with the present mode of operation;

#2. Rent additional acreage;

#3. Purchase additional acreage; and

#4. Substitute currently rented acreage with an equivalent amount of purchased land.

These four alternatives are common for operators in the study area. Necessarily, one of the options is to continue with the present operation and the fourth option assumes that sufficient acreage is being rented by the operator for substitution by purchasing an equivalent amount. The latter alternative is not an option under full owernship conditions. With this exception, all alternatives are available to the entreprenuer with a specified frequency and amount of acreage.

The strategies are evaluated at specific times and a selection of one of the alternatives is made by using three decision criteria:

a. The selected strategy best meets the dominant goal;

b. The strategy decision values of all primary goals meet their respective satisficing levels for the chosen alternative; and

c. If all alternatives fail to meet one or more of the satisficing levels, the strategy is to automatically continue with the current operation until such time that the alternatives are reconsidered.

The last criteria is a safeguard to guarantee that, in the case of no feasible alternatives, the firm will continue operating. It reflects unwillingness on the part of the operator to stop operations simply because there is no better alternative. However, it assumes that all alternatives including the possibility of a distinct preference for continuing with the present operation, have been rejected on the basis of one or more inadequate strategy decision values relative to the satisficing levels. It is also presumed that there is little probability in a viable firm of using the latter condition in the decision process.

The following discussion describes the derivation of both the satisficing levels and the strategy decision values for each of the objectives. The goals are accompanied by a number indicating their position in the simulator arrays of satisficing levels and strategy decision values. The goal numbers are used in the remainder of the analysis and discussion of results when a need for brevity exists.

Control More Acres by Renting or Buying, #1

The minimum satisficing level for the goal of controlling more acres is the current physical size of operation in acres. The cropland consisting of irrigated and dryland is added to the native rangeland to give the total land base or size of the firm.

The strategy decision value is the summation of land requirements for all enterprises in the planned organization of each alternative strategy. In the current analysis, plans #2 and #3 of renting and purchasing land, respectively, have the same strategy decision values at any given time. Similarly, the alternatives of continuing the current operation and trading rented land for purchasing an equivalent amount, plans #1 and #4, respectively have the same values but are smaller operations. Thus, if this goal is the dominant objective, an alternative goal of lower rank will be relied on as the selection criterion because of the tie in acreages.

Avoid Being Forced Out of Business, #2

The satisficing level for avoiding liquidation of the firm is a maximum that cannot be exceeded by a plan. It is denoted as the variable SAFE and is defined by Hutton and Hinman as the percentage of equity below which specified loan security requirements must be met. It reflects a maximum debt-asset ratio limit of 0.40 prior to relying on chattle and land equity for securing pending loans.

The strategy decision value is computed by the following formula:

$$\text{STRAT (K, 2)} = [\text{DEBT (1)} + \text{DEBT (2)} + \text{DEBT (3)}] \ / \ \text{YREND} \qquad (3)$$

where STRAT (K, 2) is the value of the kth plan for the second goal in the array;

DEBT (1) = real estate debt outstanding;

DEBT (2) = chattle debt outstanding;

DEBT (3) = debt on open account outstanding; and

YREND = current value of all physical assets but does not include cash-on-hand or a cash deficiency.

The resulting value approximates the current debt-asset ratio. If the value is greater than 0.40 for the kth plan and this objective is in the primary group of goals, the alternative is rejected as a feasible plan. If this goal is dominant, the strategy having the smallest value is selected to minimize the debt-asset ratio of alternative plans.

<u>Maintain or Increase Family Living, #3</u>

The basic minimum value for family living standards is associated with low income standards and is calculated by \$2,720 + \$600 per child up to a maximum of \$5,720 per family.[11] The basic value or standard is replaced by the current consumption, less one standard deviation (\$2,828), if greater than the previous low income standard. The revised value then becomes the minimum satisficing level for selecting a plan. The reduction of a standard deviation allows for variation in consumption between good and poor income periods for example.

The basic family consumption associated with a plan under consideration is estimated using the following equation in hundreds of dollars where applicable:

$$\begin{aligned}\text{TAKOUT} = {} & 36.3714 + 3.2575\ (\text{number of dependents}) \\ & + 0.0863\ (\text{number of dependents} \times \text{off-farm income}) \\ & + 0.0512\ (\text{total income}) - 0.0002\ (\text{total income})^2 \\ & + 0.0032\ (\text{net worth} \times \text{education})\end{aligned}$$

subject to: total income \$128,000.

The function was developed from a random survey of 122 farm operators in the study area. Their estimates of consumption were used as the dependent variable in a multiple linear regression analysis of farm and operator characteristics influencing family consumption levels. The above function was based on total farm income in the 1969-1970 production year. It is necessary to delete graze-out stocker steer receipts from the currently used farm income since this enterprise was of minor importance in the survey period relative to the grazing provisions in the 1972 wheat program assumed in this study.

The function is also modified for total income levels greater than \$128,000; the point at which the marginal propensity to consume from income is equal to zero.

Since only a few respondents reported total income levels above \$120,000 and income is expected to increase as the firm grows, a marginal propensity of .05 with respect to income between \$128,000 and \$300,000 is added to consumption. This rate approximates the marginal propensity of the linear term in the original equation. The revised function for the above range in total income is:

$$\begin{aligned} \text{TAKOUT} = {} & 36.3714 + 3.2575 \text{ (number of dependents)} \\ & + 0.0863 \text{ (number of dependents x off-farm income)} \\ & + 0.0512 \text{ (1280)} - 0.0002 \text{ (1280)}^2 \\ & + 0.0032 \text{ (net worth x education)} + 0.05 \text{ (total income} - \\ & \quad 1280). \end{aligned} \tag{5}$$

subject to: $\$128,000 < \text{total income} \geq \$300,000$.

For income levels greater than \$300,000 a logarithmic term replaces the quadratic term for income. Using only irrigation operations to represent the upper extreme of observed income levels, another regression analysis consisting of the original independent variables in the equation but deleting the quadratic income term indicated a beta coefficient on a logarithmic term of 36.113 significant at the 95 percent level. This modification is then used for estimating consumption by the following:

$$\begin{aligned} \text{TAKOUT} = {} & 36.3714 + 3.2575 \text{ (number of dependents)} \\ & + 0.0863 \text{ (number of dependents x off-farm income)} \\ & + 0.0512 \text{ (total income)} + 36.113 \text{ (log 10 total income)} \\ & + 0.0032 \text{ (net worth x education)} \end{aligned} \tag{6}$$

subject to: total income $>$ \$300,000.

Avoid Years of Low Profits or Losses, #4

The minimum value for avoiding extremely poor years is defined as zero income unless a cash deficiency exists. In the latter case, the minimum level is the interest payment associated with the deficiency, i.e., the cash deficiency multiplied by the interest rate on open loans.

The strategy decision value for each plan is the return to fixed resources less a selected number of standard deviations in the variance of net returns (returns over variable costs). The derivation of the variance of net returns and the strategy decision calculation is given in Appendix C.

To allow a greater degree of variability between irrigated and dryland operations, two levels of specification are available. The first level is used if the proportion of land being irrigated exceeds ten percent and the second for ten percent or less. In the present analysis of irrigated firms, the expected value of net returns less 1.645 standard deviations must be greater than the minimum level before a plan is considered a feasible alternative. However, if the irrigated acreage declines to the ten percent level, 0.674 of a deviation is used.

Increase Leisure Time, #5

The minimum value for leisure time varies by the total acres of a plan: (1) 640 acres, 7 days; (2) 641 to 1279 acres, 10 days; and (3) 1280 acres or more, 14 days. The periodic value is based on the days of leisure time allowed by the selected plan and unlike the other satisficing levels is not a function of the current size of operation. The specific levels were estimated from survey data obtained prior to the analysis.

Each plan's total labor requirements for crop and livestock enterprises are calculated for each of four labor periods and each is multiplied by 1.2 to account for overhead labor use. The requirements are subtracted from the quantity of labor available in each period to estimate leisure hours available. If the hours of leisure are equal to or less than 20 hours for any labor period, no leisure hours are allowed for that period. The number of days is based on an average work day of ten hours such that the number of leisure hours divided by ten represents days available for leisure. The days of leisure must be equal to or greater than the previous minimum stipulated by the plan's size before it is considered a feasible alternative.

Increase Net Worth, #6

The minimum net worth level used for the satisficing value is defined as the current net worth of the firm.

This strategy decision value for each plan is computed as follows:

STRAT (K,6) = TASSET + CASH - DEBT (1) - DEBT (2) - DEBT (3)   (7)

where STRAT (K,6) is the value of the sixth goal for the kth plan;

TASSET = value of all physical assets at the start of the planning year;

CASH = the estimated cash-on-hand after implementing the plan;

DEBT (1) = principal balance of real estate loans;

DEBT (2) = principal balance of chattel loans; and

DEBT (3) = principal balance of open account loans.

For a plan to be feasible, the estimated net worth at the end of the planned production period must be equal to or greater than the current net worth.

## Reduce Borrowing Needs, #7

The maximum satisficing value associated with reducing borrowing needs is the sum of current chattel and open account loans (includes possible refinancing charges). Real estate borrowing is excluded from the estimate because of its long-term repayment schedule.

The strategy decision value for reducing borrowing needs is the summation of intermediate debts, short-term debts, and any cash deficiency where cash deficiency is defined as the cash carryover less one-half the variable costs of the current operation. Plans involving expansion of acreage (#2 and #3) adjust the variable cost estimate by the proportionate increase in acres. If the expected borrowing needs of a plan do not exceed 75 percent of the security value of chattel assets, the strategy decision value is void and set to zero. Thus, there is a possibility of an effective limitation on expansion by this goal only when the expected borrowing needs (excluding real estate) exceed the security value of chattel items. If the goal is dominant, the objective is to minimize the borrowing needs between alternative strategies by selecting the plan which has the least short-term and intermediate debts including cash deficiencies.

Make the Most Annual Profits, #8

The minimum satisficing level for making the most annual profits is zero income. Consequently, a plan having a negative anticipated net return after deducting cash outlays, interest payments and family consumption is disqualified as an alternative for the succeeding production period.

This strategy decision value is defined as:

$$\text{STRAT}(K,8) = \text{TRET} - \text{TCOST} - \sum_{i=1}^{3} (\text{DEBT}(I) - \text{RATE}(I)) - \text{TAKOUT}(8)$$

where STRAT (K,8) is the value of the eighth goal for the kth plan;

TRET = gross farm income;

TCOST = variable costs;

DEBT (I) = principal balance of real estate, chattel and open account loans;

RATE (I) = interest rates for each of the above loans; and

TAKOUT = the family consumption (see previously discussed "maintaining or increasing family living" goal for calculation).

## Validation of the Multiple Goals Decision Process

The previous discussion indicates the basic decision criteria for selecting among alternative strategies as well as the mode in which the multiple goals are grouped and enter the decision-making framework. The basic framework is developed to allow several objectives in any given period to enter the decision process while pursuing alternative dominant objectives through time.

Although no formal validation procedures such as individual farm surveys were conducted to determine how multiple goals enter into the process of making decisions or what the specific decision criteria are, the framework was developed by consulting people associated with farm management and production economics teaching and research. In addition, hypothetical test situations were fabricated to evaluate the response of hierarchal changes to farm and family charactersitics over time. The results of the analysis of sixty situations is also reviewed and evaluated with respect to the multiple goals decision process in Chapter VII.

## A Summary of the Decision Model

A schematic representation of the multiple goal decison process as incorporated in the simulator is given in Figure 7. The process is briefly explained in the frames but a review of the details follows. The first step, indicated in the upper center frame, is to determine the ordinal ranking and scalar values of the goals based on characteristics of the firm by the set of regression equations. The goals are classified as primary or secondary objectives by converting the predicted scalar values to a common scale of zero to one for the lowest to the highest ranked goals, respectively. The dominant goal is the top-ranked objective in the hierarchy.

Alternative courses of action are then evaluated in the first frame of the bottom row and a strategy decision value for each goal is developed in the second frame. The ultimate selection of an alternative

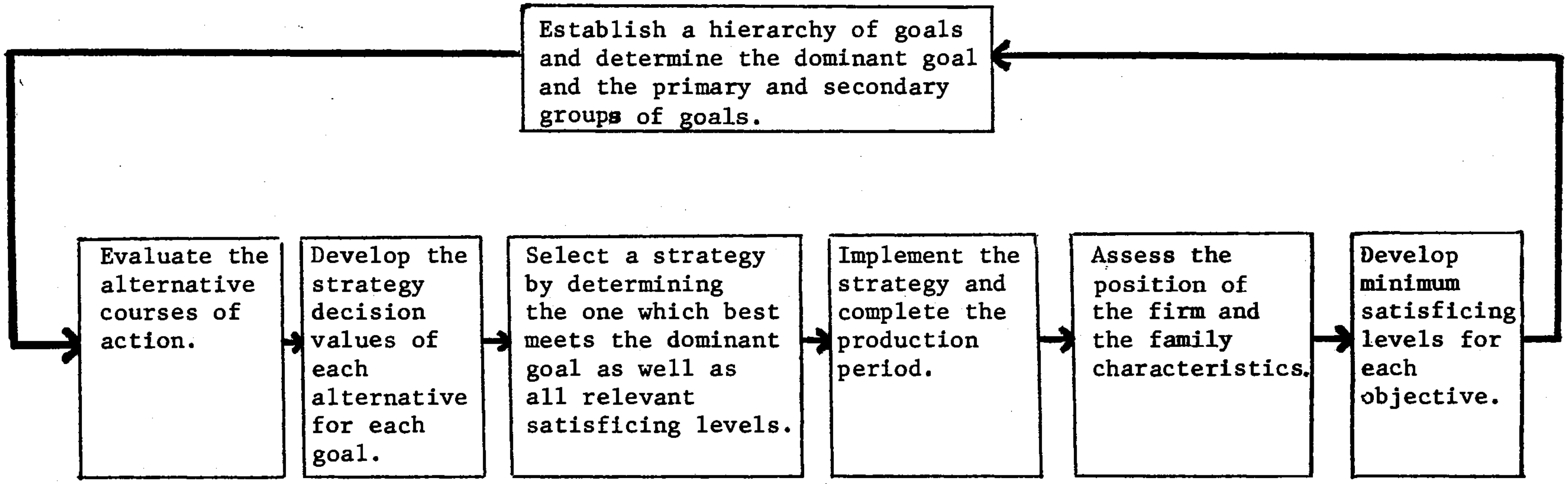


Figure 7. The Decision Model: A Schematic Representation of the Use of Multiple Goals in the Decision-Making Process of Firm Growth

follows the selection of the plan which best meets the dominant goal. Verification of the plans as a feasible alternative is accomplished if all relevant satisficing levels are met. After implementing the selected strategy and operating for the production period, another assessment of the firm and family characteristics is conducted. Based on this assessment, a new set of satisficing levels are established and a hierarchy of goals is developed. This procedure continues throughout the planning horizon under consideration.

Five subroutines are added to the Hutton-Hinman simulator to accomplish the above decision process: GØALS, STRAT, TIE, CHØØSE and UPDATE. The GØALS subroutine estimates a scalar value for each of the eight goals, ranks them and develops a zero-one scale. Only the primary goals are used in making decisions between alternative strategies.

Following the determination of the primary group of decision-making goals, alternative strategies are budgeted (simulated) with expected or average yields and the results are reported for each of four plans in the following order: (1) no change in the firm size (acres); (2) cash rent land; (3) purchase land; and (4) release rented land and purchase an equivalent amount.[12] The STRAT subroutine calculates a strategy decision value for each of the eight goals from the results of each plan.

After all plans are budgeted, the CHØØSE subroutine selects the plan which maximizes or minimizes the dominant goal depending on its nature. If two or more plans are tied with respect to the dominant goal, subroutine TIE evaluates successively lower ranked goals until one of the tied plans maximizes (minimizes) the first non-tied or alternative dominant goal in the hierarchy. The checking procedure is again performed in regard to the satisficing levels. Subroutine UPDATE then permanently revises the organization according to the selected plan and the next production period is simulated. The following discussion relates the basic logic of the similation program and particular features important to the decision process.

## Basic Logic of the Simulator

The basic logic of the simulator follows the Hutton-Hinman general agricultural firm simulator. The logic and data requirements are discussed in Agricultural Production Systems Simulation hereafter referred to as the APSS booklet.[13] The following discussion reviews the logic and table formats briefly but the user should become familiar with the more complete and detailed version prior to use.

The purpose of the simulator is to represent a farm business as it is operated over time. First, an initial set of data is introduced representing enterprises and resources of the firm. Input-output coefficients are read into a two-dimensional array in which columns represent the enterprises and rows the resources used by or products resulting from the enterprises. The first part of the array, first table, includes the rows used as resources or productive services and the second part, second table, includes the rows representing products. Intermediate products are represented by rows having the same name in each of the tables. If the expected or average output coefficients are to be modified by stochastic variability, two additional arrays in the fourth and fifth tables specify the deviations in output by enterprise and the limit to the number of deviations desired respectively. There is no provision for input variability. In addition, product price variations and trends may be specified in the second table.

Data in the third and sixth tables involve the original inventory of capital assets. Characteristics such as the type of capital, age, depreciable life, replacement costs, the category of credit the asset will secure and the units of service provided are read as data. User options include specifying "lumpy" quantities of purchases and rentals, purchase and rental price trends, quantity discounts, property and real estate taxes, insurance costs, repair costs and sale of excess input services.

The organizational enterprise levels are communicated in the first part of the seventh table and purchase or sale of items in the latter part. The last table indicates the financial structure of the firm. Included are three classes of debt and their respective security requirements, interest rates and specified payments. The initial cash-on-hand, the minimum periodic cash requirement, family consumption and outside earnings are also communicated. Other items regarding the periods to be simulated, the mode of analysis (stochastic or deterministic) and the limit to the debt-asset ratio plus other miscellaneous items are also specified.

After establishing the initial organization data, seven basic steps are performed for each period in the following order:

1. The capital management operations involving (a) prepayment of new borrowing and existing debts, (b) determination of annual depreciation, (c) automatic adjustments in debts and annual payments, and (d) updating the age and number of items in inventory;

2. The determination of activity input requirements;
3. The determination of activity output by deterministic or stochastic specification although only deterministic yields are used in the current study;
4. The determination of input supplies available from inventory;
5. The determination of excess or insufficient supplies of inputs and the respective sale or purchases required to balance the needs with supplies (intermediate products are also involved in inventory balances);
6. The financial accounting operations in which prices and and costs, after trends and variation are included, are multiplied by their appropriate products and services to arrive at the conventional cash flow items; and
7. A summary is printed consisting of: (a) the quantities supplied and used; purchased or sold; and cost or revenues of inventory items; (b) the quantities produced and gross revenue from production; and (c) the financial summary of net worth, income and expenses and other miscellaneous items.

If single periods are simulated, a check for replications is performed after each period and after all replications are performed, the successive period can be simulated with the original input data. This process continues until all periods are simulated.

If multiple-period runs are simulated, it may be necessary to revise the organization in some way prior to the completion of the analysis. This may be accomplished in one run by stipulating the years to be simulated prior to the revision, storing the results on "history" file and recalling them following the revisions. However, this involves complete certainty on the part of the user as to the time and amount of change required at the point of interruption. For example, if an equipment item is fully depreciated in the nth year, after the n periods are simulated part two of the seventh table would be revised to purchase the item and n simulations would be repeated.

There may be other situations, depending on the problem, in which a user may require special decision rules. Some of these are embodied in the growth process of a firm and it may be necessary to revise the logic to make these decisions inherent to the program. The discussion presented hereafter involves suggestions for additional decision rules and revisions in logic to formulate a growth simulator.

## Logic Revisions and Additions

With few exceptions, the data input and table format of the Hutton-Hinman simulator is used for the current firm growth simulator. The scope of the current simulation technique to implement a decision-making process over time based on an hierarchy of eight quantifiable goals. These goals, in turn, affect the growth path of the firm by selecting one of several alternative plans at specific intervals over the planning horizon.

To implement a decision-making process based on multiple goals, several modifications of and additions to the basic logic are necessary:

1. An external data file is used for communicating (a) exogenous family and operator characteristics, (b) the

basic farm organization over time, (c) the variances and covariances of crop enterprises and (d) the periodic cost of irrigation water;

2. A feature of automatically replacing depreciated machinery items is incorporated;
3. A feature of purchasing additional equipment items as requirements increase with size is included;
4. Prepayment of debts and cash purchases are related to cash on hand;
5. Levels of fixed resources are automatically revised with expansion;
6. Selected parameters regarding the frequency and amount of expansion and irrigation development are communicated;
7. Livestock programs are related to grazing availability and livstock requirements; and
8. Periodic family consumption patterns are related to the status of the organization.

The External Data File. The external data file consists of four groups of data: (a) operator and family characteristics, (b) farm organization data, (c) variances and covariances of grain and pasture activities and (d) the periodic cost of irrigation water. The first group of data communicates five basic family and operator characteristics over time; the age, farming experience and educational attainment in years for the operator and his number of dependents and the family's expected off-farm income earnings. These characteristics are exogenous variables used in the equations for estimating the hierarchy of goals.

The farm organization may also be changed following the base period. The periodic level of each enterprise is communicated in the same order, as the activities are input in the first two tables.[14] The periodic levels of land resources, i.e., irrigated, dryland and native range may also be revised.[15] The periodic cost of irrigation water is also provided.

In addition, the goal of "avoiding years of low profits or losses" involves estimating the variance of net returns. Thus, there is need for specific variance and covariance specification between crop yields and between grazing yields. However, there is no provision for covariances between crop yields and grazing yields because of the limited data file. The variance in net returns is estimated by using product prices for grain and rental rates for grazing. The procedure for calculating the variation in net returns is given in Appendix C. The correlation coefficients are given in Appendix C, Table LXXIV and the variances and covariances in Table LXXVIII.

Automatic Machinery Purchases. A major revision in logic concerns the automatic replacement of fully depreciated machinery and the automatic purchase of machinery as requirements increase with size. To minimize the computer storage requirements, additional machinery items are assumed to be purchased at the same age status of the original item. However, there must be at least 20 percent utilization before an item will be added to inventory. Therefore, it is suggested that custom rate expenses for each operation be included since the machinery item may be used but not purchased and added to the inventory. This revision negates the necessity of specifying equipment purchases in the seventh table of the input data.

Prepayment of Debts. Another revision negates specifying prepayment of debts. The change assumes that, for any period, cash in excess of minimum cash requirements[16] will be used initially for new borrowing in the order of open account, chattel and real estate. Secondly, if excess cash remains, existing debts will be paid in the same priority. The order of payment assumes that it is economical to pay open account loans having the same or higher interest rate than chattel loans and the latter will have the same or higher interest rate than real estate loans.

A major limitation is that excess funds may be exhausted by new borrowing prior to prepayment of an existing debt having a higher interest rate, i.e., using excess cash for a new low interest real estate loan before prepaying an existing chattel debt having a higher interest rate.

Additional Resources. Another revision involves the original compaction feature of the inventory array. The avility to compact the inventory array has been removed to facilitate revising the basic set of resources as expansion occurs. In particular, the labor availability, land resources, cows and machinery items may vary in quantity according to the physical size of the organization.

Irrigation Development. There is also a major revision concerning the number of parameter cards. Prior to the four required by the general agricultural firm simulator, another card is added to indicate the rate of irrigation development, whether irrigation is terminated during the multiperiod run and, if so, in what period.[17] These parameters control the purchase, replacement and salvaging or irrigation facilities in the CAPTAL subroutine.

It should be noted that the parameter values are constant for all periods of each analysis but if changes are desired between analyses, they may be changed by revising the data as indicated by the APSS booklet.[18]

Other Features. Some new features regarding the use of the simulator are also added:

1. A consumption function estimates family withdrawals for each plan and each production period following the base period;[19]
2. The automatic adjustment of steer numbers to small grain pasture availability;
3. The automatic purchase of cows in expansion strategies resulting from increased expectations of range availability;
4. The automatic sale of cows if the expected range availability only provides for one-half or less of the herd requirements;
5. The flexibility to add a price cycle or other form of price structure over time through an automatic periodic revision of a specific input item;[20]
6. The flexibility to replace an inventory item with three other items of equivalent life at the appropriate time intervals such as replacing one tractor with successively larger and more expensive tractors;[21] and
7. The automatic adjustment of minimum cash requirements following the base period.

Summary of Revisions

The discussion in this chapter emphasizes the changes in logic and the additional features added to the Hutton-Hinman general agricultural firm simulator necessary to incorporate the multiple-goal decision-making procedure. There are several key parameters which must be specified prior to the analysis: (a) the number of standard deviations to be deducted from the expected income of each plan for evaluating the minimum level of returns to fixed resources which can be expected with $\alpha$ probability, (b) the number of acres available for expansion through renting or buying, (c) the frequency with which alternative strategies are to be evaluated following the base period, and (d) the time interval of irrigation and rate of well drilling. It should also by emphasized that two levels of probability are to be specified: the first for irrigated operations and the second for dryland units.

A complete delineation of the basic and future farm organization data used in the present analysis is discussed later. Prior to developing these items and the input-output relationships, financial characteristics, and other miscellaneous items, an analysis of the expected farm organization with declining water resources is conducted for the purpose of delineating the beginning irrigation status and intertemporal farm organization. These estimates are necessary for specifying the external data file components of the farm enterprises and land resource mixes for each period of the planning horizon.

FOOTNOTES

[1] George D. Irwin, "A Comparative Review of Some Firm Growth Models," Agricultural Economics Research, Vol. 20, No. 3 (July, 1968), p. 94.

[2] R. F. Hutton and H. R. Hinman, A General Agricultural Firm Simulator, Revised, Pennsylvania Agriculture Experiment Station, Bulletin No. 72 (July, 1969).

[3] William J. Baumol, Economic Theory and Operations Analysis, 2nd Edition (New Jersey, 1965), pp. 295-310 and R. M. Cyert and J. G. March, A Behavioral Theory of the Firm, (Englewood Cliffs, 1963).

[4] George F. Patrick and Ludwig M. Eisgruber, "The Impact of Managerial Ability and Capital Structure on Growth of the Farm Firm," American Journal of Agricultural Economics, Vol. 50, No. 3 (August, 1968), p. 494.

[5] J. R. Martin and J. S. Plaxico, Polyperiod Analysis of Growth and Capital Accumulation of Farms in the Rolling Plains of Oklahoma and Texas, USDA Technical Bulletin 1381 (September, 1967), and Vernon R. Eidman, Harold O. Carter and Gerald W. Dean, Decision Models for California Turkey Growers, Giannini Foundation Monograph No. 21 (July, 1968).

[6] R. R. Officer and A. N. Halter, "Utility Analysis in a Practical Setting," American Journal of Agricultural Economics, Vol. 50 (1968), pp. 257-277.

[7] Wyatte L. Harman, Roy E. Hatch, Vernon R. Eidman and P. L. Claypool, An Evaluation of Factors Affecting the Hierarchy of Multiple Goals, Oklahoma Agriculture Experiment Station Technical Bulletin T-134 (June, 1972).

[8] L. L. Thurston and E. J. Clave, The Measurement of Attitude (Chocago, 1929); F. Mosteller, "Remarks on the Method of Paired Comparisons: I. The Least Squares Solution Assuming Equal Standard Deviations and Equal Correlations," Psychometrika, Vol. 16 (1951), pp. 3-9; and Ronald D. Krenz, "Paired Comparisons as Applied to Seeding Cropland to Grass," Journal of Farm Economics, Vol. 46, No. 5 (December 1964), pp. 1219-1226.

[9] Darrell R. Bock and Lyle V. Jones, The Measurement of Prediction of Judgment and Choice (San Francisco, 1968), pp. 208-211.

[10]Other procedures are the Guttman scale analysis which only divides responses into favorable-unfavorable attitudinal groups and Kendall's rank correlation method which provides an ordinal ranking of items but no perspective as to their relative importance to each other. See M. G. Kendall, Rank Correlation Methods, 3rd Edition (New York, 1962) and L. A. Guttman, "A Basis for Scaling Qualitative Data," American Sociological Review, Vol. 9 (April, 1944), pp. 139-150.

[11]Family Assistance Act of 1970 (Washington, D.C., June 1970), p. 42.

[12]The parameter LØNG indicates the level of expansion acres by renting or buying, i.e., 320 acres in the present analysis. The results from each plan are indicated by a message immediately following the problem title and prior to the purchase or sale of assets. If a message does not appear, the results following the problem title are for an actual period of production.

[13]R. F. Hutton, "Introduction to Simulation," Agricultural Production Systems Simulation, V. R. Eidman (ed.), Oklahoma State University, 1971.

[14]The table formats are standardized so that the first seventeen activities use irrigated cropland, the next three use dryland and the twenty-first uses range. The next two activities use rows 9 and 12 respectively and the last or twenty-fourth activity uses row 7.

[15]The levels are specified in the respective order of irrigated cropland, dryland and native range. The first and sixth tables are formatted to include the revised levels in the respective rows 8, 5 and 6.

[16]After the base period, the minimum cash requirements are assumed to be one-half the variable costs (TCØST) less the total purchase cost of columns 22 and 23 of the first table.

[17]If irrigation terminates during the planning horizon under consideration, place a "1" in columns 1 and 2 for the parameter QUITIR. Indicate the period of termination by the parameter YRQUIT in columns 3 and 4. The next three columns 5-7 are used for the additional well drilling activity indicated by the number to be drilled per year for the parameter DRL.

[18]Refer to discussion on pages 45-50 and the data listing in Appendix E, ApSS booklet.

[19]The base period's family withdrawal is specified in the last table of input data.

[20]The input item must be that in row 16 of the third table of input data and the price structure over time is communicated by the external data file.

[21]The item in inventory to be replaced must be that in row 17 and the replacements are specified in rows 18-20 of the third table.

# CHAPTER IV

## AN EVALUATION OF WATER RESOURCE ADJUSTMENTS OVER TIME WITH DIMINISHING WATER SUPPLIES

Prior to evaluating the effects of selected factors on firm growth, it is necessary to establish both the length of the planning horizon and the representative farms with which the analysis is concerned. A planning horizon of twenty years is selected for three primary reasons: (a) it is of sufficient length to evaluate most of the effects of a declining water supply in selected water situations; (b) it is of sufficient length to evaluate the effects of a multi-objective decision-making process with alternating dominant goals upon the growth of firms and, (c) it provides sufficient time to meet all of the present land and machinery financial commitments and most of the planned financial requirements for developing and maintaining irrigation facilities. However, it is recognized that the reliability of expected input-output relationships, absolute price levels, relative price relationships and the estimate of future irrigation development diminishes with the length of period under consideration. Selection of a shorter time frame would improve the reliability of coefficients used but would provide less information on the effects of a declining water supply and the multi-objective decision process on firm growth.

The delineation of representative hydrologic conditions is basic to the analysis of water resource adjustments and to the establishment of representative farm organizations over time. The following discussion describes the selected water situations, their hydrologic characteristics, the analysis of water resource adjustments over time and the expected economic life of the water supply situations. The resulting farm organizations over time in the selected hydrologic situations are the basis for delineating the representative farm organizations in the following chapter.

## The Selection of Hydrologic Situations and Modal Farms

Several situations identified by varying hydrologic conditions are given in Appendix A, Table LIII. They are identified by combinations of depth-to-water and saturated thickness intervals. Based on the hydrologic characteristics and the proportions of the study area represented, three water situations are selected to initially represent low, moderate and high water supply conditions. The former has a relatively thin saturated zone of about 75 feet; the moderate situation has 250 feet and the highest condition has an initial saturated thickness of 450 feet.

The type of farming operation influences the depletion rate of the underground water supply. Intensive irrigated crop farms are found in all three water situations as well as relatively extensive ranching operations in the thinner saturated areas. Both types of operations (crop farm and ranch) are evaluated in the 75-foot saturated situation. The crop farm is characterized by the 75-foot depth-to-water (50' to 100') category whereas the irrigated ranch is assumed to have a depth-to-water of 25 feet. They represent 7.35 and 4.39 percent of the study area respectively. The third situation has an average of 250 feet saturated thickness with 175 feet depth-to-water and represents 7.17 percent of the area. The fourth is characterized by 450 feet saturated thickness and 125 feet depth-to-water and represents 2.68 percent of the area. The latter two situations involve primarily crop farming operations. The four situations represent over one-fifth of the study area. The selected water supply conditions will be referred to hereafter as the "Class A" water situation for the 75-foot saturated aquifer, "Class B" for the 250-foot situation and "Class C" for the 450-foot category.

The modal crop farm consists of 1,280 acres of land of which 1,120 acres is cropland and 160 acres is range. The modal ranch situation is larger and consists of more rangeland: 7,040 acres of land with 4,800 acres of range and 2,240 acres of cropland. The distribution of crops on the intensive crop farm is assumed to consist of 65 percent feed grains and 35 percent wheat or small grains. Specifically, there are 620 acres of grain sorghum, 108 acres of corn for grain and 392 acres of wheat. The irrigated ranch has doubled acreages of each crop since it has twice the cropland acreage. The wheat limitation is not restrictive if feed grain acreage is converted to wheat.

Enterprises included as choices by which profits may be maximized include irrigated corn for grain and both dryland and irrigated grain sorghum, wheat for grain and small grain grazing. Four levels of irrigation are available for corn, wheat and small grain grazing and five for grain sorghum. The specific application rates per acre are given in Table V. They apply to furrow irrigation on clay loam soils. Other resources available include operator labor of 578 hours for the period of March through May, 530 hours for June and July, 468 for August and September and 1,059 for October through February. Additional labor needs can be hired for $2.50 per hour. Operating capital requirements are charged eight percent interest but no limitation on the amount that can be borrowed is imposed. The existing irrigation facilities including wells, engines, pumps, and distribution systems bear annual depreciation charges with the exception of existing holes which are assumed to be sunk costs.

Compliance with the 1972 farm program is assumed for both wheat and feed grain. The supported wheat base on the crop farm is 15,240 bushels and feed grain base 17,686.2 bushels. The wheat certificate is $1.62 per bushel on the base yield whereas the feed grain price support of $0.385 per bushel applies to one-half the base. To obtain these support payments, 383.6 acres are set-aside acres but can be used for small grain grazing activity. In addition, 75 percent of the domestic wheat allotment or 315 acres and ten percent of the feed grain allotment, 14 acres, may be set-aside for additional payments of $0.94 and $0.495 per bushel respectively. Payments are based on a wheat yield of 32.4 bushels per acre and a feed grain yield of 126.33 bushels per acre. The irrigated ranch supported base and set-aside acres are twice the crop farm because of the doubled cropland acreage.

## Determining the Optimum Resource Adjustments and Economic Life of the Water Situations

The optimum adjustment to the declining water supply provides the basis for projecting the future farm organization. The adjustments over time are important from two viewpoints: (1) the varying irrigated dryland acreage ratio influences the stream of net farm income from irrigation operations and, (2) the profitability of enterprises influences the economic life of the selected water situations. The stream of net income and the economic life of the selected water situations. The stream of net income and the economic life of the selected water situations, in turn, affect the capital accumulation process of the firm and its economic viability over the planning horizon. Thus, it is necessary to have the optimal farm organization for each period throughout the planning horizon to evaluate the growth potential of the firm in the simulation framework.

Linear programming is used for analyzing the resource adjustments and economic life of the water resources in the selected situations. A linear programming model is developed for each of the four hydrologic and type-of-farming situations. Thus, four basic linear programming models are used: three for the irrigated crop farms in each of the three water situations and one for the irrigated ranch in the "Class A" water situation. An example of the tableau is in Appendix A, Table LIV.

## The Methodological Approach

The evaluation of resource adjustments with a declining water supply is a recursive process in the sense that future enterprise mixes are functionally related to past water extraction rates and additional development. Given an objective of obtaining a farm organization over time which will result in a rapid capital accumulation, the objective of the linear programming analysis is to make the most annual profits given the limited availability of water for irrigated enterprises. In essence, land and water are assumed to be the limiting resources.

Specifically, acreage restrictions are imposed on cropland, grain sorghum, corn and wheat unless feed grains are transferred to wheat. Seasonal water restrictions are imposed by limiting the number of irrigation wells and from recirculating up to 25 percent of the seasonal water use.

To evaluate the recursive process of estimating the varying enterprise mix over time as the water supply diminishes, an option termed "PARARIM" in the MPS/360 system is utilized. This process simultaneously adjusts an objective function element and a row limit. In the current problem, as the static water level declines, the cost per unit of water increases and the well capacity declines in periods following the penetration of the water-beraing formation by the pump. Although the functional relationship of well capacity to time may be nonlinear, linear approximations can be made for restricted intervals without introducing a large bias into the resulting enterprise mix. This is possible since the mix is primarily sensitive to water availability rather than the cost of pumping water. However, this estimating procedure requires a priori knowledge of the periodic changes in the objective function element or cost per unit of water and the row limit or seasonal availability of water.

To arrive at preliminary estimates of the water cost per unit in relation to the declining well capacity over time, a Fortran program written and developed for this specific purpose was utilized.[1] The program develops cost estimates based on the engine size, pump size and hydrologic conditions. As the pump is lowered or the capacity parameter revised downward the above program automatically adjusts the pumping lift and necessary facilities to the revised status and recomputes a new cost estimate. Having a method of relating the hydrologic conditions and the required irrigation facilities to the pumping cost per unit of water leaves one primary variable to be estimated over time: the well capacity.

Estimates of periodic well capacities in relation to incremental declines in the static water level can be made by the following calculation:

$$GPM_{t+i} = (GPM_t) \cdot (ST_{t+i} \div ST_t)^2 \tag{1}$$

The estimated well capacity, $GPM_{t+i}$, is measured in terms of gallons per minute for the ith period following some period t when pumps are located within 50 feet of the bottom of the aquifer and are considered to penetrate the aquifer. Thus, $GPM_t$ is well capacity in period t assuming the pump is no more than 50 feet above the bottom of the aquifer. $ST_t$ is the remaining saturated thickness in feet in period t. $ST_{t+i}$ is the saturated thickness in the period for which the estimated well capacity is being calculated.

Prior to the time period t, well capacity can be maintained by lowering the pump. During this period, there is only a relatively small decline in capacity in the time intervals between pump adjustments. Thus it is assumed that the originally developed well capacity is constant and equal to $GPM_t$ until the pump is lowered within 50 feet of the bottom of the water-bearing formation.

The above procedure also requires an estimate of the reduction in the saturated thickness from the period t to the ith period under consideration. The current saturated thickness, $ST_{t+i}$, can be estimated by determining the decline coefficient for the farm such that:

$$DC = \frac{1 \text{ acre-foot}}{0.15\ N} \tag{2}$$

and

$$ST_{t+i} = ST_{t+(i-1)} - [(DC) \cdot (TW_{t+(i-1)})] \tag{3}$$

where N = number of acres in the farm or ranch, 0.15 represents the assumed specific yield of the formation and $TW_{t+(i-1)}$ is the total water (acre-feet) pumped in the previous period. The decline coefficient, DC, represents the decline of the static water level in feet when one acre-foot is extracted from an underground formation of N surface acres containing 15 percent water by volume.[2]

Assuming an upper limit on the available pumping hours per year, the relationship between well yields and time is nonlinear. This results from the inability to extract equivalent amounts of water per period as the well capacity declines. As an example, the dashed curve in Figure 8 depicts the well yield over time as the static water level declines. The accompanying data is in Table III. Using a decline coefficient of .005208 for the modal crop farm and a 2,000 hour annual pumping season for each of two wells for twenty years, the annual water use declines from about 737 acre-feet to 240 acre-feet. The annual water use is estimated by:

$$TW_{t+i} = \left[\frac{(GPM_{t+i})(W)}{452.6}\right] (APS) \div 12 \tag{4}$$

where W is the number of wells, APS is the annual pumping season in hours and 452.6 is a coefficient for converting gallons per minute to acre-inches per hour. Since $TW_{t+i}$ is the annual estimate of water use in acre-feet, it is necessary to divide the acre-inches by 12 inches per foot.

If each year is recursively evaluated, the estimated well capacity follows the dashed curve of Figure 7. Using linear approximations of

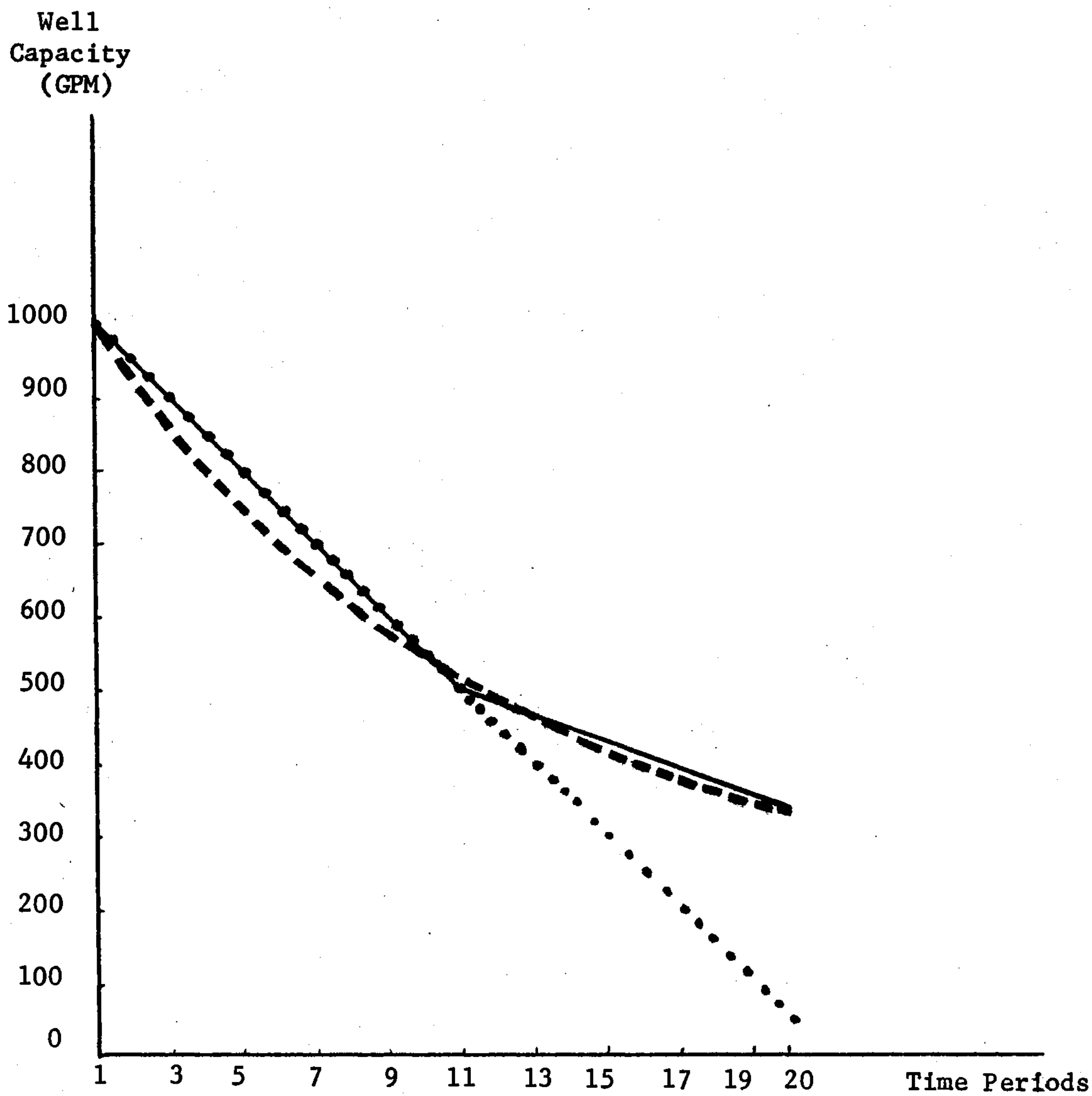


Figure 8. Hypothetical Example of Bias in Well Capacity Estimating Procedure

TABLE III

HYPOTHETICAL EXAMPLE OF THE RELATIONSHIP OF WELL CAPACITY TO TIME WITH A DECLINING WATER SUPPLY

| Time Period | Saturated Thickness | Well Capacity | Periodic Water Use [a] | Static Water Level Decline |
|---|---|---|---|---|
| | (feet) | (gpm) | (acre-feet) | (feet) |
| 1 | 100 | 1,000 | 736.7 | 3.84 |
| 2 | 96.16 | 925 | 681.7 | 3.55 |
| 3 | 92.61 | 858 | 631.7 | 3.29 |
| 4 | 89.32 | 798 | 588.3 | 3.06 |
| 5 | 86.26 | 744 | 548.3 | 2.86 |
| 6 | 83.40 | 696 | 512.5 | 2.67 |
| 7 | 80.73 | 652 | 480.0 | 2.50 |
| 8 | 78.23 | 612 | 450.0 | 2.34 |
| 9 | 75.89 | 576 | 424.2 | 2.21 |
| 10 | 73.68 | 543 | 400.0 | 2.08 |
| 11 | 71.60 | 513 | 378.3 | 1.97 |
| 12 | 69.63 | 485 | 356.7 | 1.86 |
| 13 | 67.77 | 459 | 338.3 | 1.76 |
| 14 | 66.01 | 436 | 321.7 | 1.68 |
| 15 | 64.33 | 414 | 305.0 | 1.59 |
| 16 | 62.74 | 394 | 290.0 | 1.51 |
| 17 | 61.23 | 375 | 276.7 | 1.44 |
| 18 | 59.79 | 357 | 263.3 | 1.37 |
| 19 | 58.42 | 341 | 251.7 | 1.31 |
| 20 | 57.11 | 326 | 240.0 | 1.25 |

[a]Assuming an upper limit of 2,000 pumping hours annually for each of two wells.

the curve introduces some bias, but results in significant savings in both time and computer costs. The solid linearly-segmented line in Figure 7 illustrates the type of bias introduced by using linear approximations of the decline curve. Generally, the periodic well capacity estimated by the linear approximations is slightly higher than the period-by-period recursive process given by the dashed curve.

However, in the current analysis, the bias is minimized by allowing further irrigation development. The intensification of irrigation increases the annual use rate if additional wells are profitable. Therefore the annual decline rate of the static water level increases relative to no additional development. The contrast with no additional development is seen in the comparison of the dotted line to the dashed curve.

Assuming a constant annual pumping rate over the twenty-year period, the decline in well capacity is linear. Thus, there is no bias in the estimating procedure if the annual decline in the static water level remains constant over the time period under consideration, i.e., no difference between the dotted line and the first linear segment of the solid line occurs for periods one through 11 nor would any bias be introduced by estimating periods 12 through 20.

In the present analysis, the rate of development may be sufficiently restrictive causing the decline in well capacity to be slightly curvilinear but the bias is minimal. Thus, the resulting optimum enterprise mix of irrigated and dryland crops is a close approximation and is sufficiently reliable to estimate the farm organization and the water resource adjustments over time.

Assumptions of the Analysis

The critical assumptions regarding water resource adjustments over time involve input prices, output prices and input-output coefficients as well as the expected rate of irrigation development. Other assumptions are also involved but these are most pertinent for estimating the periodic enterprise levels. The types of enterprises and their levels, in turn, influence the net farm income stream over the planning horizon.

Table IV relates selected input and product prices assumed in the linear programming evaluation of water resource adjustments. The yields per acre associated with specific irrigation and fertilizer rates and the net returns avove variable costs are given in the following Table V. The input prices and grazing receipts reflect prevailing prices of the 1970-1971 period and the product prices for grain reflect prevailing price support levels. The enterprise budgets, input-output relationships and prices were developed for the study area by updating existing budgets and conferring with extension and experiment station personnel familiar with the area.[3]

The second major assumption concerns the current status and the future development of irrigation. Since the study area is not intensively developed with respect to irrigation and drilling in continuing at a rapid pace, it is necessary to appraise the current status of irrigation in the study area and estimate a projected rate of development.

A survey was conducted in the summer of 1970 to obtain an estimate of the current irrigation practices, facilities, well yields and variable costs. The survey sites were non-random and predetermined by the use of geologic maps of the underground formation prior to the survey. The selected surveying of specific sites facilitated an appraisal of the

TABLE IV

SUMMARY OF SELECTED INPUT AND PRODUCT PRICES BY CROP ENTERPRISE

| Item | Crop | Unit | Price Per Unit |
|---|---|---|---|
| Inputs:[a] | | | |
| Seed | Grain sorghum | cwt. | $24.00 |
| | Corn | cwt. | $47.00 |
| | Wheat for grain | bu. | $ 2.50 |
| | Small grain pasture | bu. | $ 1.75 |
| Mixed Fertilizer | Corn | lb. | $ .10 |
| Nitrogen | All crops | lb. | $ .05 |
| Ammonium Nitrate | Dryland wheat | lb. | $ .08 |
| Phosphate | Corn | lb. | $ .08 |
| Herbicide | Corn and sorghum | ac. | $ 5.63 |
| Insecticide | Corn | ac. | $ 7.07 |
| Insecticide | Grain sorghum | ac. | $ 1.85 |
| Labor | All crops | hr. | $ 2.50 |
| FOLR[b] | All crops | ac. | -- |
| Products: | | | |
| Grain | Grain sorghum | cwt. | $ 1.75 |
| | Corn | bu. | $ 1.10 |
| | Wheat for grain | bu. | $ 1.25 |
| Grazing | Wheat for grain and small grain pasture | aum. | $ 8.00 |

[a] No irrigation cost is given since it varies between water situations and increases over time.

[b] Fuel, oil, lubrication and repairs per acre vary by enterprise.

TABLE V

SUMMARY OF NET RETURNS AND YIELDS ASSOCIATED WITH IRRIGATION AND FERTILIZER RATES BY CROP ENTERPRISE[a]

| Crop | Level of Irrigation | Level of Fertilization | Yield Per Acre | Net Returns Above Specified Costs[b] |
|---|---|---|---|---|
| | (ac. in.) | (lbs.) | --- | (dollars) |
| Grain Sorghum | 0.0 | 0 | 1,000 lbs. | 5.21 |
| | 7.0 | 30[c] | 2,000 lbs. | 6.45 |
| | 12.0 | 60[d] | 3,500 lbs. | 29.34 |
| | 16.5 | 100[d] | 5,000 lbs. | 48.22 |
| | 20.5 | 100[d] and 25[e] | 6,000 lbs. | 58.65 |
| | 24 | 125[d] and 25[e] | 6,500 lbs. | 63.52 |
| Corn | 16.5 | 50[d], 50[e] and 10[f] | 80 bu. | 26.94 |
| | 20.5 | 50[d],100[e] and 20[f] | 110 bu. | 50.87 |
| | 24.0 | 50[d],150[e] and 40[f] | 130 bu. | 64.27 |
| | 27.0 | 50[d],200[e] and 60[f] | 145 bu. | 72.08 |
| Wheat for Grain | 0.0 | 15[c] | 12 bu. | 7.06 |
| | 7.0 | 25[d] | 20 bu. | 9.34 |
| | 12.0 | 35[d] | 35 bu. | 25.17 |
| | 16.5 | 60[d] | 45 bu. | 37.86 |
| | 20.5 | 80[d] | 55 bu. | 48.39 |
| Small Grain Pasture | 0.0 | 0.0 | 1.60 aum. | 7.65 |
| | 7.0 | 15[c] | 2.00 aum. | 6.02 |
| | 12.0 | 40[d] | 2.80 aum. | 8.98 |
| | 16.5 | 60[d] | 3.50 aum. | 12.05 |
| | 20.5 | 80[d] | 4.50 aum. | 18.38 |

[a]Enterprise alternatives are limited to those commonly found in the study area.

[b]Does not include a charge for capital, irrigation or fixed resources such as land, machinery and irrigation equipment.

[c]ammonium nitrate

[d]anhydrous ammonia

[e]mixed dry fertilizer

[f]phosphate

differences between saturated thickness intervals. The primary use of this survey data in the current analysis of water resource adjustments is to evaluate common irrigation practices, estimate the current well yields and determine the current status of development on farms in the selected thickness intervals.

The survey results indicated an average of approximately 2.5 wells per farm for saturated thickness intervals less than 300 feet and 1.75 for over 300 feet. The estimated well capacities by saturated thickness interval ranged from approximately 400 to over 1,000 gallons per minute as the saturated thickness increased from less than 100 feet to over 400 feet, respectively.

Estimating the future rate of development is also critical to the analysis. As was indicated earlier, the rate of further intensification influences the rate of decline in the static water level and thereby the estimated well capacity. Records for six counties from the northern High Plains Water District in the northern Texas panhandle indicate an increase of 1,103 wells for the 1967-1972 period.[4] Thus, there were about 220 wells drilled per year or approximately .21 wells drilled per farm (using the 1969 census estimate of 1,041 irrigated farms).[5] The annual rates vary from a high of about .31 wells per farm in 1969 to a low of .16 in 1970.

Data from the survey of irrigated farms provided estimates of the number and capacity of wells in each water situation. Initial well yields are 400 gallons per minute for "Class A" water, 750 for "Class B" and 1,000 for "Class C." Three wells are in existence for the crop farm in the "Class A" and "B" water situations and two in "Class C." The irrigated ranch in "Class A" water is assumed to have six wells since it has twice as much cropland as the crop farm. The future rate of development for all units is one well per five years or an average of .2 per year.

<u>Results of the Analysis</u>

The results of each of the four linear programming models are given in Tables VI to IX. In general, the optimal irrigation strategy is to intensify irrigation development up to the imposed limit of one additional well per five-year period. The optimum irrigation practice is to irrigate corn, grain sorghum, wheat and small grain pasture acreages with maximum application rates until either summer or spring seasonal water restrictions are limiting. If the total feed grain acreage of corn and sorghum is not irrigated due to a summer water limitation, the remaining acreage is transferred to wheat or small grain pasture and is irrigated to the limit of spring water availability. The remaining dryland crop acres, if any, are utilized for dryland small grain pasture.

Specifically, results in Table VI of the modal crop farm in the 'Class A" water situation indicate that nearly two additional wells are needed by the tenth period or the time of breakover to opportunity dryland returns from small grain grazing of $50,733.[6] The variable pumping cost per acre-foot ranges from a low of $6.48 to $13.79. The irrigated acreage declines from 38 percent of the cropland to 26 percent over the ten-year period. It declines by about 132 acres; from about 425 acres in the first period to nearly 293 acres in the tenth period. Conversely dryland acreage increases from 695 to 827 acres over the same period. The decline in irrigated acreage is a result of summer seasonal water limitations on grain sorghum and spring limitations on wheat. Irrigated

TABLE VI

SUMMARY OF WATER RESOURCE ADJUSTMENTS OF THE "CLASS A", CROP FARM IRRIGATED SITUATION

| Irrigation Situation and Period | Net Farm Income | Wells | Water Use | Variable Cost per Acre-Foot | Grain Sorghum, P + 4 | Corn, P + 5 | Wheat for Grain, P + 3 | Grazed Small Grains, Dryland | Grazed Small Grains, P + 3 | Additional Set-Aside Acreage | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Wheat | Fd.Gr. |
| | (dol.) | (no.) | (ac.ft.) | (dol.) | (acres) | | | | | | |
| 1 | 65,853 | 3.00 | 675.81 | 6.48 | 87.12 | 108 | 212.28 | 694.48 | 18.12 | 315 | 14 |
| 2 | 64,993 | 3.18 | 648.19 | 7.18 | 79.07 | 108 | 220.33 | 712.60 | - | 315 | 14 |
| 3 | 63,844 | 3.40 | 630.16 | 7.87 | 73.82 | 108 | 213.76 | 724.42 | - | 315 | 14 |
| 4 | 62,648 | 3.60 | 607.33 | 8.57 | 67.17 | 108 | 205.44 | 739.39 | - | 315 | 14 |
| 5 | 61,490 | 3.80 | 584.51 | 9.26 | 60.52 | 108 | 197.12 | 754.36 | - | 315 | 14 |
| 6 | 60,371 | 4.00 | 561.68 | 9.96 | 53.86 | 108 | 188.80 | 769.34 | - | 315 | 14 |
| 7 | 59,289 | 4.20 | 538.86 | 10.66 | 47.21 | 108 | 180.48 | 784.31 | - | 315 | 14 |
| 8 | 58,223 | 4.40 | 516.03 | 11.35 | 40.56 | 108 | 172.16 | 799.28 | - | 315 | 14 |
| 9 | 52,914 | 4.60 | 506.23 | 12.30 | 33.22 | 108 | 163.02 | 815.76 | - | 315 | 14 |
| 10 | 51,639 | 4.80 | 487.98 | 13.79 | 28.07 | 108 | 156.59 | 827.33 | - | 315 | 14 |
| 11-20 | 50,733 | - | - | - | - | - | - | 1,120.00 | - | 315 | 14 |

TABLE VII

SUMMARY OF WATER RESOURCE ADJUSTMENTS OF THE "CLASS A," IRRIGATED RANCH SITUATION

| Irrigation Situation and Period | Net Farm Income | Wells | Water Use | Variable Cost per Acre-Foot | Grain Sorghum, P + 4 | Corn, P + 5 | Wheat for Grain, P + 3 | Grazed Small Grains, Dryland | Grazed Small Grains, P + 3 | Additional Set-Aside Acreage: Wheat | Additional Set-Aside Acreage: Fd.Gr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ranch | (dol.) | (no.) | (ac.ft.) | (dol.) | (acres) | | | | | | |
| 1 | 142,345 | 6.00 | 1394.82 | 5.88 | 174.24 | 216 | 424.56 | 1388.96 | 36.24 | 630 | 28 |
| 2 | 141,769 | 6.20 | 1393.11 | 6.12 | 173.76 | 216 | 425.04 | 1390.04 | 35.16 | 630 | 28 |
| 3 | 141,194 | 6.40 | 1391.41 | 6.37 | 173.28 | 216 | 425.52 | 1391.12 | 34.08 | 630 | 28 |
| 4 | 140,620 | 6.60 | 1389.71 | 6.61 | 172.80 | 216 | 426.00 | 1392.20 | 33.00 | 630 | 28 |
| 5 | 140,047 | 6.80 | 1388.01 | 6.85 | 172.32 | 216 | 426.48 | 1393.28 | 31.92 | 630 | 28 |
| 6 | 139,474 | 7.00 | 1386.31 | 7.10 | 171.84 | 216 | 426.96 | 1394.36 | 30.84 | 630 | 28 |
| 7 | 138,903 | 7.20 | 1384.61 | 7.34 | 171.36 | 216 | 427.44 | 1395.44 | 29.76 | 630 | 28 |
| 8 | 137,783 | 7.40 | 1382.91 | 7.83 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 9 | 137,225 | 7.61 | 1382.91 | 8.07 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 10 | 136,668 | 7.82 | 1382.91 | 8.32 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 11 | 136,111 | 8.02 | 1382.91 | 8.56 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 12 | 135,554 | 8.23 | 1382.91 | 8.80 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 13 | 134,997 | 8.44 | 1382.91 | 9.05 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 14 | 134,440 | 8.65 | 1382.91 | 9.29 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 15 | 133,882 | 8.86 | 1382.91 | 9.53 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 16 | 133,325 | 9.06 | 1382.91 | 9.78 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 17 | 132,768 | 9.27 | 1382.91 | 10.02 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 18 | 132,211 | 9.48 | 1382.91 | 10.26 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 19 | 131,654 | 9.69 | 1382.91 | 10.51 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |
| 20 | 131,097 | 9.90 | 1382.91 | 10.75 | 158.13 | 216 | 440.67 | 1425.20 | - | 630 | 28 |

TABLE VIII

SUMMARY OF WATER RESOURCE ADJUSTMENTS OF THE "CLASS B," CROP FARM IRRIGATED SITUATION

| Irrigation Situation and Period | Net Farm Income | Wells | Water Use | Variable Cost Per Acre-Foot | Grain Sorghum, P + 4 | Corn, P + 5 | Wheat for Grain, P + 3 | Grazed Small Grains, Dryland | Grazed Small Grains, P + 3 | Additional Set-Aside Acreage: Wheat | Additional Set-Aside Acreage: Fd.Gr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (dol.) | (no.) | (ac.ft.) | (dol.) | ---------- | ---------- | ---------- | (acres) | ---------- | ---------- | ---------- |
| 1 | 67,276 | 3.00 | 1,255.95 | 6.06 | 248.40 | 108 | 51.00 | 331.6 | 381.00 | 315.00 | 14 |
| 2 | 67,123 | 3.20 | 1,336.77 | 6.20 | 271.44 | 108 | 27.96 | 279.76 | 432.84 | 315.00 | 14 |
| 3 | 66,944 | 3.40 | 1,417.59 | 6.34 | 294.48 | 108 | 4.92 | 227.92 | 484.68 | 315.00 | 14 |
| 4 | 66,685 | 3.60 | 1,498.41 | 6.48 | 317.52 | 108 | - | 176.08 | 518.40 | 296.88 | 14 |
| 5 | 66,384 | 3.80 | 1,579.23 | 6.62 | 340.56 | 108 | - | 124.24 | 547.20 | 273.84 | 14 |
| 6 | 66,057 | 4.00 | 1,660.05 | 6.76 | 363.60 | 108 | - | 72.40 | 576.00 | 250.80 | 14 |
| 7 | 65,703 | 4.20 | 1,740.87 | 6.90 | 386.64 | 108 | - | 20.56 | 604.80 | 227.76 | 14 |
| 8 | 65,378 | 4.28 | 1,772.92 | 7.04 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 9 | 65,085 | 4.28 | 1,772.92 | 7.18 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 10 | 64,791 | 4.28 | 1,772.92 | 7.32 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 11 | 56,600 | 4.28 | 1,710.92 | 7.38 | 395.86 | 108 | - | 78.47 | 537.67 | 218.54 | 14 |
| 12 | 56,130 | 4.28 | 898.97 | 7.67 | 371.22 | 108 | - | 640.78 | - | 243.18 | 14 |
| 13 | 55,693 | 4.28 | 854.29 | 7.96 | 346.58 | 108 | - | 665.42 | - | 267.82 | 14 |
| 14 | 55,285 | 4.28 | 809.63 | 8.24 | 321.94 | 108 | - | 690.06 | - | 292.46 | 14 |
| 15 | 54,893 | 4.28 | 768.15 | 8.53 | 297.30 | 108 | 2.10 | 712.60 | - | 315.00 | 14 |
| 16 | 54,392 | 4.28 | 759.04 | 8.82 | 272.66 | 108 | 26.74 | 712.60 | - | 315.00 | 14 |
| 17 | 53,895 | 4.28 | 753.27 | 9.11 | 248.02 | 108 | 51.38 | 712.60 | - | 315.00 | 14 |
| 18 | 53,403 | 4.28 | 745.82 | 9.40 | 223.38 | 108 | 76.02 | 712.60 | - | 315.00 | 14 |
| 19 | 52,914 | 4.28 | 738.38 | 9.68 | 198.74 | 108 | 100.66 | 712.60 | - | 315.00 | 14 |
| 20 | 52,429 | 4.28 | 730.94 | 9.97 | 174.10 | 108 | 125.30 | 712.60 | - | 315.00 | 14 |

TABLE IX

SUMMARY OF WATER RESOURCE ADJUSTMENTS OF THE "CLASS C," CROP FARM IRRIGATED SITUATION

| Irrigation Situation and Period | Net Farm Income | Wells | Water Use | Variable Cost Per Acre-Foot | Grain Sorghum, P + 4 | Corn, P + 5 | Wheat for Grain, P + 3 | Grazed Small Grains, Dryland | Grazed Small Grains, P + 3 | Additional Set-Aside Acreage Wheat | Additional Set-Aside Acreage Fd.Gr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Crop farm | (dol.) | (no.) | (ac.ft.) | (dol.) | (acres) | | | | | | |
| 1 | 66,223 | 2.0 | 1,097.25 | 6.18 | 210.00 | 108 | 89.4 | 418.00 | 294.60 | 315.00 | 14 |
| 2 | 66,160 | 2.2 | 1,202.61 | 6.29 | 240.72 | 108 | 58.68 | 348.88 | 363.72 | 315.00 | 14 |
| 3 | 66,068 | 2.4 | 1,307.97 | 6.39 | 271.44 | 108 | 27.96 | 279.76 | 432.84 | 315.00 | 14 |
| 4 | 65,942 | 2.6 | 1,413.33 | 6.50 | 302.16 | 108 | - | 210.64 | 499.20 | 312.24 | 14 |
| 5 | 65,706 | 2.8 | 1,518.69 | 6.61 | 332.88 | 108 | - | 141.52 | 537.60 | 281.52 | 14 |
| 6 | 65,443 | 3.0 | 1,624.05 | 6.71 | 363.60 | 108 | - | 72.40 | 576.00 | 250.80 | 14 |
| 7 | 65,152 | 3.2 | 1,729.41 | 6.82 | 394.32 | 108 | - | 3.28 | 614.40 | 220.08 | 14 |
| 8 | 64,937 | 3.21 | 1,734.41 | 6.93 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 9 | 64,702 | 3.21 | 1,734.41 | 7.03 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 10 | 64,511 | 3.21 | 1,734.41 | 7.14 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 11 | 64,320 | 3.21 | 1,734.41 | 7.25 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 12 | 64,150 | 3.21 | 1,734.41 | 7.35 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 13 | 63,956 | 3.21 | 1,734.41 | 7.46 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 14 | 63,765 | 3.21 | 1,734.41 | 7.57 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 15 | 63,574 | 3.21 | 1,734.41 | 7.68 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 16 | 63,401 | 3.21 | 1,734.41 | 7.78 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 17 | 63,210 | 3.21 | 1,734.41 | 7.89 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 18 | 63,019 | 3.21 | 1,734.41 | 8.00 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 19 | 62,846 | 3.21 | 1,734.41 | 8.10 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |
| 20 | 62,673 | 3.21 | 1,734.41 | 8.21 | 395.78 | 108 | - | - | 616.22 | 218.62 | 14 |

corn acreage does not decline and there is no irrigated small grain pasture after the first period.

The periodic reductions in irrigated sorghum and wheat acreage are absorbed by dryland small grain pasture. The irrigated acreage reduction is accompanied by periodic reductions in total water use; from about 676 acre-feet in the first period to nearly 488 acre-feet in the tenth period.

Net income, the return over variable costs and annual depreciation on irrigation facilities is affected by both the decline in irrigated acreage and the increase in irrigation costs. Over the ten-year period of irrigation, net income declines from $65,853 to $51,639; or an average of about $1,421 per year.

The results of analyzing the same water situation under ranch conditions and a shallower depth-to-water are given in Table VII, the primary result is that the larger proportion of contributing rangeland to the surface acres significantly reduces the periodic decline in the static water level relative to the intensive crop farm situation. The decline coefficient per acre-foot pumped for the ranch is .000947 as compared to the crop farm coefficient of .005208. Therefore, the economic life is extended to the full twenty-year planning horizon versus the ten-year life of the crop farm.

Generally the optimum irrigated enterprises over time of the ranch are similar to the crop farm situation except for the absolute acreage levels. The primary difference is that irrigated acreage is maintained from year eight through twenty by drilling additional wells. In the case of the crop farm, the limited drilling of .2 wells per year could not maintain irrigated acreage.

Net income again declined primarily, in this case, as a result of increases in variable pumping costs. The variable cost per acre-foot is $5.88 in the first period and increases to $10.75 in the last period. The first seven periods indicate both a decrease in irrigated acreage and an increase in irrigation variable cost. Thereafter, the irrigated acreage is constant but the variable cost per acre-foot increases. Net income decreases from $142,345 in the first year to $131,097 in the last, an average reduction of approximately $562 per year. Since the twentieth period net income exceeds the dryland opportunity returns of $101,466, the breakover point has not been reached and the economic life of the water supply exceeds the twenty year planning horizon.

The results of the "Class B" water situation, Table VIII, are for a crop farm situation. Like the "Class A" crop farm, three wells are in existence in the first period but they each have an estimated capacity of 750 gallons per minute as compared to 400 for the previous situation. The relatively thicker saturated thickness of 250 feet as compared to 75 feet in the "Class A" water situation facilitates maintenance of well yields until pumps are lowered within 50 feet of the bottom of the aquifer.

The first ten years of irrigation indicate an increase in irrigated acreage of nearly 332 acres as additional wells are drilled and well yields are maintained by lowering pumps. All cropland is irrigated by the eighth year and continues to be irrigated until the pumps reach the maximum depth in the eleventh period. Irrigated acreage then declines until the fifteenth period. Afterwards, irrigated acreage remains constant but only by substituting irrigated grain sorghum with wheat since additional well drilling activity is less profitable than the substitution alternative. Another factor causing this substitution is the fulfilling of the maximum wheat set-aside requirements.

Previously, the discussion related that the irrigated enterprise levels are primarily quantity sensitive in contrast to being price sensitive. An exception occurs in the twelfth period when all irrigated small grain pasture is terminated and immediately replaced by dryland small grain pasture. The cost of water in conjunction with the additional labor and other input charges causes the irrigated small grain pasture to be less profitable than dryland.

Another difference in this situation involves meeting the additional set-aside acreage requirements over time. In contrast to the "Class A" water situation which met the minimum participation levels as well as the maximum additional level of set-aside acreage for all the periods, the "Class B" water situation reduces the additional set-aside acreage of wheat as total irrigated acreage increases over the first eleven periods. As irrigated acreage decreases in succeeding years, the additional set-aside on wheat increases to the limit and eventually irrigated wheat returns to the optimum solution by substituting it for the decline in summer irrigated acreage.

The net income again declines over the planning horizon from $67,276 to $52,429 or about $742 per year on the average. However, during the intensive development periods one to ten, when well yields are maintained, net income only declines $2,485 to $249 per period. Thereafter when well yields are declining and it is unprofitable to drill additional wells, net income declines $12,362 or $1,236 per period. The opportunity dryland returns are being rapidly approached by the twentieth period but the economic life of the water supply is over 20 years.

The "Class C" water situation has sufficient saturated thickness to maintain well yields by lowering pumps over a longer period than the "Class B" situation. In essence, all of the cropland is fully irrigated by the eighth period and the fully irrigated organization is maintained for the remainder of the planning horizon (Table IX). Again, the additional set-aside acreage is reduced as irrigation development intensifies.

Net income declines from $66,223 to $62,673 over the twenty-year period or an average of $178 per year. Given the opportunity dryland returns of $50,733, several additional years of profitable irrigation can be expected beyond the twenty-year horizon.

## Summary of the Water Resource Adjustments

The water resources adjustment analysis evaluated three diverse hydrologic conditions ranging from 75 to 450 feet of saturated thickness. Two types of farm were also evaluated: an intensive crop farm of 1,280 acres consisting of over 90 percent cropland and an irrigated ranch of 7,040 acres consisting of 32 percent cropland. The crop farm situation was analyzed for the three water situations whereas the ranch situation was evaluated for only the thinnest aquifer of 75 feet.

Generally, the results indicate that the irrigated acreage levels of grain sorghum are sensitive to the summer seasonal water limitation with irrigated corn commanding the summer irrigation water prior to irrigating grain sorghum. The spring limitation restricts irrigated wheat and small grain grazing acreage when in competition with preplant applications of summer crops. Excess cropland not utilized for irrigation purposes is used for dryland small grain grazing.

Wheat and feed grain program payments for additional set-aside acreage over the minimum participation requirements are included in the model. In all cases, the additional wheat set-aside acreage is almost eliminated when irrigation is developed sufficiently to permit the substitution of more profitable crop production activities. However, when the residual dryland acreage is sufficient, the maximum additional wheat set-aside acreage is met. The feed grain additional set-aside acreage is met for all situations in each period and is not affected by irrigation activities.

The comparative effects of the initial water conditions are evaluated with respect to both the stream of farm income over time and the expected economic life of the water supplies. "Class A" water with 75 feet thickness under crop farming conditions has an economic life of ten years but under ranching conditions over twenty years. The primary difference arises because of the initially assumed intensity of irrigation development; the crop farm has three wells on 1,280 surface acres whereas the ranch has six wells on 7,040 acres. The intensity affects the decline in the static water level as water is extracted over time.

The "Class B" and "C" situations with 250 and 450 feet of saturated thickness, respectively, are able to irrigate profitably for the twenty-year period. The primary differences being that no reductions in well capacities occur in "Class C" whereas they are encountered in the latter half of the period of the "B" water situation.

FOOTNOTES

[1]The program was developed by Ronald Schaffer in conjunction with Dr. Vernon R. Eidman. For an explanation of the program, see Solomon Bekure, "An Economic Analysis of the INtertemporal Allocation of Ground Water in the Central Ogallala Formation" (unpub. Ph.D. dissertation, Oklahoma State University, 1971), pp. 206-210.

[2]The following hypothetical example relates the estimation process for one period. Assume the previously discussed modal farm of 1,280 acres pumped 1,000 acre-feet in the previous period, $TW_{t+(i-1)}$, from two wells ans $ST_t$ of 100 feet. Consider, also, that the previous period was the first period in which the entire aquifer was being utilized such that $ST_t = ST_{t+(i-1)} = 100$ feet. The decline coefficient, DC, is .005208 by equation (2) and the saturated thickness for the next period, $ST_{t+1}$ is 94.79 feet by equation (3). The estimated well capacity for the ith or first period according to equation (1) is 899 gallons per minute if $GPM_t$ is assumed to be 1,000 gallons per minute. Consequently, the periodic decline is 5.21 feet and each well capacity is estimated to decline by approximately 100 gallons per minute.

[3]The input-output relationships rely primarily on the current enterprise budgets provided by the budget generator system at Oklahoma State University, Department of Agricultural Economics, Stillwater, Oklahoma.

[4]See North Plains Water News, Vol. 13, 14, 15 and 16, quarterly publication of the North Plains Water Conservation District.

[5]U. S. Department of Commerce, Bureau of Census, 1969 Census of Agriculture, Vol., Parts 21, 36, 37 and 41 (U. S. Government Printing Office, Washington, D.C., 1967).

[6]The opportunity dryland returns are based on the normative or optimal dryland farm consisting of small grain grazing. In reality, there may be more diversification under dryland farming conditions than indicated.

# CHAPTER V

# THE REPRESENTATIVE FARM SITUATIONS

The previous discussion presented the expected water resource adjustments and the economic life of selected hydrologic situations with diminishing water supply conditions. The results of the preliminary analysis provide a basis for projecting the future periodic enterprise mixes and the proportionate change in the irrigated-dryland acreage ratio over time. Both factors influence the firm's ability to accumulate capital and gain net worth over the planning horizon. While the previous analysis was based on a modal size of crop farm and ranch, the ability to grow in net worth may also be influenced by the current size of operation and current land equity in the operation. Capital accumulation may also be influenced by the family consumption requirements. Thus, the current age of operator with specified family characteristics may affect the growth potential of the firm. The following discussion indicates the initial hydrologic conditions, the current size of operation, the beginning land equity position and the current age of the operator for the representative situations to be analyzed.

## Characteristics of Representative Situations

The factors or characteristics used as a basis for differentiating between representative situations include the three previously discussed water situations, three beginning sizes of irrigated crop farms and one size of ranch, three starting land equity positions and two initial ages of operators. The three water situations have been delineated but, as a review, they are based on various saturated thickness categories of 75 feet for the "Class A" water situation, 250 feet for "Class B" and 450 feet for the "Class C" situation. The following discussion emphasizes the beginning selected sizes, land equity positions and ages of operators.

## Selected Sizes

The three beginning sizes of irrigated crop farms are based on the frequency distribution of farms contacted in the 1970 survey. A summary of the characteristics by size category for crop farms and irrigated ranches is given in Table X. Generally, the representative crop farms of 640, 1,600 and 2,880 acres used in this analysis are consistent with the average farm size of each of the categories. Minor differences occur for the purpose of equating representative sizes with common blocks of land in multiples of 80 or 160 acres. For the same reason, cropland acreages are slightly different. The 640-acre crop farm has 560 acres of cropland, 1,600-acre operation has 1,440 cropland acres and the 2,880-acre unit has 2,680 acres of cropland. The percentage of cropland to the total operation varies from 87.5 to 93 percent as compared to the range of 87 to 93 percent for the three size categories of farms surveyed. The crop farm situations will be referred to hereafter as I, II and III for the respective 640, 1,600 and 2,880-acre operations.

The representative ranch situation differs to a greater extent from the average surveyed ranch data than the crop farms. The range in

TABLE X

A SUMMARY OF THE CHARACTERISTICS OF SURVEYED IRRIGATED FARMS AND RANCHES, SOUTH CENTRAL PLAINS[a]

| Item | Unit | Crop Farm: Less than 960 | Crop Farm: 961 to 2,240 | Crop Farm: 2,241 to 3,520[f] | Ranch: over 2,241 |
|---|---|---|---|---|---|
| Size of Operation | acres | 586 | 1,591 | 2,878 | 6,331 |
| Cropland | acres | 512 | 1,388 | 2,668 | 1,496 |
| Percent Cropland | percent | 87 | 87 | 93 | 24 |
| Cropland Owned | percent | 36 | 36 | 39 | 40 |
| Land Owned | percent | 37 | 44 | 57 | 57 |
| Cropland Irrigated | percent | 68 | 44 | 51 | 44 |
| Assets | dollars | 97,166 | 173,600 | 381,100 | 479,833 |
| Debts | dollars | 20,030 | 43,570 | 116,800 | 138,250 |
| Percent Debts of Assets | percent | 21 | 35 | 31 | 29 |
| Age of Operator | number | 47 | 44 | 45 | 48 |
| Tenure status: | | | | | |
| Full Owners[c] | percent | 25 | 15 | 44 | 33 |
| Part Owners[d] | percent | 33 | 60 | 56 | 50 |
| Renters[e] | percent | 42 | 25 | -- | 17 |
| Number of Observations | number | 24 | 20 | 9 | 12 |

[a]Data compiled from randomly sampled farms of 50 acres or more excluding dryland operations in the study area. Physical, financial and age-of-operator characteristics are averages of the observations in the size category.

[b]A ranch has 50 percent or more of the operation in rangeland.

[c]Full owners have over 80 percent ownership of land resources.

[d]Part owners have 80 percent or less ownership of land resources but excludes no ownership.

[e]Renters have no land ownership.

[f]Excludes four large operations having much lower cropland and irrigated acreage percentages.

size of irrigated ranches in the survey varied from 2,720 to 12,600 acres with four having less than 3,520 acres and eight over 3,520. Because of the high degree of variability, a modal unit of 7,040 acres with 2,240 acres cropland is used to represent the irrigated ranches in the area.

## Land Equity Situations

The selected land equity situations are broadly categorized into full owners, part owners and renters. For the purposes of this analysis, the respective terminology communicates the extent of land ownership in the beginning period only. The full owner begin with ownership of all land in the operation whereas the part owner only owns one-half of the land and the renter owns none. The tenure status or land equity of an operator, as is also the case in the size of operation, may change over the planning horizon, i.e., just as a 640-acre farm may expand to a larger size, a renter may become a part owner or full owner of land resources over the period under consideration.

Referring again to Table X, the tenure status of the surveyed crop farm operators, indicates a trend away from renters and a trend toward part ownership as firms increase in size. However, all three land equity positions are analyzed for each representative size of firm for evaluating the combined effects of beginning size and tenure on firm growth.

## Operator Age

Two initial operator ages of 25 and 45 years are selected for comparative evaluation of family consumption patterns on the multiple goals decision process in firm growth. The ages of operators by size categories (Table X) in the survey indicate no apparent relationship or age to size. However, the average age of surveyed operators in 1970 including dryland operators was 47 years whereas operators having irrigated operations only averaged 46 years. The 1969 Census of Agriculture reports an average age of over 49 years and ten years earlier, in the 1959 census, the average age of operators was 48 years for the counties in the study area.[1]

The frequency distribution of operators in the 1969 Census of Agriculture indicates about 36 percent below the age of 35 and 64 percent 35 years of age or older. The extreme age brackets indicate only about three percent below age 25 and approximately 13 percent 65 years of age or older. About one-third of the operators were reported in the 25 to 44 age bracket and nearly one-half in the 45 to 64 age bracket.

The selected initial ages of 25 and 45 used in the current analysis give inclusive age profiles of the predominant age groups in the study area. The selection of these starting ages are also amenable to the twenty-year planning horizon since the 45 year-of-age operator approaches retirement age at the end of the planning period.

## Summary of the Representative Situations

The combinations of the selected characteristics regarding water situations, farm size, tenure status and age-of-operators result in sixty situations to be simulated and analyzed. The schematic structure of the situations to be analyzed is given in Figure 9. A common structural framework is evaluated for each crop farm situation involving the three classes of water situations, land equity positions and two age profiles. The irrigated ranch is analyzed for only the "Class A" water

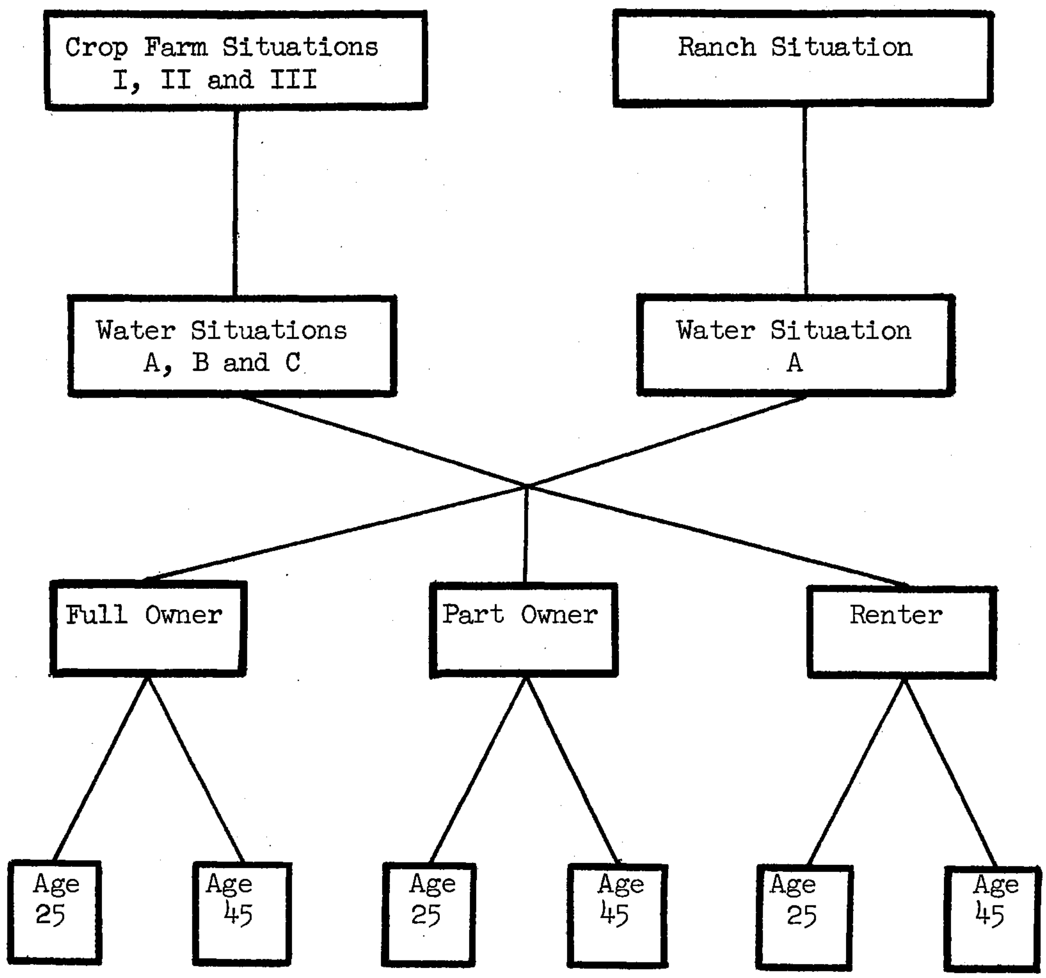


Figure 9. A General Schematic Representation of Selected Characteristics to be Simulated for Representative Crop Farm and Ranch Situations

situation but for each of the equity positions and age profiles.

## The Physical and Financial Characteristics of the Representative Situations

The physical and financial characteristics of the representative situations vary by each of the previously discussed factors. Since it is necessary to differentiate between the current or beginning status of each situation and the future organization, the immediate discussion describes the beginning status of both the physical and financial characteristics of the firms. Thereafter, the future farm and operator characteristics used in the external data file for communicating the basic organizational framework are developed.

The beginning status of the basic representative situations is given in Tables XI to XIV. Table XI gives the characteristics of the base period for Farm I, the 640-acre unit, by land equity and water resource situations. Table XII and Table XIII give the initial status for Farm II and Farm III respectively. The irrigated ranch characteristics are given in Table XIV.

Generally, the physical characteristics are represented by three water situations in conjunction with the size. Thus, the initial irrigated acreage is functionally related to the previous analysis of water use over time by adjusting the number of wells used on the previously assumed modal farm to the representative size of operation and the water situation under consideration. For example, the modal crop farm of 1,280 acres in the analysis of water resource adjustments started with three wells for water situations "A" and "B' and two for "Class C" water. The 640-acre unit begins with two wells for "Class A' and "B"

TABLE XI

REPRESENTATIVE FARM I STARTING SITUATIONS WITH SPECIFIED IRRIGATION DEVELOPMENT AND LAND OWNERSHIP CONDITIONS, SOUTH CENTRAL PLAINS[a]

| Item | Land Ownership Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Full Owner[b] | | | Part Owner[c] | | | Renter[d] | | |
| | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] |
| **Land Specifications:** | | | | | | | | | |
| Land Operated | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 |
| Cropland | 560 | 560 | 560 | 560 | 560 | 560 | 560 | 560 | 560 |
| Range | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| Land Owned | 640 | 640 | 640 | 320 | 320 | 320 | --- | --- | --- |
| Cropland | 560 | 560 | 560 | 280 | 280 | 280 | --- | --- | --- |
| Range | 80 | 80 | 80 | 40 | 40 | 40 | --- | --- | --- |
| Land Rented | --- | --- | --- | 320 | 320 | 320 | 640 | 640 | 640 |
| Cropland | --- | --- | --- | 280 | 280 | 280 | 560 | 560 | 560 |
| Range | --- | --- | --- | 40 | 40 | 40 | 80 | 80 | 80 |
| **Crop Enterprises:** | | | | | | | | | |
| Dryland Acres | 276 | 33 | 208 | 276 | 33 | 208 | 276 | 33 | 208 |
| Small Grain Graze-out | 276 | 33 | 208 | 276 | 33 | 208 | 276 | 33 | 208 |
| Irrigated Acres | 284 | 527 | 352 | 284 | 527 | 352 | 284 | 527 | 352 |
| Corn | 72 | 72 | 54 | 72 | 72 | 54 | 72 | 72 | 54 |
| Grain Sorghum | 58 | 166 | 105 | 58 | 166 | 105 | 58 | 166 | 105 |
| Wheat | 142 | 34 | 46 | 142 | 34 | 46 | 142 | 34 | 46 |
| Small Grain Graze-out | 12 | 255 | 147 | 12 | 255 | 147 | 12 | 255 | 147 |
| **Livestock Enterprises:** | | | | | | | | | |
| Cows | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Winter Stockers[h] | 202 | 278 | 224 | 202 | 278 | 224 | 202 | 278 | 224 |
| Spring Stockers[i] | 57 | 288 | 262 | 57 | 288 | 262 | 57 | 288 | 262 |

TABLE XI (Continued)

| Item | Full Owner[b] | | | Part Owner[c] | | | Renter[d] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] |
| Financial Conditions: | | | | | | | | | |
| Assets, Total[j] | $179,352 | $192,090 | $202,448 | $119,352 | $128,590 | $135,448 | $59,352 | $65,090 | $68,448 |
| Real Estate | 120,000 | 127,000 | 134,000 | 60,000 | 63,500 | 67,000 | -- | -- | -- |
| Chattel | 59,352 | 65,090 | 68,448 | 59,352 | 65,090 | 68,448 | 59,352 | 65,090 | 68,448 |
| Cash | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Debts, Total[k] | $ 51,167 | $ 54,530 | $ 57,265 | $ 35,327 | $ 37,766 | $ 39,577 | $19,487 | $21,002 | $21,889 |
| Real Estate | 30,000 | 31,750 | 33,500 | 15,000 | 15,875 | 16,750 | -- | -- | -- |
| Chattel | 8,221 | 10,033 | 9,656 | 8,221 | 10,033 | 9,656 | 8,221 | 10,003 | 9,656 |
| Open | 12,946 | 12,747 | 14,109 | 12,106 | 11,858 | 13,171 | 11,266 | 10,969 | 12,233 |
| Net Worth | $128,185 | $137,560 | $145,183 | $ 84,025 | $ 90,824 | $ 95,871 | $39,865 | $44,088 | $46,559 |
| Debt-Asset Ratio | 0.285 | 0.284 | 0.283 | 0.296 | 0.294 | 0.292 | 0.328 | 0.323 | 0.320 |

Land Ownership Conditions

[a]Developed from 1970 survey data of 24 randomly sampled farms.

[b]Owns all land operated.

[c]Owns one-half of land operated.

[d]Owns none of land operated.

[e]Represents an area having 75' of saturated aquifer and 75' depth to water with two wells per farm yielding 400 gallons per minute.

[f]Represents an area having 250' of saturated aquifer and 175' depth to water with two wells per farm yielding 750 gallons per minute.

[g]Represents an area having 450' of saturated aquifer and 125' depth to water with one well per farm yielding 1,000 gallons per minute.

[h]Stocker cattle purchased in the fall and sold in May after grazing winter wheat and small grain graze-out pasture.

[i]Stocker cattle purchased in March and sold in May after grazing small grain graze-out pasture.

[j]Refer to Appendix Table LV for details.

[k]Refer to Appendix Table LVI for details.

TABLE XII

REPRESENTATIVE FARM II STARTING SITUATIONS WITH SPECIFIED IRRIGATION DEVELOPMENT AND LAND OWNERSHIP CONDITIONS, SOUTH CENTRAL PLAINS[a]

| Item | Land Ownership Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Full Owner[b] | | | Part Owner[c] | | | Renter[d] | | |
| | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] |
| <u>Land Specifications</u>: | | | | | | | | | |
| Land Operated | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 |
| Cropland | 1,440 | 1,440 | 1,440 | 1,440 | 1,440 | 1,440 | 1,440 | 1,440 | 1,440 |
| Range | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 |
| Land Owned | 1,600 | 1,600 | 1,600 | 800 | 800 | 800 | --- | --- | --- |
| Cropland | 1,440 | 1,440 | 1,440 | 720 | 720 | 720 | --- | --- | --- |
| Range | 160 | 160 | 160 | 80 | 80 | 80 | --- | --- | --- |
| Land Rented | --- | --- | --- | 800 | 800 | 800 | 1,600 | 1,600 | 1,600 |
| Cropland | --- | --- | --- | 720 | 720 | 720 | 1,440 | 1,440 | 1,440 |
| Range | --- | --- | --- | 80 | 80 | 80 | 160 | 160 | 160 |
| <u>Crop Enterprises</u>: | | | | | | | | | |
| Dryland Acres | 1,014 | 652 | 738 | 1,014 | 652 | 738 | 1,014 | 652 | 738 |
| Small Grain Graze-out | 1,014 | 652 | 738 | 1,014 | 652 | 738 | 1,014 | 652 | 738 |
| Irrigated Acres | 426 | 788 | 702 | 426 | 788 | 702 | 426 | 788 | 702 |
| Corn | 108 | 108 | 108 | 108 | 108 | 108 | 108 | 108 | 108 |
| Grain Sorghum | 87 | 248 | 210 | 87 | 248 | 210 | 87 | 248 | 210 |
| Wheat | 212 | 51 | 89 | 212 | 51 | 89 | 212 | 51 | 89 |
| Small Grain Graze-out | 19 | 381 | 295 | 19 | 381 | 295 | 19 | 381 | 295 |
| <u>Livestock Enterprises</u>: | | | | | | | | | |
| Cows | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Winter Stockers[h] | 428 | 541 | 514 | 428 | 541 | 514 | 428 | 541 | 514 |
| Spring Stockers[i] | 468 | 813 | 731 | 468 | 813 | 731 | 468 | 813 | 731 |

TABLE XII (Continued)

| Item | Land Ownership Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Full Owner[b] | | | Part Owner[c] | | | Renter[d] | | |
| | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] |
| Financial Conditions: | | | | | | | | | |
| Assets, Total[j] | $393,660 | $421,451 | $444,760 | $241,660 | $260,451 | $274,760 | $89,660 | $99,451 | $104,760 |
| Real Estate | 304,000 | 322,000 | 340,000 | 152,000 | 161,000 | 170,000 | -- | -- | -- |
| Chattel | 89,660 | 99,451 | 104,760 | 89,660 | 99,451 | 104,760 | 89,660 | 99,451 | 104,760 |
| Cash | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Debts, Total[k] | $113,469 | $120,806 | $126,959 | $ 73,341 | $ 78,302 | $ 82,079 | $33,213 | $35,798 | $ 37,199 |
| Real Estate | 76,000 | 80,500 | 85,000 | 38,000 | 40,250 | 42,500 | -- | -- | -- |
| Chattel | 10,453 | 13,172 | 13,608 | 10,453 | 13,172 | 13,608 | 10,453 | 13,172 | 13,608 |
| Open | 27,016 | 27,134 | 28,351 | 24,888 | 24,880 | 25,971 | 22,760 | 22,626 | 23,591 |
| Net Worth | $280,191 | $300,645 | $317,801 | $168,319 | $182,149 | $192,681 | $56,447 | $63,653 | $ 67,561 |
| Debt-Asset Ratio | 0.288 | 0.287 | 0.285 | 0.303 | 0.301 | 0.299 | 0.370 | 0.360 | 0.355 |

[a]Developed from 1970 survey data of 20 randomly sampled farms.

[b]Owns all land operated.

[c]Owns one-half of land operated.

[d]Owns none of land operated.

[e]Represents an area having 75' of saturated aquifer and 75' depth to water with three wells per farm yielding 400 gallons per minute.

[f]Represents an area having 250' of saturated aquifer and 175' depth to water with three wells per farm yielding 750 gallons per minute.

[g]Represents an area having 450' of saturated aquifer and 125' depth to water with two wells per farm yielding 1,000 gallons per minute.

[h]Stocker cattle purchased in the fall and sold in May after grazing winter wheat and small grain graze-out pasture.

[i]Stocker cattle purchased in March and sold in May after grazing small grain graze-out pasture.

[j]Refer to Appendix Table LV for details.

[k]Refer to Appendix Table LVI for details.

TABLE XIII

REPRESENTATIVE FARM III STARTING SITUATIONS WITH SPECIFIED IRRIGATION AND LAND OWNERSHIP CONDITIONS, SOUTH CENTRAL PLAINS[a]

| Item | Land Ownership Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Full Owner[b] | | | Part Owner[c] | | | Renter[d] | | |
| | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] |
| Land Specifications: | | | | | | | | | |
| Land Operated | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |
| Cropland | 2,680 | 2,680 | 2,680 | 2,680 | 2,680 | 2,680 | 2,680 | 2,680 | 2,680 |
| Range | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| Land Owned | 2,880 | 2,880 | 2,880 | 1,440 | 1,440 | 1,440 | --- | --- | --- |
| Cropland | 2,680 | 2,680 | 2,680 | 1,340 | 1,340 | 1,340 | --- | --- | --- |
| Range | 200 | 200 | 200 | 100 | 100 | 100 | --- | --- | --- |
| Land Rented | --- | --- | --- | 1,440 | 1,440 | 1,440 | 2,880 | 2,880 | 2,880 |
| Cropland | --- | --- | --- | 1,340 | 1,340 | 1,340 | 2,680 | 2,680 | 2,680 |
| Range | --- | --- | --- | 100 | 100 | 100 | 200 | 200 | 200 |
| Crop Enterprises: | | | | | | | | | |
| Dryland Acres | 1,830 | 1,104 | 1,276 | 1,830 | 1,104 | 1,276 | 1,830 | 1,104 | 1,276 |
| Small Grain Graze-out | 1,830 | 1,104 | 1,276 | 1,830 | 1,104 | 1,276 | 1,830 | 1,104 | 1,276 |
| Irrigated Acres | 850 | 1,576 | 1,404 | 850 | 1,576 | 1,404 | 850 | 1,576 | 1,404 |
| Corn | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 216 |
| Grain Sorghum | 174 | 496 | 420 | 174 | 496 | 420 | 174 | 496 | 420 |
| Wheat | 424 | 102 | 178 | 424 | 102 | 178 | 424 | 102 | 178 |
| Small Grain Graze-out | 36 | 762 | 590 | 36 | 762 | 590 | 36 | 762 | 590 |
| Livestock Enterprises: | | | | | | | | | |
| Cows | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Winter Stockers[h] | 812 | 1,040 | 986 | 812 | 1,040 | 986 | 812 | 1,040 | 986 |
| Spring Stockers[i] | 808 | 1,499 | 1,335 | 808 | 1,499 | 1,335 | 808 | 1,499 | 1,335 |

TABLE XIII (Continued)

| Item | Land Ownership Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Full Owner[b] | | | Part Owner[c] | | | Renter[d] | | |
| | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] | Class A Water[e] | Class B Water[f] | Class C Water[g] |
| Financial Conditions: | | | | | | | | | |
| Assets, Total[j] | $726,460 | $776,580 | $816,698 | $448,460 | $483,830 | $509,198 | $170,460 | $191,080 | $201,698 |
| Real Estate | 556,000 | 585,500 | 615,000 | 278,000 | 292,750 | 307,500 | -- | -- | -- |
| Chattel | 170,460 | 191,080 | 201,698 | 170,460 | 191,080 | 201,698 | 170,460 | 191,080 | 201,698 |
| Cash | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Debts, Total[k] | $211,339 | $224,571 | $235,162 | $137,947 | $147,813 | $153,982 | $ 64,555 | $ 69,999 | $ 72,802 |
| Real Estate | 139,000 | 147,375 | 156,110 | 69,500 | 73,687 | 78,055 | -- | -- | -- |
| Chattel | 20,127 | 25,564 | 26,436 | 20,127 | 25,564 | 26,436 | 20,127 | 25,564 | 26,436 |
| Open | 52,212 | 51,632 | 52,616 | 48,820 | 48,562 | 48,491 | 44,428 | 44,435 | 46,366 |
| Net Worth | $515,121 | $552,009 | $581,536 | $310,513 | $336,017 | $355,216 | $105,905 | $121,081 | $128,896 |
| Debt-Asset Ratio | 0.291 | 0.289 | 0.288 | 0.308 | 0.304 | 0.302 | 0.379 | 0.366 | 0.361 |

[a]Developed from 1970 survey data of 9 randomly sampled farms.

[b]Owns all land operated.

[c]Owns one-half of land operated.

[d]Owns none of land operated.

[e]Represents an area having 75' saturated aquifer and 75' depth to water with six wells per farm yielding 400 gallons per minute.

[f]Represents an area having 250' saturated aquifer and 175' depth to water with six wells per farm yielding 750 gallons per minute.

[g]Represents an area having 450' saturated aquifer and 125' depth to water with four wells per farm yielding 1,000 gallons per minute.

[h]Stocker cattle purchased in the fall and sold in May after grazing winter wheat and small grain graze-out pasture.

[i]Stocker cattle purchased in March and sold in May after grazing small grain graze-out pasture.

[j]Refer to Appendix Table LV for details.

[k]Refer to Appendix Table LVI for details.

TABLE XIV

REPRESENTATIVE RANCH WITH SPECIFIED IRRIGATION AND LAND OWNERSHIP CONDITIONS, SOUTH CENTRAL PLAINS[a]

| | Land Ownership Conditions | | |
|---|---|---|---|
| | Full Owner[b] | Part Owner[c] | Renter[d] |
| Item | Class A Water[e] | Class A Water[e] | Class A Water[e] |
| **Land Specifications:** | | | |
| Land Operated | 7,040 | 7,040 | 7,040 |
| Cropland | 2,240 | 2,240 | 2,240 |
| Range | 4,800 | 4,800 | 4,800 |
| Land Owned | 7,040 | 3,520 | -- |
| Cropland | 2,240 | 1,120 | -- |
| Range | 4,800 | 2,400 | -- |
| Land Rented | -- | 3,520 | 7,040 |
| Cropland | -- | 1,120 | 2,240 |
| Range | -- | 2,400 | 4,800 |
| **Crop Enterprises:** | | | |
| Dryland Acres | 1,390 | 1,390 | 1,390 |
| Small Grain Graze-out | 1,390 | 1,390 | 1,390 |
| Irrigated Acres | 850 | 850 | 850 |
| Corn | 216 | 216 | 216 |
| Grain Sorghum | 174 | 174 | 174 |
| Wheat | 424 | 424 | 424 |
| Small Grain Graze-out | 36 | 36 | 36 |
| **Livestock Enterprises:** | | | |
| Cows | 250 | 250 | 250 |
| Winter Stockers[f] | 721 | 721 | 721 |
| Spring Stockers[g] | 528 | 528 | 528 |
| **Financial Conditions:** | | | |
| Assets, Total[h] | $1,123,535 | $659,535 | $195,535 |
| Real Estate | 928,000 | 464,000 | - |
| Chattel | 195,535 | 195,535 | 195,535 |
| Cash | - | - | - |
| Debts, Total[i] | $ 303,326 | $180,830 | $ 58,334 |
| Real Estate | 232,000 | 116,000 | - |
| Chattel | 19,547 | 19,547 | 19,547 |
| Open | 51,779 | 45,283 | 38,787 |
| Net Worth | $ 820,209 | $478,705 | $137,201 |
| Debt-Asset Ratio | 0.270 | 0.274 | 0.298 |

[a] Developed from 1970 survey data of 12 randomly sampled ranches.

[b] Owns all land operated.

[c] Owns one-half of land operated.

[d] Owns none of land operated.

[e] Represents an area having 75' of saturated aquifer and 25' depth to water with six wells per farm yielding 400 gallons per minute.

[f] Stocker cattle purchased in the fall and sold in May after grazing winter wheat and small grain graze-out pasture.

[g] Stocker cattle purchased in March and sold in May after grazing small grain graze-out pasture.

[h] Refer to Appendix A, Table LV for details.

[i] Refer to Appendix A, Table LVI for details.

and one well for "Class C" water. The 1,600-acre operation has the same number as the modal farm but the 2,880-acre crop farm has twice as many; six wells in "A" and "B" water situations and four in "Class C" water. The irrigated ranch in "Class A" water also has six wells in the base period.

The initial financial characteristics involve estimates of the current real estate and chattel debt and asset values as well as debts on open account or cash balances. Generally, the real estate asset value is based on the acreage and prevailing land values of $150 per acre for dryland, $100 for native range and $250, $275 and $300 for irrigated cropland in the respective water situations "A," "B" and "C." Minor increases in land value are assumed for the thicker saturated thickness categories consistent with their increasing economic life expectancy under intensive crop farming conditions.

Current real estate debts are assumed to be 25 percent of the balance payable in the first five periods. For example, a full owner has ownership of all land in the operation but 25 percent of the balance is to be paid over the first five years of the analysis in five equal payments. In contrast, the part ownership category begins with full ownership of one-half the land in the operation but has the same debt and repayment schedule on the outstanding real estate loan. The tenant or renter category has no existing land ownership, and, therefore, no land debt in the base period.

The chattel asset value includes the current depreciated value of machinery items and irrigation facilities, the investment cost of the cow herd and the purchase cost of all stocker steers on hand at the beginning of the base period. Chattel debts consist of the outstanding principal on relatively new (two years or less) machinery items and irrigation facilities. Refer to Appendix A, Tables LV to LVII, for the base data used in making estimates of debts and assets.

The previous items are assumed to be typical debt and asset positions of representative firms in the study area. However, the estimation of bank loans or cash balances is more difficult to typify. A regression equation is developed for the irrigation operators using total debts of those surveyed as the dependent variable. The resulting equation in hundreds of dollars is:

$$\text{Total debts (\$00)} = -12.748 - \underset{(.151)}{.439X_1} + \underset{(.125)}{.263X_2} + \underset{(.018)}{.264X_3} \qquad (1)$$

where $X_1$ represents the number of cows, $X_2$ the number of winter stockers and $X_3$ the estimated assets in hundreds of dollars. The F-value of the equation is 98.93, $R^2 = .825$ and the standard error of the estimate 411.1 with the individual regression coefficients significantly different from zero at the 95 percent level of probability. By using the predicted level of total debts for each representative situation and subtracting the previously estimated real estate and chattel, an estimate of open account loans (if negative, cash-on-hand) can be calculated.

The previous equation also requires a priori estimates of cow numbers and winter stocker numbers. The number of cows is estimated for the base period by considering the summery carrying capacity of the rangeland. Wheat grazing plus small grain grazing availability from October 15 to March 15 determines the number of winter stockers. Spring stockers are not included in estimating the debt status since they are purchased after January 1. The number of cows and winter stockers vary by size of operation, the amount of native range on the farm or ranch and the amount of irrigated and dryland wheat plus small grain grazing. The differences between the initial representative situations, Farm I, Farm II, Farm III and ranch are in the following discussion.

Initial Organization of Farm I

The initial physical and financial characteristics of the smallest crop farm represented in the analysis are given in Table XI. The beginning characteristics vary by land equity position and water resource situation. The common land base is 640 acres with 560 acres of cropland and 80 acres of native pasture. The full owner land equity position owns all of the land; the part owner owns one-half and rents one half and the renter owns none.

The specific crop enterprises are based on the previous analysis of water resource adjustments. The acreage of each irrigated crop is adjusted by a factor of two-thirds reflecting the reduction of wells from three in the previous water resource analysis of the modal farm to two for the smaller representative farm situation. The dryland acreage is a residual of the cropland base less the total irrigated acreage. For example, referring to Table VI, Chapter IV, two-thirds of the irrigated corn acres of 108 is about 72 acres and two-thirds of the irrigated grain sorghum acres of 87 is about 58 acres. By calculating the irrigated acreage of each crop and summing the cropland used for irrigated crop enterprises, the total irrigated is 284 acres. Since 560 acres of cropland are on the farm, a residual of 276 acres of dryland small grain graze-out exists. This dryland component will not necessarily be two-thirds of the dryland on the previously used modal farm since it is the residual component based on total cropland of the representative farm.

The "Class B" water situation also has two wells but nearly twice the well capacity of "Class A" water. Thus, the irrigated acreage is nearly doubled (284 compared to 527) and the dryland graze-out residual is appropriately reduced from 276 to 33 acres. The "Class C" water situation assumes only one well but it has two-thirds the total capacity of the "Class B" wells resulting in about two-thirds of "Class B" irrigated acreage or 352 acres.

The varying irrigated wheat and small grain pasture acreages by water situation result in stocker steer adjustments also. Winter stockers bought in the fall and carried through on graze-out small grain to mid-May vary from 202 head in "Class A" water to 278 head in "Class B" water. The "Class C" water situation can carry 224 head. In addition, 57 additional spring stockers can be purchased in mid-March for "A," 288 in "B" and 262 head in "C." Five cows can be carried on the 80 acres of native range regardless of water situation.

The financial conditions vary by both the water situation and land equity position. The full owner's assets vary from over $179,000 in "Class A" water to over $202,000 in "Class C" water. Most of the increase is attributable to the relatively higher irrigated cropland value of $300 per acre assumed for the thicker saturated thickness of "Class C" water versus $250 per acre for "A" water. The part owner's asset position is lower than the full owner since only one-half of the land is owned. The renter's assets consist of only chattel items. The debt positions likewise vary primarily due to the land values.

Generally, the net worth position increases with the respectively thicker saturated thickness categories of "A," "B" and "C" water conditions and with the respectively higher land equity positions of renter, part owner and full owner. The debt-asset ratio is almost constant with respect to water situations but increases slightly as the land ownership decreases. Net worth ranges from a low of nearly $40,000 in the thinnest saturated thickness of "Class A" water with no land equity to a high of over $145,000 in the thickest saturated thickness, "Class C," with full ownership in land. These respective situations also result in the highest and lowest debt-asset ratios of .328 and .283.

## Initial Organization of Farm II

Generally, Farm II is of larger size than Farm I; 1,600 acres as compared to 640 acres. Table XII indicates a cropland base of 1,440 acres and 160 acres of native pasture. Again, the ownership conditions are delineated as full owner, part owner and renter with 100 percent, 50 percent and 0 percent land owned respectively.

The beginning irrigated crop enterprises for each water situation are identical to the first period's optimal levels obtained in the water resources analysis. Dryland crops again utilize the residual cropland in excess of that used for irrigated crops. Livestock enterprises include ten cows for 160 acres range and both stocker enterprises vary according to the available wheat and small grain grazing. The levels of irrigated crops and the stocker numbers are influenced by the water situations as in the Farm I situation. Likewise, the asset and debt positions are influenced by the various land values for the selected water situations.

## Initial Organization of Farm III

The largest representative crop farm situation has 2,680 acres cropland and 200 acres of range for a total beginning size of 2,880 acres, Table XIII. Since it has about twice the amount of cropland as Farm II, six irrigation wells are assumed for water situations "A" and "B" and four for "Class C" water as compared to three and two wells, respectively, for the previous crop farm situation. Consequently, the irrigated crop enterprises are twice the acreage of Farm II with dryland small grain grazing absorbing the residual cropland. Appropriate increases in winter and spring stockers are also assumed. Twelve cows are carried on the 200 acres of native pasture.

The initial debt and asset positions again vary by land equity position and water situation. Net worth ranges from nearly $106,000 to over $580,000 and the associated extremes of debt-asset ratios are .379 and .288 respectively.

## Initial Organization of the Ranch

The irrigated ranch situation Table XIV, consists of about two-thirds native range, 4,800 acres, and one-third cropland, 2,240 acres. Only one water situation, "Class A," having 75 feet saturated thickness and a shallow depth-to-water of 25 feet is evaluated. Six irrigation wells and the same irrigated crop acreages are assumed for the base period as Farm III in "A" water. However, dryland small grain grazing acreage is different since it is the residual claimant of cropland. The number of both types of stockers is appropriately adjusted to wheat and small grain grazing availability. The number of cows, 250, is significantly larger than the crop farms because of the predominance of range rather than cropland in the organization.

Beginning assets vary from over $1.1 million to less than $200,000 as the land equity position diminishes. The initial debt position likewise varies with resulting net worth positions of about $820,000, $479,000 and $137,000 for the respective full owner, part owner and renter land equity conditions. The respective debt-asset ratios are .27, .274 and .298.

Summary of the Initial Organizations

The beginning crop farm organizations reflect the increasing cropland base and number of irrigation wells as the size of operation increases from 640 acres for Farm I to 2,880 acres for Farm III. The ranch situation reflects an even larger size of operation, 7,040 acres, but slightly less cropland than Farm III and significantly more rangeland.

All representative situations begin with adjusted acreages, if necessary, of irrigated corn, grain sorghum, wheat and small grain grazing. The adjustments are based on the number of wells assumed for the representative farms in relation to the number used on the modal farm in the water resources analysis. The remaining cropland for dryland purposes is the residual in excess of that being irrigated and is utilized for small grain grazing.

Since livestock enterprises were not considered in the water resources analysis, the expected availability of grazing from wheat, small grain grazing and native range determine the initial numbers of winter and spring stockers as well as the number of cows. Cow numbers are dependent on the expected amount of grazing from range whereas stocker numbers reflect the wheat and small grain grazing availability which varies by water situation as well as the cropland base.

The financial characteristics vary by size, land equity position and water situation. Generally, asset levels increase as size, land equity and saturated thickness of the water-bearing formation increase. The beginning debt positions follow the same pattern. The corresponding debt-asset ratios generally increase as land equity and saturated thickness decrease and as crop farm size increases. The range in net worth is from $39,865 for the renter in "Class A" water on Farm I to $820,209 for the full owner of a ranch in the same water situation. The highest initial net worth on the crop farm situations is $581,536 for the full owner of Farm III in "Class C" water. The previous discussion has concentrated on the beginning status of the representative situations and the following relates the future farm organizations and family characteristics.

## Future Organizational Characteristics of the Representative Situations

The organizational characteristics required for the simulation analysis include specifying:

1. The enterprise levels;
2. The level of irrigated cropland, dryland and native pasture;
3. The variable cost of pumping irrigation water;
4. The operator and family characteristics; and
5. The off-farm income earnings.

TABLE XV

ACREAGES OF CROP ENTERPRISES BY SPECIFIED WATER SITUATIONS, FARM I, SOUTH CENTRAL PLAINS[a]

| Period | "Class A" Water Situation: Irrigated Crops: Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Dryland Small Grain Graze-out | "Class B" Water Situation: Irrigated Crops: Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Dryland Small Grain Graze-out | "Class C" Water Situation: Irrigated Crops: Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Dryland Small Grain Graze-out |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 58 | 142 | 72 | 12 | 276 | 166 | 34 | 72 | 255 | 33 | 105 | 46 | 54 | 147 | 208 |
| 2 | 53 | 148 | 72 | - | 287 | 182 | 16 | 72 | 290 | - | 120 | 29 | 54 | 182 | 175 |
| 3 | 49 | 143 | 72 | - | 296 | 197 | - | 72 | 291 | - | 135 | 14 | 54 | 216 | 141 |
| 4 | 45 | 138 | 72 | - | 305 | 213 | - | 72 | 275 | - | 151 | - | 54 | 250 | 105 |
| 5 | 41 | 132 | 72 | - | 315 | 228 | - | 72 | 260 | - | 166 | - | 54 | 269 | 71 |
| 6 | 36 | 126 | 72 | - | 326 | 244 | - | 72 | 244 | - | 182 | - | 54 | 288 | 36 |
| 7 | 32 | 121 | 72 | - | 335 | 259 | - | 72 | 229 | - | 197 | - | 54 | 307 | 2 |
| 8 | 27 | 115 | 72 | - | 346 | 265 | - | 72 | 223 | - | 198 | - | 54 | 308 | - |
| 9 | 22 | 109 | 72 | - | 357 | 265 | - | 72 | 223 | - | 198 | - | 54 | 308 | - |
| 10 | 19 | 105 | 72 | - | 364 | 265 | - | 72 | 223 | - | 198 | - | 54 | 308 | - |
| 11 | - | - | - | - | 560 | 265 | - | 72 | 223 | - | 198 | - | 54 | 308 | - |
| 12 | - | - | - | - | 560 | 249 | - | 72 | - | 239 | 198 | - | 54 | 308 | - |
| 13 | - | - | - | - | 560 | 232 | - | 72 | - | 256 | 198 | - | 54 | 308 | - |
| 14 | - | - | - | - | 560 | 216 | - | 72 | - | 272 | 198 | - | 54 | 308 | - |
| 15 | - | - | - | - | 560 | 199 | - | 72 | - | 289 | 198 | - | 54 | 308 | - |
| 16 | - | - | - | - | 560 | 183 | - | 72 | - | 305 | 198 | - | 54 | 308 | - |
| 17 | - | - | - | - | 560 | 166 | - | 72 | - | 322 | 198 | - | 54 | 308 | - |
| 18 | - | - | - | - | 560 | 150 | - | 72 | - | 338 | 198 | - | 54 | 308 | - |
| 19 | - | - | - | - | 560 | 133 | - | 72 | - | 355 | 198 | - | 54 | 308 | - |
| 20 | - | - | - | - | 560 | 117 | - | 72 | - | 371 | 198 | - | 54 | 308 | - |

[a] Developed by linear programming a farm having three wells and adjusting the irrigated crop acreages for two wells in the poor and moderate water situations and one well in the good water situation.

TABLE XVI

ACREAGES OF CROP ENTERPRISES BY SPECIFIED WATER SITUATIONS, FARM II, SOUTH CENTRAL PLAINS[a]

| | "Class A" Water Situation | | | | | "Class B" Water Situation | | | | | "Class C" Water Situation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Irrigated Crops | | | | Dryland | Irrigated Crops | | | | Dryland | Irrigated Crops | | | | Dryland |
| Period | Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Small Grain Graze-out | Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Small Grain Graze-out | Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Small Grain Graze-out |
| 1 | 87 | 212 | 108 | - | 1,014 | 248 | 51 | 108 | 381 | 652 | 210 | 89 | 108 | 295 | 738 |
| 2 | 79 | 220 | 108 | - | 1,033 | 271 | 28 | 108 | 433 | 600 | 240 | 58 | 108 | 364 | 670 |
| 3 | 74 | 214 | 108 | - | 1,044 | 294 | 5 | 108 | 485 | 548 | 270 | 28 | 108 | 432 | 602 |
| 4 | 67 | 205 | 108 | - | 1,060 | 318 | - | 108 | 518 | 496 | 302 | - | 108 | 500 | 530 |
| 5 | 61 | 197 | 108 | - | 1,074 | 341 | - | 108 | 547 | 444 | 332 | - | 108 | 538 | 462 |
| 6 | 54 | 189 | 108 | - | 1,089 | 364 | - | 108 | 576 | 392 | 364 | - | 108 | 576 | 392 |
| 7 | 47 | 180 | 108 | - | 1,105 | 387 | - | 108 | 605 | 340 | 394 | - | 108 | 614 | 324 |
| 8 | 41 | 172 | 108 | - | 1,119 | 396 | - | 108 | 616 | 320 | 396 | - | 108 | 616 | 320 |
| 9 | 33 | 163 | 108 | - | 1,136 | 396 | - | 108 | 616 | 320 | 396 | - | 108 | 616 | 320 |
| 10 | 28 | 157 | 108 | - | 1,147 | 396 | - | 108 | 616 | 320 | 396 | - | 108 | 616 | 320 |
| 11 | - | - | - | - | 1,440 | 396 | - | 108 | 538 | 398 | 396 | - | 108 | 616 | 320 |
| 12 | - | - | - | - | 1,440 | 371 | - | 108 | - | 961 | 396 | - | 108 | 616 | 320 |
| 13 | - | - | - | - | 1,440 | 347 | - | 108 | - | 985 | 396 | - | 108 | 616 | 320 |
| 14 | - | - | - | - | 1,440 | 322 | - | 108 | - | 1,010 | 396 | - | 108 | 616 | 320 |
| 15 | - | - | - | - | 1,440 | 297 | 2 | 108 | - | 1,033 | 396 | - | 108 | 616 | 320 |
| 16 | - | - | - | - | 1,440 | 273 | 26 | 108 | - | 1,033 | 396 | - | 108 | 616 | 320 |
| 17 | - | - | - | - | 1,440 | 248 | 51 | 108 | - | 1,033 | 396 | - | 108 | 616 | 320 |
| 18 | - | - | - | - | 1,440 | 223 | 76 | 108 | - | 1,033 | 396 | - | 108 | 616 | 320 |
| 19 | - | - | - | - | 1,440 | 199 | 100 | 108 | - | 1,033 | 396 | - | 108 | 616 | 320 |
| 20 | - | - | - | - | 1,440 | 174 | 125 | 108 | - | 1,033 | 396 | - | 108 | 616 | 320 |

[a]Developed by linear programming using three wells for the poor and moderate water situations and adjusting the irrigated crop acreage to two wells for the good water situation.

TABLE XVII

ACREAGES OF CROP ENTERPRISES BY SPECIFIED WATER SITUATIONS, FARM III, SOUTH CENTRAL PLAINS[a]

| | "Class A" Water Situation | | | | | "Class B" Water Situation | | | | | "Class C" Water Situation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Irrigated Crops | | | | Dryland | Irrigated Crops | | | | Dryland | Irrigated Crops | | | | Dryland |
| Period | Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Small Grain Graze-out | Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Small Grain Graze-out | Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Small Grain Graze-out |
| 1 | 174 | 424 | 216 | 36 | 1,830 | 496 | 102 | 216 | 762 | 1,104 | 420 | 178 | 216 | 590 | 1,276 |
| 2 | 158 | 440 | 216 | - | 1,866 | 542 | 56 | 216 | 866 | 1,000 | 480 | 106 | 216 | 728 | 1,150 |
| 3 | 148 | 428 | 216 | - | 1,888 | 588 | 10 | 216 | 970 | 896 | 540 | 56 | 216 | 864 | 1,004 |
| 4 | 134 | 410 | 216 | - | 1,920 | 636 | - | 216 | 1,036 | 792 | 604 | - | 216 | 1,000 | 860 |
| 5 | 122 | 394 | 216 | - | 1,948 | 682 | - | 216 | 1,094 | 688 | 664 | - | 216 | 1,076 | 724 |
| 6 | 108 | 378 | 216 | - | 1,978 | 728 | - | 216 | 1,152 | 584 | 728 | - | 216 | 1,152 | 584 |
| 7 | 94 | 360 | 216 | - | 2,010 | 774 | - | 216 | 1,210 | 480 | 788 | - | 216 | 1,228 | 448 |
| 8 | 82 | 344 | 216 | - | 2,038 | 798 | - | 216 | 1,232 | 434 | 792 | - | 216 | 1,232 | 440 |
| 9 | 66 | 326 | 216 | - | 2,072 | 798 | - | 216 | 1,232 | 434 | 792 | - | 216 | 1,232 | 440 |
| 10 | 56 | 314 | 216 | - | 2,094 | 798 | - | 216 | 1,232 | 434 | 792 | - | 216 | 1,232 | 440 |
| 11 | - | - | - | - | 2,680 | 798 | - | 216 | 1,076 | 590 | 792 | - | 216 | 1,232 | 440 |
| 12 | - | - | - | - | 2,680 | 742 | - | 216 | - | 1,722 | 792 | - | 216 | 1,232 | 440 |
| 13 | - | - | - | - | 2,680 | 694 | - | 216 | - | 1,770 | 792 | - | 216 | 1,232 | 440 |
| 14 | - | - | - | - | 2,680 | 644 | - | 216 | - | 1,820 | 792 | - | 216 | 1,232 | 440 |
| 15 | - | - | - | - | 2,680 | 594 | 4 | 216 | - | 1,866 | 792 | - | 216 | 1,232 | 440 |
| 16 | - | - | - | - | 2,680 | 546 | 52 | 216 | - | 1,866 | 792 | - | 216 | 1,232 | 440 |
| 17 | - | - | - | - | 2,680 | 796 | 102 | 216 | - | 1,866 | 792 | - | 216 | 1,232 | 440 |
| 18 | - | - | - | - | 2,680 | 446 | 152 | 216 | - | 1,866 | 792 | - | 216 | 1,232 | 440 |
| 19 | - | - | - | - | 2,680 | 398 | 200 | 216 | - | 1,866 | 792 | - | 216 | 1,232 | 440 |
| 20 | - | - | - | - | 2,680 | 348 | 250 | 216 | - | 1,866 | 792 | - | 216 | 1,232 | 440 |

[a]Developed by linear programming a farm having three wells and adjusting the irrigated crop acreages for six wells in the poor and moderate water situations and four wells in the good water situation.

TABLE XVIII

ACREAGES OF CROP ENTERPRISES, "CLASS A" WATER, IRRIGATED RANCH, SOUTH CENTRAL PLAINS[a]

| | Irrigated Crops | | | | |
|---|---|---|---|---|---|
| Period | Grain Sorghum | Wheat | Corn | Small Grain Graze-out | Dryland Small Grain Graze-out |
| 1 | 174 | 424 | 216 | 36 | 1,390 |
| 2 | 174 | 425 | 216 | 36 | 1,389 |
| 3 | 173 | 426 | 216 | 35 | 1,390 |
| 4 | 173 | 426 | 216 | 34 | 1,391 |
| 5 | 172 | 427 | 216 | 33 | 1,392 |
| 6 | 172 | 427 | 216 | 32 | 1,393 |
| 7 | 171 | 428 | 216 | 31 | 1,394 |
| 8 | 158 | 441 | 216 | 30 | 1,395 |
| 9 | 158 | 441 | 216 | - | 1,425 |
| 10 | 158 | 441 | 216 | - | 1,425 |
| 11 | 158 | 441 | 216 | - | 1,425 |
| 12 | 158 | 441 | 216 | - | 1,425 |
| 13 | 158 | 441 | 216 | - | 1,425 |
| 14 | 158 | 441 | 216 | - | 1,425 |
| 15 | 158 | 441 | 216 | - | 1,425 |
| 16 | 158 | 441 | 216 | - | 1,425 |
| 17 | 158 | 441 | 216 | - | 1,425 |
| 18 | 158 | 441 | 216 | - | 1,425 |
| 19 | 158 | 441 | 216 | - | 1,425 |
| 20 | 158 | 441 | 216 | - | 1,425 |

[a] Developed by linear programming.

The periodic values of each of these items used in the analysis are communicated by means of the external data file. Consequently, the original farm organization may be altered as time progresses. This feature is important where land resource mixes, enterprise levels and family characteristics vary over time. The periodic values also provide a basis to estimate the characteristics of new land brought into the organization as expansion strategies are adopted.

## The Periodic Levels of Enterprises and Land Resources

The periodic levels of crop enterprises following the base period are given in Tables XV and XVIII for the crop farm situations and ranch. The base period data, period 1, is included only for purposes of continuity. Periods 2 to 20 give the crop enterprises and their levels for future use in revising the farm organization, particularly as the level of irrigation changes. The periodic acreages are based on the previous water resources analysis and proportionally adjusted in relation to the size of operation and its corresponding well numbers. The "Class A" and "Class B" irrigated enterprises are adjusted by a factor of two-thirds and the "Class C" acreages by a factor of one-half for Farm I, Table XV. Farm III and ranch acreages in Tables XVII and XVIII are doubled but Farm II acreages in Table XVI are not adjusted. The adjustment factors are based on the number of wells used for the modal farm in the water resources analysis as compared to the number on the representative farm or ranch. If all cropland is not irrigated, it is utilized by the small grain grazing enterprise. The trends in irrigated acreage of particular crops are similar to those previously discussed in the analysis of water resource adjustments. For example, in Table XV of Farm I, the acreages of irrigated grain sorghum, wheat and small grain grazing decrease in "Class A" water until the opportunity returns from dryland are met in period 11 when the farm maximizes profits by producing dryland small grain grazing.[2]

In "Class B" water, the acreages of grain sorghum and small grain grazing increase until all cropland is irrigated. In the twelfth period, when well capacities begin declining as a result of pumps penetrating the aquifer, irrigated grain sorghum decreases with off-setting increases in dryland small grain grazing. Also, at this point, the profits are maximized by replacing the irrigated small grain grazing with dryland and curtailing well drilling activities.

One exception to the crop enterprises from the water resources analysis is made in the last few years of the planning horizon of Farm I. No irrigated wheat is assumed for periods 15 to 20 for the smaller farm since the adjusted periodic acreage would be small. It is also in the optimal solution only because the assumed maximum set-aside acreage limit was met. Thus it is reasonable to continue with dryland grazing for the short time remaining in the planning horizon rather than imposing insignificant acreages of a new enterprise on the organization.

The "Class C" irrigated crop enterprises follow the same pattern as those in the water resources analysis. The cropland base on Farm I is fully irrigated by the eighth period and since well yields do not diminish over the planning horizon, the operation continues to be fully irrigated until the twentieth period. However, the larger crop farms in Tables XVI and XVII have more cropland than the modal farm in the previous water resources analysis and, thus, some dryland small grain grazing is utilized to absorb the residual dryland crop acres.

Table XVIII gives the ranch enterprises for the "A" water situation. They are identical to the results from the water resources analysis. The irrigated acreage declines slowly as a result of the relatively slower depletion rate of the underground water supply.

Regarding the land resource levels of irrigated cropland, dryland and native pasture over time, the sum of each period's irrigated acreage for each representative situation when subtracted from the cropland base gives the residual dryland crop acreage. Native pasture acreage is constant over time for each size of farm.

## The Periodic Pumping Costs

Another item needed prior to the analysis is the periodic estimate of pumping irrigation water. This information is also communicated by the external data file for periods two through twenty unless, in the case of "Class A" water, none is pumped in the later periods. The periodic costs per acre-foot are given previously in Tables VI to XI, Chapter IV. The present analysis uses the same costs on an acre-inch basis, i.e. divide the previous periodic cost estimates by 12 inches per foot.

The simulation model utilizes one row as the water resource and the periodic levels of irrigated enterprises in the organization accumulate the required amount. The cost per acre-inch is then revised periodically and the appropriate period's total variable cost is calculated and deducted as irrigation expenses from the farm income.

## The Periodic Family and Operator Characteristics

The family and operator characteristics include the number of dependents, the age of operator, years of experience, educational attainment, and the off-farm income earnings per period. The number of dependents are related to the age of operator. Table XIX gives the two age profiles of the 25 and 45 year-old operators, the periodic number of dependents excluding the operator and the years of farming experience. The 25 year-old operator is assumed to begin with one year of farming experience and one dependent whereas the age 45 operator begins with three dependents and 21 years of experience.

Other characteristics which do not vary by age of operator but are required for determining the hierarchy of goals are the operator's education level and off-farm income. Both operators are assumed to be high school graduates with $3,500 off-farm earnings for each period. The family and operator characteristics with the exception of income earnings, are exogenous parameters in the eight regression equations. They consequently influence the relative importance of goals and the multiple goals decision process of strategy selection.

In addition, the family consumption patterns over time vary due to the increasing number of dependents from one to three for the first few periods of the age 25 operator and the age 45 operator's decreasing number of dependents from three to one. However, the previous discussion of the consumption function in Chapter III indicates that net worth and farm income are also important variables in determining family consumption. Thus, the effect of dependents on consumption may be insignificant relative to increases in farm sales or net worth.

TABLE XIX

SUMMARY OF FAMILY AND OPERATOR CHARACTERISTICS FOR AGE 25 AND 45 OPERATORS[a]

| Period | Age 25 Operator | | | Age 45 Operator | | |
|---|---|---|---|---|---|---|
| | Age | Dependents[b] | Experience | Age | Dependents[b] | Experience |
| 1 | 25 | 1 | 1 | 45 | 3 | 21 |
| 2 | 25 | 2 | 2 | 46 | 3 | 22 |
| 3 | 27 | 2 | 3 | 47 | 3 | 23 |
| 4 | 28 | 3 | 4 | 48 | 2 | 24 |
| 5 | 29 | 3 | 5 | 49 | 2 | 25 |
| 6 | 30 | 3 | 6 | 50 | 1 | 26 |
| 7 | 31 | 3 | 7 | 51 | 1 | 27 |
| 8 | 32 | 3 | 8 | 52 | 1 | 28 |
| 9 | 33 | 3 | 9 | 53 | 1 | 29 |
| 10 | 34 | 3 | 10 | 54 | 1 | 30 |
| 11 | 35 | 3 | 11 | 55 | 1 | 31 |
| 12 | 36 | 3 | 12 | 56 | 1 | 32 |
| 13 | 37 | 3 | 13 | 57 | 1 | 33 |
| 14 | 38 | 3 | 14 | 58 | 1 | 34 |
| 15 | 39 | 3 | 15 | 59 | 1 | 35 |
| 16 | 40 | 3 | 16 | 60 | 1 | 36 |
| 17 | 41 | 3 | 17 | 61 | 1 | 37 |
| 18 | 42 | 3 | 18 | 62 | 1 | 38 |
| 19 | 43 | 3 | 19 | 63 | 1 | 39 |
| 20 | 44 | 3 | 20 | 64 | 1 | 40 |

[a]Characteristics not correlated to age are the educational attainment of 12 years and annual off-farm income earnings of $3,500.

[b]Does not include the operator.

# Miscellaneous Items Regarding the Representative Situations

There are some miscellaneous items regarding the representative farm situations. They primarily concern the farm overhead items which vary by size of operation and the variations in cash rent and irrigation facility investment costs associated with the selected water situations. In addition, specifications are also made for the future development of irrigation by farm size.

## General Farm Overhead Costs

The annual overhead costs for each of the representative situations are given in Appendix A, Table LIX. They include depreciation and maintenance costs for fixed items such as buildings, fencing, livestock trailers and other miscellaneous stock items, fuel tanks, irrigation pipe trailers and pickups. Incidental costs are included for services related to the farm business such as telephone, electricity, dues in farm organizations, bookkeeping, and insurance premiums. The Farm I situation of 640 acres has an annual overhead of $4,616.50; Farm II, $6,201.50 and Farm III, $7,711.50. The irrigated ranch is much larger and thus has a significant amount of permanent fencing and more livestock equipment resulting in an averhead expense of $11,286.50 per year.

Annually hired labor is also a component of farm overhead when needed. The $8,000 expense per man is incurred if the sum of seasonally hired labor hours exceeds the man-equivalent hours of 2,500 specified as a parameter in the program. The releasing of annual labor is also possible by evaluating the seasonal surpluses of labor.

## Land Rental Costs and Irrigation Facility Investments

The land rental costs are adjusted to reflect the thickness of water-bearing materials similar to the land purchase costs. That is, just as the purchase cost per irrigated cropland acre increases from $250 and $275 to $300 for the respective water situations "A," "B" and "C," the annual cash rental rates per irrigated cropland acre also increase from $20 to $25 and $30 respectively. The dryland cropland yearly rental cost is $10 per acre and rangeland $3.00 per acre.

The irrigation facilities also require different sizes of equipment relating to the water conditions. The cost estimates are obtained by the previously discussed program[3] used for calculating the periodic costs per unit of water. In "Class A" water with 75 feet thickness and 75 feet depth-to-water, each pump costs $1,110.94 and has a 15-year life. New holes cost $1,562.50 each and have a 20-year life. The original engines costing $419.03 are replaced in periods 5, 10, 15 and 20 by engines costing $293.82, $206.83 and $114.93 respectively. The engines and pumps are slightly less expensive for the ranch with 25 feet depth to water.

The related costs of irrigation facilities in "Class B" water with wells yielding 750 gallons per minute in 250 feet saturated thickness and 175 feet depth-to-water conditions are significantly higher. For example, pumps cost $3,843.50; wells $5,312.50; and the existing engines are $1,971.87. Replacement engine costs increase as the lift increases and later decrease as well capacity declines. The engines to be replaced in period five cost $2,221.18 each; in period ten, $2,452.49; and in periods 15 and 20, $2,053.97.

The "Class C" water situation also requires extensive investment primarily due to high well capacities of 1,000 gallons per minute being maintained for the 20-year period and the accompanying decline in the static water level increasing the pumping lift over time. Each existing engine costs $3,335.69 and replacement engines are $3,656.10, $3,976.52 and $4,296.93. Pumps cost $4,473.12 and additional holes are $7,187.50.

In addition to the above expenses, Farm I has a distribution system of underground pipe and related gated pipe and valves with a value of $12,696 with a 25-year life. Farm II, because of the increased size of operation and number of wells, has a system valued at $19,044 and the Farm III and ranch have twice as many wells which increases the value to $38,088 in distribution facilities.

## Development and Intensification of Irrigation Over Time

As was discussed earlier, the average annual rate of irrigation development in the study area has been about one new well per farm over a period of five years or .2 per year. The farms in the analysis are of various sizes so the rate is adjusted based on the amount of cropland in relation to the modal farm in the water resources analysis. Farm I has one-half the cropland base and assumes a rate of new well drilling of .1 per year. Farm II has slightly more cropland and drills .25 per year. Farm III has twice the cropland base of Farm II and intensifies development at twice the rate: .5 wells per year.

The previous drilling rates are also increased by the proportion of new land brought into the organization. For example, on the 640-acre Farm I, if 320 acres are rented or purchased in period one, the additional facilities in period two are based on the original rate of .1 well per year plus the .05 well associated with the proportionate increase in size (320 ÷ 640 = (.5 x .1) + .1 = .15). In addition, if the selected option is to purchase, .15 of all investments in irrigation facilities are incurred but if the land is rented .15 of only the pump and engine costs are incurred.

## Farm Program Provisions

The provisions of the 1972 farm program allow for price support payments and additional set-aside payments beyond the required set-aside acreage for feed grains and wheat. Table XX summarizes the payments for each situation. The basic allotments are developed from survey data of participating farms in the previously discussed size categories, Table X. Refer to Appendix A, Table LX for specific details. Projected yields per acre vary by situation and are based on the levels of irrigated and dryland enterprises in the first period. The total payments are constant over time and adjusted proportionately with increases in farm size as the firm is simulated.

## Miscellaneous Items

The same input-output relationships, price levels and yields are used in the simulation analysis as in the previous water resources analysis. No trends are included for price levels, technology or yields. The situations are also analyzed with deterministic yields as opposed to stochastic. However, the multiple-goals decision process allows for replications of stochastic yields.[4]

TABLE XX

FARM PROGRAM PAYMENTS FOR REPRESENTATIVE SITUATIONS BY COMMODITY PROGRAM

| Representative Situation | Wheat Certificate[a] | Wheat Additional Set-aside[b] | Feed Grain Price Support[c] | Feed Grain Additional Set-aside | Total Payment |
|---|---|---|---|---|---|
| | dollars | | | | |
| "Class A" water: | | | | | |
| Farm I | 3,386.91 | 1,473.30 | 3,020.77 | 778.66 | 8,659.64 |
| Farm II | 7,763.00 | 3,378.40 | 6,082.52 | 1,563.93 | 18,787.85 |
| Farm III | 10,422.16 | 4,535.09 | 22,303.46 | 5,732.19 | 42,992.90 |
| Ranch | 12,043.49 | 5,240.52 | 6,555.92 | 1,688.19 | 25,528.12 |
| "Class B" water: | | | | | |
| Farm I | 6,242.31 | 2,715.39 | 2,856.25 | 736.25 | 12,550.20 |
| Farm II | 11,295.17 | 4,915.57 | 5,751.25 | 1,478.75 | 23,440.74 |
| Farm III | 15,633.24 | 6,802.64 | 21,088.75 | 5,420.00 | 48,944.63 |
| "Class C" water: | | | | | |
| Farm I | 4,042.05 | 1,758.28 | 2,881.39 | 742.73 | 9,424.45 |
| Farm II | 10,363.61 | 4,510.16 | 5,801.86 | 1,491.76 | 22,167.39 |
| Farm III | 14,267.23 | 6,208.23 | 21,274.33 | 5,467.70 | 47,217.49 |

[a]$1.62 per bushel.

[b]$0.94 per bushel.

[c]$0.385 per bushel.

[d]$0.495 per bushel.

FOOTNOTES

[1]U. S. Department of Commerce, Bureau of the Census, 1969 Census of Agriculture and 1959 Census of Agriculture, (U. S. Government Pringing Office, Washington, D.C.).

[2]It is recognized that dryland farms in the study area tend to diversify by producing grain sorghum, wheat for grain and small grain grazing. The normative results of the linear program indicate that profits are maximum by converting to the small grain grazing enterprise under expected yields and prices. Since the growth potential of firms is being analyzed, the organization maximizing profits is used for evaluation purposes although the resulting growth may be somewhat different than that obtained by using a more realistic dryland organization.

[3]Ron E. Shaffer and Vernon R. Eidman, "A Cost Study of Alternative Irrigation Systems in Northwestern Oklahoma" (unpub. manuscript, Department of Agricultural Economics, Oklahoma State University).

[4]Refer to Roy Edward Hatch, "Growth Potential and Survival Capability of Southern Plains Dryland Farms: A Simulation Analysis Incorporating Multiple-Goal Decision Making" (unpub. Ph.D. dissertation, Oklahoma State University, July, 1973), Appendix C, pp. 184-198.

# CHAPTER VI

## RESULTS OF THE ANALYSIS

The results of the analysis of firm growth and the decision process using multiple goals are presented in the following discussion. The format is based on the size and type of farm with specific emphasis on the water resource situations, initial land equity positions and age-of-operator situations. Thus, the order of presentation is Farm I with "Class A," "B" and "C" water, Farm II with the three water situations, Farm III with the same water conditions and the irrigated ranch with "Class A" water.

Crop farms I, II and III have an initial size of 640, 1,600 and 2,880 acres respectively, with 87 to 93 percent cropland. The ranch situation has an initial size of 7,040 acres of which about one-third is cropland. The water situations represent the initial thickness of the saturated aquifer in which "Class A" has 75 feet, "Class B" 250 feet and "Class C" has 450 feet of water. The extremes in land equity positions are 0 and 100 percent ownership for the renter and full owner, respectively, with the part owner beginning with 50 percent land ownership. Two age profiles of operators are evaluated for the initial ages of 25 and 45.

The results of each period indicate the year-end status of the production period in regard to farm size, percent owned, net worth, debt-asset ratio, the dominant, restrictive and secondary goals[1] and the resulting expansion strategy adopted as a result of the multiple goals decision process.

Clarification of the term "restrictive" will aid in explaining the decision process. Restrictive goals are those in the primary group which effectively prevent the selection of the strategy which best meets the dominant or alternative dominant goal. However, to be totally restrictive, the goal must prevent the selection of all four alternatives: "BUY," "RENT," "TRADE" or "NONE."[2] (The "TRADE" strategy trades or gives up rented land for buying.) The amount of land available for expansion in each decision period is 320 acres.

For purposes of consolidating the tables, initial equity positions are denoted by abbreviations of "F.O." for full owner, "P.O." for part owner and "Rent." for the tenant or renter. In addition, the goals are delineated by numbers where

#1 is to control more acreage;

#2 is to avoid being forced out of business;

#3 is to maintain or increase the family living standard;

#4 is to avoid years of low profits or losses;

#5 is to increase leisure time;

#6 is to increase net worth;

#7 is to reduce borrowing needs and

#8 is to make the most profit.

Reference A at the end of this chapter can be used as a guide also. For purposes of brevity, the primary group of goals is not listed but includes all except the secondary group.

The selection frequency of alternative strategies is each fourth period following the base period 1. Although the dominant (highest ranked) goal is given for each period, only those listed for the decision periods 1, 5, 9, 13, and 17 affect the selection process. When the dominant objective is tied between strategies, the alternative dominant goal is also listed.

## Farm I Results

The results for Farm I, the smallest crop farm situation to be analyzed, are presented by land equity positions of "Class A" water with the age 25 operator in Table XXI and the 45 year-old operator in the following Table XXII. The successive set, Tables XXV and XXVI, give the results of "Class B" water for the two age profiles and the last two Tables XXVII and XXVIII indicate the growth and decision processes in the "Class C" water situation for both ages of operators.

### The Effects of Beginning Age and Land Equity In "Class A" Water, Farm I

The results of various beginning land equity positions for the age 25 operator in Table XXI generally indicate that all beginning land equities result in economically viable firms for the twenty-year planning horizon, i.e., all of the situations increase in net worth. However, there is a slight decrease in net worth between periods ten and eleven because of the automatic adjustment in land values from the irrigated to the dryland operation. The economic life of the "Class A" water terminates in the tenth period and the resulting conversion to dryland crop farming causes the decrease in net worth by adjusting the cropland value.

TABLE XXI

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS
WITH MULTIPLE GOALS: FARM I, CLASS A WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 640 | 640 | 640 | 640 | 640 | 960 | 960 | 960 | 960 | 1,280 |
| | P. O. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| | Rent. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | P. O. | 50 | 33 | 33 | 33 | 33 | 50 | 50 | 50 | 50 | 60 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 25 | 25 | 25 | 25 | 20 |
| Net Worth | F. O. | $133,390 | $142,060 | $150,850 | $159,990 | $168,280 | $181,430 | $193,170 | $204,850 | $215,800 | $230,030 |
| | P. O. | $ 79,098 | $ 92,906 | $106,360 | $120,300 | $133,170 | $149,840 | $164,980 | $180,300 | $194,880 | $210,280 |
| | Rent. | $ 25,640 | $ 37,945 | $ 49,724 | $ 61,905 | $ 73,026 | $ 87,832 | $101,872 | $116,199 | $129,814 | $143,653 |
| Debt-Asset Ratio | F. O. | 0.18 | 0.14 | 0.09 | 0.04 | 0.01 | 0.24 | 0.24 | 0.17 | 0.16 | 0.27 |
| | P. O. | 0.18 | 0.13 | 0.08 | 0.00 | 0.00 | 0.21 | 0.20 | 0.11 | 0.07 | 0.23 |
| | Rent. | 0.18 | 0.12 | 0.06 | 0.00 | 0.00 | 0.27 | 0.28 | 0.17 | 0.12 | 0.08 |
| Dominant Goals[2] | F. O. | #2 | #2 | #2 | #4 | #4 | #2 | #4 | #4 | #4 | #2 |
| | P. O. | #8 | #8 | #6 | #6 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #8 | #8 | #8 | #6 | #6 | #4 | #4 | #4 | #6 | #6 |
| Restrictive Goals[3] | F. O. | – | – | – | – | – | – | – | – | – | – |
| | P. O. | (#2) | – | – | – | – | – | – | – | – | – |
| | Rent. | (#2, #7) | – | – | – | – | – | – | – | – | – |
| Secondary Goals[4] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #8, #3, #7, #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | NONE | – | – | – | BUY | – | – | – | BUY | – |
| | P. O. | RENT | – | – | – | BUY | – | – | – | BUY | – |
| | Rent. | RENT | – | – | – | BUY | – | – | – | RENT | – |

TABLE XXI(Continued)

| Item | Land Equity 1/ | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 1,280 | 1,280 | 1,280 | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 |
| | P. O. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| Percent Owner | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 83 | 83 | 83 |
| | P. O. | 60 | 60 | 60 | 67 | 67 | 67 | 67 | 71 | 71 | 71 |
| | Rent. | 20 | 20 | 20 | 33 | 33 | 33 | 33 | 43 | 43 | 43 |
| Net Worth | F. O. | $193,110 | $205,620 | $219,040 | $234,070 | $248,760 | $264,110 | $278,810 | $297,350 | $316,140 | $335,960 |
| | P. O. | $185,580 | $196,850 | $209,060 | $223,850 | $238,510 | $253,870 | $269,640 | $288,960 | $309,660 | $331,480 |
| | Rent. | $140,104 | $149,262 | $159,298 | $173,053 | $186,627 | $200,822 | $215,371 | $232,262 | $250,398 | $269,528 |
| Debt-Asset Ratio | F. O. | 0.21 | 0.10 | 0.03 | 0.14 | 0.13 | 0.08 | 0.05 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.17 | 0.01 | 0.00 | 0.06 | 0.06 | 0.00 | 0.00 | 0.05 | 0.02 | 0.00 |
| | Rent. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dominant Goals 2/ | F. O. | #2 | #4 | #4 | #2 | #2 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #6 | #6 | #6 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals 4/ | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | RENT | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | BUY | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

TABLE XXII

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM I, CLASS A WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Farm Size | F. O. | 640 | 960 | 960 | 960 | 960 | 960 | 960 | 960 | 960 | 960 |
| | P. O. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| | Rent. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | P. O. | 50 | 33 | 33 | 33 | 33 | 50 | 50 | 50 | 50 | 40 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 25 | 25 | 25 | 25 | 20 |
| Net Worth | F. O. | $133,710 | $147,620 | $161,160 | $174,380 | $187,230 | $199,910 | $213,380 | $225,890 | $238,720 | $251,790 |
| | P. O. | $ 79,469 | $ 92,444 | $105,480 | $118,910 | $132,170 | $149,220 | $165,210 | $181,410 | $196,920 | $213,460 |
| | Rent. | $ 25,922 | $ 37,385 | $ 48,746 | $ 60,496 | $ 71,968 | $ 87,152 | $101,070 | $115,260 | $129,630 | $143,870 |
| Debt-Asset Ratio | F. O. | 0.18 | 0.35 | 0.31 | 0.28 | 0.25 | 0.20 | 0.18 | 0.10 | 0.08 | 0.02 |
| | P. O. | 0.18 | 0.13 | 0.08 | 0.001 | 0.00 | 0.21 | 0.20 | 0.11 | 0.06 | 0.04 |
| | Rent. | 0.18 | 0.12 | 0.07 | 0.00 | 0.00 | 0.27 | 0.28 | 0.17 | 0.13 | 0.10 |
| Dominant Goals[2/] | F. O. | #4 | #3 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #4 | #4 | #4 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #8 | #8 | #8 | #8 | #8 | #8 | #8 | #8 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | #5 | - | - | - | #5 | - |
| | P. O. | (#2) | - | - | - | - | - | - | - | - | - |
| | Rent. | (#2, #7) | - | - | - | - | - | - | - | (#2) | - |
| Secondary Goals[4/] | F. O. | #5 | #5 | #6, #5, #8, #7 | #7 | #7 | #7 | #2, #5, #8, #1, #3 | #1, #3, #7 | #1, #3, #7 | #1, #3, #7 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #1, #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #1, #5 | #1, #5 |
| Expansion Strategy | F. O. | BUY | - | - | - | NONE | - | - | - | NONE | - |
| | P. O. | RENT | - | - | - | BUY | - | - | - | RENT | - |
| | Rent. | RENT | - | - | - | BUY | - | - | - | RENT | - |

TABLE XXII (Continued)

| Item | Land Equity[1/] | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 | 1,600 | 1,600 |
| | P. O. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| Percent Owned | F. O. | 100 | 100 | 100 | 75 | 75 | 75 | 75 | 80 | 80 | 80 |
| | P. O. | 40 | 40 | 40 | 50 | 50 | 50 | 50 | 57 | 57 | 57 |
| | Rent. | 20 | 20 | 20 | 33 | 33 | 33 | 33 | 43 | 43 | 43 |
| Net Worth | F. O. | $225,720 | $239,210 | $253,660 | $271,020 | $289,210 | $308,170 | $327,730 | $348,170 | $368,590 | $390,260 |
| | P. O. | $200,440 | $213,440 | $227,500 | $244,210 | $260,900 | $278,370 | $297,340 | $319,050 | $342,240 | $366,680 |
| | Rent. | $141,270 | $151,420 | $162,500 | $177,180 | $191,730 | $206,940 | $222,650 | $240,780 | $260,220 | $280,720 |
| Debt-Asset Ratio | F. O. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dominant Goals[2/] | F. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | P. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals[4/] | F. O. | #5 | #5 | #5 | #1, #5 | #5, #1 | #3, #5, #1 | #3, #5, #1 | #5, #3, #1 | #5, #3, #1 | #8, #7, #2, #5, #1 |
| | P. O. | #1, #5 | #1, #5 | #1, #5 | #1, #5 | #1, #5 | #1, #5 | #3, #2, #1, #5 | #2, #3, #1, #5 | #2, #3, #1, #5 | #2, #3, #1, #5 |
| | Rent. | #1, #5 | #1, #5 | #1, #5 | #1, #5 | #1, #5 | #1, #5 | #1, #5 | #1, #5 | #1, #5 | #1, #5 |
| Expansion Strategy | F. O. | - | - | RENT | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | BUY | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

TABLE XXIII

COMPARISON OF FAMILY CONSUMPTION PATTERNS FOR AGE 25 AND 45 OPERATORS BY INITIAL LAND EQUITY POSITION, FARM I, CLASS A WATER

| Period | Full Ownership | | Part Ownership | | Renter | |
|---|---|---|---|---|---|---|
| | Age 25 | Age 45 | Age 25 | Age 45 | Age 25 | Age 45 |
| 1 | $6,000 | $6,000 | $6,000 | $6,000 | $6,000 | $6,000 |
| 2 | 7,052 | 8,798 | 7,521 | 8,777 | 7,501 | 8,756 |
| 3 | 7,655 | 8,790 | 8,141 | 8,769 | 8,120 | 8,748 |
| 4 | 7,629 | 8,781 | 8,132 | 8,760 | 8,110 | 8,738 |
| 5 | 8,229 | 8,140 | 8,747 | 8,119 | 8,724 | 8,096 |
| 6 | 8,743 | 8,123 | 9,300 | 8,672 | 9,277 | 8,649 |
| 7 | 8,727 | 7,479 | 9,172 | 7,917 | 9,149 | 7,893 |
| 8 | 9,705 | 7,458 | 9,017 | 7,762 | 8,993 | 7,737 |
| 9 | 8,681 | 7,434 | 8,871 | 7,616 | 8,846 | 7,590 |
| 10 | 8,879 | 7,420 | 10,301 | 9,046 | 10,276 | 9,020 |
| 11 | 8,055 | 6,377 | 8,388 | 7,134 | 8,363 | 7,107 |
| 12 | 8,041 | 6,367 | 8,378 | 7,129 | 8,361 | 7,106 |
| 13 | 8,046 | 6,372 | 8,383 | 7,134 | 8,365 | 7,110 |
| 14 | 8,392 | 6,808 | 8,639 | 7,391 | 8,620 | 7,366 |
| 15 | 8,398 | 6,815 | 8,645 | 7,397 | 8,625 | 7,372 |
| 16 | 8,403 | 6,822 | 8,651 | 7,404 | 8,631 | 7,377 |
| 17 | 8,409 | 6,829 | 8,657 | 7,410 | 8,636 | 7,383 |
| 18 | 8,666 | 7,178 | 8,826 | 7,581 | 8,805 | 7,552 |
| 19 | 8,673 | 7,186 | 8,833 | 7,589 | 8,811 | 7,559 |
| 20 | 8,680 | 7,194 | 8,841 | 7,598 | 8,818 | 7,567 |
| Total | 164,063 | 146,371 | 171,443 | 155,205 | 171,031 | 154,726 |
| Average | 8,203 | 7,318 | 8,572 | 7,760 | 8,552 | 7,736 |

TABLE XXIV

COMPARISON OF INTEREST EARNINGS FOR AGE 25 AND 45 OPERATORS BY INITIAL LAND EQUITY POSITION, FARM I, CLASS A WATER

| Period | Full Ownership | | Part Ownership | | Renter | |
|---|---|---|---|---|---|---|
| | Age 25 | Age 45 | Age 25 | Age 45 | Age 25 | Age 45 |
| | dollars | | | | | |
| 1 | --- | --- | --- | --- | --- | --- |
| 2 | --- | --- | --- | --- | --- | --- |
| 3 | --- | --- | --- | --- | --- | --- |
| 4 | --- | --- | --- | --- | 241.80 | 203.66 |
| 5 | --- | --- | 117.07 | 49.91 | 441.15 | 296.08 |
| 6 | --- | --- | --- | --- | --- | --- |
| 7 | --- | --- | --- | --- | --- | --- |
| 8 | --- | --- | --- | --- | --- | --- |
| 9 | --- | --- | --- | --- | --- | --- |
| 10 | --- | --- | --- | --- | --- | --- |
| 11 | --- | 1,524.20 | --- | 870.64 | 235.35 | 250.74 |
| 12 | --- | 2,759.70 | --- | 2,686.20 | 1,885.70 | 1,954.50 |
| 13 | --- | 3,666.00 | 615.85 | 3,672.30 | 2,675.75 | 2,798.60 |
| 14 | --- | 4,579.20 | --- | 2,356.80 | 1,536.10 | 1,334.00 |
| 15 | --- | 5,009.60 | --- | 2,472.70 | 1,225.65 | 1,348.20 |
| 16 | --- | 5,800.30 | --- | 3,265.30 | 1,804.15 | 2,033.50 |
| 17 | --- | 6,402.50 | 405.36 | 3,857.60 | 2,256.40 | 2,513.30 |
| 18 | 39.30 | 4,832.80 | --- | 2,837.20 | 1,320.65 | 1,330.20 |
| 19 | 379.71 | 5,285.00 | --- | 3,445.00 | 1,385.05 | 1,758.90 |
| 20 | 1,396.00 | 6,515.60 | 825.36 | 4,681.40 | 2,321.30 | 2,807.40 |
| Total | 1,815.01 | 46,374.90 | 1,963.64 | 30,191.05 | 17,329.05 | 18,629.08 |

TABLE XXV

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM I, CLASS B WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size, Acres | F. O. | 640 | 640 | 640 | 640 | 640 | 960 | 960 | 960 | 960 | 1,280 |
| | P. O. | 640 | 640 | 640 | 640 | 640 | 960 | 960 | 960 | 960 | 1,280 |
| | Rent. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 75 |
| | P. O. | 50 | 50 | 50 | 50 | 50 | 67 | 67 | 67 | 67 | 50 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Net Worth | F. O. | $184,660 | $202,220 | $216,010 | $230,970 | $245,540 | $266,490 | $285,480 | $305,590 | $325,870 | $350,000 |
| | P. O. | $105,780 | $117,450 | $127,120 | $137,920 | $148,100 | $164,130 | $177,840 | $192,350 | $206,680 | $224,490 |
| | Rent. | $ 26,701 | $ 38,418 | $ 48,238 | $ 59,437 | $ 70,086 | $ 82,902 | $ 97,233 | $108,890 | $119,420 | $135,670 |
| Debt-Asset Ratio | F. O. | 0.15 | 0.11 | 0.08 | 0.02 | 0.005 | 0.21 | 0.20 | 0.14 | 0.11 | 0.10 |
| | P. O. | 0.17 | 0.12 | 0.08 | 0.04 | 0.03 | 0.32 | 0.32 | 0.24 | 0.23 | 0.22 |
| | Rent. | 0.24 | 0.13 | 0.08 | 0.04 | 0.10 | 0.04 | 0.0 | 0.03 | 0.09 | 0.31 |
| Dominant Goals[2/] | F. O. | #2 | #2 | #4 | #4 | #4 | #1 | #1 | #1 | #1, #2 | #1 |
| | P. O. | #2 | #4 | #4 | #4 | #4 | #1 | #1 | #4 | #4 | #4 |
| | Rent. | #8 | #8 | #8 | #6 | #4 | #6 | #6 | #4 | #4 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | (#2) | - |
| | Rent. | (#2,#7) | - | - | - | (#2) | - | - | - | - | - |
| Secondary Goals[4/] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | NONE | - | - | - | BUY | - | - | - | RENT | - |
| | P. O. | NONE | - | - | - | BUY | - | - | - | RENT | - |
| | Rent. | RENT | - | - | - | RENT | - | - | - | BUY | - |

TABLE XXV (Continued)

| Item | Land Equity 1/ | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size, Acres | F. O. | 1,280 | 1,280 | 1,280 | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 |
| | P. O. | 1,280 | 1,280 | 1,280 | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| Percent Owned | F. O. | 75 | 75 | 75 | 80 | 80 | 80 | 80 | 83 | 83 | 83 |
| | P. O. | 50 | 50 | 50 | 60 | 60 | 60 | 60 | 67 | 67 | 67 |
| | Rent. | 20 | 20 | 20 | 33 | 33 | 33 | 33 | 43 | 43 | 43 |
| Net Worth | F. O. | $372,400 | $346,600 | $366,920 | $394,620 | $420,110 | $446,690 | $473,040 | $505,030 | $535,050 | $565,840 |
| | P. O. | $240,250 | $224,760 | $240,370 | $261,900 | $284,170 | $307,200 | $329,780 | $357,570 | $383,150 | $409,660 |
| | Rent. | $152,690 | $152,400 | $167,011 | $188,080 | $212,380 | $234,120 | $256,410 | $282,810 | $312,060 | $337,310 |
| Debt-Asset Ratio | F. O. | 0.04 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | P. O. | 0.17 | 0.12 | 0.0 | 0.12 | 0.09 | 0.0 | 0.0 | 0.04 | 0.02 | 0.0 |
| | Rent. | 0.26 | 0.25 | 0.09 | 0.22 | 0.10 | 0.07 | 0.0 | 0.14 | 0.04 | 0.007 |
| Dominant Goals 2/ | F. O. | #4 | #4 | #4 | #4 | #4 | #4 | #1, #4 | #1 | #1 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #6 | #6 | #6 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals 4/ | F. O. | #5 | #5 | #5 | #5 | #5 | #3, #5 | #3, #5 | #5, #3 | #5, #3 | #3 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | BUY | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

TABLE XXVI

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM I, CLASS B WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity 1/ | Time Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Farm Size | F. O. | 640 | 960 | 960 | 960 | 960 | 960 | 960 | 960 | 960 | 1,280 |
| | P. O. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| | Rent. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | P. O. | 50 | 33 | 33 | 33 | 33 | 50 | 50 | 50 | 50 | 40 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Net Worth | F. O. | $185,060 | $206,070 | $221,930 | $239,540 | $257,430 | $276,460 | $299,470 | $320,070 | $340,930 | $364,660 |
| | P. O. | $106,130 | $121,870 | $135,160 | $148,990 | $163,220 | $181,850 | $202,430 | $219,650 | $235,840 | $258,190 |
| | Rent. | $ 26,985 | $ 37,861 | $ 47,164 | $ 57,916 | $ 68,853 | $ 82,038 | $ 97,203 | $108,790 | $120,040 | $137,200 |
| Debt-Asset Ratio | F. O. | 0.15 | 0.33 | 0.30 | 0.27 | 0.26 | 0.20 | 0.14 | 0.12 | 0.08 | 0.24 |
| | P. O. | 0.16 | 0.12 | 0.08 | 0.04 | 0.04 | 0.30 | 0.23 | 0.23 | 0.22 | 0.17 |
| | Rent. | 0.23 | 0.14 | 0.08 | 0.05 | 0.12 | 0.05 | 0.00 | 0.03 | 0.09 | 0.30 |
| Dominant Goals 2/ | F. O. | #4 | #3 | #3 | #3 | #3, #6 | #6 | #6 | #6 | #6 | #6 |
| | P. O. | #4 | #4 | #4 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #8 | #4 | #4 | #8 | #8 | #8 | #8 | #8 | #8 | #6 |
| Restrictive Goals 3/ | F. O. | – | – | – | – | #2 | – | – | – | – | – |
| | P. O. | (#2) | – | – | – | – | – | – | – | (#2) | – |
| | Rent. | (#2, #7) | – | – | – | (#2) | – | – | – | – | – |
| Secondary Goals 4/ | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #1, #5 | #5 |
| Expansion Strategy | F. O. | BUY | – | – | – | NONE | – | – | – | BUY | – |
| | P. O. | RENT | – | – | – | BUY | – | – | – | RENT | – |
| | Rent. | RENT | – | – | – | RENT | – | – | – | BUY | – |

TABLE XXVI (Continued)

| Item | Land Equity[1] | Time Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Farm Size | F. O. | 1,280 | 1,280 | 1,280 | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 |
| | P. O. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | P. O. | 40 | 40 | 40 | 50 | 50 | 50 | 50 | 57 | 57 | 57 |
| | Rent. | 20 | 20 | 20 | 33 | 33 | 33 | 33 | 43 | 43 | 43 |
| Net Worth | F. O. | $387,080 | $345,230 | $363,330 | $387,330 | $416,430 | $444,030 | $472,610 | $505,570 | $541,690 | $574,390 |
| | P. O. | $281,460 | $271,440 | $290,230 | $315,700 | $345,200 | $372,610 | $400,930 | $433,770 | $469,830 | $502,400 |
| | Rent. | $155,180 | $155,910 | $171,580 | $193,760 | $219,220 | $242,170 | $265,750 | $293,490 | $324,150 | $350,880 |
| Debt-Asset Ratio | F. O. | 0.19 | 0.15 | 0.06 | 0.12 | 0.04 | 0.00 | 0.00 | 0.004 | 0.00 | 0.00 |
| | P. O. | 0.12 | 0.05 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.26 | 0.24 | 0.07 | 0.20 | 0.08 | 0.05 | 0.00 | 0.11 | 0.008 | 0.00 |
| Dominant Goals[2] | F. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | P. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals[4] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #5 | #5 | #1, #5 | #2, #3, #1, #5 | #2, #3, #1, #5 | #2, #3, #1, #5 | #2, #3, #1, #5 | #2, #1, #3, #5 | #2, #1, #5, #3 | #1, #2, #5, #3 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | BUY | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

TABLE XXVII

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM I, CLASS C WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size, Acres | F. O. | 640 | 640 | 640 | 640 | 640 | 960 | 960 | 960 | 960 | 1,280 |
| | P. O. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| | Rent. | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | P. O. | 50 | 33 | 33 | 33 | 33 | 25 | 25 | 25 | 25 | 20 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $152,340 | $166,220 | $180,610 | $196,270 | $211,160 | $230,529 | $251,690 | $265,729 | $279,340 | $294,720 |
| | P. O. | $ 86,329 | $ 97,732 | $107,020 | $117,300 | $126,620 | $136,840 | $143,750 | $148,980 | $152,520 | $157,990 |
| | Rent. | $ 20,034 | $ 20,399 | $ 20,252 | $ 20,100 | $ 18,336 | $ 16,170 | $ 12,626 | $ 9,033 | $ 4,207 | ($ 947) |
| Debt-Asset Ratio | F. O. | 0.18 | 0.13 | 0.09 | 0.05 | 0.06 | 0.27 | 0.26 | 0.23 | 0.22 | 0.35 |
| | P. O. | 0.19 | 0.15 | 0.10 | 0.06 | 0.10 | 0.13 | 0.16 | 0.12 | 0.18 | 0.16 |
| | Rent. | 0.25 | 0.18 | 0.13 | 0.09 | 0.40 | 0.44 | 0.63 | 0.63 | 0.84 | NA |
| Dominant Goals[2/] | F. O. | #2 | #2 | #2 | #4 | #4 | #1 | #1 | #1 | #1, #4 | #3 |
| | P. O. | #8 | #6 | #6 | #4 | #4 | #6 | #4 | #6 | #4 | #6 |
| | Rent. | #8 | #8 | #8 | #8 | #4 | #4 | #4 | #4 | #4 | #4 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | (#2, #7) | - | - | - | (#2, #7) | - | - | - | (#2, #7) | - |
| | Rent. | #2, #7 | - | - | - | #2, #7 | - | - | - | #2, #7 | - |
| Secondary Goals[4/] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #3, #5 |
| Expansion Strategy | F. O. | NONE | - | - | - | BUY | - | - | - | BUY | - |
| | P. O. | RENT | - | - | - | RENT | - | - | - | RENT | - |
| | Rent | NONE | - | - | - | NONE | - | - | - | NONE | - |

TABLE XXVII (Continued)

| Item | Land Equity 1/ | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size, Acres | F. O. | 1,280 | 1,280 | 1,280 | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 |
| | P. O. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 |
| | Rent. | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 |
| Percent Owned | F. O. | 100 | 100 | 100 | 80 | 80 | 80 | 80 | 83 | 83 | 83 |
| | P. O. | 20 | 20 | 20 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $309,540 | $325,990 | $343,610 | $364,300 | $381,610 | $400,090 | $418,770 | $443,100 | $463,290 | $484,680 |
| | P. O. | $161,350 | $165,590 | $170,210 | $178,580 | $183,250 | $188,000 | $192,120 | $196,940 | $200,130 | $203,330 |
| | Rent. | ($ 5,916) | ($ 10,675) | ($ 15,489) | ($ 20,089) | ($ 26,494) | ($ 33,429) | ($ 41,833) | ($ 50,292) | ($ 60,569) | ($ 71,774) |
| Debt-Asset Ratio | F. O. | 0.30 | 0.26 | 0.24 | 0.19 | 0.19 | 0.15 | 0.13 | 0.22 | 0.22 | 0.18 |
| | P. O. | 0.09 | 0.00 | 0.02 | 0.29 | 0.33 | 0.31 | 0.31 | 0.27 | 0.30 | 0.28 |
| | Rent. | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dominant Goals 2/ | F. O. | #3 | #3 | #3, #1, #2 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 |
| | P. O. | #6 | #6 | #6 | #4 | #3 | #3 | #3, #4 | #4 | #3 | #4 |
| | Rent. | #6 | #8 | #6 | #8 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | #2, #7 | - | - | - |
| | Rent. | - | - | #2, #7 | - | - | - | #2, #7 | - | - | - |
| Secondary Goals 4/ | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #3 | #5 | #5 | #5 | #4, #5 | #5 | #4, #5 | #5 | #4, #5 | #5 |
| Expansion Strategy | F. O. | - | - | RENT | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | NONE | - | - | - |
| | Rent. | - | - | NONE | - | - | - | NONE | - | - | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers. Net worth in parentheses refers to negative values and NA means not applicable.

TABLE XXVIII

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM I, CLASS C WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity 1/ | Time Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Farm Size | F. O. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| | P. O. | 640 | 960 | 960 | 960 | 960 | 1,280 | 1,280 | 1,280 | 1,280 | 1,600 |
| | Rent. | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 75 | 75 | 75 | 75 | 80 |
| | P. O. | 50 | 33 | 33 | 33 | 33 | 25 | 25 | 25 | 25 | 20 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $152,660 | $169,300 | $187,540 | $207,970 | $228,410 | $249,800 | $269,090 | $282,320 | $294,150 | $309,770 |
| | P. O. | $ 86,611 | $ 97,184 | $105,990 | $115,690 | $125,330 | $135,980 | $143,790 | $149,890 | $154,360 | $160,850 |
| | Rent. | $ 20,280 | $ 19,650 | $ 18,961 | $ 18,230 | $ 16,852 | $ 15,101 | $ 12,534 | $ 9,978 | $ 6,313 | $ 2,442 |
| Debt-Asset Ratio | F. O. | 0.18 | 0.37 | 0.33 | 0.29 | 0.29 | 0.27 | 0.26 | 0.22 | 0.23 | 0.33 |
| | P. O. | 0.19 | 0.15 | 0.10 | 0.06 | 0.10 | 0.13 | 0.16 | 0.12 | 0.18 | 0.15 |
| | Rent. | 0.25 | 0.19 | 0.14 | 0.10 | 0.42 | 0.46 | 0.63 | 0.61 | 0.77 | 0.88 |
| Dominant Goals 2/ | F. O. | #4 | #3 | #4 | #4 | #4 | #4 | #6 | #6 | #6 | #6 |
| | P. O. | #4 | #4 | #4 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #8 | #8 | #8 | #8 | #8 | #8 | #8 | #8 | #8 | #8 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | (#2) | - | - | - | - | - |
| | P. O. | (#2, #7) | - | - | - | (#2, #7) | - | - | - | (#2, #7) | - |
| | Rent. | #2, #7 | - | - | - | #2, #7 | - | - | - | #2, #7 | - |
| Secondary Goals 4/ | F. O. | #5 | #5 | #7, #5, #8 | #7, #5, #8 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5, #1 | #5, #1 | #5, #1 | #5, #1 | #5, #1 |
| Expansion Strategy | F. O. | BUY | - | - | - | RENT | - | - | - | BUY | - |
| | P. O. | RENT | - | - | - | RENT | - | - | - | RENT | - |
| | Rent. | NONE | - | - | - | NONE | - | - | - | NONE | - |

TABLE XXVIII (Continued)

| Item | Land Equity[1/] | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| | P. O. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| | Rent. | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 |
| Percent Owned | F. O. | 80 | 80 | 80 | 83 | 83 | 83 | 83 | 86 | 86 | 86 |
| | P. O. | 20 | 20 | 20 | 33 | 33 | 33 | 33 | 29 | 29 | 29 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $324,160 | $340,180 | $357,250 | $380,170 | $399,140 | $419,190 | $439,610 | $461,660 | $481,540 | $502,490 |
| | P. O. | $165,310 | $170,770 | $176,620 | $186,280 | $192,400 | $198,690 | $204,410 | $208,100 | $209,230 | $210,520 |
| | Rent. | ($ 1,187) | ($ 4,545) | ($ 7,860) | ($ 10,890) | ($ 15,377) | ($ 20,211) | ($ 26,363) | ($ 32,395) | ($ 39,992) | ($ 48,303) |
| Debt-Asset Ratio | F. O. | 0.29 | 0.24 | 0.23 | 0.31 | 0.30 | 0.27 | 0.25 | 0.31 | 0.31 | 0.28 |
| | P. O. | 0.08 | 0.00 | 0.02 | 0.29 | 0.31 | 0.30 | 0.30 | 0.27 | 0.32 | 0.29 |
| | Rent. | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dominant Goals[2/] | F. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | P. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #8 | #8 | #6 | #8 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | (#2, #7) | - | - | - |
| | Rent. | - | - | #2, #7 | - | - | - | #2, #7 | - | - | - |
| Secondary Goals[4/] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #1, #5 | #1, #5 | #1, #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5, #1 | #1 | #2, #5, #4, #1 | #1 | #3 | #4 | #3, #4 | #4, #1 | #1, #4 | #1, #4 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | RENT | - | - | - |
| | Rent. | - | - | NONE | - | - | - | NONE | - | - | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers. Net worth in parentheses refer to negative values and N.A. means not applicable.

The increases in net worth for the full owner is $202,570, the part owner $252,382 and the renter $243,888. However, the full owner does not expand in period one whereas the other situations expand 320 acres in each decision period. The reluctance of the full owner to expand in the first period is due to the dominant goal #2 of "avoiding being forced out of business." Thus, the strategy selection is based on the plan which minimizes the debt-asset ratio. The other equity positions begin with a dominant goal of "making the most profits," #8, in the first period but rent land because the debt-asset ratio associated with purchasing land exceeds the maximum satisficing level of .40 indicated by listing the goals in parentheses. (The goals in totally restrictive situations where "NONE" is selected are indicated by no parentheses.)

In decision period five, all situations select the alternative to purchase land but the renter bases his decision on goal #6, "increase net worth," whereas the other two select it on the basis of "avoiding years of low profits or losses," goal #4. The dominant goals for each equity situation are identical for decision periods nine and 13 but the renter increases net worth $72.00 by selecting the rental option in lieu of buying in period nine. All three purchase land in the thirteenth period.

By period 17, all equity situations are pursuing the same goal of "avoiding years of low profits or losses." However, the full owner elects to rent instead of buy since the expected returns to fixed resources, the decision criterion for goal #4, from renting exceed the purchase option by $51.00.

The situations encounter no totally restrictive conditions causing the operator to continue with the present organization for lack of a better alternative. The predominant secondary goal is increasing leisure time, #5.

Each beginning land equity position terminates in twenty years with a part ownership status and no outstanding debts. However, the full owner maintains his original tenure status until the last decision period in which he rents 320 of 1,920 acres. The part owner and renter increase their land equity positions from the respective 50 and zero percent to 71 and 43 percent. The part owner began with 320 acres owned and terminates with 1,600 acres owned of 2,240 acres operated. The tenant or renter situation began with all rented land and purchases 960 acres of the 2,240-acre operation.

In summary, the dominant objectives are generally consistent and relatively stable over time. The least stability is shown by the full owner which begins by "avoiding being forced out of business" and changes to "avoiding years of low profits or losses" but temporarily reverts to the original objective following each purchase of additional land. The part owner quickly shifts to "increase net worth" and stabilizes with "avoiding years of low profits or losses" after the fourth period. The renter follows a similar course of action but does not stabilize with the latter goal until period 14.

In the case of the age 45 operator, again all starting equity positions result in successful operations over the twenty-year period. The full owner gains $256,550 in worth, the part owner $287,211 and the renter $254,798. Other similarities between the two age profiles involve the same ending tenure status of part ownership and the reluctance of the full owner to expand at each opportunity as did the other equity situations.

However, the contrasting goal structures for the older operator result in different sequences of dominant goals, some totally restrictive goals and a variety of secondary goals. In period one, both the full and part owners begin with goal #4 to "avoid years of low profits or losses" and only the renter desires to "make the most profits." The part owner and renter are again prevented from purchasing land because of debt-asset ratio limitations whereas the full owner is able to buy an additional 320 acres which immediately results in a structural change in goals as before. Goal #3, to "maintain or increase family living" temporarily becomes the dominant goal in period two. Thereafter, until period 11, the original goal, #4, remains the dominant goal. Goal #6, "increase net worth," becomes the stable dominant goal beginning in the eleventh period.

All alternatives are rejected on the basis of inadequate leisure time for the 45 year-old full owner in decision periods five and nine. The option to continue with the present organization, "NONE," is selected until the leisure time goal is no longer restrictive. At this time, the conversion to dryland operations allows enough leisure time to enable selecting the rental and purchase strategies in periods 13 and 17 respectively. The rental option in period 13 results in a periodic net worth increase of $526.00 over buying land.

The strategies selected by the part owner and renter are identical for each decision period. In contrast to the beginning period's choices to rent land because of excessive debt-asset ratios, the common choice to rent in period nine is based on "increasing net worth." The selection results in the part owner increasing his worth position by $69.00 and the renter by $87.00 for the next production period.

The dominant goals over time of the part owner and renter are stable and predominantly reflect the common objective of "increasing net worth." The part owner changes from the goal of "avoiding years of low profits or losses" in the fourth period to "increasing net worth" and the renter changes from "making the most profits" in the ninth period to the same goal.

A variety of secondary goals occur for all initial equity positions with "leisure time," "controlling more acres," "reducing borrowing needs" and "increasing the family living standard" recurring much of the time.

In summary, the age 45 operator gains more net worth than the 25 year old operator for the three beginning land equity positions. The relative increase is partially due to a reduction in the average family consumption of over $800 per year. However, Table XXIII indicates little difference in the average annual consumption between beginning equity situations for either the age 25 or age 45 operators. Consumption under the full owner situations is slightly less than the other equity situations because of the full owners' tendency to expand less in size. The consumption function is highly dependent on gross farm income which, in turn, is directly related to the size of operation.

The other factor resulting in greater gains of net worth by the older operator is interest earnings on savings, Table XXIV. For example, the 45 year old full owner earns a total of $44,460 more in interest payments than the age 25 full owner. Similarly, the age 45 part owner earns $28,227 more than the corresponding 25 year old part owner situation but the older tenants earnings only exceed the younger tenant by $1,300. Most of these earnings occur and accumulate in the latter half of the planning horizon and coupled with lower consumption result in significantly greater gains.

## The Effects of Beginning Age and Land Equity in "Class B" Water, Farm I

The "Class B" water situation, unlike "A" does not convert to dryland operations. However, there is also a point in which net worth decreases similar to the "Class A" situation. The reduction in worth in period 12 for the "Class B" situations is caused by the conversion of irrigated small grain grazing to dryland small grain grazing and the accompanying adjustment in the land asset values.

The age 25 operator in Table XXV begins with the dominant goal #2 of "avoiding being forced out of business" for both equity positions of full and part owner. Thus, the debt-asset ratio is minimized by electing to continue with the present organization. The tenant, however, chooses the rental strategy based on "making the most profits," #8, since purchasing land exceeds the .40 limit on the debt-asset ratio of goal #2 and the borrowing needs limitation of goal #7 (indicated in parentheses since the limitations only affect the selection of one plan) Purchasing more land is also prevented in period five, but, afterwards, the purchase option is selected for each decision period.

The part owner and full owner follow identical strategies over the planning horizon. Each buys land in decision periods 5, 13, and 17. The part owner is prevented from buying in period nine because of the limiting debt-asset ratio. The full owner's decision to rent is more complex since the dominant goal of "controlling more acres" is tied between the two expansion plans, BUY and RENT. Thus, the first non-tied goal or alternative dominant goal of "avoiding being forced out of business," #2, minimizes the debt-asset ratio of the two expansion alternatives as pre-selected by the dominant goal. Similar conditions exist in the seventeenth period where "controlling more acres" is again the dominant goal but "avoiding years of low profits or losses," the alternative dominant goal #4, selects the purchase option.

No totally restrictive decisions are encountered in any of the periods. The predominant secondary objective is goal #5, "increase leisure time." The dominant goals over the periods indicate some instability particularly in the full owner and tenant situations. In the first two periods, the full owner pursues "avoiding being forced out of business" and the next three "avoiding years of low profits or losses." "Controlling more acres" is the dominant objective in the following periods 6 to 10 and 17 to 20 with a temporary reversion to "avoiding years of low profits or losses" in periods 11 to 16. The tenant began in periods one to three by "making the most profits" and then alternated between goal #6 of "increasing net worth" and "avoiding years of low profits or losses," #4, until the fourteenth period. Thereafter, the latter goal remains dominant.

The part owner's objectives are relatively stable. After the initial objective, in period one, of "avoiding being forced out of business," the primary objective is to "avoid years of low profits or losses" except in periods six and seven of "controlling more acres.'

The full owner and part owner situations are free of debt by the twentieth period even though an additional 320 acres is purchased at the end of period 17. The renter is the only situation which expands to the maximum size of 2,240 acres. The full owner and part owner do not expand in period one resulting in a terminal size of 1,920 acres. At the end of twenty years the farms have 83 percent, 67 percent and 43 percent of the land owned for the full owner, part owner and renter situations, respectively.

The results of the age 45 "Class B" water situation are in Table XXVI. All equity situations begin with the same dominant goals as in the "Class A" water situation of the 45 year-old operator. As a result, the same selection of alternatives is made in period one: the full owner purchases and the rental strategy is selected by the part owner and tenant since either the purchase option exceeds the debt-asset ratio limit of .40 or the limit on borrowing needs of goal #7 is exceeded. In period five, a set of special conditions now allowed for in the simulation program exist in the full owner situation. The two expansion plans BUY and RENT have the same values for the dominant goal to "increase family living." The choice to buy is based on the alternative dominant goal #6, "increase net worth."

However, after the selection is made, the purchase plan is found to be infeasible because of the debt-asset ratio limit of goal #2 (no parentheses since the decision is totally restrictive). Instead of selecting renting, the strategy of continuing with the present organization, NONE, is chosen until another decision period occurs. Incidentally, the purchase strategy is chosen in each successive period on the basis of the same goal to "increase net worth."

Likewise, the part owner, in period five, buys land to "increase net worth" but the renter elects to rent in order to "make the most profits" because the debt-asset ratio limit prevents buying. In period nine, the opposite selections are made by the part owner and renter for the same reasons. Afterwards, both purchase land in periods 13 and 17.

The dominant goals for all equity positions are relatively stable. The full owner switches from goal #4, "avoiding years of low profits or losses," to "increasing family living" in periods two through five and thereafter "increase net worth" is the dominant goal. The part owner likewise begins with "avoiding years of low profits or losses" and converts to "increasing net worth" in the fourth period. The renter reverts to the first period's goal of "making the most profits" in the fourth period when goal #4, to "avoid years of low profits or losses" is dominant in periods two and three. Then in period ten and thereafter "increase net worth" is dominant.

Only one completely restrictive decision prevents a distinct selection of one of the four alternative strategies. In period five, the full owner encounters a peculiar decision situation which the program is not designed to handle. The unrestrictive goals are predominantly "increase leisure time," "control more acres," "avoid being forced out of business" and "increase family living." In contrast to the age 45 operator in "Class A" water, "increasing leisure time" does not prevent expansion.

In summary, the 45 year-of-age operator, again as in the "Class A" water situation, has a greater ending net worth position in all equity situations than the age 25 operator. Similar to the previous water situation, the age 45 part owner gains more, $396,270, than the full owner's increase of $389,330 or the tenant's gain of $323,895. In contrast, the full owner 25 year-old operator, rather than the part owner as in "A" water, gains the most in net worth, $381,180, as compared to increases of $303,880 and $310,600 for the respective part owner and tenant situations. The part owner in "A" water excels in net worth gains because of the relative increase in accumulated land equity as a result of increased purchasing activity. However, in "B" water, the full owner terminates with more land equity since the starting equity position is initially greater than the other equity situations and no other situation purchases more land.

Consumption patterns and interest earnings between age profiles have much less influence on the differences in net worth gains in this water situation than in "A." Other primary factors are total net income earnings, income tax outlays and outstanding debts. The 45 year-old part owner, for example, rents 320 acres in the first period whereas the age 25 part owner does not expand the size of operation until later. As a result, an additional accumulation of over $85,000 cash is realized from increases in total net income earnings of over $148,000, about $18,000 more interest earnings, nearly $45,000 more income taxes paid, and $15,000 more family consumption (the residual is used for new and replaced equipment items). The remainder of the approximate $92,000 increase in net worth by the age 45 part owner consists of a net increase after depreciation in chattel assets of nearly $7,000.

The older full owner again earns more net income, nearly $70,000 which is converted to about $55,000 more assets most of which is land. However, about $26,000 more is paid in income taxes, $18,000 less interest is earned and about $12,000 less is consumed than the younger operator. The final net worth increase of the older operator after all of the extenuating circumstances is only about $8,000.

The renter situations earn almost no interest payments. The 45 year-old gains about $13,000 more in net worth due to about $16,000 less consumption, nearly $7,000 more income taxes and an outstanding real estate debt of over $2,000 on the part of the age 25 renter.

## The Effects of Beginning Age and Land Equity In "Class C" Water, Farm I

The "Class C" water situation develops a fully irrigated unit by the eighth period and maintains that level of irrigation for the rest of the planning horizon. The wells are large capacity and the initial investment cost for an additional well exceeds $21,000. As the lift increases over time, the larger replacement engines increase the cost to over $22,000 per well. In addition, the irrigated cropland value is $300 per acre; an increase of $25 over "Class B" and $50 over land in "Class A" water.

The combined effects of more expensive irrigation facilities and higher costs for land as compared to other water situations cause the tenant to lose net worth over the first few years. The 25 year-old encounters negative net worth or bankruptcy at the end of the tenth period (indicated by the parentheses surrounding $947 in Table XXVII). Thereafter, the results are presented only for evaluating the possibility of returning to a viable position, i.e., attaining a positive net worth.

Two totally restrictive objectives are encountered by both tenants; "avoiding being forced out of business," #2, and "reducing borrowing needs," #7, in the first three decision periods 1, 5 and 9. In the first period, the rental strategy would have been selected on the basis of "making the most profits" but the short-term borrowing needs of all plans exceed the chattel security value; the upper limit for goal #7. The debt-asset ratio limit is also restrictive. Consequently, the strategy of continuing with the current organization is adopted. The subsequent investment requirements for new and replaced irrigation facilities and machinery items are instrumental in preventing sufficient capital accumulation for exansion in either of the latter two decision periods 5 and 9.

However, the full owner and part owner equity situations are successful in maintaining viable operations and realize gains of over $332,300 and $117,000 in net worth, respectively. The full owner again pursues the dominant goal of "avoiding being forced out of business" while the part owner attempts to "make the most profits" in period one. Thus, they respectively elect to continue with the present organization and rent additional land. The debt-asset ratio limit disqualifies the purchase option in the latter case of the part owner.

In decision periods 5 and 9, they both are "avoiding years of low profits or losses," #4, but the part owner cannot purchase land because of the debt-asset ratio limit on goal #2 and the short-term borrowing needs exceed the limited chattel security of goal #7. However, in the thirteenth period the part owner is able to buy land to "increase net worth" but the full owner relies on the third-ranked alternative dominant goal #2 of "avoiding being forced out of business" to minimize the debt-asset ratio by renting instead of buying. By the last decision period 17, the part owner is restricted to continuing with the present organization by the goals of "avoiding being forced out of business and "reducing borrowing needs." The full owner can purchase an additional

320 acres at this time. Consequently each attain the same size of operation, 1,920 acres, but the full owner has 83 percent land equity and the part owner 33 percent. Each situation terminates with outstanding debts in the final period in contrast to their respective debt-free conditions in "A" and "B" water conditions.

As in other water situations for the age 25 operator, goal #5 to "increase leisure time" is the predominant secondary objective. However, the dominant objectives are relatively instable over time with the full owner predominantly pursuing goal #1 of "controlling more acres" after period 5. "Maintaining family living" appears in periods 10 through 13. Prior to period 6, "avoiding being forced out of business" is dominant in the first three periods and "avoiding years of low profits or losses" in periods 4 and 5.

The part owner equity situation is the most instable with "making the most profits" dominant in period 1, "increasing net worth" in periods 2, 3, 6, 8, and 10 through 13 and "avoiding years of low profits or losses" in all other periods except 15 through 17 and 19 when "maintaining family living" is most important.

The tenant situation indicates a higher degree of stability with "making the most profits" in periods 1 through 4 and "avoiding years of low profits or losses" until period 10 when net worth becomes significantly negative.

The 45 year-old operator's degree of success with the various beginning equity positions is similar to the younger operator, Table XXVIII. The age 45 tenant is bankrupt in period 11 and the full owner and part owner situations realize net worth gains of nearly $350,000 and $124,000 respectively.

The tenant's restrictions on expansion opportunities are again goals #2 and #7 for decision periods 1, 5 and 9. The limitations of debt-asset ratios and borrowing needs are simultaneously restrictive for all plans. Again a high degree of stability exists with respect to the dominant goal of "making the most profits" until net worth is significantly negative.

The full owner and part owner begin period 1 by selecting different strategies on the basis of the same objective of "avoiding years of low profits or losses." The part owner rents instead of buying land like the full owner because of the limiting debt-asset ratio and borrowing requirements associated with the purchase strategy. Similar conditions exist for decision periods 5, 9 and 17 but the purchasing strategy is chosen in period 13. The full owner is only prevented from buying in the fifth period in which the debt-asset ratio limit is exceeded by the purchasing alternative. Both situations expand to the limit of 2,240 acres. The full owner terminates with 86 percent land equity and the part owner 29 percent. Neither are free of debt in the ending period as they were in the "A" and "B" water situations.

The predominant secondary objective is again to "increase leisure time" and only the tenant equity position meets total restrictions on all alternative strategies. A high degree of stability occurs with respect to the dominant objectives over time. The full owner "avoids low profits or losses" predominantly for periods 1 through 6 and then converts to "increasing net worth." The part owner behaves similarly with the conversion to "increasing net worth" in the fourth period.

In summary, the tenant situations of both age profiles incur bankruptcy but the part and full owners maintain viable operations.

The older operator gains the most in net worth but only by margins of about $18,000 and $7,000 under initial land equity situations of 100 and 50 percent, respectively. None of the situations are able to accumulate sufficient capital to earn interest payments.

The total net income earnings are again important but the outstanding debts in the last period also are important factors in the comparative net worth gains. The age 25 full owner consumes $28,000 less than the older operator and pays about $22,000 less in income taxes but terminates with nearly $86,000 more debts than the older operator. The younger part owner situation is almost the same except for consuming about $1,500 more than the age 45 situation. About $11,000 less income taxes are paid, over the period but about $7,000 less outstanding debts exist in period 20 for the younger operator.

### Summary of Farm I Situations

The relative increases in acres owned and operated and net worth by age of operator, initial land equity position and the water situations for Farm I are given in Table XXIX. Generally, the eighteen situations result in economically viable firms with the exception of the renter situation in "Class C" water for both ages of operators. The additional investment costs of increasing and replacing irrigation facilities and machinery items prevents the adoption of expansion strategies. Primarily two objectives are restrictive with respect to adopting the expansion plans: the debt-asset ratios exceed the upper limit of .40 and the short-term borrowing needs exceed the security value of 75 percent of the current chattel assets.

TABLE XXIX

SUMMARY OF INCREASES IN ACRES OPERATED, LAND OWNED AND NET WORTH AS RELATED TO BEGINNING LAND EQUITY, AGE OF OPERATOR AND WATER SITUATION, FARM I[a]

| Water Situation | Age of Operator | Increase In Acres Operated | | | Increase In Acres Owned | | | Increase In Net Worth | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F.O. | P.O. | RENT. | F.O. | P.O. | RENT. | F.O. | P.O. | RENT. |
| | | ---acres--- | | | --- acres --- | | | --- dollars --- | | |
| A | 25 | 1,280 | 1,600 | 1,600 | 960 | 1,280 | 960 | 202,570 | 252,382 | 243,888 |
| | 45 | 960 | 1,600 | 1,600 | 640 | 960 | 960 | 256,550 | 287,211 | 254,798 |
| B | 25 | 1,280 | 1,280 | 1,600 | 960 | 960 | 960 | 381,180 | 303,880 | 310,609 |
| | 45 | 1,280 | 1,600 | 1,600 | 1,280 | 960 | 960 | 389,330 | 396,270 | 323,895 |
| C | 25 | 1,280 | 1,280 | 0 | 960 | 320 | 0 | 332,340 | 117,001 | (20,034)[b] |
| | 45 | 1,600 | 1,600 | 0 | 1,280 | 320 | 0 | 349,830 | 123,909 | (20,280)[b] |

[a]Increases are calculated from the base farm's ending situation of period 1, the base period.

[b]Loss in net worth of the base farm, period 1.

The results indicate that the maximum increase in size of 1,600 acres is attained by most of the part owners and all renters in "Class A" and "B" water. Of the full owners, only the age 45 full owner in "Class A" water increases to the maximum size. Age 25 operators, by minimizing their debt-asset ratio in period 1, are prevented from attaining the maximum size of operation and the age 45 full owner encounters leisure time restrictions in "Class A" water and a debt-asset ratio limitation in the "B" water situation.

The increases in owned acreage are less than the increases in size with one exception; the 45 year-old full owner in the "B" water situation. Thus, all successful situations with the previous exception terminate with part ownership in land resources. However, the terminal percentage of owned land is significantly higher for the full owners than the other equity situations. The most significant effect on the ability to purchase land is seen in "Class C" water where restrictions are encountered with respect to excessive borrowing needs.

As was previously indicated, increases in net worth are primarily affected by net income earnings, consumption patterns, interest earnings, income taxes and the debt repayment capacity. Generally, the age 45 operators gain more in net worth than the younger operators but the effects of beginning equity situations are mixed. Interest earnings are a significant factor in "Class A" water whereas the debt repayment capacity, net income earnings, income taxes and total consumption are most significant in the other water situations.

The "Class C" situations result in less gain in net worth than "Class B" water. The primary difference under full ownership is the outstanding real estate debts in the final period as well as the inability to purchase land under the part ownership situations of "C" water.

In comparing "Class A" increases in net worth to "Class B" the relative increases in owned acreage are generally comparable but the ending net worth in "A" is less because of the conversion to dryland. The associated adjustment in land asset value is reflected in net worth. Thus, a relatively lower gain in net worth occurs in "A" water regardless of the initial equity or age situation.

## Farm II Results

The Farm II situations begin with a larger size of operation, 1,600 acres, than the 640-acre Farm I situations. The same initial land equity situations of 100, 50 and 0 percent land ownership, ages 25 and 45 operators and "A," "B" and "C" water situations are analyzed. The larger operation provides a wider range in the initial net worth positions between equity situations. For example, the range in net worth for the age 25 operator with Farm I varies from a high of over $133,000 for the full owner to nearly $26,000 for the renter. In the Farm II situation, the 25 year-old full owner has $253,000 and the renter just over $26,000 net worth. The older age situation is almost identical. Consequently, the real estate security for supporting potential capital needs for Farm II is significantly greater than Farm I for the full owners and part owners but the renter has almost no advantage other than a marginal increase in chattel security.

Family consumption patterns are higher for Farm II situations since they are related to gross farm sales and net worth. Labor costs and operating capital requirements are also greater as are the investment costs for new and replaced irrigation facilities and machinery items. Farm overhead outlays, personal property and real estate taxes and possibly income taxes are also higher than Farm I conditions. However, most of these additional costs are offset by higher gross farm income and commodity program payments.

Items held in common between size situations are the family characteristics, off-farm income earnings and the four alternative strategies. The same limit in expansion of 320 acres each four-year period is imposed. Thus, the expansion alternatives are not equi-proportional between the initial size of operation for Farms I, II, III or the irrigated ranch.

In the interest of brevity, the complete tables of results similar to those previously presented for the Farm I situation of the twenty-year period are shortened indicating only the decision periods and the terminal year. A summary table of the changes over time in acres operated, land owned and net worth will be presented similar to that previously given for Farm I situations.

## The Effects of Beginning Age and Land Equity In "Class A" Water, Farm II

The effects of the two beginning ages and the three land equity positions on the dominant goals, restrictive goals and the accompanying selection of a strategy for each of the decision periods of "Class A" water can be seen in Tables XXX and XXXI. The complete results for each period of the planning horizon are in Appendix B, Tables LXI and LXII.

The 25 year-old operator begins in period 1 with a different dominant goal for each of the three equity situations. The full owner is

TABLE XXX

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS:
FARM II, CLASS A WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 5 | 9 | 13 | 17 | 20 |
| Farm Size, Acres | F.O. | 1,600 | 1,600 | 1,920 | 1,920 | 2,240 | 2,560 |
| | P.O. | 1,600 | 1,920 | 2,240 | 2,560 | 2,880 | 3,200 |
| | Rent. | 1,600 | 1,920 | 2,240 | 2,560 | 2,880 | 3,200 |
| Percent Owned | F.O. | 100 | 100 | 100 | 100 | 100 | 100 |
| | P.O. | 50 | 58 | 50 | 44 | 50 | 55 |
| | Rent. | 0 | 0 | 0 | 13 | 22 | 30 |
| Net Worth | F.O. | $253,000 | $326,410 | $402,310 | $426,550 | $528,700 | $614,680 |
| | P.O. | $139,740 | $198,950 | $256,330 | $283,170 | $360,000 | $425,090 |
| | Rent. | $ 26,477 | $ 76,883 | $125,250 | $156,280 | $211,650 | $255,230 |
| Debt-Asset Ratio | F.O. | 0.21 | 0.05 | 0.10 | 0.00 | 0.00 | 0.00 |
| | P.O. | 0.22 | 0.29 | 0.19 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.24 | 0.13 | 0.03 | 0.00 | 0.00 | 0.02 |
| Dominant Goals[2] | F.O. | #2 | #4 | #2 | #4 | #1, #6 | #1 |
| | P.O. | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #8 | #6 | #6 | #6 | #4 | #4 |
| Restrictive Goals[3] | F.O. | - | - | - | - | - | - |
| | P.O. | - | (#2) | - | - | - | - |
| | Rent. | (#2, #7) | (#2) | - | - | - | - |
| Secondary Goals[4] | F.O. | #5 | #5 | #5 | #5 | #5 | #5 |
| | P.O. | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F.O. | NONE | BUY | NONE | BUY | BUY | - |
| | P.O. | BUY | RENT | RENT | BUY | BUY | - |
| | Rent. | RENT | RENT | BUY | BUY | BUY | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

TABLE XXXI

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS A WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 5 | 9 | 13 | 17 | 20 |
| Farm Size | F.O. | 1,600 | 1,920 | 2,240 | 2,560 | 2,560 | 2,560 |
| | P.O. | 1,600 | 1,920 | 2,240 | 2,560 | 2,880 | 3,200 |
| | Rent. | 1,600 | 1,920 | 2,240 | 2,560 | 2,880 | 3,200 |
| Percent Owned | F.O. | 100 | 83 | 86 | 88 | 88 | 88 |
| | P.O. | 50 | 58 | 50 | 44 | 50 | 55 |
| | Rent. | 0 | 0 | 0 | 13 | 22 | 30 |
| Net Worth | F.O. | $253,380 | $330,350 | $407,410 | $435,300 | $535,120 | $621,040 |
| | P.O. | $140,120 | $197,870 | $258,280 | $289,030 | $370,900 | $440,450 |
| | Rent. | $ 27,821 | $ 77,121 | $127,630 | $163,060 | $223,580 | $270,900 |
| Debt-Asset Ratio | F.O. | 0.21 | 0.06 | 0.11 | 0.00 | 0.00 | 0.00 |
| | P.O. | 0.22 | 0.29 | 0.19 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.23 | 0.13 | 0.02 | 0.00 | 0.00 | 0.00 |
| Dominant Goals[2] | F.O. | #3, #2 | #4 | #4 | #4 | #6 | #6 |
| | P.O. | #4 | #4 | #6 | #6 | #6 | #6 |
| | Rent. | #4 | #8 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3] | F.O. | - | - | - | #5 | #5 | - |
| | P.O. | - | (#2) | - | - | - | - |
| | Rent. | (#2, #7) | (#2) | - | - | - | - |
| Secondary Goals[4] | F.O. | #5 | #5 | #3, #5 | #3 | #3 | #3 |
| | P.O. | #5 | #5 | #5 | #3, #2,<br>#1, #5 | #2, #3,<br>#1, #5 | #2, #5<br>#1, #3 |
| | Rent. | #5 | #5 | #5 | #2, #1, #5 | #2, #1, #5 | #3, #2<br>#5, #1 |
| Expansion Strategy | F.O. | RENT | BUY | BUY | NONE | NONE | - |
| | P.O. | BUY | RENT | RENT | BUY | BUY | - |
| | Rent. | RENT | RENT | BUY | BUY | BUY | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

minimizing the debt-asset ratio by "avoiding being forced out of business," #2. The part owner is "avoiding years of low profits or losses," #4, and the tenant is maximizing profits, #8. As a result, the full owner continues with the present farm organization and the part owner purchases 320 acres. The tenant is prevented from selecting the plan which best meets the maximum profit criterion of purchasing land and chooses to rent. The restrictive goals #2 and #7 in parentheses indicate that buying land results in an excessive debt-asset ratio and excessive short-term borrowing needs. (The use of no parentheses again indicate that the decision is totally restrictive, i.e., no plan is a feasible alternative.)

The age 25 full owner is able to buy land in period 5 on the basis of goal #4, "avoiding years of low profits or losses," but changes back to goal #2, the original goal in periods 1 through 3, in the sixth period, Appendix B, Table LXI. Thus, no expansion occurs in period nine. Goal #4 again becomes dominant in periods 11 through 15 to allow buying land in the thirteenth period. In periods 16 through 20, "controlling more acres" becomes dominant and since the expansion plans of buying and renting are tied with respect to operation size, the alternative dominant goal #6, "increase net worth," selects the purchase option in period 17. The situation terminates in period 20 with no debts and full ownership of 2,560 acres.

The age 25 part owner can not buy in period 5 because of a limiting debt-asset ratio. He also elects to rent in decision period 9 since the returns to fixed resources, the criterion for goal #4, are expected to be $326.00 higher by renting. Thereafter, continuing with the same dominant objective of "avoiding years of low profits or losses" results in buying land in periods 13 and 17. Since expansion occurs in each decision period, the part owner adds 1,600 acres to the original 1,600 acre unit making a total operation of 3,200 acres of which 1,760 is owned and free of debt.

The tenant is also prevented from buying in period 5 because of the limiting debt-asset ratio but purchases in each subsequent decision period. "Increasing net worth" is the dominant goal in periods 4 through 16 after "making the most profits" in the first three periods. In period 17, the goal of "avoiding years of low profits or losses" is the dominant objective. The renter situation also attains the maximum size of 3,200 acres but only owns 960 acres.

The dominant objectives change over time for the 25 year-old full owner and tenant but the part owner has the same objective throughout the 20 year period. All situations have only one secondary objective "increase leisure time."

The age 45 part owner and renter situations select the same strategies as the respective age 25 situations. Some differences in the dominant objectives exist, but the same periodic restrictions cause the selection of like strategies in periods 1 and 5. The 45 year-old full owner encounters a completely restrictive decision framework in periods 13 and 17 due to inadequate leisure time. Prior to being restricted, the rental option is selected in period 1 on the basis of the alternative dominant goal #2 of minimizing the debt-asset ratio between purchasing and renting. In periods 5 and 9, the objective of "avoiding years of low profits or losses" purchases land.

Generally, the situations are successful over the 20 year period and all but the age 25 full owner terminate as part owners. Almost no outstanding debts exist at the end of the 20 years even though part owners and renters expand to the maximum size of 3,200 acres. There are only two periods encountered in which the decision process is completely restricted. The 45 year-old full owner situation can not attain enough leisure time from any plan in periods 13 and 17 to prevent rejecting each of them. Both ages of tenants in early decision periods, rent in lieu of buying land because of restrictive borrowing needs and limiting debt-asset ratios. The part owners are also prevented from buying in period 5 because of the debt-asset ratio limit. The 25 year-old full owner meets no restrictions but the dominant objective, #2, in two decision periods 1 and 9 minimizes the debt-asset ratio by electing to forego expansion strategies. Consequently, the full owners of both age categories end with 2,560-acre operations and the part owners and renters terminate with the maximum of 3,200 acres.

## The Effects of Beginning Age and Land Equity In "Class B" Water, Farm II

The decision processes are given in Tables XXXII and XXXIII for the two ages of "Class B" water for Farm II. All land equity and age situations result in economically viable firms over the 20 year planning horizon. In this case, both age situations of renters do not expand the first half of the analysis because of limiting debt-asset ratios and borrowing needs. In period 13, renting is selected in lieu of buying because of the debt-asset ratio limit. Finally, in period 17, no restrictive goals are encountered and land is purchased. Thus, the tenant situations follow identical strategies and expand to the same size of 2,240 acres although different patterns of dominant objectives exist.

TABLE XXXII

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS B WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 5 | 9 | 13 | 17 | 20 |
| Farm Size, Acres | F.O. | 1,600 | 1,600 | 1,920 | 2,240 | 2,560 | 2,880 |
| | P.O. | 1,600 | 1,920 | 2,240 | 2,560 | 2,880 | 3,200 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 2,240 |
| Percent Owned | F.O. | 100 | 100 | 83 | 86 | 88 | 89 |
| | P.O. | 50 | 42 | 50 | 56 | 50 | 55 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 14 |
| Net Worth | F.O. | $321,530 | $429,860 | $545,490 | $537,500 | $656,830 | $769,790 |
| | P.O. | $172,290 | $238,890 | $306,440 | $273,110 | $338,830 | $408,490 |
| | Rent. | $ 24,215 | $ 46,304 | $ 61,636 | $ 73,741 | $106,500 | $140,430 |
| Debt-Asset Ratio | F.O. | 0.20 | 0.05 | 0.02 | 0.00 | 0.00 | 0.00 |
| | P.O. | 0.22 | 0.09 | 0.24 | 0.30 | 0.20 | 0.20 |
| | Rent. | 0.40 | 0.29 | 0.35 | 0.07 | 0.02 | 0.27 |
| Dominant Goals[2] | F.O. | #2 | #1, #2 | #1, #4 | #1, #4 | #1, #6 | #1 |
| | P.O. | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #8 | #4 | #4 | #6 | #6 | #6 |
| Restrictive Goals[3] | F.O. | - | - | - | - | - | - |
| | P.O. | (#7) | - | - | (#2) | - | - |
| | Rent. | #2, #7 | #2, #7 | #2, #7 | (#2) | - | - |
| Secondary Goals[4] | F.O. | #5 | #5 | #3, #5 | #3, #5 | #5 | #3 |
| | P.O. | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F.O. | NONE | RENT | BUY | BUY | BUY | - |
| | P.O. | RENT | BUY | BUY | RENT | BUY | - |
| | Rent. | NONE | NONE | NONE | RENT | BUY | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

TABLE XXXIII

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS B WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period 1 | 5 | 9 | 13 | 17 | 20 |
|---|---|---|---|---|---|---|---|
| Farm Size | F.O. | 1,600 | 1,920 | 2,240 | 2,560 | 2,880 | 3,200 |
| | P.O. | 1,600 | 1,920 | 2,240 | 2,560 | 2,880 | 3,200 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 2,240 |
| Percent Owned | F.O. | 100 | 83 | 86 | 88 | 89 | 90 |
| | P.O. | 50 | 42 | 36 | 44 | 50 | 55 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 14 |
| Net Worth | F.O. | $321,910 | $432,610 | $553,730 | $526,500 | $636,690 | $747,850 |
| | P.O. | $172,660 | $237,810 | $305,030 | $295,550 | $375,670 | $457,660 |
| | Rent. | $ 24,635 | $ 45,215 | $ 63,744 | $ 80,494 | $118,690 | $154,460 |
| Debt-Asset Ratio | F.O. | 0.20 | 0.06 | 0.14 | 0.09 | 0.03 | 0.00 |
| | P.O. | 0.22 | 0.09 | 0.13 | 0.15 | 0.13 | 0.12 |
| | Rent. | 0.39 | 0.29 | 0.34 | 0.006 | 0.00 | 0.23 |
| Dominant Goals[2] | F.O. | #3, #2 | #4 | #6 | #6 | #6 | #6 |
| | P.O. | #4 | #4 | #6 | #6 | #6 | #6 |
| | Rent. | #4 | #8 | #8 | #8 | #6 | #6 |
| Restrictive Goals[3] | F.O. | - | - | - | - | - | - |
| | P.O. | (#7) | (#7) | - | - | - | - |
| | Rent. | #2, #7 | #2, #7 | #2, #7 | (#2) | - | - |
| Secondary Goals[4] | F.O. | #5 | #3, #5 | #5, #3 | #3 | #3 | #3 |
| | P.O. | #5 | #5 | #5 | #5 | #5 | #3, #1, #2, #5 |
| | Rent. | #5 | #5 | #5 | #1, #5 | #2, #1, #5 | #2, #1, #5 |
| Expansion Strategy | F.O. | RENT | BUY | BUY | BUY | BUY | - |
| | P.O. | RENT | RENT | BUY | BUY | BUY | - |
| | Rent. | NONE | NONE | NONE | RENT | BUY | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal number.

In contrast, neither of the full owners of age 25 or 45 meet totally restrictive conditions. However, the part owners encounter restrictive borrowing needs early in the planning horizon and the 25 year old is similarly prevented from buying in period 13 due to the debt-asset ratio limit.

The part owners exhibit a high degree of stability regarding the dominant objectives over time. The 25 year old consistently pursues "avoiding years of low profits or losses" with exception of period 10 when "reducing borrowing needs" becomes most important. The 45 year-of-age part owner follows the same course of "avoiding years of low profits or losses" until period 6 when "increasing net worth" becomes the dominant objective.

The two age categories of full owners differ with respect to the major goals over time. The 25 year-old begins by "avoiding being forced out of business" but in period 3 and thereafter "controlling more acres," #1, is dominant. Thus, since the expansion strategies are tied with respect to goal #1, alternative dominant goals are relied upon to select between buying and renting. The rental strategy is chosen in period 5 on the basis of goal #2 and land is purchased thereafter to "avoid years of low profits or losses" and "increase net worth."

The dominant goals of the 45 year-old full owner are similar to the alternative dominant goals of the age 25 full owner. The rental strategy is selected after the alternative goal #2 breaks the tie between buying and renting options as preselected by the dominant goal #3 of "maintaining or increasing family living." Thereafter, land is purchased in each decision period with "increasing net worth" as the predominant top-ranked goal.

In summary, the situations are all viable firms for the next twenty years. The tanant situations, however, meet repeated totally restrictive conditions because of limited borrowing needs and debt-asset ratios in the earlier portion of the planning horizon. The part owners' decisions are affected slightly by similar conditions but the full owners meet no restrictive conditions.

The terminal status of each land equity and age situation with respect to land ownership is that of a part owner. The full owners of both age profiles are the only debt-free situations in the twentieth period. The ending size of the full owners differ as a result of the 25 year-old not expanding in the first period. Thus, the age 45 full owner and both ages of part owners expand to the maximum size of 3,200 acres. The tenants only increase by 640 acres to a size of 2,240 acres of which 320 acres is owned land. The full owners terminate with 2,560 acres owned and the part owners attain ownership of 1,280 acres.

### The Effects of Beginning Age and Land Equity In "Class C" Water, Farm II

The success of firms in "Class C" water for the Farm II situation are similar to Farm I in which the full and part owner situations gain net worth over the planning horizon but the renter does not, Tables XXXIV and XXXV. Excessive capital requirements again prevent the renters from expanding in the early periods. Bankruptcy or negative net worth is evident by the end of period 10, Appendix B, Tables LXV and LXVI. The part owners also encounter restrictive borrowing needs early in the analysis but are totally restrictive in only one decision

TABLE XXXIV

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS:
FARM II, CLASS C WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 5 | 9 | 13 | 17 | 20 |
| Farm Size | F.O. | 1,600 | 1,600 | 1,920 | 2,240 | 2,560 | 2,880 |
| | P.O. | 1,600 | 1,920 | 1,920 | 2,240 | 2,560 | 2,880 |
| | Rent | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 |
| Percent Owned | F.O. | 100 | 100 | 83 | 86 | 88 | 89 |
| | P.O. | 50 | 42 | 42 | 36 | 44 | 50 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F.O. | $312,320 | $428,740 | $537,410 | $645,620 | $766,600 | $853,430 |
| | P.O. | $166,600 | $229,410 | $275,160 | $308,010 | $335,530 | $337,640 |
| | Rent. | $ 20,154 | $ 21,280 | $ 3,912 | ($ 27,058) | ($ 68,866) | ($116,130) |
| Debt-Asset Ratio | F.O. | 0.21 | 0.06 | 0.06 | 0.00 | 0.00 | 0.01 |
| | P.O. | 0.23 | 0.11 | 0.12 | 0.01 | 0.22 | 0.31 |
| | Rent. | 0.45 | 0.49 | 0.89 | NA | NA | NA |
| Dominant Goals[2] | F.O. | #2 | #1, #2 | #1, #6 | #1, #6 | #1, #6 | #1 |
| | P.O. | #4 | #4 | #4 | #4 | #4 | #7 |
| | Rent. | #8 | #4 | #4 | #6 | #6 | #6 |
| Restrictive Goals[3] | F.O. | - | - | - | - | - | - |
| | P.O. | (#7) | #7 | (#7) | - | - | - |
| | Rent. | #2, #7 | #2, #7 | #2, #7 | #2, #7 | #2, #7 | - |
| Secondary Goals[4] | F.O. | #5 | #5 | #3, #5 | #5, #3 | #3 | #3, #4 |
| | P.O. | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F.O. | NONE | RENT | BUY | BUY | BUY | - |
| | P.O. | RENT | NONE | RENT | BUY | BUY | - |
| | Rent. | NONE | NONE | NONE | NONE | NONE | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal number. Numbers in parentheses refer to negative numbers and NA means not applicable.

TABLE XXXV

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS C WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period 1 | 5 | 9 | 13 | 17 | 20 |
|---|---|---|---|---|---|---|---|
| Farm Size | F.O. | 1,600 | 1,920 | 2,240 | 2,560 | 2,560 | 2,560 |
| | P.O. | 1,600 | 1,920 | 1,920 | 2,240 | 2,560 | 2,560 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 |
| Percent Owned | F.O. | 100 | 83 | 86 | 88 | 88 | 88 |
| | P.O. | 50 | 42 | 42 | 36 | 44 | 56 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F.O. | $312,700 | $430,870 | $542,230 | $634,340 | $745,120 | $838,370 |
| | P.O. | $167,130 | $228,640 | $274,210 | $310,640 | $342,650 | $365,820 |
| | Rent. | $ 20,471 | $ 19,903 | $ 5,988 | ($ 19,727) | ($ 53,764) | ($ 93,099) |
| Debt-Asset Ratio | F.O. | 0.21 | 0.07 | 0.16 | 0.14 | 0.02 | 0.00 |
| | P.O. | 0.23 | 0.11 | 0.12 | 0.01 | 0.22 | 0.29 |
| | Rent. | 0.44 | 0.51 | 0.85 | 0.00 | 0.00 | 0.00 |
| Dominant Goals[2] | F.O. | #3, #2 | #4 | #6 | #6 | #6 | #6 |
| | P.O. | #4 | #4 | #6 | #6 | #6 | #6 |
| | Rent. | #4 | #8 | #8 | #6 | #6 | #6 |
| Restrictive Goals[3] | F.O. | - | - | - | - | - | - |
| | P.O. | (#7) | #7 | (#7) | - | - | - |
| | Rent. | #2, #7 | #2, #7 | #2, #7 | #2, #7 | #2, #7 | - |
| Secondary Goals[4] | F.O. | #5 | #3, #5 | #5, #3 | #3 | #3 | #3 |
| | P.O. | #5 | #5 | #5 | #3, #2, #1, #5 | #5 | #1, #2, #5 |
| | Rent. | #5 | #5 | #5 | #2, #4, #1, #5 | #2, #1, #5, #4 | #2, #1, #5, #4 |
| Expansion Strategy | F.O. | RENT | BUY | BUY | NONE | NONE | - |
| | P.O. | RENT | NONE | RENT | BUY | BUY | - |
| | Rent. | NONE | NONE | NONE | NONE | NONE | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers. Numbers in parentheses refer to negative numbers.

period: 5. In periods 1 and 9, the rental strategy is selected in lieu of buying.

A high degree of stability is evident in the dominant objectives as well as the restrictive goals in both age situations of the part owners. The age 25 situation continues with goal #4 through the first seventeen periods but in periods 18 through 20, "reducing borrowing needs" becomes dominant. The 45 year-old also begins by "avoiding years of low profits or losses," #4, but changes to "increasing net worth" in period 6 and thereafter.

The full owner situations are also relatively stable with the primary difference between the ages of operators being that the age 25 situation predominantly maximizes the size of operation by goal #1, "control more acres," whereas the older operator elects to "increase net worth" most of the time. A unique set of circumstances is encountered in the 45 year-old full owner in decision periods 13 and 17. Usually net worth is increased, goal #6, by selecting expansion strategies of buying or renting. However, continuing with the present organization excels in expected net worth by over $3,000 in both decision periods and is selected as the best strategy. The prime reason for not expanding is the outstanding debt balance related to the expansion alternatives versus not expanding. The circumstances do not provide sufficient cash-on-hand to meet the operating capital requirements and the additional machinery capital requirements for expanding without extending the borrowing needs to the point of a relatively lower net worth position.

All of the situations terminate in a part ownership land equity status. None of the situations are able to attain the maximum size of operation. The part owners of both age profiles expand 1,280 acres of which one-half is purchased. However, the ending size of the full owner situations differ by 320 acres since the older operator makes the decision to "increase net worth" by not expanding in two decision periods 13 and 17 and the 25 year-old chooses not to expand in only one period. The younger full owner rents in period 5 and purchases thereafter resulting in 2,560 acres owned of the 2,880 acre-unit whereas the age 45 operator terminates with 2,240 acres owned of a 2,560-acre operation.

Summary of Farm II Situations

The relative changes in acres operated, acres owned and net worth for Farm II are given in Table XXXVI. The results are generally typical of those of the Farm I situation. Both age profiles of the renter situations in "Class C" water encounter bankruptcy and all other maintain viable firms. Also, the similarity of relatively greater increases in net worth as the initial land equity position increases from 0 to 100 percent is again depicted.

However, borrowing needs restrictions are encountered more frequently and for longer periods with Farm II situations than with Farm I. The main effect of these conditions is the reduction of increases in owned land; not necessarily the size of operation. The rental strategy is usually selected in lieu of buying unless the goals are totally restrictive in nature.

In "Class A" water, the 45 year-old operator again gains more net worth than the age 25 operator for all equity situations. The relative gains between equity situations are greater for the full owner than the other equity situations even though the latter expand to larger sizes.

TABLE XXXVI

SUMMARY OF INCREASES IN ACRES OPERATED, LAND OWNED AND NET WORTH AS RELATED TO BEGINNING LAND EQUITY, AGE OF OPERATOR AND WATER SITUATION, FARM II[a]

| Water Situation | Age of Operator | Increase In Acres Operated | | | Increase In Owned Land | | | Increase In Net Worth | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F.O. | P.O. | RENT. | F.O. | P.O. | RENT. | F.O. | P.O. | RENT. |
| | | --- acres --- | | | --- acres --- | | | --- dollars --- | | |
| A | 25 | 960 | 1,600 | 1,600 | 960 | 960 | 960 | 361,680 | 285,350 | 228,753 |
| | 45 | 960 | 1,600 | 1,600 | 640 | 960 | 960 | 367,660 | 300,330 | 243,079 |
| B | 25 | 1,280 | 1,600 | 640 | 960 | 960 | 320 | 448,260 | 236,200 | 116,215 |
| | 45 | 1,600 | 1,600 | 640 | 1,280 | 960 | 320 | 425,940 | 285,000 | 129,825 |
| C | 25 | 1,280 | 1,280 | 0 | 960 | 640 | 0 | 541,110 | 171,040 | (20,154)[b] |
| | 45 | 960 | 960 | 0 | 640 | 640 | 0 | 525,670 | 198,690 | (20,471)[b] |

[a] Increases are calculated from the base farm's ending situation of period 1, the base period.

[b] Loss in net worth of the base farm, period 1.

However, the part owners and renters purchase no more land than the age 25 full owner and only 320 acres more than the 45 year-old full owner. Generally, the advantages of the older operator in gaining more net worth are again functions of higher net income earnings, lower total family consumption, income tax payments and additional interest earnings.

The age 45 full owner gains about $6,000 more net worth. However, he pays over $12,000 more income taxes, consumes about $2,500 less and earns over $600 less interest. Thus, it appears that he should not gain more than the younger operator. The older operator, however, earns in excess of $52,000 more net returns over the 20-year period which is accumulated in cash in the latter periods. The younger operator invests funds in an additional 320 acres of land which depreciates in value as irrigation diminishes and the adjustment to dryland values is made.

In the "Class B" water situation, no significant interest earnings are received by the part owners and renters. Thus, the resulting higher gains in net worth of 45-year old operators are primarily due to lower total family consumption, additional income taxes and relatively less terminal debts. The age 45 part owner and renter consume about $16,000 less than the 25 year-old. As a result, the older renter gains nearly $14,000 more net worth. The increased consumption and the remaining debts of about $40,000 of the age 25 part owner are instrumental in the nearly $49,000 increase in net worth of the 45 year-old part owner.

However, the age 45 full owner does not exceed the younger operator in net worth gains. The age 25 full owner earns about $21,000 more interest, consumes nearly $15,000 more, and pays $17,000 less income taxes than the older operator. The resulting comparative gain in net worth is about $22,000 for the age 25 over the age 45 situation.

The relative gains in net worth are again higher for all full owner situations in "Class C" water. However, the 25 year-old full owner gains about $15,500 more than the older operator primarily due to the additional value of owned land of 320 acres which does not diminish in value as in the previously discussed "A" water situation. Much of the additional asset value is offset by the younger operator consuming about $18,000 more, paying nearly $11,000 more in income taxes, earning nearly $5,500 less in interest and terminating with $10,000 more debts. The part owners follow identical strategies and the combined effects of reduced total consumption of nearly $45,000 of the older operator, about $14,000 more net income, nearly $1,500 less outstanding debts and nearly $4,000 more income taxes result in nearly $28,000 more net worth as compared to the 25 year-old situation.

In comparing the water situations, Farm II full owners gain more in net worth as the saturated thickness increases, i.e., "Class A" water begins with less saturated thickness than "B" and "B" begins with less than "C". However, the relative gains in net worth of the part owners and renters by water situation are reversed relative to the full owners. The relatively lower land equity situation in "Class A" water gains more in net worth than those in the thicker aquifers of "B" and "C" water primarily because of their ability to purchase as much or more land and terminate with no outstanding debts.

The general trend toward part ownership of land resources is again evident. The only situation maintaining 100 percent land equity is the 25 year-old full owner in "Class A" water. With respect to increases in size, several situations attain maximum expansion but the rental strategy makes it possible. None of the equity positions or age situations in "Class C" water are able to attain maximum size.

## Farm III Results

The Farm III situations are the largest crop farms evaluated in the analysis. They begin with 2,880 acres of which 200 acres are rangeland and 2,680 acres are cropland. Representative situations are again based on initial land equity positions, age of operator and water conditions. The periodic results can be seen in Appendix B, Tables LXVII to LXXII.

### The Effects of Beginning Land Equity and Age In "Class A" Water, Farm III

Similar to the previously discussed crop farm situations with "A" water conditions, the representative situations for Farm III also maintain viable units for the 20-year planning horizon. The primary element of interest in the Farm III situations is the almost totally restrictive goal to "increase leisure time" for the full owners, Tables XXXVII and XXXVIII. The 45 year-old full owner is able to expand only once and the age 25 full owner experiences totally restrictive conditions in decision periods 9, 13 and 17. The younger part owner is also restricted by leisure time in the last decision period 17. Other than the full owner situations, the strategies selected by the two ages of operators in part owner and renter situations are similar and, in fact, identical for the tenant situation.

Another point of interest is that the 25 year-old full owner makes each strategy selection on the basis of alternative dominant goals: "avoiding being forced out of business" in periods 1 and 5 and profit

TABLE XXXVII

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS A WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 5 | 9 | 13 | 17 | 20 |
| Farm Size | F.O. | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 |
| | P.O. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,160 |
| | Rent. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,480 |
| Percent Owned | F.O. | 100 | 100 | 90 | 90 | 90 | 90 |
| | P.O. | 50 | 45 | 50 | 54 | 58 | 58 |
| | Rent. | 0 | 0 | 9 | 17 | 23 | 29 |
| Net Worth | F.O. | $469,180 | $620,010 | $787,670 | $875,350 | $1,089,700 | $1,280,200 |
| | P.O. | $256,870 | $388,350 | $521,130 | $599,090 | $ 770,970 | $ 920,020 |
| | Rent. | $ 45,617 | $147,230 | $245,950 | $320,010 | $ 433,710 | $ 539,180 |
| Debt-Asset Ratio | F.O. | 0.21 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P.O. | 0.22 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.25 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 |
| Dominant Goals[2] | F.O. | #7, #2 | #1, #2 | #1, #8 | #1, #8 | #1, #8 | #1 |
| | P.O. | #4 | #4 | #4 | #4 | #1, #8 | #1 |
| | Rent. | #8 | #6 | #6 | #4 | #4 | #4 |
| Restrictive Goals[3] | F.O. | - | - | #5 | #5 | #5 | - |
| | P.O. | - | - | - | - | #5 | - |
| | Rent. | (#7) | - | - | - | - | - |
| Secondary Goals[4] | F.O. | #5 | #5 | #3 | #4, #3 | #4 | #4 |
| | P.O. | #5 | #5 | #3, #5 | #5, #3 | #3 | #3 |
| | Rent. | #5 | #5 | #5 | #5 | #1, #2, #3, #5 | #1, #5, #2, #3 |
| Expansion Strategy | F.O. | NONE | RENT | NONE | NONE | NONE | - |
| | P.O. | RENT | BUY | BUY | BUY | NONE | - |
| | Rent. | RENT | BUY | BUY | BUY | BUY | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

TABLE XXXVIII

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS A WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period 1 | 5 | 9 | 13 | 17 | 20 |
|---|---|---|---|---|---|---|---|
| Farm Size | F.O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| | P.O. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,160 |
| | Rent. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,480 |
| Percent Owned | F.O. | 100 | 90 | 90 | 90 | 90 | 90 |
| | P.O. | 50 | 45 | 50 | 54 | 58 | 65 |
| | Rent. | 0 | 0 | 9 | 17 | 23 | 29 |
| Net Worth | F.O. | $469,560 | $629,720 | $799,040 | $894,140 | $1,116,200 | $1,313,600 |
| | P.O. | $257,250 | $387,270 | $523,080 | $605,240 | $ 782,210 | $ 935,410 |
| | Rent. | $ 45,995 | $146,150 | $247,880 | $326,140 | $ 444,930 | $ 554,920 |
| Debt-Asset Ratio | F.O. | 0.21 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P.O. | 0.22 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.24 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 |
| Dominant Goals[2] | F.O. | #7, #3, #2 | #4 | #6 | #6 | #6 | #6 |
| | P.O. | #4 | #4 | #4 | #4 | #6 | #6 |
| | Rent. | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3] | F.O. | - | #5 | #5 | #5 | #5 | - |
| | P.O. | - | - | - | - | - | - |
| | Rent. | (#2, #7) | - | - | - | - | - |
| Secondary Goals[4] | F.O. | #5 | #3 | #3 | #3 | #4 | #4 |
| | P.O. | #5 | #5 | #1, #2, #5, #3 | #3 | #3 | #3 |
| | Rent. | #5 | #5 | #8, #7, #3, #1, #2 | #3, #1, #5, #2 | #5, #1, #3, #2 | #2, #3 |
| Expansion Strateg6 | F.O. | RENT | NONE | NONE | NONE | NONE | - |
| | P.O. | RENT | BUY | BUY | BUY | BUY | - |
| | Rent. | RENT | BUY | BUY | BUY | BUY | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

maximization in the latter decision periods. The dominant objective in all decision periods except the first is to "control more acres" and in period one to accomplish a reduction in borrowing needs. The latter dominant goal is tied (all values are zero) for all plans since none of their borrowing needs exceed the security value of chattel assets. Thus, the tie is broken by continuing with the present farm organization, NONE, because of the alternative dominant goal to minimize the debt-asset ratio.

A similar but unique situation occurs in period one of the age 45 full owner in which the dominant goal is again to "reduce borrowing needs" similar to the 25 year-old full owner. However, the second ranked #3 of "maintaining or increasing family living" reduces the choice of the four tied strategies down to two: renting and buying. These two expansion strategies maximize family consumption but again are tied so the third ranked objective of "avoiding being forced out of business," #2, ultimately selects the rental option to minimize the debt-asset ratio.

The younger part owner emphasizes "avoiding years of low profits or losses" until "controlling more acres" becomes most important in the seventeenth period and thereafter. In contrast, the age 45 situation does not pursue "controlling more acres" in the latter periods but changes to "increasing net worth" following a sustained objective of "avoiding years of low profits or losses" for 14 periods.

The age 25 renter begins by "making the most profits" and shifts to "increasing net worth" for periods 2 through 9. Thereafter, goal #4 of "avoiding years of low profits or losses" is the dominant objective. The older tenant maximizes net worth for the entire planning horizon.

The secondary goals are numerous for both age profiles and equity situations. The consequence of several secondary objectives is that fewer satisficing levels of primary goals must be met by the plans. Refer to Appendix B, Tables LXVII and LXVIII of the two age situations specifically observing the age 25 and 45 renters' numerous irrelevant objectives.

In summary, both ages of renters and the older part owner attain the maximum expansion in size of 1,600 acres primarily by purchasing 1,280 acres. The full owners and the younger part owner meet restrictive conditions on the basis of inadequate leisure time. The two full owner situations rent 320 acres as the only expansion decision.

### The Effects of Beginning Land Equity and Age In "Class B" Water, Farm III

The representative situations in "Class B" water again maintain economically viable units for the twenty-year period. The tenant situations, however, are almost totally restricted to no expansion and, in addition, indicate some decline in net worth from period 4 to 12, Appendix B, Tables LXIX and LXX. During this time, several factors contribute to the decline such as replacing costly irrigation engines in period 5, substantial declines in irrigated acreage beginning in period 11, significant periodic investments in additional irrigation facilities plus the normal machinery replacement costs and increases in operating capital reserves as irrigated acreage increases. These factors contribute to accumulated debts and, for the first time heretofore, with the exception of unsuccessful firms, high periodic debt-asset ratios are associated with the basic farm organizations.

The combination of factors results in totally restrictive goal conditions for the tenants in Tables XXXIX and XL of "avoiding being forced out of business," #2, and "reducing borrowing needs," #7, for all decision periods except the thirteenth. In period 13, the rental of 320 acres is selected since "reducing borrowing needs," #7, is not restrictive and the high debt-asset ratio associated with buying land prevents selecting it for making the most profits, #8, the dominant goal.

In contrast, neither of the age profiles of the full or part owner situations encounter restrictive decisions. In addition, most of the decisions are made on the basis of the second-ranked goals. The 25 year-old part owner relies on several alternative dominant goals in lieu of the prevailing objective of "reducing borrowing needs." The full owners also rely on alternative dominant goals for selecting the rental strategy in period one and the purchase strategy for the rest of the decision periods. In period one, several objectives are tied with respect to buying and renting resulting in minimization of debt-asset ratios, goal #2, in each age situation.

Thus, the initial equity position of the operator is of extreme importance in these situations. The full and part owners are able to expand to the maximum size of 4,480 acres but the inadequate security for extensive borrowing prevents the tenants from purchasing land and, essentially, prevents expansion by renting except for one latter decision period.

Both full owners follow the same decision process of strategy selection over time. However, different dominant and alternative dominant objectives result in the same strategy selections. For example, the

TABLE XXXIX

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS B WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 5 | 9 | 13 | 17 | 20 |
| Farm Size | F.O. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,480 |
| | P.O. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,480 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 |
| Percent Owned | F.O. | 100 | 90 | 91 | 92 | 92 | 93 |
| | P.O. | 50 | 55 | 59 | 63 | 65 | 68 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F.O. | $610,950 | $806,790 | $1,015,500 | $986,510 | $1,168,100 | $1,337,700 |
| | P.O. | $325,630 | $437,230 | $ 549,770 | $491,430 | $ 557,720 | $ 658,310 |
| | Rent. | $ 41,435 | $ 49,910 | $ 29,776 | $ 8,769 | $ 43,680 | $ 73,623 |
| Debt-Asset Ratio | F.O. | 0.19 | 0.06 | 0.09 | 0.00 | 0.00 | 0.00 |
| | P.O. | 0.21 | 0.25 | 0.27 | 0.28 | 0.24 | 0.24 |
| | Rent. | 0.41 | 0.43 | 0.65 | 0.72 | 0.52 | 0.43 |
| Dominant Goals[2] | F.O. | #1, #7, #2 | #1, #9 | #1, #8 | #1, #8 | #1, #8 | #1 |
| | P.O. | #4 | #7, #8 | #7, #8 | #7, #4 | #7, #8 | #7 |
| | Rent. | #8 | #6 | #6 | #8 | #6 | #6 |
| Restrictive Goals[3] | F.O. | - | - | - | - | - | - |
| | P.O. | - | - | - | - | - | - |
| | Rent. | #2, #7 | #2, #7 | #2, #7 | (#2) | #2, #7 | - |
| Secondary Goals[4] | F.O. | #5 | #4, #5, #3 | #4 | #3, #4 | #4 | #4 |
| | P.O. | #5 | #5 | #5 | #5 | #5 | #5, #2 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F.O. | RENT | BUY | BUY | BUY | BUY | - |
| | P.O. | BUY | BUY | BUY | BUY | BUY | - |
| | Rent. | NONE | NONE | NONE | RENT | NONE | -- |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

TABLE XL

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS B WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period 1 | 5 | 9 | 13 | 17 | 20 |
|---|---|---|---|---|---|---|---|
| Farm Size | F.O. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,480 |
| | P.O. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,480 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 |
| Percent Owned | F.O. | 100 | 90 | 91 | 92 | 92 | 93 |
| | P.O. | 50 | 55 | 59 | 63 | 65 | 68 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F.O. | $611,320 | $805,710 | $1,017,400 | $992,710 | $1,179,400 | $1,353,600 |
| | P.O. | $326,010 | $436,150 | $ 551,730 | $497,700 | $ 589,560 | $ 675,070 |
| | Rent. | $ 41,813 | $ 48,830 | $ 30,700 | $ 13,934 | $ 52,899 | $ 87,303 |
| Debt-Asset Ratio | F.O. | 0.19 | 0.06 | 0.09 | 0.00 | 0.00 | 0.00 |
| | P.O. | 0.21 | 0.25 | 0.27 | 0.26 | 0.23 | 0.22 |
| | Rent. | 0.41 | 0.43 | 0.64 | 0.62 | 0.47 | 0.39 |
| Dominant Goals[2] | F.O. | #3, #7, #1, #2 | #1, #6 | #1, #6 | #1, #6 | #1, #6 | #1 |
| | P.O. | #4 | #4 | #6 | #4 | #6 | #6 |
| | Rent. | #4 | #8 | #8 | #8 | #8 | #8 |
| Restrictive Goals[3] | F.O. | - | - | - | - | - | - |
| | P.O. | - | - | - | - | - | - |
| | Rent. | #2, #7 | #2, #7 | #2, #7 | (#2) | #2, #7 | - |
| Secondary | F.O. | #5 | #4, #3 | #4 | #3 | #3, #4 | #4 |
| | P.O. | #5 | #5 | #2. #5 | #3, #1, #5, #2 | #2 | #2 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | $1, #2, #5 |
| Expansion Strategy | F.O. | RENT | BUY | BUY | BUY | BUY | - |
| | P.O. | BUY | BUY | BUY | BUY | BUY | - |
| | Rent. | NONE | NONE | NONE | RENT | NONE | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

25 year-old full owner relies on the alternative dominant goal of maximizing profits in periods 5, 9, 13 and 17 whereas the 45 year-old is increasing net worth but both purchase land in the four decision periods. Also, the part owners' decisions are identical but for different dominant and alternative objectives.

## The Effects of Beginning Land Equity and Age In "Class C" Water, Farm III

The results of Farm III representative situations in Tables XLI and XLII again indicate the tenant situations do not have sufficient borrowing capacity to expand or, at least, meet the increasing capital requirements in the early periods. Thus, bankruptcy occurs by the seventh period for both age situations beginning with no land equity, Appendix B, Tables LXXI and LXXII.

The part owners also encounter borrowing restrictions in decision periods 1, 5 and 9 but are able to purchase land thereafter. Borrowing requirements are totally restrictive in the fifth and ninth periods.

No restrictions on strategy selections are met by the full owners of either age profile. Both select identical strategies over time. Alternative dominant goals are again used as the selection criteria as in the "Class B" water situation for full owners. In fact, the dominant and alternative dominant goals in each decision period are identical for the respective ages of full owners in the "B" and "C" water situations. The same periodic decisions were also made.

The dominant objectives are relatively stable over time. The full owners pursue "controlling more acres" predominantly whereas the part owners begin by "avoiding years of low profits or losses" and change to

TABLE XLI

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS C WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 5 | 9 | 13 | 17 | 20 |
| Farm Size | F.O. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,480 |
| | P.O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,520 | 3,840 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |
| Percent Owned | F.O. | 100 | 90 | 91 | 92 | 92 | 93 |
| | P.O. | 50 | 45 | 45 | 45 | 50 | 54 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F.O. | $595,480 | $809,200 | $1,005,700 | $1,199,900 | $1,445,000 | $1,657,700 |
| | P.O. | $316,060 | $414,050 | $ 472,890 | $ 507,300 | $ 568,500 | $ 624,670 |
| | Rent. | $ 34,520 | $ 14,142 | ($ 57,790) | ($ 170,240) | ($ 324,580) | ($ 487,760) |
| Debt-Asset Ratio | F.O. | 0.20 | 0.07 | 0.12 | 0.03 | 0.00 | 0.00 |
| | P.O. | 0.22 | 0.11 | 0.13 | 0.01 | 0.21 | 0.22 |
| | Rent. | 0.44 | 0.74 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dominant Goals[2] | F.O. | $1, #7, #2 | #1, #8 | #1, #8 | #1, #8 | #1, #8 | #1 |
| | P.O. | #4 | #4 | #4 | #4 | #6 | #8 |
| | Rent. | #8 | #6 | #6 | #3, #6 | #3, #6 | #3 |
| Restrictive Goals[3] | F.O. | - | - | - | - | - | - |
| | P.O. | (#7) | #7 | #7 | - | - | - |
| | Rent. | #2, #7 | #2, #7 | #2, #7 | #2, #7 | #2, #7 | - |
| Secondary Goals[4] | F.O. | #5 | #4, #3, #5 | #4 | #4 | #4 | #4 |
| | P.O. | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #3 | #5 | #5, #5 | #4 |
| Expansion Strategy | F.O. | RENT | BUY | BUY | BUY | BUY | - |
| | P.O. | RENT | NONE | NONE | BUY | BUY | - |
| | Rent. | NONE | NONE | NONE | NONE | NONE | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers. Numbers in parentheses refer to negative numbers.

TABLE XLII

FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS C WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 5 | 9 | 13 | 17 | 20 |
| Farm Size | F.O. | 2,880 | 3,200 | 3,520 | 3,840 | 4,160 | 4,480 |
| | P.O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,520 | 3,840 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |
| Percent Owned | F.O. | 100 | 90 | 91 | 92 | 92 | 93 |
| | P.O. | 50 | 45 | 45 | 45 | 50 | 54 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F.O. | $595,860 | $808,120 | $1,007,700 | $1,206,100 | $1,456,400 | $1,673,600 |
| | P.O. | $316,440 | $412,970 | $ 474,850 | $ 513,570 | $ 580,150 | $ 641,220 |
| | Rent. | $ 34,898 | $ 12,953 | ($ 55,582) | ($ 161,630) | ($ 307,230) | ($ 461,860) |
| Debt-Asset Ratio | F.O. | 0.20 | 0.07 | 0.12 | 0.02 | 0.00 | 0.00 |
| | P.O. | 0.22 | 0.11 | 0.13 | 0.01 | 0.16 | 0.22 |
| | Rent. | 0.44 | 0.75 | 53.17 | 0.00 | 0.00 | 0.00 |
| Dominant Goals[2] | F.O. | #3, #7, #1, #2 | #1, #6 | #1, #6 | #1, #6 | #1, #6 | #1 |
| | P.O. | #4 | #4 | #6 | #6 | #6 | #6 |
| | Rent. | #4 | #8 | #6 | #3, #8 | #3, #6 | #3 |
| Restrictive Goals[3] | F.O. | - | - | - | - | - | - |
| | P.O. | (#7) | #7 | #7 | - | - | - |
| | Rent. | #2, #7 | #2, #7 | #2, #7 | #2, #7 | #2, #7, #5 | - |
| Secondary Goals[4] | F.O. | #5 | #4, #3 | #4 | #4 | #4 | #4 |
| | P.O. | #5 | #5 | #1, #2, #3, #5 | #1, #2, #5, #3 | #1, #3, #5, #2 | #4, #1, #3, #5, #2 |
| | Rent. | #5 | #5 | #3 | #5, #4 | #4 | #4 |
| Expansion | F.O. | RENT | BUY | BUY | BUY | BUY | - |
| | P.O. | RENT | NONE | NONE | BUY | BUY | - |
| | Rent. | NONE | NONE | NONE | NONE | NONE | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers. Numbers in parentheses refer to negative numbers.

"increasing net worth." The tenants were not able to avoid bankruptcy by maximizing farm profits, returns to fixed resources or net worth.

### Summary of Farm III Situations

In summarizing the Farm III situations by initial land equity, age of operator and water condition, the striking similarity of selected strategies over time regarding the ages of operators is the most noticeable aspect. Almost no differences in the strategies exist and the primary dominant objectives being pursued by the two age categories using common initial land equity positions are also similar. The full owners of both ages predominantly pursue goal #1 of "controlling more acres" and the part owners are generally pursuing goal #4, "avoid years of low profits or losses," or goal #6, "increase net worth." The high degree of similarity between age categories is less imminent in the renter situations with a mixture over time of goals #8, #4, and #6.

A high degree of similarity has also been indicated regarding the restrictive goals and their timing. For example, both the age 25 and 45 full owners in "Class A" water encounter leisure time restrictions for most of the decision periods. The tenants of both "B" and "C" water situations for both age profiles meet restrictive borrowing needs and debt-asset ratios over most of the planning horizon.

Regarding the relative gains in net worth, increases in the size of operation and additional land purchases, Table XLIII summarizes the representative situations. In "Class A" water, the gains in net worth again follow similar patterns to the other farm situations I and II. The greater gains are associated with increases in initial equity positions and the increase in the age of the operator. Even though both ages of

TABLE XLIII

SUMMARY OF INCREASES IN ACRES OPERATED, LAND OWNED AND NET WORTH AS RELATED TO BEGINNING LAND EQUITY, AGE OF OPERATOR AND WATER SITUATION, FARM III[a]

| Water Situation | Age of Operator | Increase In Acres Operated | | | Increase In Owned Land | | | Change In Net Worth | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F.O. | P.O. | RENT. | F.O. | P.O. | RENT. | F.O. | P.O. | RENT. |
| | | --- acres --- | | | --- acres --- | | | --- dollars --- | | |
| A | 25 | 320 | 1,280 | 1,600 | 0 | 960 | 1,280 | 811,020 | 663,150 | 493,563 |
| | 45 | 320 | 1,280 | 1,600 | 0 | 1,280 | 1,280 | 844,040 | 678,160 | 508,925 |
| B | 25 | 1,600 | 1,600 | 320 | 1,280 | 1,600 | 0 | 726,750 | 332,680 | 32,188 |
| | 45 | 1,600 | 1,600 | 320 | 1,280 | 1,600 | 0 | 742,280 | 349,060 | 45,490 |
| C | 25 | 1,600 | 960 | 0 | 1,280 | 640 | 0 | 1,062,220 | 308,610 | (34,520)[b] |
| | 45 | 1,600 | 960 | 0 | 1,280 | 640 | 0 | 1,077,740 | 324,780 | (34,898)[b] |

[a]Increases are calculated from base farm's ending situation of period 1, the base period.

[b]Loss in the net worth of the base farm, period 1.

full owners are almost totally restricted from expansion of the base farm and purchase no additional land, the 45 year-old gains about $33,000 more net worth primarily because of $10,000 lower consumption, $34,000 more net returns, $13,000 more interest but $10,000 additional income taxes are paid. The same reasons apply to the older part owner and tenant. In the latter case, about $16,000 less consumption, $4,000 more interest earnings and $5,000 more income tax payments result in about $15,000 more net worth for the older operator. In the former situation of the part owners, about $15,000 more net worth is realized by the age 45 operator by approximately the same amount of reduction in consumption. An additional $9.000 of net income is offset by nearly $3,000 less interest earnings and about $7,000 more income taxes paid.

In the "Class B" water situation, the relative uniformity of the decision processes affords a unique opportunity to isolate the effects of age on firm growth. The age 45 operator excels in net worth gains over the 20-year period when compared to the younger operator in all beginning equity positions. The older full owner consumes about $16,000 less, earns nearly $4,000 more in interest earnings, and pays about $5,000 more in income taxes resulting in a net worth increase of nearly $16,000 over the age 25 operator. Similarly, the age 45 part owner gains about $16,000 more in net worth by reducing total consumption by about the same amount but neither age situation earned interest payments on surplus capital. Additional income tax payments are essentially offset by increased net income. The gain in net worth of the older versus younger tenant of over $13,000 is a result of a reduction in consumption of over $17,000, nearly $8,000 more tax payments and $5,000 more net income earnings.

Likewise, the older full owner and part owners gain relatively more in net worth in the "Class C" water situation than the age 25 operator. Over $16,000 is gained in the respective age 45 full and part owner situations primarily because of a like reduction in consumption.

The consumption patterns follow the expected patterns with the older operator situations consuming less than the age 25 situations. Table XLIV presents the periodic consumption levels of "Class C" water, Farm III as an indication of the highest standards of living expected by the largest crop farm and the highest water supply condition of the 54 crop farm situations evaluated. Only the six years prior to bankruptcy are presented for the two age categories of tenants.

In general, projected twenty-year average consumption levels approach $30,000 per year for the part and full owners with only slight differences between age and equity situations. Since the strategies selected are identical, the major explanatory variable is the number of dependents. The age 45 operator begins with three dependents in period 1 and reduces to one by period 6, whereas the 25 year-old increases from one to three by the fourth period. As a result, the older operator's family consumes more in periods 2 through 4 and, thereafter, the younger situation consumes the most per year. (The consumption of $6,000 in period 1, the base period, is a common parameter.)

## Ranch Results

The irrigated ranch situation is evaluated for "Class A" water conditions only since ranches are not predominant in "B" and "C" water situations. It is a unique situation in which a large part of the

TABLE XLIV

SUMMARY OF PERIODIC CONSUMPTION LEVELS AS RELATED TO INITIAL LAND EQUITY AND AGE OF OPERATOR, CLASS C WATER, FARM III

| | Full Owner | | Part Owner | | Renter | |
|---|---|---|---|---|---|---|
| Period | Age 25 | Age 45 | Age 25 | Age 45 | Age 25 | Age 45 |
| 1 | $ 6,000 | $ 6,000 | $ 6,000 | $ 6,000 | $ 6,000 | $ 6,000 |
| 2 | 27,174 | 28,430 | 27,067 | 28,323 | 23,304 | 24,559 |
| 3 | 28,287 | 28,914 | 28,169 | 28,797 | 26,171 | 26,798 |
| 4 | 28,641 | 29,269 | 28,513 | 29,141 | 27,008 | 27,636 |
| 5 | 29,631 | 29,003 | 29,491 | 28,863 | 28,294 | 27,666 |
| 6 | 30,489 | 29,861 | 29,783 | 29,155 | 28,761 | 28,132 |
| 7 | 30,698 | 29,442 | 30,026 | 28,770 | -- | -- |
| 8 | 30,730 | 29,474 | 30,048 | 28,792 | -- | -- |
| 9 | 20,745 | 29,490 | 30,052 | 28,797 | -- | -- |
| 10 | 31,141 | 29,886 | 30,054 | 28,800 | -- | -- |
| 11 | 31,158 | 29,904 | 30,057 | 28,802 | -- | -- |
| 12 | 31,176 | 29,922 | 20,060 | 28,806 | -- | -- |
| 13 | 31,195 | 29,942 | 30,063 | 28,810 | -- | -- |
| 14 | 31,522 | 30,269 | 30,569 | 29,315 | -- | -- |
| 15 | 31,546 | 30,294 | 30,576 | 29,323 | -- | -- |
| 16 | 31,569 | 30,316 | 30,581 | 29,329 | -- | -- |
| 17 | 31,592 | 30,340 | 30,586 | 29,335 | -- | -- |
| 18 | 31,872 | 30,621 | 30,973 | 29,722 | -- | -- |
| 19 | 31,901 | 30,650 | 30,982 | 29,731 | -- | -- |
| 20 | 31,927 | 30,677 | 30,988 | 29,739 | -- | -- |
| Total | 588,994 | 572,704 | 574,638 | 558,350 | 139,538 | 140,791 |
| Average | 29,450 | 28,635 | 28,732 | 27,918 | 23,256[a] | 23,465[a] |

[a]Average for six years prior to bankruptcy.

operation is native rangeland. The contributing extensive surface acres significantly reduce the annual decline in the static water level per unit of water pumped as compared to the more intensive crop farms. Consequently, the economic life of the water supply is estimated to be in excess of 20 years for the ranch in contrast to the ten-year life of the crop farm in similar water conditions.

Complete results of the age 25 and 45 operators are given in Tables XLV and XLVI. Economically viable firms exist for all initial equity positions. In addition, the dominant objective #1 of "controlling more acres" is predominant particularly during the latter ten periods of the planning horizon. Thus, several strategy selections are based on alternative dominant goals which select between tied expansion plans of buying and renting land.

More specifically, the 25 year-old full owner pursues "controlling more acres" in subsequent periods to the first three in which "avoiding years of low profits or losses" is dominant. In contrast, the 45 year-old full owner pursues a different objective of "reducing borrowing needs" in periods 1 through 7, changes to "increase net worth" in periods 8 and 9 but then "controlling more acres" is dominant in the latter periods 11 through 20. The age 25 part owner does not change to goal #1 until period 17 nor does the older part owner until period 12. The age 45 tenant maintains "controlling more acres" for all periods except the fourth. The age 25 tenant changes from "increasing net worth" in period 5 to goal #1 of "controlling more acres."

Few restrictions are met except for leisure time in the case of the age 45 operator in periods 5, 9, 13, and 17 and the first period excessive borrowing needs of the 45 year-old tenant. None of the decisions

TABLE XLV

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS
WITH MULTIPLE GOALS: RANCH, CLASS A WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Farm Size | F. O. | 7,040 | 7,360 | 7,360 | 7,360 | 7,360 | 7,680 | 7,680 | 7,680 | 7,680 | 8,000 |
| | P. O. | 7,040 | 7,360 | 7,360 | 7,360 | 7,360 | 7,680 | 7,680 | 7,680 | 7,680 | 8,000 |
| | Rent. | 7,040 | 7,360 | 7,360 | 7,360 | 7,360 | 7,680 | 7,680 | 7,680 | 7,680 | 8,000 |
| Percent Owned | F. O. | 100 | 96 | 96 | 96 | 96 | 92 | 92 | 92 | 92 | 88 |
| | P. O. | 50 | 48 | 48 | 48 | 48 | 46 | 46 | 46 | 46 | 44 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Net Worth | F. O. | $814,830 | $842,510 | $870,230 | $899,790 | $928,900 | $960,030 | $986,720 | $1,015,400 | $1,040,900 | $1,072,600 |
| | P. O. | $456,550 | $474,260 | $491,770 | $510,770 | $528,930 | $548,680 | $563,380 | $ 579,380 | $ 593,000 | $ 610,640 |
| | Rent. | $ 98,276 | $106,010 | $113,310 | $121,720 | $128,930 | $137,320 | $141,180 | $ 145,730 | $ 148,870 | $ 153,110 |
| Debt-Asset Ratio | F. O. | 0.20 | 0.15 | 0.10 | 0.06 | 0.02 | 0.02 | 0.04 | 0.03 | 0.04 | 0.03 |
| | P. O. | 0.19 | 0.14 | 0.10 | 0.05 | 0.04 | 0.04 | 0.06 | 0.04 | 0.06 | 0.05 |
| | Rent. | 0.12 | 0.08 | 0.05 | 0.03 | 0.13 | 0.12 | 0.20 | 0.15 | 0.19 | 0.25 |
| Dominant Goals[2/] | F. O. | #4 | #4 | #4 | #1 | #1, #4 | #1 | #1 | #1 | #1, #7, #6 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #6 | #6 | #6 | #6 | #1, #6 | #1 | #1 | #1 | #1, #4 | #1 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals[4/] | F. O. | #3, #8, #5 | #3, #8, #5 | #3, #5, #8 | #8, #5, #3 | #8, #5, #3 | #8, #5, #3 | #2, #8, #5, #3 | #2, #8, #5, #3 | #3 | #4, #2, #8, #5, #3 |
| | P. O. | #5 | #5 | #3, #5 | #3, #5 | #3, #5 | #3, #5 | #3, #5 | #3, #5 | #3, #5 | #3, #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | RENT | - | - | - | RENT | - | - | - | RENT | - |
| | P. O. | RENT | - | - | - | RENT | - | - | - | RENT | - |
| | Rent. | RENT | - | - | - | RENT | - | - | - | BUY | - |

TABLE XLV (Continued)

| Item | Land Equity 1/ | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 8,000 | 8,000 | 8,000 | 8,320 | 8,320 | 8,320 | 8,320 | 8,640 | 8,640 | 8,640 |
| | P. O. | 8,000 | 8,000 | 8,000 | 8,320 | 8,320 | 8,320 | 8,320 | 8,640 | 8,640 | 8,640 |
| | Rent. | 8,000 | 8,000 | 8,000 | 8,320 | 8,320 | 8,320 | 8,320 | 8,640 | 8,640 | 8,640 |
| Percent Owned | F. O. | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 89 | 89 | 89 |
| | P. O. | 44 | 44 | 44 | 46 | 46 | 46 | 46 | 48 | 48 | 48 |
| | Rent. | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Net Worth | F. O. | $1,106,500 | $1,142,900 | $1,181,300 | $1,222,700 | $1,264,600 | $1,308,800 | $1,353,200 | $1,400,400 | $1,446,700 | $1,495,900 |
| | P. O. | $ 629,620 | $ 650,190 | $ 672,140 | $ 696,350 | $ 720,090 | $ 745,090 | $ 769,400 | $ 795,440 | $ 819,500 | $ 845,200 |
| | Rent. | $ 157,500 | $ 162,950 | $ 168,790 | $ 175,800 | $ 181,580 | $ 187,320 | $ 192,240 | $ 197,130 | $ 200,390 | $ 203,920 |
| Debt-Asset Ratio | F. O. | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.03 | 0.02 | 0.00 | 0.01 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.21 | 0.17 | 0.16 | 0.13 | 0.18 | 0.17 | 0.22 | 0.17 | 0.23 | 0.19 |
| Dominant Goals 2/ | F. O. | #1 | #1 | #1, #6 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #1, #4 | #1 | #1 | #1 |
| | Rent. | #1 | #1 | #1, #6 | #1 | #1 | #1 | #1, #4 | #1 | #1 | #1 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals 4/ | F. O. | #2, #8, #4, #5, #3 | #3 | #2, #8, #5, #4, #3 | #4, #3 | #3, #4 | #3, #4 | #4 | #4 | #4 | #4 |
| | P. O. | #3, #5 | #5, #3 | #5, #3 | #5, #3 | #5, #3 | #5, #3 | #5, #3 | #3 | #3 | #3 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #8, #3, #2, #7, #5 | #8, #3 #2, #7, #5 |
| Expansion Strategy | F. 0 | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | RENT | - | - | - | RENT | - | - | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

TABLE XLVI

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: RANCH, CLASS A WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 7,040 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 |
| | P. O. | 7,040 | 7,360 | 7,360 | 7,360 | 7,360 | 7,680 | 7,680 | 7,680 | 7,680 | 8,000 |
| | Rent. | 7,040 | 7,040 | 7,040 | 7,040 | 7,040 | 7,360 | 7,360 | 7,360 | 7,360 | 7,680 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | P. O. | 50 | 48 | 48 | 48 | 48 | 46 | 46 | 46 | 46 | 44 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 4 | 8 |
| Net Worth | F. O. | $815,210 | $841,340 | $867,880 | $896,760 | $926,290 | $957,200 | $988,090 | $1,021,100 | $1,051,200 | $1,086,400 |
| | P. O. | $456,930 | $473,780 | $490,820 | $509,330 | $527,850 | $547,980 | $563,510 | $ 580,400 | $ 594,950 | $ 613,590 |
| | Rent. | $ 99,632 | $106,8320 | $113,700 | $121,640 | $129,470 | $137,120 | $144,020 | $ 151,110 | $ 157,810 | $ 164,440 |
| Debt-Asset Ratio | F. O. | 0.20 | 0.21 | 0.19 | 0.18 | 0.18 | 0.16 | 0.16 | 0.13 | 0.12 | 0.09 |
| | P. O. | 0.19 | 0.14 | 0.10 | 0.05 | 0.04 | 0.04 | 0.06 | 0.04 | 0.06 | 0.05 |
| | Rent. | 0.12 | 0.08 | 0.05 | 0.03 | 0.12 | 0.23 | 0.29 | 0.23 | 0.26 | 0.31 |
| Dominant Goals[2] | F. O. | #7, #6 | #7 | #7 | #7 | #7, #6 | #7 | #7 | #6 | #6 | #7 |
| | P. O. | #4 | #4 | #1 | #4 | #4 | #4 | #4 | #4 | #6 | #4 |
| | Rent. | #1, #4 | #1 | #1 | #4 | #1, #4 | #1 | #1 | #1 | #1, #4 | #1 |
| Restrictive Goals[3] | F. O. | - | - | - | - | #5 | - | - | - | #5 | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | #7 | - | - | - | - | - | - | - | - | - |
| Secondary Goals[4] | F. O. | #3, #8, #5, #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #5 | #5 | #3, #5 | #5, #3 | #5, #3 | #3 | #3 | #3 | #3 | #3 |
| | Rent. | #5 | #5 | #5 | #5 | #3, #2, #7, #5 | #5 | #2, #7, #5 | #2, #7, #5 | #2, #7, #5 | #2, #7, #5 |
| Expansion Strategy | F. O. | BUY | - | - | - | NONE | - | - | - | NONE | - |
| | P. O. | RENT | - | - | - | RENT | - | - | - | RENT | - |
| | Rent. | NONE | - | - | - | BUY | - | - | - | BUY | - |

TABLE XLVI (Continued)

| Item | Land Equity1/ | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 | 7,360 |
| | P. O. | 8,000 | 8,000 | 8,000 | 8,320 | 8,320 | 8,320 | 8,320 | 8,640 | 8,640 | 8,640 |
| | Rent. | 7,680 | 7,680 | 7,680 | 8,000 | 8,000 | 8,000 | 8,000 | 8,320 | 8,320 | 8,320 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | P. O. | 44 | 44 | 44 | 42 | 42 | 42 | 42 | 44 | 44 | 44 |
| | Rent. | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Net Worth | F. O. | $1,123,700 | $1,163,400 | $1,205,200 | $1,249,500 | $1,294,900 | $1,342,400 | $1,390,700 | $1,442,000 | $1,494,400 | $1,549,600 |
| | P. O. | $ 633,610 | $ 655,290 | $ 678,380 | $ 704,390 | $ 730,320 | $ 757,270 | $ 783,630 | $ 811,830 | $ 838,160 | $ 866,270 |
| | Rent. | $ 171,090 | $ 178,670 | $ 186,600 | $ 196,220 | $ 202,000 | $ 207,660 | $ 211,860 | $ 216,970 | $ 219,290 | $ 221,620 |
| Debt-Asset Ratio | F. O. | 0.05 | 0.009 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.03 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.28 | 0.24 | 0.22 | 0.19 | 0.23 | 0.22 | 0.24 | 0.19 | 0.25 | 0.21 |
| Dominant Goals2/ | F. O. | #1 | #1 | #1, #6 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 |
| | P. O. | #6 | #1 | #1, #6 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 |
| | Rent. | #1 | #1 | #1, #4 | #1 | #1 | #1 | #1, #4 | #1 | #1 | #1 |
| Restrictive Goals3/ | F. O. | - | - | #5 | - | - | - | #5 | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals4/ | F. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #7, #2, #5 | #7, #2, #5 | #7, #2, #5 | #7, #2, #5 |
| Expansion Strategy | F. O. | - | - | NONE | - | - | - | NONE | - | - | - |
| | P. O. | - | - | RENT | - | - | - | BUY | - | - | - |
| | Rent. | - | - | RENT | - | - | - | RENT | - | - | - |

NOTE: See reference A at end of chapter for explanation of footnotes and key to goal numbers.

made by the younger operator are based on restrictive conditions.

Regarding the periodic selections of strategies, the age 25 full and part owners in Table XLV rent in periods 1, 5 and 9 and purchase land in the thirteenth and seventeenth periods. The tenant only purchases land in period 9 and rents in the other decision periods. Consequently, the maximum expansion is attained by each 25 year-old equity position and each terminate as part owners generally free of debt.

In contrast, the 45 year-old full owner in Table XLVI only expands in period 1 because of inadequate leisure time in latter periods. The older part owner selects the rental strategy in all decision periods except the last. The tenant buys twice and rents twice in successive decision periods following the first in which the borrowing needs limitation completely restricts any clear choice of an alternative.

In summary, the 45 year-old operator again excels in net worth gains as compared to the age 25 operator for all beginning equity positions. Even though the older full owner purchases 320 acres less and expands significantly less, 1,280 acres, than the younger full owner, the relative gain in net worth of about $53,000 by the 45 year-old is due to consuming nearly $38,000 less, about $27,000 more interest earnings and about $15,000 less net income is earned. Likewise the older part owner gains about $21,000 more in net worth by consuming $16,000 less and earning about $18,000 more interest with about $12,000 less net returns. The tenant situations earn no interest payments so the primary element of difference is about $25,000 less in consumption attributing to an ultimate increase of over $16,000 net worth gain for the older operator. Increases in income taxes paid by the older operators are also involved in the relative net worth gains.

## Summary of Results

The results of the multiple goals firm growth analysis in the South Central Plains have been discussed for each of sixty representative situations. Combinations of three crop farm sizes and one ranch size, three beginning land equity positions, three water resource situations, and two initial ages of operators are selected for the analysis. These selected factors are hypothesized to be influential in the growth or ability to increase the net worth position over time.

The previous discussion has emphasized the relation of age and increases in beginning land equity to additional gains in net worth. The average annual increases in net worth, Table XLVII, indicate that the range in annual growth potential for the biable operations is from $1,694 to $56,723. The lowest is associated with the age 25 renter of Farm III in "B" water in which the extensive borrowing requirements curtail expansion to only 320 acres rented in the thirteenth period. The highest annual growth occurs with the age 45 full owner of Farm III in the thickest saturated aquifer, "Class C" water. Expansion occurs in each decision period. Four of the five decisions are to buy land based on goal #6 to "increase net worth." In addition, no outstanding debts exist in the terminal period.

The differences in net worth gains attributed to the age of the operator are generally smaller than those associated with changes in equity and farm size. The average periodic growth for all full owners is $29,635. Farm I full owners average $16,770 increase in net worth per year; Farm II, $23,424; Farm III, $46,176 and the irrigated ranch $37,249. The part owners average $16,873 annual growth with the part owners of Farm I increasing by $12,988 per year; Farm II, $12,953;

TABLE XLVII

STARTING NET WORTH AND AVERAGE ANNUAL INCREASES IN NET WORTH AS RELATED TO WATER RESOURCE SITUATION, INITIAL FARM SIZE, EQUITY POSITION AND AGE OF OPERATOR

| Water Situation | Farm Situation | Age | Average Annual Increase in Net Worth[a] Full Owner | Part Owner | Renter |
|---|---|---|---|---|---|
| | | | | -----dollars------- | |
| A | Farm I | 25 | 10,662 | 13,283 | 12,836 |
| | | 45 | 13,503 | 15,116 | 13,410 |
| | II | 25 | 19,036 | 15,018 | 12,040 |
| | | 45 | 19,351 | 15,807 | 12,794 |
| | III | 25 | 42,685 | 34,903 | 25,977 |
| | | 45 | 44,423 | 35,693 | 26,786 |
| | Ranch | 25 | 35,846 | 20,455 | 5,560 |
| | | 45 | 38,652 | 21,544 | 6,420 |
| B | Farm I | 25 | 20,062 | 15,994 | 16,348 |
| | | 45 | 20,491 | 20,856 | 17,047 |
| | II | 25 | 23,593 | 12,432 | 6,117 |
| | | 45 | 22,418 | 15,000 | 6,833 |
| | III | 25 | 38,250 | 17,509 | 1,694 |
| | | 45 | 39,067 | 18,372 | 2,394 |
| C | Farm I | 25 | 17,492 | 6,158 | b |
| | | 45 | 18,412 | 6,522 | b |
| | II | 25 | 28,479 | 9,002 | b |
| | | 45 | 27,667 | 10,457 | b |
| | III | 25 | 55,906 | 16,243 | b |
| | | 45 | 56,723 | 17,094 | b |
| Average | | | 29,636 | 16,873 | 8,313[c] |

[a]Based on the ending net worth position of period 1, the base period.

[b]Bankruptcy encountered during planning horizon.

[c]Includes zero growth for bankrupt situations.

Farm III, $23,303 and the ranch, $21,000. The renters, including zero growth for the bankrupt situations, average $8,313 growth per period. Farm I renters average $9,940; Farm II, $6,417; Farm III, $9,475 and the ranch, $5,990. Thus, there is a strong relationship of beginning equity to growth potential as well as an indication that beginning size influences the gains in net worth. The relationship of water supply conditions to growth is mixed and varies with the associated debt repayment capacity. The following discussion evaluates the selected causal factors in more detail.

### Effects of Operator Age and Family Characteristics

Generally, the older operator realizes greater net worth increases than the age 25 operator. With few exceptions, the reduction in family consumption by the age 45 operator results in relatively greater net worth gains. Increases in income taxes from the reduced family member deductions offset some of the reduction in consumption. The annual difference in growth attributed to age, Table XLVII, is generally about $600 to $800. However, some of the variation in consumption patterns is due to differences in farm income and net worth.

### Effects of Beginning Land Equity

The full owner situations of both age categories generally gain more net worth than the respective part owners and tenants for comparable water and farm situations. The only exception being the full owners of Farm I and both ages in "Class A" and "B" water. These situations terminate with 320 acres less in the operation than the respective part owners. The part owners also generally gain more net worth than tenants. The exception is the part owner, age 25, Farm I, "Class B" water situation which expands less than the associated tenant.

The general conclusion of the effects of various levels of initial land equity on growth potential is that increases in the beginning level of land equity generally result in greater growth potential given comparable sizes of operation. However, the ultimate size of operation does not necessarily need to be equivalent between situations if terminal ownership in land resources is greater for the relatively smaller unit. For example, the age 25 full owner, "Class A" water, Farm II situation terminates with 640 acres less in size but owns 800 acres more than the associated part owner resulting in a greater gain in net worth. Other situations having similar conditions for the age 25 full owners are in "B" water, Farm II and "A" water, Farm III. The age 45 full owners having a similar situation occur in "Class A" water, Farm II and Farm III. In turn, it is also possible that a tenant situation expand to a larger size than a part owner but the latter terminates with more land owned. Examples of this situation of the age 25 part owners are "A" water, Farm III and "B" water, Farm II and for the age 45 part owner in "A" water, Farm III situation. Thus, both facets regarding the terminal amount of land owned and the ending size of operation interact to influence the growth potential in net worth over the period.

## Effects of Beginning Farm Size

The influence of beginning farm size on growth is also evident is Table XLVII. By comparing the average annual increases of a particular age category and water situation, it is evident that the gains in net worth are positively correlated to the beginning size of operation for all full owners. A similar relationship exists for the part owners in "Class A" and "C" water and the tenants in "Class A" water. The positive relationship is due to the increasing tendency to purchase more land as beginning size increases.

However, a negative relationship is indicated by the "Class B" water situation for both age categories of tenants. In each case, Farm I purchased 960 acres as compared to only 320 acres for Farm II and none for Farm III. Thus, the relative gain in net worth may diminish as beginning size increases if the smaller operations purchase more land over time.

The former positive relationship is also subject to adequate debt-repayment capacity to retire the real estate and chattel loans. In the case of both ages of part owners in "Class B" water, a mixed relationship of growth potential to beginning size is indicated. The Farm II situation purchases the same, 960 acres, as Farm I but terminates with relatively more outstanding debts and thus less gain in net worth. The Farm III situation ends with greater outstanding debts than Farms I and II but purchases 640 acres more than either which tends to offset the higher outstanding debts.

## Effects of Water Supply Conditions

Varying water supply conditions are also indicated as influential on growth potential. However, the relationship of saturated thickness to net worth gains is mixed, i.e., the intensively irrigated crop farms indicate no consistent relationship. Considering Farm I situations only, the general tendency is for "Class A" and "C" water situations to gain less in net worth than "B."

However, a similar relationship does not exist for Farms II and III. The larger operations in "B" and "C" water terminate with large outstanding debts under part owner and tenant equity conditions. The debts are related to increases in the price of land, land rental payments and irrigation facility investments as saturated thickness increases. Thus, the "Class A" water situation which has the lowest land costs and terminates irrigation activities in the latter part of the planning horizon realizes the most gain in net worth.

The full owners (both ages) of Farm II indicate the only positive relationship of increases in saturated thickness to gains in net worth. The primary reason is that the limited expansion of the operation results in a relatively free debt position in the terminal period.

Thus, the factors as hypothesized generally influence the growth potential. However, clearly defined relationships of growth to causal factors are sometimes difficult to isolate because of countervailing or complimenting effects of other factors as well as the differences in strategies adopted over time by the multiple goals decision process. Primary reasons for the causal factors being influential in net worth gains are reductions in consumption by the older operator, increases in net income from larger operations and increases in the capital security base as starting land equity increases. The effects of increases in water supply conditions vary with the associated debt repayment capacity as related to the other factors.

# Reference A

## Footnotes to Tables of Results

[1]Three initial land equity positions are evaluated. "F.O." means full owner or 100 percent ownership of land operated in period 1. "P.O." means part owner or 50 percent ownership of land operated in period 1. "RENT" means renter (tenant) or no ownership of land operated in period 1.

[2]The dominant goal is the top-ranked goal in the hierarchy. If two or more are listed, the alternative dominant goals (successively lower ranked) indicate that one or more strategy decision values for alternative plans are tied for the higher ranked goals.

[3]A restrictive goal is one of the primary goals for which the plan(s) do not meet the satisficing level. Two basic formats are used: (1) no parentheses around the restrictive goal indicates that all alternative strategies are infeasible, and (2) parentheses indicate that at least one or more alternatives are infeasible but not all of the alternatives.

[4]A secondary goal is one which is disregarded in the decision process, i.e. the strategy decision values for alternative plans do not have to meet the associated satisficing level for the goal.

## Key to Goal Numbers

#1 - control more acreage;

#2 - avoid being forced out of business;

#3 - maintain or increase family living standard;

#4 - avoid years of low profits or losses;

#5 - increase leisure time;

#6 - increase net worth;

#7 - reduce borrowing needs; and

#8 - make the most profit.

## FOOTNOTES

[1]See footnotes 2, 3 and 4 of Reference A for definitions of dominand, restrictive and secondary goals.

[2]The restrictive goal is without parentheses in the tables if the decision is totally restrictive but is enclosed by parentheses if only one or more but not all of the alternatives are excluded by the associated minimum satisficing level of the restrictive goal.

# CHAPTER VII

# AN EVALUATION OF THE MULTIPLE GOALS DECISION PROCESS

The multiple goals decision model used in this analysis is a modification of the multidimensional utility analysis proposed by C. E. Ferguson.[1] The two approaches are discussed in Chapter II. Objectives used include maximizing farm profits, net worth, family living standards, returns to fixed resources, acres operated or minimizing borrowing needs and debt-asset ratios.

In any given decision period, the objectives are grouped into primary and secondary goals. A plan is a feasible alternative if the satisficing levels of the primary goals are met. The modified procedure maximizes satisfaction by selecting one of the feasible plans which best meets the dominant objective. This chapter discusses the adequacy of the modified approach and the frequency with which each objective is used as the decision goal.

## The Decision Goal

The discussion in Chapter VI indicates the dominant, alternative dominant and restrictive goals used in the decision process. The decision goal is used as a common basis to evaluate the effectiveness of the multiple-goal decision model. The logic is that the current decision goal, whether one of the top-ranked objectives or a lower-ranked goal imposing a restraint, controls the strategy selection process. Thus, the decision goal is necessarily one of those in the primary group of objectives. In addition, goals which consistently result in tied values between plans such as goals #1 and #3 in the current analysis will not be decision goals. The following discussion relates the procedures for evaluating the multiple goals decision process by using the decision goal as a common basis for strategy selection.

## Evaluating the Multiple Goals Decision Framework

A thorough evaluation of the multiple goals decision model would compare the results of the technique to actual observations. However, this is not possible since the problem investigated in this thesis is the future growth potential of representative firms in the study area. Since insufficient time has elapsed to evaluate the accuracy of the projections, other means of a preliminary nature must be employed.

Several alternative means are utilized to evaluate the multiple goals technique. The frequency and consistency of strategy selections as related to specific decision goals, the relative stability of goals over time and the margins on which strategy selections are made will be evaluated. Generally, these evaluations are based on the results of the decision process in a synthesized setting of various representative farm situations.

The basic characteristics of such a decision-making framework are difficult to quantify. The interactions of firm and family characteristics and the degree of complexity associated with changes in the hierarchy of goals makes it difficult to assert that certain specific cause and effect relationships should occur. Thus, the evaluation is subjective in nature and statistical test criteria are not provided for evaluating the decision process.

### The Relationship of Selected Strategies to Decision Goals

The frequency of selected strategies by decision goals is given for each farm situation in Table XLVIII. The Farm I and Farm II situations each represent 86 decisions rather than 90 since four decision periods are excluded because of bankruptcy conditions. Similarly, there are 84 decisions made in the Farm III situation since six decision periods are excluded. A total of 30 decisions are made in the ranch situation giving a total of 286 decisions for all situations.

The frequencies of selected strategies on the crop farms I, II, and III with regard to all decision goals are similar. The decisions involving no expansion are based primarily on goal #2, the debt-asset ratio, goal #7, reduce borrowing needs and the simultaneous limitation by both goals. Some limitation to expansion is also due to inadequate leisure time, #5. The Farm I situation does not expand in 14 decisions or 16 percent of the decision years. About 26 percent and 30 percent of the decisions are nonexpansionary for Farms II and III, respectively. The ranch does not expand 17 percent of the time. The goals most frequently limiting expansion on crop farms are borrowing needs and excessive debts in the early portion of the 20-year period, but the ranch restrictions are primarily due to leisure time requirements of one situation; the 45 year-old full owner. In total, 23 percent of 286 decisions result in no expansion of which the majority are related to goals #2 and #7.

TABLE XLVIII

SUMMARY OF THE FREQUENCY OF DECISIONS FOR EACH PLAN AS RELATED TO ALTERNATIVE DECISION GOALS AND FARM SIZE

| Decision Goal[a] | Farm I[b] | | | Farm II[b] | | | Farm III[c] | | | Ranch[d] | | | Total[e] | | | Total Decision | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | None | Buy | Rent | None | Buy | Rent | None | Buy | Rent | None | Buy | Rent | None | Buy | Rent | | |
| | ----NUMBER----- | | | | | | | | | | | | | | | No. | % |
| #2 | 5 | - | 11 | 4 | - | 12 | 1 | - | 8 | - | - | - | 10 | - | 31 | 41 | 14.00 |
| #4 | - | 21 | 1 | - | 18 | 1 | - | 14 | 2 | - | 5 | 10 | - | 58 | 14 | 72 | 24.50 |
| #5 | 2 | - | - | 2 | - | - | 8 | - | - | 4 | - | - | 16 | - | - | 16 | 6.50 |
| #6 | - | 23 | 3 | 2 | 23 | 1 | - | 20 | - | - | 4 | 6 | 2 | 70 | 10 | 82 | 28.75 |
| #7 | - | - | - | 2 | - | 7 | 4 | - | 3 | 1 | - | - | 7 | - | 10 | 17 | 6.50 |
| #8 | - | 2 | - | - | - | - | - | 11 | - | - | - | - | - | 13 | - | 13 | 4.75 |
| #2, #7[f] | 7 | - | 11 | 12 | - | 2 | 12 | - | 1 | - | - | - | 31 | - | 14 | 45 | 15.50 |
| Total | 14 | 46 | 26 | 22 | 41 | 23 | 25 | 45 | 14 | 5 | 9 | 16 | 66 | 141 | 79 | 286 | 100.00 |
| Percent | 16 | 54 | 30 | 26 | 48 | 26 | 30 | 54 | 16 | 17 | 30 | 53 | 23 | 49 | 28 | 100 | - |

[a]Defined as the objective responsible for the strategy selection. Goals #1 and #3 are always tied with respect to two or more strategies and therefore can not be decision goals. See Reference A. Chapter VI for key to goal numbers.

[b]Based on 86 decisions.

[c]Based on 84 decisions.

[d]Based on 30 decisions.

[e]Based on 286 decisions.

[f]Both goals are simultaneously effective in the decision process.

The purchase strategy was selected in 49 percent of the total decisions. Goal #4, "avoid years of low profits or losses," and goal #6, "increase net worth," are the primary decision goals in these situations with some purchase decisions based on #8, "make the most profits." Farm I situations elect to buy 54 percent of the time; Farm II, 48 percent; Farm III, 54 percent and the ranch only 30 percent.

A decision to rent additional acreage was made in 28 percent of the total decisions. Farm I and II situations rent 30 and 26 percent of the time respectively, but Farm III only rents 16 percent of the time. The ranch operator elects to rent 53 percent of the time.

The selection of rental strategies is based on several objectives. Generally, renting is selected in lieu of buying either because of the excessive debts, because of borrowing requirements associated with buying land, or because it may be the best plan to "avoid years of low profits or losses" or "increase net worth." Fifty five of 63 decisions to rent made by crop farms are based on the former two reasons, while the ranch situations elect to rent exclusively for the latter two reasons.

In summary, there is little difference in the frequencies of strategies selected by the three crop farms. The major difference in frequencies is between the crop farms and the ranch. The crop farms select expansion strategies most of the time and, in addition, about 52 percent of the decisions are to purchase land. In contrast, the ranch rents land the majority of the time. The relatively high frequency of decisions to purchase land by the crop farms as compared to the ranch is related to their higher profit margins.

Evaluating the Consistency of Goal Selections

The previous discussion referred to the decision goals and their related strategy selections. Particular objectives tend to select certain strategies. Fourteen percent of the decisions are made by goal #2, "avoiding being forced out of business." This goal selects the rental option 75 percent of the time indicating a high degree of consistency. Twenty-five percent of the decisions based on this goal are non-expansionary and, therefore, continue with the present organization. The latter decisions are predominantly made when goal #2 is the decision goal and the debt-asset ratio is minimized. On the other hand, the selection of rental strategies is a result of goal #2 imposing a maximum debt-asset ratio of .4 deeming the purchase option infeasible.

Goal #7, "reduce borrowing needs," is the decision goal only six percent of the time (17 decisions). The strategies selected are similar to goal #2. The rental option is selected ten times or 59 percent of the time whereas no expansion occurs in seven decisions or 41 percent. The reasons for these selections are similar to those for goal #2.

There are several occasions when goals #2 and #7 are simultaneously effective in the decision process. The simultaneity is a result of both goals imposing limitations on borrowing needs and debts. About 16 percent of all decisions occur under these conditions. No expansion occurs 69 percent of the time and the rental option is selected 31 percent of the time. The reasons again are based on the same logic as the previous decisions.

Another limitation in the decision process involves inadequate leisure time based on goal #5. However, only six percent of the decisions are made to continue with the present organization because of inadequate leisure time.

The consistency of strategy selection is also high for goals #4, #6 and #8. The purchase option is chosen 81 percent of the time by #4; goal #6, 85 percent and goal #8, 100 percent of the time. The remainder of the decisions are to rent land.

In summary, 53 percent of the decisions in the current analysis are based on goals #4 and #6: "avoiding years of low profits or losses" measured by the returns to fixed resources and "increasing net worth," respectively. With the exception of goal #7 and the combined pair of #2 and #7, all decision goals select the same strategy at least 75 percent of the time.

## Evaluating the Multiple Goals Decision Process Over Time

Another important aspect of the multiple goals decision process is the evaluation of strategies selected over time and the inter-temporal mix of the decision goals. It was previously indicated that goals #4 and #6, "avoiding years of low profits or losses" and "increasing net worth" respectively, accounted for the majority, or 53 percent, of the decisions. Table XLIX gives the distribution of selected strategies over time for each decision period and the associated distribution of decision goals responsible for the strategy selections.

Sixty decisions are made in periods 1 and 5, 58 in period 9 and 54 in periods 13 and 17. Two situations encountered bankruptcy by period 9 and six situations are bankrupt in decision periods 13 and 17.

TABLE XLIX

DISTRIBUTION OF SELECTED STRATEGIES AND DECISION GOALS
FOR SPECIFIED DECISION PERIODS[1]

| Item | Decision Periods | | | | | | | | | | Total Distribution | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 5 | | 9 | | 13 | | 17 | | | |
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Strategies: | | | | | | | | | | | | |
| Purchase | 8 | 3 | 25 | 9 | 28 | 10 | 39 | 14 | 41 | 14 | 141 | 49 |
| Rent | 33 | 12 | 17 | 6 | 15 | 5 | 10 | 3 | 4 | 1 | 79 | 28 |
| No Expansion | 19 | 7 | 18 | 6 | 15 | 5 | 5 | 2 | 9 | 3 | 66 | 23 |
| Decision Goals: | | | | | | | | | | | | |
| #6 | 2 | .75 | 8 | 3 | 18 | 6 | 26 | 9 | 28 | 10 | 82 | 28.75 |
| #4 | 12 | 4 | 17 | 6 | 13 | 4 | 16 | 5.5 | 14 | 5 | 72 | 24.50 |
| #2, #7 | 19 | 7 | 12 | 4 | 10 | 3 | - | - | 4 | 1.5 | 45 | 15.50 |
| #2 | 19 | 7 | 11 | 3.5 | 5 | 1.5 | 6 | 2 | - | - | 41 | 14.00 |
| #7 | 8 | 3 | 5 | 2 | 4 | 1.5 | - | - | - | - | 17 | 6.50 |
| #5 | - | - | 3 | 1 | 4 | 1.5 | 4 | 1.5 | 5 | 2 | 16 | 6.00 |
| #8 | - | - | 4 | 1.5 | 4 | 1.5 | 2 | .75 | 3 | 1 | 13 | 4.75 |

[1]Excludes two decisions in period 9 and six in periods 13 and 17 in which bankruptcies are encountered.

The trends over time of the selected strategies indicate an increase in the decisions to purchase land in period 1 from about three percent of the total decisions to approximately 14 percent in period 17. In contrast, decreases in rental and non-expansion selections occur over the planning horizon. The increasing trend of selecting the purchase option is related to the diminishing frequency of decision goals #2, #7 and the combination of the two. For example, in period 1 about 77 percent or 46 of 60 decisions in the first period are based on the three decision criteria. As a result, the purchase option is only selected eight times or about 13 percent of the first period's decisions. In the last decision period, the reverse situation is indicated in which nearly 76 percent of the decisions purchase land and expansion is prevented in only about seven percent or four of the 54 decisions by goals #2, #7 and their combination. The increasing tendency to purchase land over time by the multiple goals decision process is related to the increasing capital position of the firm as time progresses. Thus, there are relatively few instances when "reducing borrowing needs" or "avoiding being forced out of business" impose limitations on expansionary decisions in the latter half of the planning period.

### Evaluating the Stability of Goals Over Time

The stability of dominant objectives is also an important aspect of evaluating the multiple goals decision technique. If the technique consistently results in sporadic and frequently alternating dominant goals indicating unstable or random patterns over short intervals, the estimating procedure for developing the hierarchy of goals and their relative importance to each other may be too sensitive to reflect stability or successive occurrences of a goal over short time frames. However, the technique should be sufficiently flexible to allow alternating dominant objectives over long intervals. Factors associated with consistent unstable conditions should be isolated to improve the estimating procedure in future endeavors.

An index of stability[2] is used to evaluate the current analytical technique and aid in identifying factors responsible for unstable conditions. The following equation gives the procedure for calculating the stability value from which the index is calculated.

$$\text{Stability Value}_i = LLR_i - (R_i - G_i) \tag{1}$$

where $LLR_i$ is the longest length of run observed for a single objective in situation i, $R_i$ is the sum of the number of runs including single period runs, and $G_i$ represents the total number of different dominant goals used over the planning period. Large positive values reflect stability in the dominant goals while sporatic changes of dominant goals are reflected by lower values.

Considering that there are 20 periods and eight objectives in the current analysis, the value reflecting the most stable condition is indicated by the upper limit of 20 in which the longest run is 20 and the number of runs and dominant goals is one. On the other hand, the lower extreme or most unstable value is -11 in which the longest run is one year, the number of runs is 20 and the highest number of goals is eight. A moderately stable value of five may be indicated by having runs of four different goals for successive five-year intervals reflecting a change in objectives as decision periods occur. Converting the stability value to a zero-to-one hundred index requires adding 11 to the stability value, dividing by the total possible range of 31 and multiplying by 100. The most stable situation is associated with the index of 100; the moderately stable, an index of 51; and the least stable, an index of zero.

The indices from 0 to 100 for each situation are presented in Table L. The overall performance of the multiple goals decision technique is satisfactory as is indicated by the average index of 75 for all situations. Although there are differences between indices as related to factors such as age, size, land equity and water supply, no serious instability is attributed to a specific factor. There is little difference in the stability by age categories as indicated by an average index of 72 for all age 25 situations and an average index of 77 for the 45 year-old situations.

There is some indication of less stable conditions in the Farm I situations of the 25 year-old with an average index of 53. The full owner in "Class A" water and the part owner in "Class C" water are instrumental in lowering the average by having indices of 29 and 19, respectively.

With respect to equity situations, no serious instability exists but the renters in "Class B" water indicate the lowest average index of 63. Of this group, the 25 year-old renters are the most unstable with an average index of 54 as compared to 72 for the older tenants.

The most stable conditions are indicated by all age 25 ranch operators having an average index of 88 and the age 25 part owners in "Class A" water indicating an average index of 90. With regard to all land equity situations, the full owners in "Class B" water result in the highest average stability index of 85. The two age 25 full owners of

TABLE L

SUMMARY OF STABILITY INDICES FOR EVALUATING THE MULTIPLE GOALS DECISION TECHNIQUE

| Water Situation and Initial Land Equity | Age 25 Operator | | | | | Age 45 Operator | | | | | Overall Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Farm I | Farm II | Farm III | Ranch | Average | Farm I | Farm II | Farm III | Ranch | Average | |
| "Class A" Water | | | | | | | | | | | |
| Full Owner | 29 | 45 | 94 | 90 | 65 | 65 | 84 | 81 | 71 | 75 | 70 |
| Part Owner | 87 | 100 | 87 | 87 | 90 | 90 | 45 | 81 | 52 | 67 | 79 |
| Renter | 52 | 77 | 71 | 87 | 72 | 74 | 81 | 100 | 84 | 85 | 79 |
| "Class B" Water | | | | | | | | | | | |
| Full Owner | 48 | 94 | 100 | - | 81 | 84 | 84 | 97 | - | 88 | 85 |
| Part Owner | 74 | 65 | 87 | - | 75 | 90 | 84 | 35 | - | 70 | 73 |
| Renter | 45 | 52 | 65 | - | 54 | 68 | 61 | 87 | - | 72 | 63 |
| "Class C" Water | | | | | | | | | | | |
| Full Owner | 55 | 90 | 100 | - | 82 | 77 | 84 | 65 | - | 75 | 79 |
| Part Owner | 19 | 90 | 77 | - | 62 | 81 | 84 | 87 | - | 84 | 73 |
| Renter | 68 | 68 | 68 | - | 68 | 100 | 74 | 68 | - | 81 | 75 |
| Average | 53 | 76 | 83 | 88 | 72 | 81 | 76 | 78 | 69 | 77 | 75 |

Farm III in classes B and C water have indices of 100 indicating no change in the dominant goal over the 20 years.

In summary, only about 12 percent of the situations have a stability index of less than 50, and nearly 57 percent have an index of 75 or greater. With few exceptions, the multiple goals decision technique used in the present study provides a high degree of stability for the dominant objectives. In addition, no specific factor is responsible for consistently unstable conditions.

Even though the strategy selections are consistent among decision goals and the dominant objectives indicate a high degree of stability, the technique is not without limitations. The following discussion emphasizes the major limitations of the current decision-making framework.

## Limitations of the Multiple Goals Approach

The multiple goals approach to decision making used in this analysis is primarily limited by the basic multiple goals research previously discussed, the development of the strategy selection criteria and the inability to evaluate the reality and accuracy of the decision goals, the hierarchy of goals and the associated primary and secondary groups. The following discussion relates limitations associated with these items.

### Limitations of the Basic Multiple Goals Research

The specific limitations of the basic research of multiple goals and factors indicating their relative importance to each other are related in the published results of that effort.[3] The most important limitation emphasized is the highly interrelated nature of the eight goals. In addition, it is recognized that fewer objectives of a more independent nature might improve the ability to isolate factors significant in determining the hierarchy of multiple goals.

An item crucial to the present evaluation of the decision technique is that the analysis is based on one cross section sample survey. A series of surveys over time might disclose other significant causal factors such as the general economic conditions, weather conditions or others which may influence the goal hierarchies over time and possibly even give rise to goals other than the eight objectives selected for this study.

## Limitations of the Decision Criteria for Selecting Among Strategies

The development of decision criteria for selecting among alternative strategies requires the determination of a quantitative measure in acres, hours or dollars for each goal. As previously discussed, the technique allows no trade-off conditions permitting a plan having only a slightly less than satisfactory value with respect to the decision goal to be selected on the basis of superior values for other primary goals.

The lack of trade-offs is especially important in the present analysis. Several situations are reported in the results in which the decision to rent is selected in preference to purchasing land on the basis of close decision values. Table LI gives a summary of the average, range and distribution of the differences upon which the purchase option is rejected and the rental strategy is selected. The following Table LII

TABLE LI

SUMMARY OF THE MARGIN OF STRATEGY DECISION VALUES FAVORING THE RENTAL OPTION OVER THE PURCHASE OPTION

| Decision Goals[a] | Differences in Strategy Decision Values of Renting Over Buying: Average Difference | Differences in Strategy Decision Values of Renting Over Buying: Range in Differences | Distribution of Observations: Above Average | Distribution of Observations: Below Average |
|---|---|---|---|---|
| | | | number | number |
| #2 | 0.205 | 0.06-0.46 | 19 | 26 |
| #4 | $589 | $23-$2,873 | 3 | 11 |
| #6 | $672 | $69-$3,222 | 3 | 8 |
| #7 | $42,703 | $3,104-$90,102 | 12 | 12 |

[a]Key to goal numbers:
#2 - avoid being forced out of business;
#4 - avoid years of low profits or losses;
#6 - increase net worth and
#7 - reduce borrowing needs

TABLE LII

SUMMARY OF THE MARGIN OF STRATEGY DECISION VALUES FAVORING THE NON-EXPANSION OPTION OVER THE EXPANSION OPTIONS

| Decision Goal[a] | Differences in Strategy Decision Values of No Expansion Over Expansion Strategies[b] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Purchase Option | | | | Rental Option | | | |
| | | | Distribution | | | | Distribution | |
| | Average Difference | Range in Differences | Average & Above | Below Average | Average Difference | Range in Differences | Above Average | Below Average |
| | | | – – – number – – – | | | | – – – – – – – number – – – – – – – | |
| #2 | 0.18 | 0.09-0.30 | 6 | 5 | 0.012 | 0.01-0.02 | 2 | 9 |
| #5 | 20 days | 19-21 days | 3 | 2 | 20 days | 19-21 days | 3 | 2 |
| #6 | $2,930 | #2,783-$3,077 | 1 | 1 | $4,426 | $4,065-$7,787 | 1 | 1 |
| #7 | $39,656 | $23,346-$71,307 | 1 | 2 | $23,775 | $7,295-$55,766 | 1 | 2 |

[a]Key to goal numbers:
#2 -- avoid being forced out of business;
#4 - avoid years of low profits or losses;
#5 - increase leisure time;
#6 - increase net worth and
#7 - reduce borrowing needs.

[b]Does not include decisions made under totally restrictive conditions in which all alternatives are rejected.

gives the same items with respect to the strategy decision value differences favoring non-expansion over renting and purchasing.

In the first case, Table LI, the average difference between the decision values for goals #2 and #7 are indicative of clearly decisive situations even though some differences are marginal as indicated by the lower extremes of the ranges. However, the average decision value differences of $589 and $672 are small relative to the amount of money involved for "avoiding years of low profits or losses" and "increasing net worth," goals #4 and #6, respectively. The lowest decision margins of $23 and $69 given in the range of differences for the respective goals #4 and #6 are indications of the small margin on which renting is preferred to buying. In addition, the number of observations below the average difference indicates most of the decisions are made on small margins.

In reviewing the decision criteria, discussed in Chapter III, the difference in strategy decision values of goal #4 between renting and buying is primarily influenced by the comparative difference between the cash rental payment and the interest payment on the outstanding real estate debt. The other variables such as total farm sales, operating costs, farm overhead costs and the variability of net returns are the same for both plans. Small differences are associated with property taxes and insurance premiums.

The differences in values of goal #6 are primarily functions of the outstanding debts and the cash-on-hand resulting from the two alternatives. Consequently, the differences are small in cases where the additional cash rental payments approximate either the additional interest payments or the sum of the outstanding debts and cash-on-hand resulting from purchasing land.

The average, range and distribution of the differences in the strategy decision values for decisions favoring no expansion over expansion plans of buying or renting land are given in Table LII. Most of the decisions concerning the rejection of purchasing and renting land are not extremely close. However, some close decisions are made by goal #2 in favor of no expansion over renting. The differences in debt-asset ratios are marginal and, again, a function of the outstanding debts resulting from the two expansion plans.

In summary, the small differences in strategy decision values indicate the possible sensitivity of using common decision criteria for selecting among strategies. In the absence of trade-off conditions, marginal conditions are expected to be encountered in certain circumstances. This sensitivity is of particular importance in selecting rental in lieu of purchase strategies because it affects the estimate of the terminal tenure status. Nineteen marginal decisions are made with respect to maximizing returns to fixed resources and net worth, goals #4 and #6 respectively, in which the differences in strategy decision values are below the respective average differences. The implicated trend toward part ownership is caused by the borrowing requirements and interest payments associated with the purchase option. However, the comparative tenure status between farm operators in the 1964 and 1969 census of agriculture[4] for the study area indicates a reverse trend, i.e., away from part ownership to full ownership. In 1964, 22 percent or 1,928 of the farms were being operated by full owners and in 1969, 2,982 farms or 29 percent were under full ownership status. In contrast, the percentage with part ownership decreased from 50 percent (4,346 farms) in 1964 to 44 percent (4,494 farms) in 1969. The relative proportion of tenants did not change but, like the part owners, the number of farms with tenant operators increased from 2,394 to 2,712 between 1964 and 1969. The percentages remain constant or decrease while the number of farms increase because an additional 1,454 farms exist in 1969 as compared to 1964. Of this increase, 1.125 more irrigated farms are indicated in 1969.

In addition, 14 close decisions based on goal #2, "avoid being forced out of business," are in favor of the nonexpansion strategy which, in turn, affects the terminal estimates of farm size. The present strategies in the current analysis do not include the alternative to reduce farm size. Consequently, the average size of operation generally increases over time in the present analysis. This implied trend, like the trend toward part ownership, is also contrary to the recent pattern of trends in farm size.

Consequently, the present study indicates that irrigated farms, whether they continue irrigation or convert to dryland, are expected to increase in size over the next two decades with the exception of those encountering bankruptcy. However, the average irrigated operation decreased in size from 2,109 acres in 1964 to 1,743 acres in 1969. The absence of a reduction-in-size alternative does not allow similar projections in this analysis. However, by inference, a reduction-in-size alternative might have been selected when all plans were rejected on the basis of inadequate satisficing levels. Forty-four decisions in the present study or about 15 percent of the total decisions occur under these conditions.

FOOTNOTES

[1]C. E. Ferguson, "The Theory of Multidimensional Utility Analysis in Relation to Multiple-Goal Business Behavior: A Synthesis," Southern Economic Journal, Vol. 32 (1965), pp. 169-175.

[2]A statistical test for runs or nonrandom elements is not appropriate for testing stability in this case since independent stochastic or random processes are not applicable to the consecutive occurrence of dominant goals over time. Rather, the factors influencing the occurence of a dominant goal are related to the specification of the beginning characteristics of the farm and changes in them as time progresses. Thus, the dominant goal in any given period is not an independent observation but is correlated to previous decisions and evolving farm and family characteristics. Consultations with an economitrician, statistician, testing and measurement professional and other economists disclosed no appropriate statistical test criterion.

[3]Wyatte L. Harman, Roy E. Hatch, Vernon R. Eidman and P. L. Claypool, An Evaluation of Factors Affecting the Hierarchy of Multiple Goals, Oklahoma Agriculture Experiment Station Technical Bulletin T-134 (June, 1972).

[4]U. S. Department of Commerce, Bureau of the Census, 1969 Census of Agriculture, Volume 1, Parts 21, 36, 37, and 41, (U. S. Government Printing Office, Washington, D.C., 1972) and 1964 Census of Agriculture, Volume 1, Parts 21, 36, 37, and 41, (U. S. Government Printing Office, Washington, D. C., 1967).

# CHAPTER VIII

## SUMMARY, CONCLUSIONS AND IMPLICATIONS OF THE STUDY

A multiple goal decision model is used to evaluate the growth potential of irrigated farms with diminishing water resources in the South Central Plains. The study area includes a twenty-one county area in the northern Texas panhandle, Oklahoma panhandle, southwestern Kansas and southeastern Colorado. The major crops produced in the area are grain sorghum, corn and wheat with livestock programs being predominantly beef production from cow-calf and stocker enterprises. Rapid irrigation development using the underground water supply since the mid-sixties is responsible for intensive crop farming activities and further development and intensification has resulted in a generally declining static water level in the area.

The economic consequences of diminishing the water resources are increased pumping costs and eventual declines in well yields. Declining well capacities result in less irrigated acres or more irrigation wells to offset the loss of irrigated acreage. The ultimate result is loss of farm profits over time and an eventual reduction to the level of opportunity returns from dryland farming. Possible technological advances, improved management practices, improved input and output price relationships and increased yields may affect the time to economic depletion, but do little to alleviate the consequences of the continual water-mining practices.

The analysis evaluates the growth potential of three sizes of irrigated crop farms and one ranch in three water supply situations having three initial land equity positions and two beginning ages for the operators. The irrigated crop farms designated herein as Farm I, Farm II, and III begin with 640, 1,600 and 2,880 acres respectively consisting of about 90 percent cropland. The ranch starts with 7,040 acres with approximately one-third cropland. Each crop farm situation is analyzed with three water resource situations beginning with 75, 250 and 450 feet of saturated thickness and the irrigated ranch is evaluated with the 75-foot water situation. In addition, the three initial land equity positions analyzed are 100, 50 and 0 percent land ownership and the two age profiles of operators begin with the ages of 25 and 45.

The primary objective of the study is to evaluate the growth potential in net worth of irrigated firms over time using a multiple goals decision technique. Goals are incorporated into the decision making process in a simulation model. To evaluate the intertemporal behavior of selected firms, the effects of the diminishing water supply on the farm organization are analyzed to provide a basic farm for the growth simulator. Comparisons of growth potential by water and land resource conditions, initial land ownership patterns and operator ages are made. The following discussion summarizes the means by which the objectives of the study are attained and the conclusions of the growth potential of irrigated farms in the study area.

## Summary and Conclusions

The basic premise used in the multiple-goal decision model is that the selection of a strategy depends on the top-ranked or dominant goal in the hierarchy subject to meeting the satisficing levels of all primary goals. The primary group of goals consists of the highest ranked goals in the hierarchy. These are the only goals used in the strategy selection process. In contrast, the secondary group includes all goals ranked below the primary group. The group classifications are based on relatively large differences in the scalar values associated with the goals. The scalar values are developed by regression equations following each production period using current farm and operator characteristics. A hierarchy of goals is established for the following period. The process allows variation in hierarchies over time as the physical, financial and family characteristics evolve. Alternating dominant goals and groups of primary and secondary goals are reflected in the strategy selection process of firm growth decisions.

Regarding the second objective of the study, one of four plans is selected: (1) continue with the present organization, (2) rent 320 acres of additional land, (3) purchase 320 acres or (4) trade 320 acres of rented land for purchasing an equivalent amount. In the current analysis, the decision process evaluates the growth strategies every fourth period following the first year.

The strategies are evaluated on the basis of their expected numerative value for each goal in the primary group. The strategy decision values for each goal are compared to the respective satisficing levels based on the current operation. The selection process utilizes the top ranked or dominant goal to select the strategy which best meets the goal. An alternative dominant or successively lower ranked goal is utilized for selecting between strategies having tied values for the dominant goal. The satisficing levels of the primary group of goals must be met by the strategy for its ultimate selection and implementation. If not, the next best strategy with respect to the top goal is evaluated. The process of elimination continues until an automatic acceptance of continuing with the present organization is implemented if all other plans fail to meet the satisficing levels of one or more primary goals.

Three water resource situations are analyzed to evaluate the growth potential with diverse hydrologic conditions. The primary differences are related to the varying saturated thickness of the underground water strata. A modal crop farm situation of 1,280 acres having 1,120 acres cropland is analyzed having 75 feet, 250 feet and 450 feet saturated thickness. A 7,040-acre irrigated ranch with 2,240 acres cropland is also evaluated for the 75-foot situation. Three wells of 400 and 750 gallons per minute each are in existence on the crop farms in the 75-foot and 250-foot saturated aquifers, respectively. Two wells of 1,000 gallons per minute each exist on the crop farm in the 450-foot zone. The irrigated ranch has twice the cropland so there are six wells of 400 gallons per minute in existence.

The results indicate that the 75-foot situation under intensive crop farming conditions, 1970-1971 prices and yields and 1972 government program alternatives can be expected to be economically depleted in ten years. The two relatively thicker aquifer conditions exceed a 20-year economic life under crop farm conditions. The irrigated ranch also has at least a 20-year life because of the moderate intensification of irrigation over the extensive surface area.

In essence, the crop farm with 75 feet of saturated thickness continues to develop additional irrigation facilities at the imposed maximum limit of 0.2 wells per period. This rate of development is insufficient to maintain irrigated acreage. Subsequent periodic reductions in grain sorghum and wheat acreage occur until the opportunity dryland returns on the farm are encountered in the eleventh period.

The irrigated ranch with essentially the same water supply condition continues to drill wells at the same rate of 0.2 wells per period. However, this situation is generally able to maintain irrigated acreage due to the relative reduction in periodic static water level declines as influenced by the relatively larger surface area contributing to the water supply.

With 250 feet of saturated thickness, the crop farm intensifies irrigation development to a fully irrigated unit and then curtails drilling activity because of the more profitable alternative of trading irrigated grain sorghum and small grain grazing for dryland grazing activity.

However, with 450 feet of saturated thickness, well capacities do not decline over the 20-year period. Sufficient aquifer thickness exists to compensate for possible reductions in well yields by lowering pumps. Thus, wells are drilled until all cropland is fully irrigated and, thereafter, irrigated acreage is maintained and drilling activity stops.

The third objective of the analysis is to evaluate the growth potential of sixty representative situations utilizing the base farm data developed by the water resources analysis. The results indicate that most of the representative situations will be viable firms realizing substantial gains in net worth over the 20-year planning horizon. Only ten percent or six situations encounter bankruptcy conditions. The remaining 54 situations vary in their relative gains in net worth for the period.

Generally, increases in beginning farm size, land equity or the age of operator result in relative increases in net worth over the 20 years. For example, the average annual increase in net worth for all full owners is $29,636; part owners $16,873 and tenants, including no growth for bankrupt situations, average $8,313 increase per period. A similar relationship exists as the size of the beginning unit increases. The average annual increase in net worth for the 640-acre farm, Farm I, is $19,849; the 1,600-acre unit or Farm II, $21,336 and Farm III, the 2,880-acre operation, $39,477. The older operator also generally realizes greater gains in net worth per period of about $600 to $800 given similar expansion strategies.

The relationship of improved water supply conditions to increases in net worth gains is mixed. Generally, the part owner and renter situations within farm size categories indicate that the relative gains in net worth decrease as the saturated thickness increases. Relatively lower land equity positions diminish the borrowing capacity of the firm and influence decisions to expand. The effects on full owner situations vary depending on the beginning farm size which influences capital accumulation and relative gains in net worth.

The multiple goals decision process does not provide for expansion in several situations in which inadequate leisure time, high borrowing needs or high debt-asset ratios in comparison to the satisficing levels are encountered. When the purchasing alternative is rejected it is primarily because of the financial position of the firm. In essence, there is an increasing tendency to purchase land over the 20-year period and a decreasing tendency to rent or continue with the current farm organization as capital accumulation occurs. Also, a few situations of the older operator are prevented from expanding by renting or buying because of the leisure time satisficing levels associated with the plans under consideration.

The results of the analysis indicate that a high proportion of viable and expanding irrigated farms can be expected for the next 20 years if the relative input and output price relationships, crop yields and commodity program conditions remain constant. The growth potential of the farms is affected by these primary factors.

Increases in the "price-cost" squeeze on profit margins, pressures for increases in the standard of living and reduction of commodity program benefits are expected to reduce the debt-repayment capacity and capital accumulation over time. As a result, a significantly moderated growth potential is expected. In contrast, continuing upward trends of crop yields, adoption of more efficient farming methods and increases in managerial expertise will tend to increase the growth potential.

The area implications of the study indicate a trend toward part ownership of land resources, larger farm operations and significant requirements for input capital needs; both short- and long-term. The implication of larger farms might be modified if a reduction-in-size plan is included as an alternative strategy. About 15 percent of all decisions chose the non-expansion option which, in turn, might have selected a reduction in the size of operation in some situations. The part ownership implication is also subject to imposed analytical assumptions wherein a relaxation of the 0.4 debt-asset ratio limit or the borrowing needs limitation might have resulted in a higher proportion of full owners.

Given the assumptions, the results indicate that three of the sixty situations attain full ownership of land. All other situations except the six which encountered bankruptcy terminate with part ownership of the operator.

Regarding the increase in size of operation, 47 percent increased the size of unit in each period to the additional 1,600-acre limit. Twenty-eight percent added 960 to 1,280 acres to the initial operations, 15 percent increased the size by 320 to 640 acres and ten percent, those encountering bankruptcy, added none.

The present analysis of several representative situations indicates that the decision technique using multiple goals can be effective in the selection of growth strategies. However, several limitations of the decision process were reviewed in detail in Chapter VII. Primarily, the high degree of interrelationship of the goals, the lack of trade-offs between strategies and the inability to validate the model by predicting actual farm operator decisions are areas in which significant improvement would be desirable. The following discussion indicates more specific limitations of the present analysis and further needs for research efforts in the general area of multi-objective decision making analyses.

## Limitations of the Analysis and Suggestions for Additional Research

The analysis held several key variables constant: (1) the frequency of strategy evaluations; (2) the size of expansion alternatives; (3) the length of the planning horizon; (4) the common consumption function based on both dryland and irrigation operators and the re-lated extensions at relatively high gross income levels; (5) the equations for developing the hierarchy of goals; and (6) the short-term decision framework.

No attempt to evaluate the effects of varying frequencies of strategy evaluations or sizes of expansion strategies is made in the present study. For example, the effect on growth potential of more frequent strategy selection periods and various incremental units of expansion needs to be evaluated. In addition, the growth potential should be evaluated with other strategies such as a reduction-in-size alternative.

The length of planning horizon, 20 years, is also held constant but seems to be adequate for this study with the exception that the alternative water situations are not allowed to reach their respective economic life of the water supplies. In addition, the consumption function relies on limited data regarding the number of observations and the range of observations. Thus, consumption estimates based on high income levels need to be refined.

The basic process of developing the hierarchy of goals by predictive equations is limited by several factors: (a) the basic research effort in which the equations were developed did not offer choices of objectives other than in the preliminary stages of pretesting, (b) the equations did not explain a high portion of the variance with coefficients of multiple determination generally less than 0.6, and (3) the high degree of interrelationship between alternative objectives prevented a clear delineation of the causal factors of changes in the relative importance of multiple goals.

The short-term nature of the present decision process also needs to be compared to alternative decision criteria utilizing intermediate or long-term assessments of decisions. For example, prior to purchasing land, a preliminary evaluation could be made of the expected return from invested capital in the firm as compared to a return obtained from finance institutions.

There are also several methodological questions regarding the multiple goals decision process: (1) How would alternative trade-off rules affect the decision processes? (2) How can the hierarchy of goals be evaluated as to their relative accuracy and realism? and (3) To what extent do exogenous variables affect the decision processes and relative importance of objectives? Trade-off conditions and the importance of exogenous variables on decision making might be ascertained by further research efforts in multiple goals evaluations or surveys of farm operators. The relative accuracy of projections made concerning growth potential can be tested only by the passing of time. The degree of complexity associated with such research efforts is correlated with the degree of realism incorporated into the analysis.

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## APPENDIX A

## BASE DATA FOR THE WATER RESOURCES ANALYSIS AND REPRESENTATIVE FARM SITUATIONS

TABLE LIII

SOIL AND WATER RESOURCE INVENTORY[1]

| Saturated Thickness | Depth to Water | Clay A Acres | Clay B Acres | Sand A Acres | Sand B Acres | Non Irrigable Acres | Total Acres | Percent |
|---|---|---|---|---|---|---|---|---|
| Under 100 ft. | | | | | | | | |
| | Under 50 ft. | 109,307 | 37,799 | 24,694 | 38,339 | 279,716 | 489,855 | 4.39 |
| | 51-100 ft. | 327,401 | 58,149 | 58,066 | 86,754 | 289,497 | 819,867 | 7.35 |
| | 101-150 ft. | 295,892 | 14,071 | 38,564 | 64,021 | 46,470 | 459,018 | 4.12 |
| | 151-200 ft. | 294,876 | 13,284 | 46,803 | 48,844 | 133,981 | 537,788 | 4.82 |
| | 201-250 ft. | 78,469 | 12,262 | 14,355 | 18,606 | 28,016 | 151,708 | 1.36 |
| | 251-300 ft. | 47,142 | 12,473 | 8,423 | 11,614 | 20,855 | 100,507 | 0.90 |
| | 301-350 ft. | 17,223 | 6,923 | 5,725 | 8,354 | 11,014 | 49,239 | 0.44 |
| | Over 350 ft. | 9,916 | 4,088 | 6,382 | 9,313 | 7,733 | 37,432 | 0.35 |
| | Subtotal | 1,180,226 | 159,049 | 203,012 | 285,845 | 817,282 | 2,645,414 | 23.73 |
| 101-200 ft. | | | | | | | | |
| | Under 50 ft. | 64,404 | 23,923 | 20,742 | 42,163 | 159,732 | 310,964 | 2.79 |
| | 50-100 ft. | 124,530 | 49,654 | 32,080 | 107,839 | 223,056 | 537,159 | 4.82 |
| | 101-150 ft. | 182,723 | 35,932 | 22,416 | 25,511 | 92,988 | 359,570 | 3.22 |
| | 151-200 ft. | 306,505 | 22,995 | 27,836 | 34,708 | 215,069 | 607,113 | 5.54 |
| | 201-250 ft. | 240,957 | 22,653 | 16,355 | 19,432 | 58,982 | 358,379 | 3.21 |
| | 251-300 ft. | 140,565 | 17,526 | 20,576 | 32,716 | 43,936 | 255,319 | 2.29 |
| | 301-350 ft. | 40,830 | 5,576 | 6,012 | 10,398 | 31,531 | 94,347 | 0.85 |
| | Over 350 ft. | 4,475 | 1,066 | 1,827 | 3,167 | 15,168 | 25,703 | 0.23 |
| | Subtotal | 1,104,989 | 179,325 | 147,844 | 275,934 | 840,462 | 2,548,554 | 22.86 |
| 201-300 ft. | | | | | | | | |
| | Under 50 ft. | 49,217 | 29,403 | 4,630 | 11,575 | 120,868 | 215,693 | 1.94 |
| | 51-100 ft. | 155,084 | 68,119 | 39,663 | 56,401 | 313,447 | 632,714 | 5.68 |
| | 101-150 ft. | 194,715 | 56,813 | 39,481 | 11,181 | 121,663 | 423,853 | 3.80 |
| | 151-200 ft. | 550,915 | 42,688 | 40,368 | 17,154 | 148,625 | 799,750 | 7.17 |
| | 201-250 ft. | 240,708 | 22,483 | 12,690 | 3,979 | 49,480 | 329,340 | 2.95 |
| | 251-300 ft. | 122,604 | 9,471 | 24,803 | 7,875 | 50,066 | 214,759 | 1.93 |
| | 301-350 ft. | 98,096 | 7,029 | 17,978 | 2,082 | 85,335 | 210,520 | 1.89 |
| | Over 350 ft. | 22,639 | 1,768 | 2,037 | --- | 16,399 | 42,843 | 0.38 |
| | Subtotal | 1,433,978 | 237,774 | 181,650 | 110,247 | 905,883 | 2,869,472 | 25.74 |
| 301-400 ft. | | | | | | | | |
| | Under 50 ft. | 69,487 | 14,252 | 13,239 | 1,483 | 47,201 | 145,662 | 1.31 |
| | 51-100 ft. | 174,692 | 35,460 | 28,269 | 23,687 | 76,678 | 338,786 | 3.04 |
| | 101-150 ft. | 218,434 | 28,251 | 29,058 | 22,252 | 70,049 | 368,044 | 3.30 |
| | 151-200 ft. | 562,963 | 76,836 | 71,451 | 35,406 | 132,675 | 879,331 | 7.89 |
| | 201-250 ft. | 89,954 | 15,060 | 4,218 | 2,096 | 21,686 | 133,014 | 1.19 |
| | 251-300 ft. | 29,873 | 4,901 | 141 | --- | 965 | 35,880 | 0.32 |
| | 301-350 ft. | 30,132 | 5,419 | 2,573 | 512 | 12,824 | 51,460 | 0.46 |
| | Over 350 ft. | 8,902 | 1,803 | 380 | 78 | 2,114 | 13,277 | 0.12 |
| | Subtotal | 1,184,437 | 181,982 | 149,329 | 85,514 | 364,192 | 1,965,454 | 17.63 |

TABLE LIII (Continued)

| Saturated Thickness | Depth to Water | Clay A Acres | Clay B Acres | Sand A Acres | Sand B Acres | Non Irrigable Acres | Total Acres | Percent |
|---|---|---|---|---|---|---|---|---|
| 401-500 ft. | | | | | | | | |
| | Under 50 ft. | 2,236 | 1,799 | --- | 418 | 25,559 | 30,012 | 0.27 |
| | 51-100 ft. | 54,314 | 13,491 | 16,962 | 13,456 | 19,263 | 117,486 | 1.05 |
| | 101-150 ft. | 117,557 | 5,927 | 58,480 | 72,732 | 44,233 | 298.929 | 2.68 |
| | 151-200 ft. | 101,764 | 4,433 | 27,866 | 39,693 | 29,677 | 203,433 | 1.82 |
| | 201-250 ft. | 13,052 | 3,540 | --- | --- | 1,883 | 18,475 | 0.17 |
| | 251-300 ft. | 14,010 | 2,791 | --- | --- | 1,584 | 18,385 | 0.17 |
| | 301-350 ft. | 15,287 | 3,052 | --- | --- | 1,730 | 20,069 | 0.18 |
| | Over 350 ft. | 5,497 | 1,516 | --- | --- | 801 | 7,814 | 0.07 |
| | Subtotal | 323,717 | 36,549 | 103,308 | 126,299 | 124,730 | 714,603 | 6.41 |
| Over 500 ft. | | | | | | | | |
| | Under 50 ft. | 15,945 | 289 | 7,458 | 3,694 | 5,504 | 32,890 | 0.30 |
| | 51-100 ft. | 33,509 | --- | 22,306 | 14,037 | 9,496 | 79,348 | 0.71 |
| | 101-150 ft. | 70,493 | 55 | 50,966 | 68,512 | 26,120 | 216,646 | 1.94 |
| | 151-200 ft. | 17,608 | 1,742 | 31,297 | 6,163 | 13,898 | 70,708 | 0.63 |
| | 201-250 ft. | 294 | 910 | --- | --- | 206 | 1,410 | 0.01 |
| | 251-300 ft. | 223 | 690 | --- | --- | 157 | 1,070 | 0.01 |
| | 301-350 ft. | 785 | 2,431 | --- | --- | 533 | 3,769 | 0.03 |
| | Over 350 ft. | --- | --- | --- | --- | --- | --- | -- |
| | Subtotal | 138,857 | 6,617 | 112,027 | 92,406 | 55,934 | 405,841 | 3.63 |
| Total | | | | | | 3,108,423 | 11,149,338 | 100.00 |

[1]Source: Bekure, Solomon, An Economic Analysis of the Intertemporal Allocation of Ground Water in the Central Ogallala Formation, unpublished dissertation, Oklahoma State University, May, 1971.

TABLE LIV

BASIC LINEAR PROGRAMMING TABLEAU FOR WATER RESOURCES ANALYSIS*

Grain Sorghum

| Row | 1GSDR | 2GSPR | 3GSP1 | 4GSP2 | 5GSP3 | 6GSP4 |
|---|---|---|---|---|---|---|
| 1OBJF | 9.27 | 21.53 | 23.11 | 28.11 | 34.26 | 37.04 |
| 2CRLD | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| RANGELND | | | | | | |
| 3GRSG | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 4CORN | | | | | | |
| 5WHET | | | | | | |
| 6SLGS | -10.0 | -20.0 | -35.0 | -50.0 | -60.0 | -65.0 |
| 7SLCN | | | | | | |
| 8SLWT | | | | | | |
| 9SLGZ | | | | | | |
| 9SLGZOUT | | | | | | |
| 9SLRANGE | | | | | | |
| 10MMLB | .45 | 1.99 | 1.99 | 1.99 | 1.99 | 1.99 |
| 11JJLB | .76 | .82 | 1.53 | 2.19 | 2.26 | 2.26 |
| 12ASLB | | | | | .27 | .71 |
| 13OFLB | | | | .22 | .32 | .32 |
| 14SPIG | | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| 16P2IG | | | 5.0 | 5.0 | 5.0 | 5.0 |
| 17P3IG | | | | 4.5 | 4.5 | 4.5 |
| 18P4IG | | | | | 4.0 | 4.0 |
| 19P5IG | | | | | | 3.5 |
| 20PRWH | | | | | | |
| 21P1WH | | | | | | |
| 22P2WH | | | | | | |
| 23P3WH | | | | | | |
| 24TWTR | | -7.0 | -12.0 | -16.5 | -20.5 | -24.0 |
| 25WLL1 | | | | | | |
| 26WLL2 | | | | | | |
| 27WLL3 | | | | | | |
| ACCNEW | | | | | | |
| WELLNEW | | | | | | |
| NEWLIMT | | | | | | |
| 28ACWL | | | | | | |
| 29RDWT | | | | | | |
| 30RSPE | | -7.0 | -7.0 | -7.0 | -7.0 | -7.0 |
| 32RSP2 | | | -5.0 | -5.0 | -5.0 | -5.0 |
| 33RSP3 | | | | -4.5 | -4.5 | -4.5 |
| 34RSP4 | | | | | -4.0 | -4.0 |
| 35RSP5 | | | | | | -3.5 |
| 36RWPR | | | | | | |
| 37RWP1 | | | | | | |
| 38RWP2 | | | | | | |
| 39RWP3 | | | | | | |
| 40CAPT | -1.99 | -7.49 | -8.05 | -9.05 | -10.38 | -12.02 |
| PROTECT | 1. | 1. | 1. | 1. | 1. | 1. |
| LBSET | | | | | | |
| WHASAMAX | | | | | | |
| FGASAMAX | | | | | | |
| WHNORM | | | | | | |
| FGNORM | | | | | | |
| WHTBASE | | | | | | |
| FGRBASE | | | | | | |
| 41CHWC | | | | | | |

*NOTE: Refer to page following tableau for explanation of row and column identification

TABLE LIV (Continued)

| | Corn | | | | Wheat | |
|---|---|---|---|---|---|---|
| Row | 8CNP2 | 9CNP3 | 10CNP4 | 10CNP5 | 11WHDR | 12WHPR |
| 10BJF | 49.64 | 58.04 | 65.54 | 73.13 | 8.77 | 12.81 |
| 2CRLD | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| RANGELND | | | | | | |
| 3GRSG | | | | | | |
| 4CORN | 1.0 | 1.0 | 1.0 | 1.0 | | |
| 5WHET | | | | | 1.0 | 1.0 |
| 6SLGS | | | | | | |
| 7SLCN | -80.0 | -110.0 | -130.0 | -145.0 | | |
| 8SLWT | | | | | -12.0 | -20.0 |
| 9SLGZ | | | | | - .25 | - .4 |
| 9SLGZOUT | | | | | | |
| 9SLRANGE | | | | | | |
| 10MMLB | 1.99 | 1.99 | 1.99 | 1.99 | | |
| 11JJLB | 2.26 | 2.26 | 2.26 | 2.26 | .11 | .34 |
| 12ASLB | .00 | .27 | .71 | 1.15 | .28 | .94 |
| 13OFLB | .32 | .32 | .32 | .32 | .08 | 1.14 |
| 14SPIG | 7.0 | 7.0 | 7.0 | 7.0 | | |
| 16P2IG | 4.5 | 4.5 | 4.5 | 4.5 | | |
| 17P3IG | | 4.0 | 4.0 | 4.0 | | |
| 18P4IG | | | 3.5 | 3.5 | | |
| 19P5IG | | | | 3.0 | | |
| 20PRWH | | | | | | 7.0 |
| 21P1WH | | | | | | |
| 22P2WH | | | | | | |
| 23P3WH | | | | | | |
| 24TWTR | -16.5 | - 20.5 | - 24.0 | - 27.0 | | - 7.0 |
| 25WLL1 | | | | | | |
| 26WLL2 | | | | | | |
| 27WLL3 | | | | | | |
| ACCNEW | | | | | | |
| WELLNEW | | | | | | |
| NEWLIMT | | | | | | |
| 28ACWL | | | | | | |
| 29RDWT | | | | | | |
| 30RSPE | - 7.0 | - 7.0 | - 7.0 | - 7.0 | | |
| 32RSP2 | - 4.5 | - 4.5 | - 4.5 | - 4.5 | | |
| 33RSP3 | | - 4.0 | - 4.0 | - 4.0 | | |
| 34RSP4 | | | - 3.5 | - 3.5 | | |
| 35RSP5 | | | | - 3.0 | | |
| 36RWPR | | | | | | - 7.0 |
| 37RWP1 | | | | | | |
| 38RWP2 | | | | | | |
| 39RWP3 | | | | | | |
| 40CAPT | -18.02 | - 19.67 | - 21.72 | - 24.24 | - 3.23 | - 5.03 |
| PROTECT | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| LBSET | | | | | | |
| WHASAMAX | | | | | | |
| FGASAMAX | | | | | | |
| WHNORM | | | | | | |
| FGNORM | | | | | | |
| WHTBASE | | | | | | |
| FGRBASE | | | | | | |
| 41CHWC | | | | | | |

TABLE LIV (Continued)

| Row | Wheat | | | | Small Grain Grazing | |
|---|---|---|---|---|---|---|
| Row | 13WHP1 | 14WHP2 | 15WHP3 | 16GZDR | 17GZPR | 18GZPI |
| 10BJF | 14.36 | 17.44 | 19.34 | 3.35 | 4.54 | 6.66 |
| 2CRLD | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| RANGELND | | | | | | |
| 3GRSG | | | | | | |
| 4CORN | | | | | | |
| 5WHET | 1.0 | 1.0 | 1.0 | | | |
| 6SLGS | | | | | | |
| 7SLCN | | | | | | |
| 8SLWT | -35.0 | 45.0 | -55.0 | | | |
| 9SLGZ | - .5 | -1.0 | - 1.25 | | | |
| 9SLGZOUT | | | | 1.6 | -2.0 | -2.8 |
| 9SLRANGE | | | | | | |
| 10MMLB | .71 | 1.32 | 1.59 | | | .71 |
| 11JJLB | .34 | .34 | .34 | .38 | .58 | .58 |
| 12ASLB | .94 | .94 | .94 | .34 | .51 | .51 |
| 13OFLB | 1.14 | 1.14 | 1.14 | | | .91 |
| 14Spig | 5.0 | 9.5 | 13.5 | | | 5.0 |
| 16P2IG | | | | | | |
| 17P3IG | | | | | | |
| 19P4IG | | | | | | |
| 19P5IG | | | | | | |
| 20PRWH | 7.0 | 7.0 | 7.0 | | 7.0 | 7.0 |
| 21P1WH | 5.0 | 5.0 | 5.0 | | | 5.0 |
| 22P2WH | | 4.5 | 4.5 | | | |
| 23P3WH | | | 4.0 | | | |
| 24TWTR | -12.0 | -16.5 | -20.5 | | -7.0 | -12.0 |
| 25WLL1 | | | | | | |
| 26WLL2 | | | | | | |
| 27WLL3 | | | | | | |
| ACCNEW | | | | | | |
| WELLNEW | | | | | | |
| NEWLIMT | | | | | | |
| 28ACWL | | | | | | |
| 29RDWT | | | | | | |
| 30RSPE | - 5.0 | - 9.5 | -13.5 | | | - 5.0 |
| 32RSP2 | | | | | | |
| 33RSP3 | | | | | | |
| 34RSP4 | | | | | | |
| 35RSP5 | | | | | | |
| 36RWPR | - 7.0 | - 7.0 | - 7.0 | | -7.0 | - 7.0 |
| 37RWP1 | - 5.0 | - 5.0 | - 5.0 | | | - 5.0 |
| 38RWP2 | | - 4.5 | - 4.5 | | | |
| 39RWP3 | | | - 4.0 | | | |
| 40CApt | - 5.60 | - 6.52 | - 7.27 | -2.51 | -3.41 | - 5.00 |
| PROTECT | 1. | 1. | 1. | 1. | 1. | 1. |
| LBSET | | | | 1. | 1. | 1. |
| WHASAMAX | | | | | | |
| FGASAMAX | | | | | | |
| WHNORM | | | | | | |
| FGNORM | | | | | | |
| WHTBASE | | | | | | |
| FRGBASE | | | | | | |
| 41CHWC | | | | | | |

TABLE LIV (Continued)

| Row | 19GZP2 | 20GZP3 | TRWHTASA | TRFGRASA | WHASAPMT | FGASAPMT |
|---|---|---|---|---|---|---|
| | | | Price Support and Additional Set-Aside Payments | | | |
| 1OBJF | 7.66 | 8.66 | | | - .94 | - .495 |
| 2CRLD | 1.0 | 1.0 | | | | |
| RANGLND | | | | | | |
| 3GRSG | | | | | | |
| 4CORN | | | | | | |
| 5WHET | | | | | | |
| 6SLGS | | | | | | |
| 7SLCN | | | | | | |
| 8SLWT | | | | | | |
| 9SLGZ | | | | | | |
| 9SLGZOUT | -3.5 | -5.0 | | | | |
| 9SLRANGE | | | | | | |
| 10MMLB | 1.32 | 1.59 | | | | |
| 11JJLB | .58 | .58 | | | | |
| 12ASLB | .51 | .51 | | | | |
| 130FLB | .91 | .91 | | | | |
| 14Spig | 9.5 | 13.5 | | | | |
| 16P2IG | | | | | | |
| 17P3IG | | | | | | |
| 18P4IG | | | | | | |
| 19P5IG | | | | | | |
| 20PRWH | 7.0 | 7.0 | | | | |
| 21P1WH | 5.0 | 5.0 | | | | |
| 22P2WH | 4.5 | 4.5 | | | | |
| 23P3WH | | 4.0 | | | | |
| 24TWTR | -16.5 | -20.5 | | | | |
| 25WLL1 | | | | | | |
| 26WLL2 | | | | | | |
| 27WLL3 | | | | | | |
| ACCNEW | | | | | | |
| WELLNEW | | | | | | |
| NEWLIMT | | | | | | |
| 28ACWL | | | | | | |
| 29RDWT | | | | | | |
| 30RSPE | - 9.5 | -13.5 | | | | |
| 32RSP2 | | | | | | |
| 33RSP3 | | | | | | |
| 34RSP4 | | | | | | |
| 35RSP5 | | | | | | |
| 36RWPR | - 7.0 | - 7.0 | | | | |
| 37RWP1 | - 5.0 | - 5.0 | | | | |
| 38RWP2 | - 4.5 | - 4.5 | | | | |
| 39RWP3 | | - 4.0 | | | | |
| 40CApt | - 5.75 | - 6.50 | | | | |
| PROTECT | 1. | 1. | | | | |
| LBSET | 1. | 1. | -1. | -1. | | |
| WHASAMAX | | | 1.0 | 1.0 | | |
| FGASAMAX | | | | | | |
| WHNORM | | | -32.40 | | 1. | |
| FGNORM | | | | -126.33 | | 1. |
| WHTBASE | | | | | | |
| FGRBASE | | | | | | |
| 41CHWC | | | | | | |

TABLE LIV (Continued)

| Row | WHCERT | FGRSUPP | 21GSSL | 22CNSL | 23WHSL | 24GZSL |
|---|---|---|---|---|---|---|
| | | | | Sell Activities | | |
| 10BJF | - 1.62 | - .385 | - 1.75 | - 1.10 | - 1.25 | - 8.00 |
| 2CRLD | | | | | | |
| RANGELAND | | | | | | |
| 3GRSG | | | | | | |
| 4CORN | | | | | | |
| 5WHET | | | | | | |
| 6SLGS | | | 1.0 | | | |
| 7SLCN | | | | 1.0 | | |
| 8SLWT | | | | | 1.0 | |
| 9SLGZ | | | | | | 1.0 |
| 9SLGZOUT | | | | | | |
| 9SLRANGE | | | | | | |
| 10MMLB | | | | | | |
| 11JJLB | | | | | | |
| 12ASLB | | | | | | |
| 130FLB | | | | | | |
| 14SPIG | | | | | | |
| 16P2IG | | | | | | |
| 17P3IG | | | | | | |
| 18P4IG | | | | | | |
| 19P5IG | | | | | | |
| 20PRWH | | | | | | |
| 21P1WH | | | | | | |
| 22P2WH | | | | | | |
| 23P3WH | | | | | | |
| 24TWTR | | | | | | |
| 25WLL1 | | | | | | |
| 26WLL2 | | | | | | |
| 27WLL3 | | | | | | |
| ACCNEW | | | | | | |
| WELLNEW | | | | | | |
| NEWLIMT | | | | | | |
| 28ACWL | | | | | | |
| 29RDWT | | | | | | |
| 30RSPE | | | | | | |
| 32RSP2 | | | | | | |
| 33RSP3 | | | | | | |
| 34RSP4 | | | | | | |
| 35RSP5 | | | | | | |
| 36RWPR | | | | | | |
| 37RWP1 | | | | | | |
| 38RWP2 | | | | | | |
| 39RWP3 | | | | | | |
| 40CApt | | | | | | |
| PROTECT | | | | | | |
| LBSET | | | | | | |
| WHAMSAMAX | | | | | | |
| FGAMSAMAX | | | | | | |
| WHNORM | | | | | | |
| FGNORM | | | | | | |
| WHTBASE | 1. | | | | | |
| FGRBASE | | 2. | | | | |
| 41CHWC | | | | | | |

TABLE LIV (Continued)

| Row | Sell Range 24GZOTSL | RANGEPAS | 24SLRANG | 25LBMM | Buy Labor 26LBJJ | 27LBAS |
|---|---|---|---|---|---|---|
| 10BJF | -8.00 | | -4.29 | 2.50 | 2.50 | 2.50 |
| 2CRLD | | 1. | | | | |
| RANGLND | | | | | | |
| 3GRSG | | | | | | |
| 4CORN | | | | | | |
| 5WHET | | | | | | |
| 6SLGS | | | | | | |
| 7SLCN | | | | | | |
| 8SLWT | | | | | | |
| 9SLGZ | | | | | | |
| 9SLGZOUT | 1.0 | | | | | |
| 9SLRANGE | | -.7 | 1. | | | |
| 10MMLB | | | | -1.0 | | |
| 11JJLB | | | | | -1.0 | |
| 12ASLB | | | | | | -1.0 |
| 13OFLB | | | | | | |
| 14Spig | | | | | | |
| 16P2IG | | | | | | |
| 17P3IG | | | | | | |
| 18P4IG | | | | | | |
| 19P5IG | | | | | | |
| 20PRWH | | | | | | |
| 21P1WH | | | | | | |
| 22P2WH | | | | | | |
| 23P3WH | | | | | | |
| 24TWTR | | | | | | |
| 25WLL1 | | | | | | |
| 26WLL2 | | | | | | |
| 27WLL3 | | | | | | |
| ACCNEW | | | | | | |
| WELLNEW | | | | | | |
| NEWLIMT | | | | | | |
| 28ACWL | | | | | | |
| 29RDWT | | | | | | |
| 30RSPE | | | | | | |
| 32RSP2 | | | | | | |
| 33RSP3 | | | | | | |
| 34RSP4 | | | | | | |
| 35RSP5 | | | | | | |
| 36RWPR | | | | | | |
| 37RWP1 | | | | | | |
| 38RWP2 | | | | | | |
| 39RWP3 | | | | | | |
| 40CAPT | | -.5 | | -2.50 | -2.50 | -2.50 |
| PROTECT | | | | | | |
| LBSET | | | | | | |
| WHASAMAX | | | | | | |
| FGASAMAX | | | | | | |
| WHNORM | | | | | | |
| FGNORM | | | | | | |
| WHTBASE | | | | | | |
| FGRBASE | | | | | | |
| 41CHWC | | | | | | |

TABLE LIV (Continued)

| Row | 28LBOF | 29VCST | 301WLL | 312WLL | 323WLL | NEWACC |
|---|---|---|---|---|---|---|
| | | | Irrigation, Pumping, and Depreciation Costs | | | |
| 1OBJF | 2.50 | 15/ | 16/ | 17/ | 18/ | 19/ |
| 2CRLD | | | | | | |
| RANGELND | | | | | | |
| 3GRSG | | | | | | |
| 4CORN | | | | | | |
| 5WHET | | | | | | |
| 6SLGS | | | | | | |
| 7SLCN | | | | | | |
| 8SLWT | | | | | | |
| 9SLGZ | | | | | | |
| 9SLGZOUT | | | | | | |
| 9SLRANGE | | | | | | |
| 10MMLB | | | | | | |
| 11JJLB | | | | | | |
| 12ASLB | | | | | | |
| 13OFLB | -1. | | | | | |
| 14SPIG | | | | | | |
| 16P2IG | | | -22/ | -22/ | -22/ | -22/ |
| 17P3IG | | | -22/ | -22/ | -22/ | -22/ |
| 18P4IG | | | -22/ | -22/ | -22/ | -22/ |
| 19P5IG | | | -22/ | -22/ | 22/ | -22/ |
| 20PRWH | | | | | | |
| 21P1WH | | | | | | |
| 22P2WH | | | | | | |
| 23P3WH | | | | | | |
| 24TWTR | | 1.0 | | | | |
| 25WLL1 | | | 1.0 | | | |
| 26WLL2 | | | | 1.0 | | |
| 27WLL3 | | | | | 1.0 | |
| ACCNEW | | | | | | 1.0 |
| WELLNEW | | | | | | |
| NEWLIMT | | | | | | |
| 28ACWL | | | -1.0 | -1.0 | -1.0 | -1.0 |
| 29RDWT | | | | | | |
| 30RSPE | | | | | | |
| 32RSP2 | | | | | | |
| 33RSP3 | | | | | | |
| 34RSP4 | | | | | | |
| 35RSP5 | | | | | | |
| 36RWPR | | | | | | |
| 37RWP1 | | | | | | |
| 38RWP2 | | | | | | |
| 39RWP3 | | | | | | |
| 40CAPT | -2.50 | -31/ | | | | |
| PROTECT | | | | | | |
| LBSET | | | | | | |
| WHASAMAX | | | | | | |
| FGASAMAX | | | | | | |
| WHNORM | | | | | | |
| FGNORM | | | | | | |
| WHTBASE | | | | | | |
| FGRBASE | | | | | | |
| 41CHWC | | 30/ | | | | |

TABLE LIV (Continued)

| New Well Costs and Water Reduction | | | | Transfer Feed Grains to Wheat | | |
|---|---|---|---|---|---|---|
| Row | NEWWELL | 33WLAC | 34REDW | 35TRGS | 36TRCN | 37SPGC |
| 1OBJF | 20/ | | | | | 21/ |
| 2CRLD | | | | | | |
| RANGELND | | | | | | |
| 3GRSG | | | | 1.0 | | |
| 4CORN | | | | | 1.0 | |
| 5WHET | | | | -1.0 | -1.0 | |
| 6SLGS | | | | | | |
| 7SLCN | | | | | | |
| 8SLWT | | | | | | |
| 9SLGZ | | | | | | |
| 9SLGZOUT | | | | | | |
| 9SLRANGE | | | | | | |
| 10MMLB | | | | | | |
| 11JJLB | | | | | | |
| 12ASLB | | | | | | |
| 13OFLB | | | | | | |
| 14SPIG | | -23/ | 26/ | | | -1.0 |
| 16P2IG | -22/ | | 27/ | | | |
| 17P3IG | -22/ | | 27/ | | | |
| 18P4IG | -22/ | | 27/ | | | |
| 19P5IG | -22/ | | 27/ | | | |
| 20PRWH | | -24/ | 28/ | | | |
| 21P1WH | | -25/ | 29/ | | | |
| 22P2WH | | -25/ | 29/ | | | |
| 23P3WH | | -25/ | 29/ | | | |
| 24TWTR | | | | | | |
| 25WLL1 | | | | | | |
| 26WLL2 | | | | | | |
| 27WLL3 | | | | | | |
| ACCNEW | | | | | | |
| WELLNEW | 1.0 | | | | | |
| NEWLIMT | 1.0 | | -.2 | | | |
| 28ACWL | -1.0 | 1. | | | | |
| 29RDWT | | | 1.0 | | | |
| 30RSPE | | | | | | 4.0 |
| 32RSP2 | | | | | | |
| 33RSP3 | | | | | | |
| 34RSP4 | | | | | | |
| 35RSP5 | | | | | | |
| 36RWPR | | | | | | |
| 37RWP1 | | | | | | |
| 38RWP2 | | | | | | |
| 39RWP3 | | | | | | |
| 40CAPT | | | | | | -21/ |
| PROTECT | | | | | | |
| LBSET | | | | | | |
| WHASAMAX | | | | | | |
| FGASAMAX | | | | | | |
| WHNORM | | | | | | |
| FGNORM | | | | | | |
| WHTBASE | | | | | | |
| FGRBASE | | | | | | |
| 41CHWC | | | | | | |

TABLE LIV (Continued)

| Row | | Recirculate Run-off Water | | | | |
|---|---|---|---|---|---|---|
| Row | 39SP2C | 40SP3C | 41SP4C | 42SP5C | 43WPRC | 44WP1C |
| 1OBJF | 21/ | 21/ | 21/ | 21/ | 21/ | |
| 2CRLD | | | | | | |
| RANGELND | | | | | | |
| 3GRSG | | | | | | |
| 4CORN | | | | | | |
| 5WHET | | | | | | |
| 6SLGS | | | | | | |
| 7SLCN | | | | | | |
| 8SLWT | | | | | | |
| 9SLGZ | | | | | | |
| 9SLGZOUT | | | | | | |
| 9SLRANGE | | | | | | |
| 10MMLB | | | | | | |
| 11JJLB | | | | | | |
| 12ASLB | | | | | | |
| 13OFLB | | | | | | |
| 14SPIG | | | | | | |
| 16P2IG | -1.0 | | | | | |
| 17P3IG | | -1.0 | | | | |
| 18P4IG | | | -1.0 | | | |
| 19P5IG | | | | -1.0 | | |
| 20PRWH | | | | | -1.0 | |
| 21P1WH | | | | | | -1.0 |
| 22P2WH | | | | | | |
| 23P3WH | | | | | | |
| 24TWTR | | | | | | |
| 25WLL1 | | | | | | |
| 26WLL2 | | | | | | |
| 27WLL3 | | | | | | |
| ACCNEW | | | | | | |
| WELLNEW | | | | | | |
| NEWLIMT | | | | | | |
| 28ACWL | | | | | | |
| 29RDWT | | | | | | |
| 30RSPE | | | | | | |
| 32RSP2 | 4.0 | | | | | |
| 33RSP3 | | 4.0 | | | | |
| 34RSP4 | | | 4.0 | | | |
| 35RSP5 | | | | 4.0 | | |
| 36RWPR | | | | | 4.0 | |
| 37RWP1 | | | | | | 4.0 |
| 38RWP2 | | | | | | |
| 39RWP3 | | | | | | |
| 40CAPT | -21/ | -21/ | -21/ | -21/ | -21/ | |
| PROTECT | | | | | | |
| LBSET | | | | | | |
| WHASAMAX | | | | | | |
| FGASAMAX | | | | | | |
| WHNORM | | | | | | |
| FGNORM | | | | | | |
| WHTBASE | | | | | | |
| FGRBASE | | | | | | |
| 41CHWC | | | | | | |

TABLE LIV (Continued)

| Row | 45WP2C | 46WP3C | 47CCHG | SIGN | P01 | P02 |
|---|---|---|---|---|---|---|
| | Capital Charge | | | | Row Limits | |
| 1OBJF | | | .08 | N | | |
| 2CRLD | | | | ≤ | 1/ | |
| RANGELND | | | | ≤ | 2/ | |
| 3GRSG | | | | ≤ | 3/ | |
| 4CORN | | | | ≤ | 4/ | |
| 5WHET | | | | ≤ | 5/ | |
| 6SLGS | | | | ≤ | 0 | |
| 7SLCN | | | | ≤ | 0 | |
| 8SLWT | | | | ≤ | 0 | |
| 9SLGZ | | | | ≤ | 0 | |
| 9SLGZOUT | | | | ≤ | 0 | |
| 9SLRANGE | | | | ≤ | 0 | |
| 10MMLB | | | | ≤ | 578. | |
| 11JJBL | | | | ≤ | 530. | |
| 12ASLB | | | | ≤ | 468. | |
| 13OFLB | | | | ≤ | 1059. | |
| 14SPIG | | | | ≤ | 0 | |
| 16P2IG | | | | ≤ | 0 | |
| 17P3IG | | | | ≤ | 0 | |
| 18P4IG | | | | ≤ | 0 | |
| 19P5IG | | | | ≤ | 0 | |
| 20PRWH | | | | ≤ | 0 | |
| 21P1WH | | | | ≤ | 0 | |
| 22P2WH | -1.0 | | | ≤ | 0 | |
| 23P3WH | | -1.0 | | ≤ | 0 | |
| 24TWTR | | | | ≥ | 0 | |
| 25WLL1 | | | | ≤ | 6/ | |
| 26WLL2 | | | | ≤ | 6/ | |
| 27WLL3 | | | | ≤ | 6/ | |
| ACCNEW | | | | ≤ | 7/ | |
| WELLNEW | | | | ≤ | 8/ | |
| NEWLIMT | | | | ≤ | 0 | |
| 28ACWL | | | | ≤ | 0 | |
| 29RDWT | | | | = | 0 | 1.0 |
| 30RSPE | | | | ≤ | 0 | |
| 32RSP2 | | | | ≤ | 0 | |
| 33RSP3 | | | | ≤ | 0 | |
| 34RSP4 | | | | ≤ | 0 | |
| 35RSP5 | | | | ≤ | 0 | |
| 36RWPR | | | | = | 0 | |
| 37RWP1 | | | | = | 0 | |
| 38RWP2 | 4.0 | | | = | 0 | |
| 39RWP3 | | 4.0 | | = | 0 | |
| 40CAPT | | | 1.0 | ≥ | 0 | |
| PROTECT | | | | ≥ | 9/ | |
| LBSET | | | | ≥ | 10/ | |
| WHASAMAX | | | | ≤ | 11/ | |
| FGASAMAX | | | | ≤ | 12/ | |
| WHNORM | | | | ≤ | 0 | |
| FGNORM | | | | ≤ | 0 | |
| WHTBASE | | | | ≤ | 13/ | |
| FGRBASE | | | | ≤ | 14/ | |
| 41CHWC | | | | N | 0 | |

See footnotes on following page.

Footnotes for Table LIV

[1]1,120 acres of cropland for crop farm and 2,240 for ranch.

[2]160 acres of range for crop farm and 4,800 acres for ranch.

[3]620 acres of grain sorghum for crop farm and 1,240 acres for ranch.

[4]108 acres of corn for crop farm and 216 acres for ranch.

[5]392 acres of wheat for crop farm and 784 acres for ranch.

[6]One well for crop farm and two for ranch. Three rows used for replacing wells #1, #2, or #3 of current ages 5, 10 and 15 years.

[7]The accumulated new wells drilled prior to current run, i.e., if the first run was for ten periods and drilled two wells (10.2), then the second run begins with two additional wells.

[8]Total wells allowable to meet spacing requirements are 18 wells for the crop farm and 36 for the ranch. The restriction then is the residual of 18 or 36 less the total wells of 6 and 7

[9]441 planted acres to protect history of allotments for crop farm and 882 acres for ranch.

[10]383.6 set-aside acres to participate for crop farm and 767.2 acres for ranch.

[11]315 additional wheat set-aside acres for crop farm and 630 acres for ranch.

[12]14 additional feed grain set-aside acres for crop farm and 28 acres for ranch.

[13]15,240 bushels wheat base projected yield for crop farm and 30,480 bushels for ranch.

[14]17,686.2 bushels feed grain base projected yield for crop farm and 35,372.4 bushels for ranch.

[15]Variable pumping cost per acre-inch varies by water resource situation.

[16-18]The annual depreciation of wells #1, #2 and #3. Excludes depreciation charge on well hole until replacement at age 20.

[19]Applicable only in successive runs following the addition of new wells in first run. The cost components are annual depreciation of pump, engine, hole and associated distribution facilities.

[20]Annual depreciation of new wells.

[21]Variable pumping cost per acre-inch for recirculating run-off water.

[22]Acre-inches provided by a well for 12-day season assuming ten percent down time.

[23]Acre-inches provided by a well for 70-day season assuming ten percent down time.

[24]Acre-inches provided by a well for 30-day season assuming ten percent down time.

[25]Acre-inches provided by a well for 15-day season assuming ten percent down time.

[26]Reduction in acre-inches per well for 70-day season following penetration of the aquifer (zero otherwise). Calculated by: [.5 (current well capacity) x pumping season hours x average no. of wells in all periods] divided by 450 x no. of periods in run.

[27]Reduction in acre-inches per well for 12-day season (see 26 for calculation).

[28]Reduction in acre-inches per well for 30-day season (see 26 for calculation).

[29]Reduction in acre-inches per well for 15-day season (see 26 for calculation).

[30]Successive change in variable cost per acre-inch estimated by dividing the expected variable cost in last period less 15 by the number of periods to be run.

[31]Average variable cost per acre-inch for the time interval in the run. Calculated by dividing the sum of the initial variable cost per acre-inch and the expected variable cost in the last period of the run by two.

# Row and Column Identification

| Column Name | Explanation |
|---|---|
| 1GSDR | Grain sorghum, dryland. |
| 2GSPR | Grain sorghum, preplant irrigation. |
| 3GSP1 | Grain sorghum, preplant and one postplant irrigation. |
| 4GSP2 | Grain sorghum, preplant and two postplant irrigation. |
| 5GSP3 | Grain sorghum, preplant and three postplant irrigation. |
| 6GSP4 | Grain sorghum, preplant and four postplant irrigation. |
| 8CNP2 | Corn, preplant and two postplant irrigations. |
| 9CNP3 | Corn, preplant and three postplant irrigations. |
| 10CNP4 | Corn, preplant and four postplant irrigations. |
| 10CNP5 | Corn, preplant and five postplant irrigations. |
| 11WHDR | Wheat, dryland. |
| 12SHPR | Wheat, preplant irrigation. |
| 13WHP1 | Wheat, preplant and one postplant irrigation. |
| 14WHP2 | Wheat, preplant and two postplant irrigations. |
| 15WHP3 | Wheat, preplant and three postplant irrigations. |
| 16GZDR | Small grain grazing, dryland. |
| 17GZPR | Small grain grazing, preplant irrigation. |
| 18GZP1 | Small grain grazing, preplant and one postplant irrigation. |
| 19GZP2 | Small grain grazing, preplant and two postplant irrigations. |
| 20GZP3 | Small grain grazing, preplant and three postplant irrigations. |
| TRWHTASA | Transfer wheat additional set-aside acres. |
| TRFGRASA | Transfer feed grain additional set-aside acres. |
| WHASAPMT | Wheat additional set-aside payment. |
| FGASAPMT | Feed grain additional set-aside payment. |
| WHCERT | Wheat certificate payment. |
| FGRSUPP | Feed grain price support payment. |
| 21GSSL | Sell grain sorghum. |
| 22CNSL | Sell corn. |
| 23WHSL | Sell wheat. |
| 24GZSL | Sell small grain grazing to March 15. |
| 24GZOTSL | Sell small grain graze-out after March 15. |
| RANGEPAS | Native range pasture. |
| 24SLRANG | Sell native range pasture. |
| 25LBMM | Hire seasonal labor for March through May. |
| 26LBJJ | Hire seasonal labor for June and July. |
| 27LBAS | Hire seasonal labor for August and September. |
| 28LBOF | Hire seasonal labor for October through February. |
| 29VCST | Variable pumping cost per acre-inch of irrigation water, see 15. |
| 301WLL | Annual depreciation cost for well #1, see 16. |
| 312WLL | Annual depreciation cost for well #2, see 17. |
| 323WLL | Annual depreciation cost for well #3, see 18. |
| NEWACC | Annual depreciation cost for accumulated new wells, see 19. |

| Column Name | Explanation |
|---|---|
| NEWELL | Annual depreciation cost for accumulated new well, see 20. |
| 33WLAC | Accumulate all wells for wheat irrigation. |
| 34REDW | Parametric reduction in seasonal water availability, applicable only if well yields are declining. Use MPS360 PARACOL or PARARIM options to activate such a procedure. Some difficulty in obtaining solutions by PARARIM was encountered if an equality is used on the right hand side of the parametric row. A large (false) cost can be placed on the column and the sign changed to G on the row without affecting the solution. However, the objective function value must be corrected afterwards to reflect the correct amount. |
| 35TRGS | Transfer grain sorghum acres to wheat. |
| 36TRCN | Transfer corn acres to wheat. |
| 37SPGC | Spring season circulated run-off water. |
| 39SP2C | Summer postplant irrigation period two circulated run-off water. |
| 40SP3C | Summer postplant irrigation period three circulated run-off water. |
| 41SP4C | Summer postplant irrigation period four circulated run-off water. |
| 42SP5C | Summer postplant irrigation period five circulated run-off water. |
| 43WPRC | Wheat preplant irrigation period circulated run-off water. |
| 44WP1C | Wheat postplant irrigation period one circulated run-off water. |
| 45WP2C | Wheat postplant irrigation period two circulated run-off water. |
| 46WP3C | Wheat postplant irrigation period three circulated run-off water. |
| 47CCHG | Operating capital interest charge. |
| SIGN | The row restraint signs. |
| PO1 | Primary right hand side indicating row levels. |
| PO2 | Right hand side used in PARARIM to parametically change the row level of the change row. |

| Row Name | Explanation |
|---|---|
| 1OBJF | The objective function to be minimized in current problem (signs are reversed on costs and income to result in maximization of net returns). Cost coefficients must be positive since the parametric pricing option (water cost) will not operate with a negative value. |
| 2CRLD | Cropland acres, upper bound. |
| RANGELND | Native range acres, upper bound. |
| 3GRSG | Grain sorghum acres, upper bound. |
| 4CORN | Corn acres, upper bound. |

| Row Name | Explanation |
|---|---|
| 5WHET | Wheat acres, upper bound unless grain sorghum and corn acres are transferred. |
| 6SLGS | Transfer row for selling grain sorghum. |
| 7SLCN | Transfer row for selling corn. |
| 8SLWT | Transfer row for selling wheat. |
| 9SLGZ | Transfer row for selling small grain winter grazing. |
| 9SLGZOUT | Transfer row for selling small grain spring graze-out. |
| 10MMLB | March through May labor season. |
| 11JJLB | June and July labor season. |
| 12ASLB | August and September labor season. |
| 130FLB | October through February labor season. |
| 14SPIG | Seventy-day spring irrigation water requirements. |
| 16P2IG | Twelve-day second postplant summer irrigation water requirements. |
| 17P3IG | Twelve-day third postplant summer irrigation water requirements. |
| 18P4IG | Twelve-day fourth postplant summer irrigation water requirements. |
| 19P5IG | Twelve-day fifth postplant summer irrigation water requirements. |
| 20PRWH | Thirty-day preplant wheat fall irrigation water requirements. |
| 21P1WH | Fifteen-day first postplant wheat spring irrigation water requirements. |
| 22P2WH | Fifteen-day second postplant wheat spring irrigation water requirements. |
| 23P3WH | Fifteen-day third postplant wheat spring irrigation water requirements. |
| 24TWTR | Total irrigation water requirements. |
| 25WLL1 | Number of wells about five years of age. |
| 26WLL2 | Number of wells about ten years of age. |
| 27WLL3 | Number of wells about 15 years of age. |
| ACCNEW | Number of new wells drilled in previous runs. |
| WELLNEW | Number of new wells allowed, see 8. |
| NEWLIMIT | Transfer row for parametically determined number of new wells; .2 per solution. |
| 28ACWL | Accumulate all wells to irrigate wheat. |
| 29RDWT | Row for parametric revision to reduce seasonal water availability but applicable only if well yields are declining. |
| 30RSPE | Recirculate one-fourth spring water as run-off. |
| 32RSP2 | Recirculate one-fourth second postplant summer water. |
| 33RSP3 | Recirculate one-fourth third postplant summer water. |
| 34 RSP4 | Recirculate one-fourth fourth postplant summer water. |
| 35RSP5 | Recirculate one-fourth fifth postplant summer water. |
| 36RWP1 | Recirculate one-fourth wheat first postplant run-off. |
| 37RWP2 | Recirculate one-fourth wheat second postplant run-off. |

| Row Name | Explanation |
|---|---|
| 38RWP3 | Recirculate one-fourth wheat third postplant run-off. |
| 40CAPT | Capital requirements based on six-month use. |
| PROTECT | Minimum planted acreage to protect history. |
| LBSET | Lower bound for required set-aside acres. |
| WHASAMAX | Wheat additional set-aside acreage maximum. |
| FGASAMAX | Feed grain additional set-aside acreage maximum. |
| WHNORM | Transfer row to pay for additional wheat set-aside. |
| FGNORM | Transfer row to pay for additional feed grain set-aside. |
| WHTBASE | Projected yield on wheat base. |
| FGRBASE | Projected yield for feed grain base. |
| 41CHWC | Parametric row for changing water cost per acre-inch. |

TABLE LV

INITIAL ESTIMATES OF ASSET VALUE
FOR REPRESENTATIVE FARMS

| Representative Farm Situation by Water Resource Classification[1] | Initial Tenure of Operator[2] | Value of Capital Assets: Real Estate[3] | Value of Capital Assets: Chattel Items[4] | Value of Capital Assets: Total | Initial Debt-Asset Ratio |
|---|---|---|---|---|---|
| Class A Water: | | | | | |
| Farm I | Full owner | 120,000[a] | 59,352[i] | 179,352 | .285 |
| | Part owner | 60,000[b] | 59,352[i] | 119,352 | .296 |
| | Tenant | - | 59,352[i] | 59,352 | .328 |
| Farm II | Full owner | 304,000[c] | 89,660[j] | 393,660 | .288 |
| | Part owner | 152,000[d] | 89,660[j] | 241,660 | .303 |
| | Tenant | - | 89,660[j] | 89,660 | .370 |
| Farm III | Full owner | 556,000[e] | 170,460[k] | 726,460 | .291 |
| | Part owner | 278,000[f] | 170,460[k] | 448,460 | .308 |
| | Tenant | - | 170,460[k] | 170,460 | .379 |
| Ranch | Full owner | 928,000[g] | 195,535[l] | 1,123,535 | .270 |
| | Part owner | 464,000[h] | 195,535[l] | 659,535 | .274 |
| | Tenant | - | 195,535[l] | 195,535 | .298 |
| Class B Water: | | | | | |
| Farm I | Full owner | 127,000[a] | 65,090[m] | 192,090 | .284 |
| | Part owner | 63,500[b] | 65,090[m] | 128,590 | .294 |
| | Tenant | - | 65,090[m] | 65,090 | .323 |
| Farm II | Full owner | 322,000[c] | 99,451[n] | 421,451 | .287 |
| | Part owner | 161,000[d] | 99,451[n] | 260,451 | .301 |
| | Tenant | - | 99,451[n] | 99,451 | .360 |
| Farm III | Full owner | 585,500[e] | 191,080[o] | 776,580 | .289 |
| | Part owner | 292,750[f] | 191,080[o] | 485,830 | .304 |
| | Tenant | - | 191,080[o] | 191,080 | .366 |
| Class C Water: | | | | | |
| Farm I | Full owner | 134,000[a] | 68,448[p] | 202,448 | .283 |
| | Part owner | 67,000[b] | 68,448[p] | 135,448 | .292 |
| | Tenant | - | 68,448[p] | 68,448 | .320 |
| Farm II | Full owner | 340,000[c] | 104,760[q] | 444,760 | .285 |
| | Part owner | 170,000[d] | 104,760[q] | 274,760 | .299 |
| | Tenant | - | 104,760[q] | 104,760 | .355 |
| Farm III | Full owner | 615,000[e] | 201,698[r] | 816,698 | .288 |
| | Part owner | 307,500[f] | 201,698[r] | 509,198 | .302 |
| | Tenant | - | 201,698[r] | 201,698 | .361 |

[1]Class A water represents 75 feet of saturated aquifer and 75 feet depth to water on crop farms and 25 feet depth on ranch. Class B water represents 250 feet of saturated aquifer and 175 feet depth to water. Class C represents 450 feet of saturated aquifer and 125 feet depth to water. Farm I has 640 acres of which 560 acres use cropland, 5 cows and 202 winter stockers. Farm II has 1,600 acres of which 1,440 acres are cropland, 10 cows and 428 winter stockers. Farm III has 2,880 acres of which 2,680 acres are cropland, 12 cows and 812 winter stockers. Farm IV has 7,040 acres of which 2,240 acres are cropland, 250 cows and 721 winter stockers.

[2]A full owner owns all the land operated whereas a part owner owns one-half and a tenant owns none.

[3]Range is valued at $100 per acre; dryland is valued at $150 and irrigated cropland varies by water classification. Irrigated cropland in the Class A water situation, is valued at $250; Class B, $275; and Class C, $300.

[4]Includes the current depreciated value of farm machinery, irrigation engines and pumps and the value of cows and purchase cost of winter stockers on hand as of January 1.

[a]280 acres @ $250 + 280 acres @ $150 + 80 acres @ $100. Use $275 and $300 instead of $250 for Class B and C water situations.

[b]One-Half of a.

[c]720 acres @ $250 + 720 acres @ $150 + 160 acres @ $100. See footnote a for Class B and C water situations.

[d]One-half of c.

[e]1,340 acres @ $250 + 1,340 acres @ 150 + 200 acres @ $100. See footnote a for Class B and C water situations.

[f]one-half of e.

[g]1,120 acres @ $250 + 1,120 acres @ $150 + 4,800 acres @ $100.

[h]One-half of g.

[i]Includes $35,927 farm equipment value 5 cows @ $150, 202 steers @ $102.11 and 2 well engines ($469.03 x 2) and 2 pumps (five and ten years old) @ 2/3 ($1,110.94) + 1/3 ($1,110.94).

[j]Includes $40,902 farm equipmen- value 10 cows at $150, 428 steers @ $102.11 and 3 well engines ($469.03 x 3) and 3 pumps (one, five and ten years old) @ 14/15 ($1,110.94) + 2/3 ($1,110.94) + 1/3 ($1,110.94).

[k]Includes $79,674 farm equipment value 12 cows at $150, 812 steers @ $102.11 and 6 well engines ($469.03 x 6) and 6 pumps (two each of one, five and ten years old) @ 14/15 ($1,110.94 x 2) + 2/3 ($1,110.94 x 2) + 1/3 ($1,110.94 x 2).

[l]Includes $79,674 plus 250 cows @ $150 per cow, 721 steers @ $102.11 and 6 well engines $308.82 x 6) and 6 pumps (two each of one, five and ten years old) @ 14/15 ($795.31 x 2) + 2/3 ($795.31 x 2) + 1/3 ($795.31 x 2).

[m]Includes $35,927 farm equipment value, 5 cows @ $150, 202 steers @ $102.11 and 2 well engines ($1,971,87 x 2) and 2 pumps (five and ten years old) @ 2/3 ($3,843.50) + 1/2 ($3,843.50).

[n]Includes $40,902 farm equipment value, 10 cows @ $150, 428 steers @ $102.11 and 3 well engines ($1,971.87 x 3) and 3 pumps (one, five and ten years old) @ 14/15 ($3,843.50) + 1/3 ($3,843.50).

[o]Includes $79,674 farm equipment value, 12 cows @ $150, 812 steers @ $102.11 and 6 well engines ($1,971.87 x 6) and 6 pumps (two each of one, five, and ten years old) @ 14/15 ($3,843.50 x 2) + 2/3 ($3,843.50 x 2) + 1/3 ($3,843.50 x 2).

[p]Includes $35,927 farm equipment value, 5 cows @ $150, 202 steers @ $102.11 and 2 well engines ($3,335.69 x 2) and 2 pumps (five and ten years old) @ 2/3 ($4,473.12) + 1/3 ($4,473.12).

[q]Includes $40,902 farm machinery value, 10 cows @ $150, 428 steers @ $102.11 and 3 well engines ($3,335.69 x 3) and 3 pumps (one, five and ten years old) @ 14/15 ($4,473.12) + 2/3 ($4,473.12) + 1/3 ($4,473.12).

[r]Includes $79,674 farm machinery value, 12 cows @ $150, 812 steers at $102.11 and 6 well engines ($3,335.69 x 6) and 6 pumps (two each of one, five and ten years old) @ 14/15 ($4,473.12 x 2) + 2/3 ($4,473.12 x 2) + 1/3 ($4,473.12 x 2).

TABLE LVI

INITIAL ESTIMATES OF DEBT STATUS FOR REPRESENTATIVE FARMS

| Representative Farm Situation by Water Resource Classification[1] | Initial Tenure of Operator[2] | Initial Estimate of Debt Status[3] | Value of Unpaid Debts: Real Estate Debts | Value of Unpaid Debts: Chattel Debts[4] | Value of Unpaid Debts: Total Debts | Cash-on-Hand or (Open Debts)[5] |
|---|---|---|---|---|---|---|
| **Class A Water:** | | | | | | |
| Farm I | Full owner | 51,167 | 30,000[a] | 8,221 | 38,221 | (12,946) |
| | Part owner | 35,327 | 15,000[b] | 8,221 | 23,221 | (12,106) |
| | Tenant | 19,487 | - | 8,221 | 8,221 | (11,266) |
| Farm II | Full owner | 113,469 | 76,000[c] | 10,453 | 86,453 | (27,016) |
| | Part owner | 73,341 | 38,000[d] | 10,453 | 48,453 | (24,888) |
| | Tenant | 33,213 | - | 10,453 | 10,453 | (22,760) |
| Farm III | Full owner | 211,339 | 139,000[e] | 20,127 | 159,127 | (52,212) |
| | Part owner | 137,947 | 69,500[f] | 20,127 | 89,127 | (48,820) |
| | Tenant | 64,555 | - | 20,127 | 20,127 | (44,428) |
| Ranch | Full owner | 303,326 | 232,000[g] | 19,547 | 251,547 | (51,779) |
| | Part owner | 180,830 | 116,000[h] | 19,547 | 135,547 | (45,283) |
| | Tenant | 58,334 | - | 19,547 | 19,547 | (38,787) |
| **Class B Water:** | | | | | | |
| Farm I | Full owner | 54,530 | 31,750 | 10,033 | 41,783 | (12,747) |
| | Part owner | 37,766 | 15,875 | 10,033 | 25,908 | (11,858) |
| | Tenant | 21,002 | - | 10,033 | 10,033 | (10,969) |
| Farm II | Full owner | 120,806 | 80,500 | 13,172 | 93,672 | (27,134) |
| | Part owner | 78,302 | 40,250 | 13,172 | 53,422 | (24,880) |
| | Tenant | 35,798 | - | 13,172 | 13,172 | (22,626) |
| Farm III | Full owner | 224,571 | 147,375 | 25,564 | 172,939 | (51,632) |
| | Part owner | 147,813 | 73,687 | 25,564 | 99,251 | (48,562) |
| | Tenant | 69,999 | - | 25,564 | 25,564 | (44,435) |
| **Class C Water:** | | | | | | |
| Farm I | Full owner | 57,265 | 33,500 | 9,656 | 43,156 | (14,109) |
| | Part owner | 39,577 | 16,750 | 9,656 | 26,406 | (13,171) |
| | Tenant | 21,889 | - | 9,656 | 9,656 | (12,233) |
| Farm II | Full owner | 126,959 | 85,000 | 13,608 | 98,608 | (28,351) |
| | Part owner | 82,079 | 42,500 | 13,608 | 56,108 | (25,971) |
| | Tenant | 37,199 | - | 13,608 | 13,608 | (23,591) |
| Farm III | Full owner | 235,162 | 156,110 | 26,436 | 182,546 | (52,616) |
| | Part owner | 153,982 | 78,055 | 26,436 | 105,491 | (48,491) |
| | Tenant | 72,802 | - | 26,436 | 26,436 | (46,366) |

[1] Class A water represents 75' of saturated aquifer and 75' depth to water on crop farms and 25' depth on ranch. Class B water represents 250' of saturated aquifer and 175' depth to water. Class C water represents 450' of saturated aquifer and 125' depth to water. Farm I has 640 acres of which 560 acres use cropland, 5 cows and 202 winter stockers. Farm II has 1,600 acres of which 1,440 acres are cropland, 10 cows and 428 winter stockers. Farm III has 2,880 acres of which 2,680 acres are cropland, 12 cows and 812 winter stockers. Farm IV has 7,040 acres of which 2,240 acres are cropland, 250 cows and 721 winter stockers.

[2] A full owner owns all the land operated whereas a part owner owns one-half and a tenant owns none.

[3] Debts (\$00) = $-12.748 - \underset{(.151)}{.439}$ (cows) + $\underset{(.125)}{.263}$ (stockers) + $\underset{(.018)}{.264}$ (assets, \$00); $R^2 = .825$; corrected $R^2 = .817$; std. error = 411.1; F-value = 98.93; all t-values significantly different from zero at the 95% level of significance. Assets consist only of real estate and chattel from Table .

[4] Refer to Appendix Table for each situation's initial chattel debts.

[5] A number in parenthesis represents cash-on-hand.

[a] $(25\% \times 560 \times \frac{\$250 + \$150}{2}) + (80 \times 25\% \times \$100) = \$30{,}000$. For Class B water, use an average value per acre of $\frac{\$275 + \$150}{2}$ and $\frac{\$300 + \$150}{2}$ for Class C water.

[b] One-half of b/.

[c] $(25\% \times 1{,}440 \times \frac{\$250 + \$150}{2}) + (160 \times 25\% \times \$100) = \$76{,}000$. See footnote a/ for Class B and C water situations.

[d] One-half of c/.

[e] $(25\% \times 2{,}680 \times \frac{\$250 + \$150}{2}) + (200 \times 25\% \times \$100) = \$139{,}000$. See footnote a/ for Class B and C water situations.

[f] One-half of e/.

[g] $(25\% \times 2{,}240 \times \frac{\$250 + \$150}{2}) + (4{,}800 \times 25\% \times \$100) = \$232{,}000$.

[h] One-half of g/.

TABLE LVII

SUMMARY OF CHATTEL DEBTS BY REPRESENTATIVE FARM SITUATIONS[a]

| Item | Current Age | Purchase Cost Less Down Payment | Remaining Chattel Debt | Farm I Number | Farm I Debt | Farm II Number | Farm II Debt | Farm III Number | Farm III Debt | Ranch Number | Ranch Debt |
|---|---|---|---|---|---|---|---|---|---|---|---|
| "Class A" water: | | | | | | | | | | | |
| Large tractor | 2 | $11,930 | $3,977 | 1 | $ 3,977 | 1 | $ 3,977 | 2 | $ 7,954 | 2 | $ 7,954 |
| Offset disc | 2 | 2,340 | 780 | 1 | 780 | 2 | 1,560 | 3 | 2,340 | 3 | 2,340 |
| Tandem disc | New | 1,170 | 1,170 | - | - | 1 | 1,170 | 2 | 2,340 | 2 | 2,340 |
| Cultibedder | 2 | 3,024 | 1,008 | 1 | 1,008 | 1 | 1,008 | 2 | 2,016 | 2 | 2,016 |
| Rod weeder | 1 | 1,935 | 1,290 | 1 | 1,290 | 1 | 1,290 | 2 | 2,580 | 2 | 2,580 |
| Sprayer | 1 | 900 | 600 | 1 | 600 | 1 | 600 | 2 | 1,200 | 2 | 1,200 |
| Irrigation engines | 1 | b | b | 2 | 566[c] | 3 | 848[d] | 6 | 1,697[e] | 6 | 1,117[l] |
| Total Chattel Debt | - | - | - | - | $ 8,221 | - | $10,453 | - | $20,127 | - | $19,547 |
| "Class B" water: | | | | | | | | | | | |
| Large tractor | 2 | $11,930 | $3,977 | 1 | $ 3,977 | 1 | $ 3,977 | 2 | $ 7,954 | | |
| Offset disc | 2 | 2,340 | 780 | 1 | 780 | 2 | 1,560 | 3 | 2,340 | | |
| Tandem disc | New | 1,170 | 1,170 | - | - | 1 | 1,170 | 2 | 2,340 | | |
| Cultibedder | 2 | 3,024 | 1,008 | 1 | 1,008 | 1 | 1,008 | 2 | 2,016 | | |
| Rod weeder | 1 | 1,935 | 1,290 | 1 | 1,290 | 1 | 1,290 | 2 | 2,580 | | |
| Sprayer | 1 | 900 | 600 | 1 | 600 | 1 | 600 | 2 | 1,200 | | |
| Irrigation engines | 1 | b | b | 2 | 2,378[f] | 3 | 3,567[g] | 6 | 7,134[h] | | |
| Total Chattel Debt | - | - | - | - | $10,033 | - | $13,172 | - | $25,564 | | |
| "Class C" water: | | | | | | | | | | | |
| Large tractor | 2 | $11,930 | $3,977 | 1 | $ 3,977 | 1 | $ 3,977 | 2 | $ 7,954 | | |
| Offset disc | 2 | 2,340 | 780 | 1 | 780 | 2 | 1,560 | 3 | 2,340 | | |
| Tandem disc | New | 1,170 | 1,170 | - | - | 1 | 1,170 | 2 | 2,340 | | |
| Cultibedder | 2 | 3,024 | 1,008 | 1 | 1,008 | 1 | 1,008 | 2 | 2,016 | | |
| Rod weeder | 1 | 1,935 | 1,290 | 1 | 1,290 | 1 | 1,290 | 2 | 2,580 | | |
| Sprayer | 1 | 900 | 600 | 1 | 600 | 1 | 600 | 2 | 1,200 | | |
| Irrigation engines | 1 | b | b | 1 | 2,001[i] | 2 | 4,003[j] | 4 | 8,006[k] | | |
| Total Chattel Debt | - | - | - | - | $ 9,656 | - | $13,608 | - | $26,436 | | |

[a]Initial estimates only; additional machinery may be needed for various water situations.

[b]Varies by water situation.

[c]Includes irrigation engines: 2/3 ($469.03 - 10% x $469.03) = 282.83; $282.83 x 2 engines = $565.66.

[d]Includes irrigation engines: 2/3 ($469.03 - 10% x $469.02) = 282.83; $282.83 x 3 engines = $848.49.

[e]Two times b.

[f]Includes irrigation engines: 2/3 ($1,971.87 - 10% x $1,971.87) = $1,189.04; $1,189.04 x 2 engines = $2,378.08.

[g]Includes irrigation engines: 2/3 ($1,971.87 - 10% x $1,971.87) = $1,189.04; $1,189.04 x 3 engines = $3,567.12.

[h]Two times f.

[i]Includes irrigation engines: 2/3 ($3,335.69 - 10% x $3,335.69) = $2,001.40; $2,001.40 x 1 engine = $2,001.40.

[j]Includes irrigation engines: 2/3 ($3,335.69 - 10% x $3,335.69) = $2,001.40; $2,001.40 x 2 engines = $4,002.80.

[k]Two times i.

[l]Includes irrigation engines: 2/3 ($308.82 - 10% x $308.82) = $186.22; $186.22 x 6 engines = $1,117.32.

TABLE LVIII.

INITIAL ESTIMATES OF FARM MACHINERY ITEMS
FOR REPRESENTATIVE FARMS

| Item | Farm I | Farm II | Farm III & Ranch | Current Age | Life Expectancy |
|---|---|---|---|---|---|
| | - - - - - number | - - - - - - - - - - | | - - - years | - - - - - |
| Large tractor | 1 | 1 | 2 | 2 | 10 |
| Medium tractor | 1 | 1 | 2 | 4 | 10 |
| Small tractor | 1 | 1 | 1 | 6 | 10 |
| Dry fertilizer spdr. | 1 | 1 | 2 | 5 | 10 |
| Offset disc | 1 | 2 | 3 | 2 | 10 |
| Sweeps | 1 | 2 | 4 | 2 | 10 |
| Chisel | 1 | 1 | 2 | 6 | 10 |
| Grain drills | 1 | 1 | 2 | 5 | 10 |
| Row cultivator | 1 | 1 | 2 | 5 | 8 |
| Rod weeder | 1 | 1 | 2 | 1 | 10 |
| Cultibedder | 1 | 1 | 2 | 2 | 8 |
| Sprayer | 1 | 1 | 1 | 1 | 8 |
| Shredder | 1 | 1 | 2 | 1 | 8 |
| Liquid fertilizer spdr. | 1 | 2 | 4 | 4 | 10 |
| Land float | 1 | 1 | 2 | 5 | 10 |
| Tool bar | 1 | 1 | 2 | 4 | 10 |
| Tandem disc | 0 | 1 | 2 | 0 | 10 |

TABLE LIX

ESTIMATED ANNUAL OVERHEAD COSTS FOR IRRIGATED REPRESENTATIVE FARMS, SOUTH CENTRAL PLAINS

| Item | Farm I | Farm II | Farm III | Farm IV |
|---|---|---|---|---|
| Depreciation and Maintenance | | | | |
| Buildings: | | | | |
| Machine storage and shop | 264.00 | 264.00 | 264.00 | 264.00 |
| Grain storage | 55.00 | 55.00 | 55.00 | 55.00 |
| Barn | 157.50 | 157.50 | 157.50 | 157.50 |
| Livestock equipment: | | | | |
| Permanent fencing | 65.00 | 125.00 | 160.00 | 3,125.00 |
| Temporary fencing | 50.00 | 65.00 | 75.00 | 75.00 |
| Salt box, corral, loading chute, water tanks, etc. | 25.00 | 25.00 | 25.00 | 150.00 |
| Livestock trailer (18 ft.) | 185.00 | 185.00 | 185.00 | 370.00 |
| Saddle horses | -- | -- | -- | 300.00 |
| Machinery Fixed Costs | | | | |
| Fuel storage tank | 15.00 | 15.00 | 15.00 | 15.00 |
| Shop tools | 50.00 | 55.00 | 60.00 | 60.00 |
| Grain auger | 0.0 | 35.00 | 35.00 | 35.00 |
| Irrigation pipe trailer (20 ft.) | 185.00 | 370.00 | 565.00 | 565.00 |
| Pickup ("new") | 1,500.00 | 1,750.00 | 2,000.00 | 2,000.00 |
| Pickup ("old") | 1,500.00 | 2,500.00 | 3,500.00 | 3,500.00 |
| Miscellaneous | | | | |
| Telephone | 100.00 | 100.00 | 100.00 | 100.00 |
| Bookkeeping and tax service | 50.00 | 60.00 | 75.00 | 75.00 |
| Insurance on buildings and workers | 125.00 | 125.00 | 125.00 | 125.00 |
| Electricity | 240.00 | 240.00 | 240.00 | 240.00 |
| Membership dues, magazines, etc. | 50.00 | 75.00 | 75.00 | 75.00 |
| Total Overhead Costs | 4,616.50 | 6,201.50 | 7,711.50 | 11,286.50 |

TABLE LX

SUMMARY OF CROP ACREAGE BASES, PROJECTED YIELDS AND ASSOCIATED FARM PROGRAM PAYMENTS FOR SPECIFIC FARM SIZE AND IRRIGATION SITUATIONS, SOUTH CENTRAL PLAINS

| | Farm I | | | Farm II | | | Farm III | | | Ranch |
|---|---|---|---|---|---|---|---|---|---|---|
| Item | Class A Water | Class B Water | Class C Water | Class A Water | Class B Water | Class C Water | Class A Water | Class B Water | Class C Water | Class A Water |
| Acreage Bases: | | | | | | | | | | |
| Wheat Base, ac. | 76.3[a] | 76.3[a] | 76.3[a] | 239.6[c] | 239.6[c] | 239.6[c] | 312.3[e] | 312.3[e] | 312.3[e] | 327.5[g] |
| Feed Grain Base, ac. | 118.7[b] | 118.7[b] | 118.7[b] | 239.0[d] | 239.0[d] | 239.0[d] | 876.4[f] | 876.4[f] | 876.4[f] | 257.6[h] |
| Projected Yields: | | | | | | | | | | |
| Wheat, bu.[1] | 27.4 | 50.5 | 32.7 | 20.0 | 29.1 | 26.7 | 20.6 | 30.9 | 28.2 | 22.7 |
| Feed Grain, bu.[2] | 132.2 | 125.0 | 126.1 | 132.2 | 125.0 | 126.1 | 132.2 | 125.0 | 126.1 | 132.2 |
| Set-Aside Acres: | | | | | | | | | | |
| Wheat, ac.[3] | 63.3 | 63.3 | 63.3 | 198.9 | 198.9 | 198.9 | 259.2 | 259.2 | 259.2 | 271.8 |
| Feed Grains, ac.[4] | 29.7 | 29.7 | 29.7 | 59.8 | 59.8 | 59.8 | 219.1 | 219.1 | 219.1 | 64.4 |
| Subtotal | 93.0 | 93.0 | 93.0 | 258.7 | 258.7 | 258.7 | 478.3 | 478.3 | 478.3 | 336.2 |
| Additional Set-Aside: | | | | | | | | | | |
| Wheat, ac.[5] | 57.2 | 57.2 | 57.2 | 179.7 | 179.7 | 179.7 | 234.2 | 234.2 | 234.2 | 245.6 |
| Feed Grain, ac.[6] | 11.9 | 11.9 | 11.9 | 23.9 | 23.9 | 23.9 | 87.6 | 87.6 | 87.6 | 25.8 |
| Subtotal | 69.1 | 69.1 | 69.1 | 203.6 | 203.6 | 203.6 | 321.8 | 321.8 | 321.8 | 271.4 |
| Total Set-Aside: | | | | | | | | | | |
| Wheat, ac. | 120.5 | 120.5 | 120.5 | 378.6 | 378.6 | 378.6 | 493.4 | 493.4 | 493.4 | 517.4 |
| Feed Grain, ac. | 41.6 | 41.6 | 41.6 | 83.7 | 83.7 | 83.7 | 306.7 | 306.7 | 306.7 | 90.2 |
| Total | 162.1 | 162.1 | 162.1 | 462.3 | 462.3 | 462.3 | 800.1 | 800.1 | 800.1 | 607.6 |
| Price Support Payments: | | | | | | | | | | |
| Wheat, dol.[7] | 3,386.91 | 6,242.31 | 4,042.05 | 7,763.00 | 11,295.17 | 10,363.61 | 10,422.16 | 15,633.24 | 14,267.23 | 12,043.49 |
| Feed Grain, dol.[8] | 3,020.77 | 2,856.25 | 2,881.39 | 6,082.52 | 5,751.25 | 5,801.86 | 22,303.46 | 21,088.75 | 21,274.33 | 6,555.92 |
| Subtotal | 6,407.68 | 9,098.56 | 6,923.44 | 13,845.52 | 17,046.42 | 16,165.47 | 32,725.62 | 36,721.99 | 35,541.56 | 18,599.41 |

TABLE LX. (Continued)

| Item | Farm I Class A Water | Farm I Class B Water | Farm I Class C Water | Farm II Class A Water | Farm II Class B Water | Farm II Class C Water | Farm III Class A Water | Farm III Class B Water | Farm III Class C Water | Ranch Class A Water |
|---|---|---|---|---|---|---|---|---|---|---|
| Additional Set-Aside Payments: | | | | | | | | | | |
| Wheat, dol.[9] | 1,473.30 | 2,715.39 | 1,758.28 | 3,378.40 | 4,915.57 | 4,510.16 | 4,535.09 | 6,802.64 | 6,208.23 | 5,240.52 |
| Feed Grain, dol.[10] | 778.66 | 736.25 | 742.73 | 1,563.93 | 1,478.75 | 1,491.76 | 5,732.19 | 5,420.00 | 5,467.70 | 1,688.19 |
| Subtotal | 2,251.96 | 3,451.64 | 2,501.01 | 4,942.33 | 6,394.32 | 6,001.92 | 10,267.28 | 12,222.64 | 11,675.93 | 6,928.71 |
| Total Payments: | | | | | | | | | | |
| Wheat, dol. | 4,860.21 | 8,957.70 | 5,800.33 | 11,141.40 | 16,210.74 | 14,873.77 | 14,957.25 | 22,435.88 | 20,475.46 | 17,284.01 |
| Feed Grain, dol. | 3,799.43 | 3,592.50 | 3,624.12 | 7,646.45 | 7,230.00 | 7,293.62 | 28,035.65 | 26,508.75 | 26,742.03 | 8,244.11 |
| Total | 8,659.64 | 12,550.20 | 9,424.45 | 18,787.85 | 23,440.74 | 22,167.39 | 42,992.90 | 48,944.63 | 47,217.49 | 25,528.12 |

[1]Based on expected yields and acreages of irrigated and dryland wheat in the initial organization as determined by L.P. Irrigated and dryland grazing is substituted by wheat for grain to estimate projected yields.

[2]Based on expected yields and acreages of irrigated corn and grain sorghum in the initial organization as determined by L.P.

[3]Based on 83% of wheat base.

[4]Based on 25% of feed grain base.

[5]Based on 75% of wheat base (maximum).

[6]Based on 10% of feed grain base (maximum).

[7]Based on $1.62 per bushel of projected wheat yield multiplied by the wheat base.

[8]Based on $.385 per bushel of projected feed grain yield multiplied by one-half the feed grain base.

[9]Based on $.94 per bushel of projected wheat yield multiplied by the additional set-aside acres of wheat.

[10]Based on $.495 per bushel of projected feed grain yield multiplied by the additional set-aside acres of feed grains.

[a]Derived from 17 participating and reporting firms having 240 to 880 acres cropland; .43 of 31.7% of cropland.

[b]Derived from 17 participating and reporting firms having 240 to 880 acres cropland; 21.2% of cropland.

[c]Derived from 12 participating and reporting firms having 1,120 to 1,760 acres cropland; .43 of 38.7% cropland.

[d]Derived from 11 participating and reporting firms having 1,120 to 1,760 acres cropland; 16.6% of cropland.

[e]Derived from 10 participating and reporting firms having 2,040 to 3,320 acres cropland; .43 of 27.1% of cropland.

[f]Derived from 10 participating and reporting firms having 2,040 to 3,320 acres cropland; 32.7% of cropland.

[g]Derived from 5 participating and reporting firms having 960 to 3,520 acres cropland; .43 of 34.0% of cropland.

[h]Derived from 6 participating and reporting firms having 960 to 3,520 acres cropland; 11.5% of cropland.

APPENDIX B

COMPLETE RESULTS OF FARM II

AND III SITUATIONS

TABLE LXI

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS A WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Farm Size, Acres | F. O. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 |
| | P. O. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 |
| | Rent. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | P. O. | 50 | 58 | 58 | 58 | 58 | 50 | 50 | 50 | 50 | 44 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Net Worth | F. O. | $253,000 | $270,640 | $289,420 | $308,300 | $326,410 | $345,280 | $366,170 | $384,920 | $402,310 | $420,750 |
| | P. O. | $139,740 | $154,780 | $170,670 | $184,910 | $198,950 | $214,490 | $232,020 | $244,990 | $256,330 | $271,130 |
| | Rent. | $ 26,477 | $ 39,270 | $ 51,848 | $ 64,975 | $ 76,883 | $ 89,561 | $104,980 | $115,780 | $125,250 | $136,370 |
| Debt-Asset Ratio | F. O. | 0.21 | 0.16 | 0.11 | 0.06 | 0.05 | 0.16 | 0.12 | 0.11 | 0.10 | 0.06 |
| | P. O. | 0.22 | 0.36 | 0.32 | 0.28 | 0.29 | 0.25 | 0.19 | 0.20 | 0.19 | 0.14 |
| | Rent. | 0.24 | 0.23 | 0.13 | 0.08 | 0.13 | 0.02 | 0.00 | 0.00 | 0.03 | 0.22 |
| Dominant Goals[2] | F. O. | #2 | #2 | #2 | #4 | #4 | #2 | #2 | #2 | #2 | #2 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #8 | #8 | #8 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | (#2) | - | - | - | - | - |
| | Rent. | (#2, #7) | - | - | - | (#2) | - | - | - | - | - |
| Secondary Goals[4] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | NONE | - | - | - | BUY | - | - | - | NONE | - |
| | P. O. | BUY | - | - | - | RENT | - | - | - | RENT | - |
| | Rent. | RENT | - | - | - | RENT | - | - | - | BUY | - |

TABLE LXI (Continued)

| Item | Land Equity[1/] | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size, Acres | F. O. | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 | 2,560 | 2,560 |
| | P. O. | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 |
| | Rent. | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | P. O. | 44 | 44 | 44 | 50 | 50 | 50 | 50 | 55 | 55 | 55 |
| | Rent. | 13 | 13 | 13 | 22 | 22 | 22 | 22 | 30 | 30 | 30 |
| Net Worth | F. O. | $387,410 | $406,290 | $426,550 | $450,180 | $477,120 | $502,050 | $528,700 | $556,280 | $586,730 | $614,680 |
| | P. O. | $253,580 | $267,750 | $283,170 | $300,780 | $321,820 | $340,160 | $360,000 | $381,430 | $404,750 | $425,090 |
| | Rent. | $137,780 | $146,540 | $156,280 | $168,910 | $184,720 | $197,570 | $211,650 | $225,970 | $241,830 | $255,230 |
| Debt-Asset Ratio | F. O. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.11 | 0.00 | 0.00 | 0.26 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.02 |
| Dominant Goals[2/] | F. O. | #4 | #4 | #4 | #4 | #4 | #1 | #1, #6 | #1 | #1 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #6 | #6 | #6 | #6 | #6 | #6 | #4 | #4 | #4 | #4 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals[4/] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | BUY | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers.

TABLE LXII

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS A WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 |
| | P. O. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 |
| | Rent. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 |
| Percent Owned | F. O. | 100 | 83 | 83 | 83 | 83 | 86 | 86 | 86 | 86 | 88 |
| | P. O. | 50 | 58 | 58 | 58 | 58 | 50 | 50 | 50 | 50 | 44 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Net Worth | F. O. | $253,380 | $271,660 | $291,120 | $310,770 | $330,350 | $352,010 | $369,920 | $389,360 | $407,410 | $429,320 |
| | P. O. | $140,120 | $154,300 | $168,720 | $183,470 | $197,870 | $213,780 | $232,150 | $246,010 | $258,280 | $274,070 |
| | Rent. | $ 27,821 | $ 39,884 | $ 52,155 | $ 64,835 | $ 77,121 | $ 90,251 | $105,530 | $117,210 | $127,630 | $139,750 |
| Debt-Asset Ratio | F. O. | 0.21 | 0.18 | 0.12 | 0.07 | 0.06 | 0.16 | 0.17 | 0.10 | 0.11 | 0.15 |
| | P. O. | 0.22 | 0.36 | 0.32 | 0.29 | 0.29 | 0.26 | 0.19 | 0.19 | 0.19 | 0.13 |
| | Rent. | 0.23 | 0.23 | 0.13 | 0.08 | 0.13 | 0.02 | 0.00 | 0.00 | 0.02 | 0.21 |
| Dominant Goals[2/] | F. O. | #3, #2 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #4 | #3 | #4 | #4 | #4 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #4 | #4 | #4 | #6 | #8 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | (#2) | - | - | - | - | - |
| | Rent. | (#2, #7) | - | - | - | (#2) | - | - | - | - | - |
| Secondary Goals[4/] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #3, #5 | #3, #5 | #8, #2, #1, #3, #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | P. O. | BUY | - | - | - | RENT | - | - | - | RENT | - |
| | Rent. | RENT | - | - | - | RENT | - | - | - | BUY | - |

TABLE LXII (Continued)

| Item | Land Equity[1/] | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Time Period | | | | | | | | | |
| Farm Size | F. O. | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 |
| | P. O. | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 |
| | Rent. | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 |
| Percent Owned | F. O. | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 |
| | P. O. | 44 | 44 | 44 | 50 | 50 | 50 | 50 | 55 | 55 | 55 |
| | Rent. | 13 | 13 | 13 | 22 | 22 | 22 | 22 | 30 | 30 | 30 |
| Net Worth | F. O. | $392,420 | $413,080 | $435,300 | $459,160 | $483,410 | $509,090 | $535,120 | $562,990 | $591,170 | $621,040 |
| | P. O. | $257,540 | $272,640 | $289,030 | $307,810 | $330,080 | $349,710 | $370,900 | $393,750 | $418,550 | $440,450 |
| | Rent. | $142,240 | $152,130 | $163,060 | $176,880 | $193,950 | $208,110 | $223,580 | $239,370 | $256,770 | $270,900 |
| Debt-Asset Ratio | F. O. | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 |
| Dominant Goals[2/] | F. O. | #4 | #4 | #4 | #4 | #4 | #4 | #6 | #6 | #6 | #6 |
| | P. O. | #6 | #6 | #6 | #4 | #4 | #4 | #6 | #4 | #4 | #6 |
| | Rent. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | #5 | - | - | - | #5 | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals[4/] | F. O. | #8, #2, #1, #5, #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 |
| | P. O. | #5 | #3, #2, #1, #5 | #3, #2, #1, #5 | #2, #3, #1, #5 | #2, #3, #1, #5 | #2, #3, #1, #5 | #2, #3, #1, #5 | #2, #3, #1, #5 | #2, #5, #3, #1 | #2, #5, #1, #3 |
| | Rent. | #2, #1, #5 | #2, #1, #5 | #2, #1, #5 | #2, #1, #5 | #2, #1, #5 | #2, #1, #5 | #2, #1, #5 | #2, #1, #5 | #2, #1, #5 | #3, #2, #5, #1 |
| Expansion Strategy | F. O. | - | - | NONE | - | - | - | NONE | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | BUY | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers.

TABLE LXIII

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS B WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size, Acres | F. O. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 |
| | P. O. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 83 | 83 | 83 | 83 | 86 |
| | P. O. | 50 | 42 | 42 | 42 | 42 | 50 | 50 | 50 | 50 | 56 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $321,530 | $346,900 | $373,530 | $401,900 | $429,860 | $461,710 | $492,010 | $520,260 | $545,490 | $572,520 |
| | P. O. | $172,290 | $190,210 | $205,810 | $222,890 | $238,890 | $259,140 | $277,410 | $294,440 | $306,440 | $319,410 |
| | Rent. | $ 24,215 | $ 29,693 | $ 35,369 | $ 41,672 | $ 46,304 | $ 51,003 | $ 55,032 | $ 59,212 | $ 61,636 | $ 63,202 |
| Debt-Asset Ratio | F. O. | 0.20 | 0.15 | 0.10 | 0.06 | 0.05 | 0.05 | 0.07 | 0.01 | 0.02 | 0.12 |
| | P. O. | 0.22 | 0.16 | 0.11 | 0.07 | 0.09 | 0.24 | 0.25 | 0.21 | 0.24 | 0.34 |
| | Rent. | 0.40 | 0.27 | 0.17 | 0.11 | 0.29 | 0.26 | 0.30 | 0.24 | 0.35 | 0.33 |
| Dominant Goals[2/] | F. O. | #2 | #2 | #1 | #1 | #1, #2 | #1 | #1 | #1 | #1, #4 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #7 |
| | Rent. | #8 | #8 | #8 | #6 | #4 | #4 | #4 | #4 | #4 | #4 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | (#7) | - | - | - | - | - | - | - | - | - |
| | Rent. | #2, #7 | - | - | - | #2, #7 | - | - | - | #2, #7 | - |
| Secondary Goals[4/] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #3, #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | NONE | - | - | - | RENT | - | - | - | BUY | - |
| | P. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | Rent. | NONE | - | - | - | NONE | - | - | - | NONE | - |

TABLE LXIII (Continued)

| Item | Land Equity 1/ | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size, Acres | F. O. | 2,240 | 2,240 | 2,240 | 2,560 | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 |
| | P. O. | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| Percent Owned | F. O. | 86 | 86 | 86 | 88 | 88 | 88 | 88 | 89 | 89 | 89 |
| | P. O. | 56 | 56 | 56 | 50 | 50 | 50 | 50 | 55 | 55 | 55 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 14 |
| Net Worth | F. O. | $585,160 | $518,140 | $537,500 | $565,570 | $591,840 | $624,000 | $656,830 | $695,760 | $732,410 | $769,790 |
| | P. O. | $320,600 | $262,250 | $273,110 | $288,580 | $302,830 | $320,960 | $338,830 | $362,470 | $385,410 | $408,490 |
| | Rent. | $ 66,039 | $ 69,319 | $ 73,741 | $ 82,132 | $ 89,427 | $ 97,457 | $106,500 | $118,410 | $129,300 | $140,430 |
| Debt-Asset Ratio | F. O. | 0.09 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.30 | 0.32 | 0.30 | 0.25 | 0.26 | 0.21 | 0.20 | 0.23 | 0.22 | 0.20 |
| | Rent. | 0.25 | 0.18 | 0.07 | 0.00 | 0.12 | 0.02 | 0.02 | 0.24 | 0.30 | 0.27 |
| Dominant Goals 2/ | F. O. | #1 | #1 | #1, #4 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #4 | #4 | #6 | #6 | #4 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | (#2) | - | - | - | - | - | - | - |
| | Rent. | - | - | (#2) | - | - | - | - | - | - | - |
| Secondary Goals 4/ | F. O. | #3, #5 | #3, #5 | #3, #5 | #5 | #5 | #5 | #5 | #3 | #3 | #3 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | RENT | - | - | - | BUY | - | - | - |
| | Rent. | - | - | RENT | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers.

TABLE LXIV

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS B WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity 1/ | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 |
| | P. O. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 |
| Percent Owned | F. O. | 100 | 83 | 83 | 83 | 83 | 86 | 86 | 86 | 86 | 88 |
| | P. O. | 50 | 42 | 42 | 42 | 42 | 36 | 36 | 36 | 36 | 44 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $321,910 | $349,510 | $375,720 | $403,990 | $432,610 | $465,960 | $498,680 | $528,970 | $553,730 | $579,710 |
| | P. O. | $172,660 | $189,740 | $204,870 | $221,450 | $237,810 | $258,100 | $275,590 | $292,520 | $305,030 | $318,780 |
| | Rent. | $ 24,635 | $ 29,204 | $ 34,404 | $ 40,229 | $ 45,215 | $ 50,334 | $ 55,257 | $ 60,359 | $ 63,744 | $ 66,333 |
| Debt-Asset Ratio | F. O. | 0.20 | 0.15 | 0.11 | 0.06 | 0.06 | 0.16 | 0.16 | 0.13 | 0.14 | 0.21 |
| | P. O. | 0.22 | 0.16 | 0.11 | 0.07 | 0.09 | 0.08 | 0.11 | 0.08 | 0.13 | 0.26 |
| | Rent. | 0.39 | 0.27 | 0.17 | 0.11 | 0.29 | 0.26 | 0.30 | 0.23 | 0.34 | 0.32 |
| Dominant Goals 2/ | F. O. | #3, #2 | #4 | #4 | #4 | #4 | #6 | #6 | #6 | #6 | #6 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #4 | #4 | #4 | #8 | #8 | #8 | #8 | #8 | #8 | #8 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | (#7) | - | - | - | (#7) | - | - | - | - | - |
| | Rent. | #2, #7 | - | - | - | #2, #7 | - | - | - | #2, #7 | - |
| Secondary Goals 4/ | F. O. | #5 | #5 | #5 | #3, #5 | #3, #5 | #3, #5 | #3, #5 | #5, #3 | #5, #3 | #2, #4, #3, #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | P. O. | RENT | - | - | - | RENT | - | - | - | BUY | - |
| | Rent. | NONE | - | - | - | NONE | - | - | - | NONE | - |

TABLE LXIV (Continued)

| Item | Land Equity[1/] | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 |
| | P. O. | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 |
| Percent Owned | F. O. | 88 | 88 | 88 | 89 | 89 | 89 | 89 | 90 | 90 | 90 |
| | P. O. | 44 | 44 | 44 | 50 | 50 | 50 | 50 | 55 | 55 | 55 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 14 |
| Net Worth | F. O. | $589,420 | $505,890 | $526,500 | $552,210 | $575,910 | $606,080 | $636,690 | $673,600 | $710,610 | $747,850 |
| | P. O. | $323,040 | $281,260 | $295,550 | $314,950 | $332,520 | $354,130 | $375,670 | $403,170 | $430,130 | $457,660 |
| | Rent. | $ 70,257 | $ 74,748 | $ 80,494 | $ 90,136 | $ 98,800 | $108,230 | $118,690 | $131,190 | $142,660 | $154,460 |
| Debt-Asset Ratio | F. O. | 0.17 | 0.16 | 0.09 | 0.11 | 0.11 | 0.06 | 0.03 | 0.03 | 0.02 | 0.00 |
| | P. O. | 0.22 | 0.22 | 0.15 | 0.21 | 0.21 | 0.15 | 0.13 | 0.16 | 0.15 | 0.12 |
| | Rent. | 0.24 | 0.16 | 0.006 | 0.00 | 0.06 | 0.00 | 0.00 | 0.24 | 0.25 | 0.23 |
| Dominant Goals[2/] | F. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | P. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #8 | #8 | #8 | #6 | #8 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | (#2) | - | - | - | - | - | - | - |
| Secondary Goals[4/] | F. O. | #5, #3 | #5, #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #2, #1, #5 | #3, #1, #2, #5 | #3, #1, #2, #5 |
| | Rent. | #5 | #5 | #1, #5 | #2, #1, #5 | #2, #1, #5 | #2, #1, #5 | #2, #1, #5 | #5 | #5 | #2, #1, #5 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | RENT | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal number.

TABLE LXV

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS C WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Farm Size | F. O. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 |
| | P. O. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 83 | 83 | 83 | 83 | 86 |
| | P. O. | 50 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 36 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $312,320 | $339,670 | $368,420 | $399,120 | $428,740 | $461,660 | $492,560 | $515,400 | $537,410 | $563,080 |
| | P. O. | $166,600 | $183,460 | $199,880 | $215,530 | $229,410 | $243,970 | $257,560 | $267,000 | $275,160 | $283,570 |
| | Rent. | $ 20,154 | $ 21,349 | $ 22,404 | $ 23,092 | $ 21,280 | $ 18,912 | $ 14,637 | $ 10,404 | $ 3,912 | ($ 4,062) |
| Debt-Asset Ratio | F. O. | 0.21 | 0.16 | 0.11 | 0.06 | 0.06 | 0.06 | 0.07 | 0.05 | 0.06 | 0.14 |
| | P. O. | 0.23 | 0.17 | 0.12 | 0.07 | 0.11 | 0.09 | 0.12 | 0.09 | 0.12 | 0.12 |
| | Rent. | 0.45 | 0.35 | 0.26 | 0.19 | 0.49 | 0.50 | 0.65 | 0.64 | 0.89 | NA |
| Dominant Goals[2/] | F. O. | #2 | #2 | #2 | #1 | #1, #2 | #1 | #1 | #1 | #1, #6 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #8 | #8 | #8 | #6 | #4 | #4 | #4 | #4 | #4 | #4 |
| Restrictive Goals[3/] | F. O. | – | – | – | – | – | – | – | – | – | – |
| | P. O. | (#7) | – | – | – | #7 | – | – | – | (#7) | – |
| | Rent. | #2, #7 | – | – | – | #2, #7 | – | – | – | #2, #7 | – |
| Secondary Goals[4/] | F. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #3, #5 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | NONE | – | – | – | RENT | – | – | – | BUY | – |
| | P. O. | RENT | – | – | – | NONE | – | – | – | RENT | – |
| | Rent. | NONE | – | – | – | NONE | – | – | – | NONE | – |

TABLE LXV (Continued)

| Item | Land Equity[1/] | Time Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Farm Size | F. O. | 2,240 | 2,240 | 2,240 | 2,560 | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 |
| | P. O. | 2,240 | 2,240 | 2,240 | 2,560 | 2,560 | 2,560 | 2,560 | 2,880 | 2,880 | 2,880 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 |
| Percent Owned | F. O. | 86 | 86 | 86 | 88 | 88 | 88 | 88 | 89 | 89 | 89 |
| | P. O. | 36 | 36 | 36 | 44 | 44 | 44 | 44 | 50 | 50 | 50 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $588,520 | $616,230 | $645,620 | $678,130 | $706,260 | $736,240 | $766,600 | $795,980 | $824,050 | $853,430 |
| | P. O. | $290,520 | $298,850 | $308,010 | $319,230 | $324,520 | $330,500 | $335,530 | $338,350 | $338,260 | $337,640 |
| | Rent. | ($ 11,847) | ($ 19,397) | ($ 27,058) | ($ 34,493) | ($ 45,007) | ($ 56,172) | ($ 68,866) | ($ 81,671) | ($ 97,866) | ($116,130) |
| Debt-Asset Ratio | F. O. | 0.09 | 0.05 | 0.00 | 0.06 | 0.06 | 0.02 | 0.00 | 0.03 | 0.04 | 0.01 |
| | P. O. | 0.06 | 0.00 | 0.01 | 0.19 | 0.24 | 0.21 | 0.22 | 0.29 | 0.32 | 0.31 |
| | Rent. | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dominant Goals[2/] | F. O. | #1 | #1 | #1, #6 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #7 | #7 | #7 |
| | Rent. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | #2, #7 | - | - | - | #2, #7 | - | - | - |
| Secondary Goals[4/] | F. O. | #3, #5 | #3, #5 | #5, #3 | #4, #5, #3 | #5, #4, #3 | #4, #5, #3 | #3 | #4, #3 | #3, #4 | #3, #4 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #3 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | NONE | - | - | - | NONE | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers. Net worth in parentheses refers to negative values and NA means not applicable.

TABLE LXVI

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM II, CLASS C WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity 1/ | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 2,240 | 2,240 | 2,240 | 2,240 | 2,560 |
| | P. O. | 1,600 | 1,920 | 1,920 | 1,920 | 1,920 | 1.920 | 1,920 | 1,920 | 1,920 | 2,240 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 |
| Percent Owned | F. O. | 100 | 83 | 83 | 83 | 83 | 83 | 86 | 86 | 86 | 88 |
| | P. O. | 50 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 36 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $312,700 | $342,130 | $372,290 | $401,850 | $430,870 | $464,520 | $497,920 | $521,510 | $542,230 | $564,430 |
| | P. O. | $167,130 | $183,140 | $199,090 | $214,360 | $228,640 | $242,630 | $256,090 | $265,340 | $274,210 | $283,450 |
| | Rent. | $ 20,471 | $ 20,711 | $ 21,217 | $ 21,320 | $ 19,903 | $ 17,938 | $ 14,609 | $ 11,386 | $ 5,988 | ($ 788) |
| Debt-Asset Ratio | F. O. | 0.21 | 0.16 | 0.11 | 0.06 | 0.07 | 0.17 | 0.17 | 0.14 | 0.16 | 0.23 |
| | P. O. | 0.23 | 0.17 | 0.12 | 0.07 | 0.11 | 0.09 | 0.12 | 0.09 | 0.12 | 0.12 |
| | Rent. | 0.44 | 0.36 | 0.27 | 0.20 | 0.51 | 0.51 | 0.65 | 0.62 | 0.85 | NA |
| Dominant Goals 2/ | F. O. | #3, #2 | #4 | #4 | #4 | #4 | #6 | #6 | #6 | #6 | #6 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #4 | #4 | #4 | #8 | #8 | #8 | #8 | #8 | #8 | #8 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | (#7) | - | - | - | #7 | - | - | - | (#7) | - |
| | Rent. | #2, #7 | - | - | - | #2, #7 | - | - | - | #2, #7 | - |
| Secondary Goals 4/ | F. O. | #5 | #5 | #5 | #3, #5 | #3, #5 | #3, #5 | #3, #5 | #5, #3 | #5, #3 | #5 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | P. O. | RENT | - | - | - | NONE | - | - | - | RENT | - |
| | Rent. | NONE | - | - | - | NONE | - | - | - | NONE | - |

TABLE LXVI (Continued)

| Item | Land Equity[1/] | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 |
| | P. O. | 2,240 | 2,240 | 2,240 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 | 2,560 |
| | Rent. | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 |
| Percent Owned | F. O. | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 |
| | P. O. | 36 | 36 | 36 | 44 | 44 | 44 | 44 | 56 | 56 | 56 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $585,460 | $608,980 | $634,340 | $662,090 | $688,330 | $716,520 | $745,120 | $776,210 | $806,840 | $838,370 |
| | P. O. | $291,270 | $300,520 | $310,640 | $322,900 | $329,270 | $336,400 | $342,650 | $351,540 | $358,740 | $365,820 |
| | Rent. | ($ 7,299) | ($ 13,502) | ($ 19,727) | ($ 25,633) | ($ 34,218) | ($ 43,307) | ($ 53,764) | ($ 64,156) | ($ 77,701) | ($ 93,099) |
| Debt-Asset Ratio | F. O. | 0.19 | 0.14 | 0.14 | 0.09 | 0.09 | 0.05 | 0.02 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.06 | 0.00 | 0.01 | 0.19 | 0.23 | 0.21 | 0.22 | 0.28 | 0.30 | 0.29 |
| | Rent. | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dominant Goals[2/] | F. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | P. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #6 | #8 | #6 | #8 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | #2, #7 | - | - | - | #2, #7 | - | - | - |
| Secondary Goals[4/] | F. O. | #4, #2, #3, #5 | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 |
| | P. O. | #5 | #3, #2, #1, #5 | #3, #2, #1, #5 | #5 | #5 | #5 | #5 | #5 | #5 | #1, #2, #5 |
| | Rent. | #7, #2, #1, #3, #5 | #1, #5 | #2, #4 #1, #5 | #2, #4, #1, #5 | #4 | #2, #1 #5, #4 | #2, #1, #5, #4 | #2, #4, #1, #5 | #2, #1, #5, #4 | #2, #1, #5, #4 |
| Expansion Strategy | F. O. | - | - | NONE | - | - | - | NONE | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | NONE | - | - | - | NONE | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers. Net worth in parentheses refers to negative values and NA means not applicable.

TABLE LXVII

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS A WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity 1/ | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| | P. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| | Rent. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| Percent Owned | F. O. | 100 | 100 | 100 | 100 | 100 | 90 | 90 | 90 | 90 | 90 |
| | P. O. | 50 | 45 | 45 | 45 | 45 | 50 | 50 | 50 | 50 | 54 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 9 | 9 | 9 | 9 | 17 |
| Net Worth | F. O. | $469,180 | $506,560 | $544,330 | $582,300 | $620,010 | $662,820 | $704,220 | $747,490 | $787,670 | $829,640 |
| | P. O. | $256,870 | $289,220 | $321,970 | $355,440 | $388,350 | $425,640 | $457,370 | $490,470 | $521,130 | $556,890 |
| | Rent. | $ 45,617 | $ 71,145 | $ 96,150 | $122,190 | $147,230 | $176,520 | $199,980 | $224,240 | $245,950 | $271,780 |
| Debt-Asset Ratio | F. O. | 0.21 | 0.16 | 0.11 | 0.06 | 0.04 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.22 | 0.17 | 0.11 | 0.06 | 0.04 | 0.10 | 0.09 | 0.00 | 0.00 | 0.02 |
| | Rent. | 0.25 | 0.18 | 0.10 | 0.05 | 0.02 | 0.15 | 0.14 | 0.00 | 0.01 | 0.10 |
| Dominant Goals 2/ | F. O. | #7, #2 | #7 | #1 | #1 | #1, #2 | #1 | #1 | #1 | #1, #8 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #8 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #4 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | - | - | - | - | #5 | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | (#7) | - | - | - | - | - | - | - | - | - |
| Secondary Goals 4/ | F. O. | #5 | #5 | #5 | #5 | #5 | #3, #5 | #5, #3 | #5, #3 | #3 | #4, #5, #8 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #3, #5 | #3, #5 | #3, #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | NONE | - | - | - | RENT | - | - | - | NONE | - |
| | P. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | Rent. | RENT | - | - | - | BUY | - | - | - | BUY | - |

TABLE LXVII (Continued)

| Item | Land Equity[1/] | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| | P. O. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,160 | 4,160 | 4,160 |
| | Rent. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,480 | 4,480 | 4,480 |
| Percent Owned | F. O. | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | P. O. | 54 | 54 | 54 | 58 | 58 | 58 | 58 | 58 | 58 | 58 |
| | Rent. | 17 | 17 | 17 | 23 | 23 | 23 | 23 | 29 | 29 | 29 |
| Net Worth | F. O. | $783,260 | $827,860 | $875,350 | $925,880 | $977,920 | $1,032,900 | $1,089,700 | $1,150,100 | $1,213,500 | $1,280,200 |
| | P. O. | $529,130 | $562,920 | $599,090 | $640,280 | $682,060 | $ 725,800 | $ 770,970 | $ 819,110 | $ 867,940 | $ 920,020 |
| | Rent. | $275,170 | $296,700 | $320,010 | $347,690 | $375,300 | $ 404,170 | $ 433,710 | $ 468,380 | $ 502,910 | $ 539,180 |
| Debt-Asset Ratio | F. O. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dominant Goals[2/] | F. O. | #1 | #1 | #1, #8 | #1 | #1 | #1 | #1, #8 | #1 | #1 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #1, #8 | #1 | #1 | #1 |
| | Rent. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| Restrictive Goals[3/] | F. O. | - | - | #5 | - | - | - | #5 | - | - | - |
| | P. O. | - | - | - | - | - | - | #5 | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals[4/] | F. O. | #3 | #3 | #4, #3 | #3, #4 | #3, #4 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #3, #5 | #3, #5 | #5, #3 | #2, #5, #3 | #3 | #3 | #3 | #3 | #3 | #3 |
| | Rent. | #5 | #5 | #5 | #5 | #1, #2, #3, #5 | #1, #2, #3, #5 | #1, #2, #3, #5 | #1, #2, #5, #3 | #1, #5, #2, #2 | #1, #5, #2, #3 |
| Expansion Strategy | F. O. | - | - | NONE | - | - | - | NONE | - | - | - |
| | P. O. | - | - | BUY | - | - | - | NONE | - | - | - |
| | Rent. | - | - | BUY | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers.

TABLE LXVIII

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS A WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity 1/ | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| | P. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| | Rent. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| Percent Owned | F. O. | 100 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | P. O. | 50 | 45 | 45 | 45 | 45 | 50 | 50 | 50 | 50 | 54 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 9 | 9 | 9 | 9 | 17 |
| Net Worth | F. O. | $469,560 | $507,950 | $548,020 | $588,500 | $629,720 | $671,900 | $713,630 | $757,320 | $799,040 | $842,690 |
| | P. O. | $257,250 | $288,750 | $321,020 | $354,000 | $387,270 | $424,940 | $457,500 | $491,490 | $523,080 | $559,820 |
| | Rent. | $ 45,995 | $ 70,667 | $ 95,206 | $120,750 | $146,150 | $175,800 | $200,090 | $225,230 | $247,880 | $274,690 |
| Debt-Asset Ratio | F. O. | 0.21 | 0.17 | 0.11 | 0.06 | 0.04 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.22 | 0.17 | 0.11 | 0.06 | 0.04 | 0.10 | 0.09 | 0.00 | 0.00 | 0.02 |
| | Rent. | 0.24 | 0.18 | 0.10 | 0.05 | 0.03 | 0.16 | 0.14 | 0.00 | 0.01 | 0.09 |
| Dominant Goals 2/ | F. O. | #7, #3, #2 | #7 | #7 | #4 | #4 | #4 | #6 | #6 | #6 | #6 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | #5 | - | - | - | #5 | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | (#2, #7) | - | - | - | - | - | - | - | - | - |
| Secondary Goals 4/ | F. O. | #5 | #5 | #3, #5 | #3 | #3 | #3 | #3 | #3 | #3 | #3 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #1, #2, #3, #5 | #1, #2, #3, #5 | #1, #2, #5, #3 | #1, #2, #5, #3 | #3 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #1, #2, #5 | #1, #2, #5 | #3, #1, #2, #5 | #8, #7, #3, #1, #2 | #3, #1, #5, #2 |
| Expansion Strategy | F. O. | RENT | - | - | - | NONE | - | - | - | NONE | - |
| | P. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | Rent. | RENT | - | - | - | BUY | - | - | - | BUY | - |

TABLE LXVIII (Continued)

| Item | Land Equity[1/] | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| | P. O. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,160 | 4,160 | 4,160 |
| | Rent. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,480 | 4,480 | 4,480 |
| Percent Owned | F. O. | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | P. O. | 54 | 54 | 54 | 58 | 58 | 58 | 58 | 65 | 65 | 65 |
| | Rent. | 17 | 17 | 17 | 23 | 23 | 23 | 23 | 29 | 29 | 29 |
| Net Worth | F. O. | $798,770 | $844,980 | $894,140 | $946,420 | $1,000,300 | $1,057,300 | $1,116,200 | $1,178,800 | $1,244,500 | $1,313,600 |
| | P. O. | $533,080 | $567,940 | $605,240 | $647,610 | $ 690,630 | $ 735,680 | $ 782,210 | $ 831,630 | $ 881,850 | $ 935,410 |
| | Rent. | $279,100 | $301,700 | $326,140 | $355,010 | $ 383,850 | $ 414,020 | $ 444,930 | $ 481,030 | $ 517,070 | $ 554,920 |
| Debt-Asset Ratio | F. O. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Rent. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dominant Goals[2/] | F. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | P. O. | #4 | #4 | #4 | #4 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | #5 | - | - | - | #5 | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | - | - | - | - | - | - | - | - |
| Secondary Goals[4/] | F. O. | #3 | #3 | #3 | #3 | #4, #3 | #3, #4 | #4 | #4 | #4 | #4 |
| | P. O. | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 | #3 |
| | Rent. | #3, #1, #5, #2 | #3, #1, #5, #2 | #3, #1, #5, #2 | #5, #1, #3, #2 | #5, #1, #3, #2 | #5, #1, #3, #2 | #5, #1, #3, #2 | #1, #3, #2 | #3, #2 | #2, #3 |
| Expansion Strategy | F. O. | - | - | NONE | - | - | - | NONE | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | BUY | - | - | - | BUY | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers.

TABLE LXIX

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS B WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| | P. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |
| Percent Owned | F. O. | 100 | 90 | 90 | 90 | 90 | 91 | 91 | 91 | 91 | 92 |
| | P. O. | 50 | 55 | 55 | 55 | 55 | 59 | 59 | 59 | 59 | 63 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $610,950 | $660,940 | $709,720 | $758,460 | $806,790 | $862,600 | $919,040 | $971,350 | $1,015,500 | $1,065,100 |
| | P. O. | $325,630 | $355,140 | $383,640 | $411,250 | $437,230 | $469,530 | $500,690 | $528,950 | $ 549,770 | $ 574,840 |
| | Rent. | $ 41,435 | $ 47,085 | $ 49,521 | $ 51,278 | $ 49,910 | $ 48,330 | $ 44,032 | $ 38,389 | $ 29,776 | $ 19,510 |
| Debt-Asset Ratio | F. O. | 0.19 | 0.15 | 0.10 | 0.06 | 0.06 | 0.12 | 0.12 | 0.10 | 0.09 | 0.13 |
| | P. O. | 0.21 | 0.28 | 0.25 | 0.22 | 0.25 | 0.30 | 0.30 | 0.26 | 0.27 | 0.32 |
| | Rent. | 0.41 | 0.30 | 0.21 | 0.15 | 0.43 | 0.41 | 0.54 | 0.48 | 0.65 | 0.74 |
| Dominant Goals[2] | F. O. | #1, #7, #2 | #1 | #1 | #1 | #1, #8 | #1 | #1 | #1 | #1, #8 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #7, #8 | #7 | #7 | #7 | #7, #8 | #7 |
| | Rent. | #8 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | #2, #7 | - | - | - | #2, #7 | - | - | - | #2, #7 | - |
| Secondary Goals[4] | F. O. | #5 | #5 | #3, #5 | #3, #5 | #4, #5, #3 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | P. O. | BUY | - | - | - | BUY | - | - | - | BUY | - |
| | Rent. | NONE | - | - | - | NONE | - | - | - | NONE | - |

TABLE LXIX (Continued)

| Item | Land Equity[1/] | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,480 | 4,480 | 4,480 |
| | P. O. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,480 | 4,480 | 4,480 |
| | Rent. | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| Percent Owned | F. O. | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 93 | 93 | 93 |
| | P. O. | 63 | 63 | 63 | 65 | 65 | 65 | 65 | 68 | 68 | 68 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $1,088,100 | $949,430 | $986,510 | $1,029,100 | $1,072,100 | $1,120,200 | $1,168,100 | $1,224,100 | $1,281,100 | $1,337,700 |
| | P. O. | $ 579,960 | $474,330 | $491,430 | $ 513,369 | $ 534,140 | $ 556,670 | $ 577,720 | $ 605,620 | $ 633,000 | $ 658,310 |
| | Rent. | $ 9,240 | $ 3,719 | $ 8,769 | $ 17,817 | $ 26,181 | $ 34,994 | $ 43,680 | $ 54,283 | $ 64,280 | $ 73,623 |
| Debt-Asset Ratio | F. O. | 0.09 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.29 | 0.31 | 0.28 | 0.27 | 0.30 | 0.25 | 0.24 | 0.23 | 0.23 | 0.24 |
| | Rent. | 0.80 | 0.88 | 0.72 | 0.47 | 0.62 | 0.53 | 0.52 | 0.37 | 0.43 | 0.43 |
| Dominant Goals[2/] | F. O. | #1 | #1 | #1, #8 | #1 | #1 | #1 | #1, #8 | #1 | #1 | #1 |
| | P. O. | #7 | #7 | #7, #4 | #7 | #7 | #7 | #7, #8 | #7 | #7 | #7 |
| | Rent. | #6 | #6 | #8 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | (#2) | - | - | - | #2, #7 | - | - | - |
| Secondary Goals[4/] | F. O. | #4 | #3, #4 | #3, #4 | #3, #4 | #3, #4 | #3, #4 | #4 | #4 | #4 | #4 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #3, #6, #1, #5, #2 | #4, #6, #3, #1, #5 | #5, #2 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | RENT | - | - | - | NONE | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal number.

TABLE LXX

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS B WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| | P. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |
| Percent Owned | F. O. | 100 | 90 | 90 | 90 | 90 | 91 | 91 | 91 | 91 | 92 |
| | P. O. | 50 | 55 | 55 | 55 | 55 | 59 | 59 | 59 | 59 | 63 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $611,320 | $660,470 | $708,780 | $757,020 | $805,710 | $861,900 | $919,180 | $972,370 | $1,017,400 | $1,068,000 |
| | P. O. | $326,010 | $354,660 | $382,690 | $409,810 | $436,150 | $468,820 | $500,830 | $529,970 | $ 551,730 | $ 577,790 |
| | Rent. | $ 41,813 | $ 46,607 | $ 48,577 | $ 49,841 | $ 48,830 | $ 47,627 | $ 44,166 | $ 38,166 | $ 30,700 | $ 21,331 |
| Debt-Asset Ratio | F. O. | 0.19 | 0.15 | 0.10 | 0.06 | 0.06 | 0.12 | 0.12 | 0.10 | 0.09 | 0.13 |
| | P. O. | 0.21 | 0.28 | 0.25 | 0.22 | 0.25 | 0.30 | 0.30 | 0.26 | 0.27 | 0.32 |
| | Rent. | 0.41 | 0.30 | 0.22 | 0.15 | 0.43 | 0.42 | 0.54 | 0.48 | 0.64 | 0.72 |
| Dominant Goals[2/] | F. O. | #3, #7, #1, #2 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 | #1, #6 | #1 |
| | P. O. | #4 | #7 | #7 | #4 | #4 | #4 | #6 | #6 | #6 | #6 |
| | Rent. | #4 | #6 | #6 | #6 | #8 | #8 | #8 | #8 | #8 | #8 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | #2, #7 | - | - | - | #2, #7 | - | - | - | #2, #7 | - |
| Secondary Goals[4/] | F. O. | #5 | #3, #5, #4 | #2, #5, #3, #4 | #3 | #4, #3 | #4, #3 | #4 | #4 | #4 | #4 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #2, #5 | #2, #5 | #2, #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| Expansion Strategy | F. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | P. O. | BUY | - | - | - | BUY | - | - | - | BUY | - |
| | Rent. | NONE | - | - | - | NONE | - | - | - | NONE | - |

TABLE LXX (Continued)

| Item | Land Equity 1/ | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Time Period | | | | | | | | | |
| Farm Size | F. O. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,480 | 4,480 | 4,480 |
| | P. O. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,480 | 4,480 | 4,480 |
| | Rent. | 2,880 | 2,880 | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| Percent Owned | F. O. | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 93 | 93 | 93 |
| | P. O. | 63 | 63 | 63 | 65 | 65 | 65 | 65 | 68 | 68 | 68 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $1,092,100 | $954,500 | $992,710 | $1,036,500 | $1,080,700 | $1,130,100 | $1,179,400 | $1,236,800 | $1,295,300 | $1,353,600 |
| | P. O. | $ 583,950 | $479,430 | $497,700 | $ 520,910 | $ 543,050 | $ 567,000 | $ 589,560 | $ 619,010 | $ 648,030 | $ 675,070 |
| | Rent. | $ 12,077 | $ 7,733 | $ 13,934 | $ 24,156 | $ 32,813 | $ 42,884 | $ 52,899 | $ 64,906 | $ 76,390 | $ 87,303 |
| Debt-Asset Ratio | F. O. | 0.09 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.29 | 0.31 | 0.26 | 0.26 | 0.29 | 0.24 | 0.23 | 0.22 | 0.22 | 0.22 |
| | Rent. | 0.75 | 0.77 | 0.62 | 0.40 | 0.56 | 0.48 | 0.47 | 0.33 | 0.39 | 0.39 |
| Dominant Goals 2/ | F. O. | #1 | #1 | #1, #6 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 |
| | P. O. | #6 | #4 | #4 | #4 | #4 | #6 | #6 | #7 | #6 | #6 |
| | Rent. | #8 | #8 | #8 | #8 | #8 | #8 | #8 | #8 | #8 | #8 |
| Restrictive Goals 3/ | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | (#2) | - | - | - | #2, #7 | - | - | - |
| Secondary Goals 4/ | F. O. | #4 | #4, #3 | #3 | #3 | #4, #3 | #3, #4 | #3, #4 | #3, #4 | #4 | #4 |
| | P. O. | #2, #5 | #1, #2, #5 | #3, #1, #5, #2 | #3, #5, #1, #2 | #5, #1, #2 | #3, #5, #1, #2 | #2 | #5, #3, #1, #2 | #2 | #2 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #1, #2, #5 | #1, #2, #5 | #1, #2, #5 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | RENT | - | - | - | NONE | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers.

TABLE LXXI

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS C WATER, AND 25 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| | P. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |
| Percent Owned | F. O. | 100 | 90 | 90 | 90 | 90 | 91 | 91 | 91 | 91 | 92 |
| | P. O. | 50 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $595,480 | $648,840 | $703,680 | $758,750 | $809,200 | $867,670 | $926,920 | $967,430 | $1,005,700 | $1,050,200 |
| | P. O. | $316,060 | $343,770 | $369,900 | $394,730 | $414,050 | $435,500 | $455,250 | $466,140 | $ 472,890 | $ 478,740 |
| | Rent. | $ 34,520 | $ 35,191 | $ 31,518 | $ 35,036 | $ 14,142 | $ 1,985 | ($ 14,177) | ($ 34,005) | ($ 57,790) | ($ 84,870) |
| Debt-Asset Ratio | F. O. | 0.20 | 0.16 | 0.11 | 0.06 | 0.07 | 0.12 | 0.13 | 0.10 | 0.12 | 0.16 |
| | P. O. | 0.22 | 0.17 | 0.11 | 0.07 | 0.11 | 0.10 | 0.12 | 0.09 | 0.13 | 0.13 |
| | Rent. | 0.44 | 0.37 | 0.31 | 0.28 | 0.74 | 0.95 | NA | NA | NA | NA |
| Dominant Goals[2/] | F. O. | #1, #7, #2 | #1 | #1 | #1 | #1, #8 | #1 | #1 | #1 | #1, #8 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | Rent. | #8 | #8 | #8 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | (#7) | - | - | - | #7 | - | - | - | #7 | - |
| | Rent. | #2, #7 | - | - | - | #2, #7 | - | - | - | #2, #7 | - |
| Secondary Goals[4/] | F. O. | #5 | #5 | #3, #5 | #3, #5 | #4, #3, #5 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #3, #5 | #3 | #3 | #5 |
| Expansion Strategy | F. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | P. O. | RENT | - | - | - | NONE | - | - | - | NONE | - |
| | Rent. | NONE | - | - | - | NONE | - | - | - | NONE | - |

TABLE LXXI (Continued)

| Item | Land Equity[1/] | Time Period 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,480 | 4,480 | 4,480 |
| | P. O. | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 | 3,840 | 3,840 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |
| Percent Owned | F. O. | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 93 | 93 | 93 |
| | P. O. | 45 | 45 | 45 | 50 | 50 | 50 | 50 | 54 | 54 | 54 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $1,095,900 | $1,146,300 | $1,199,900 | $1,264,000 | $1,321,700 | $1,383,200 | $1,445,000 | $1,518,700 | $1,587,000 | $1,657,700 |
| | P. O. | $ 486,460 | $ 496,210 | $ 507,300 | $ 525,870 | $ 539,010 | $ 553,860 | $ 568,500 | $ 590,560 | $ 607,660 | $ 624,670 |
| | Rent. | ($ 112,490) | ($ 140,650) | ($ 170,240) | ($ 200,590) | ($ 238,630) | ($ 279,000) | ($ 324,580) | ($ 372,170) | ($ 426,960) | ($ 487,760) |
| Debt-Asset Ratio | F. O. | 0.11 | 0.08 | 0.03 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.07 | 0.00 | 0.01 | 0.12 | 0.16 | 0.16 | 0.21 | 0.23 | 0.23 | 0.22 |
| | Rent. | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dominant Goals[2/] | F. O. | #1 | #1 | #1, #8 | #1 | #1 | #1 | #1, #8 | #1 | #1 | #1 |
| | P. O. | #4 | #4 | #4 | #4 | #7 | #6 | #6 | #7 | #8 | #8 |
| | Rent. | #6 | #3 | #3, #6 | #3 | #3 | #3 | #3, #6 | #3 | #3 | #3 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | #2, #7 | - | - | - | #2, #7 | - | - | - |
| Secondary Goals[4/] | F. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #5 |
| | Rent. | #5 | #5 | #5 | #5 | #4, #5 | #5, #4 | #5, #5 | #5, #5 | #4 | #4 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | NONE | - | - | - | NONE | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers. Net worth in parentheses refers to negative values and NA means not applicable.

TABLE LXXII

COMPARATIVE EFFECTS OF INITIAL LAND EQUITY ON FIRM GROWTH AND THE DECISION-MAKING PROCESS WITH MULTIPLE GOALS: FARM III, CLASS C WATER, AND 45 YEARS OF AGE OPERATOR

| Item | Land Equity[1/] | Time Period 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm Size | F. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 |
| | P. O. | 2,880 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |
| Percent Owned | F. O. | 100 | 90 | 90 | 90 | 90 | 91 | 91 | 91 | 91 | 92 |
| | P. O. | 50 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $595,860 | $648,360 | $702,730 | $757,320 | $808,120 | $866,970 | $927,050 | $968,450 | $1,007,700 | $1,053,100 |
| | P. O. | $316,440 | $343,290 | $368,950 | $393,300 | $412,970 | $434,790 | $455,380 | $467,160 | $ 474,850 | $ 481,690 |
| | Rent. | $ 34,898 | $ 34,712 | $ 30,543 | $ 23,523 | $ 12,953 | $ 1,165 | ($ 14,110) | ($ 32,925) | ($ 55,582) | ($ 81,239) |
| Debt-Asset Ratio | F. O. | 0.20 | 0.16 | 0.11 | 0.06 | 0.07 | 0.13 | 0.13 | 0.10 | 0.12 | 0.16 |
| | P. O. | 0.22 | 0.17 | 0.12 | 0.07 | 0.11 | 0.10 | 0.12 | 0.09 | 0.13 | 0.13 |
| | Rent. | 0.44 | 0.37 | 0.32 | 0.29 | 0.75 | 0.97 | NA | NA | NA | NA |
| Dominant Goals[2/] | F. O. | #3, #7, #1, #2 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 | #1, #6 | #6 |
| | P. O. | #4 | #4 | #4 | #4 | #4 | #4 | #6 | #6 | #6 | #6 |
| | Rent. | #4 | #4 | #6 | #8 | #8 | #8 | #6 | #6 | #6 | #6 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | (#7) | - | - | - | #7 | - | - | - | #7 | - |
| | Rent. | #2, #7 | - | - | - | #2, #7 | - | - | - | #2, #7 | - |
| Secondary Goals[4/] | F. O. | #5 | #2, #3, #5, #4 | #2, #5, #3, #4 | #3 | #4, #3 | #3, #4 | #4 | #4 | #4 | #4 |
| | P. O. | #5 | #5 | #5 | #5 | #5 | #1, #2, #3, #5 | #1, #2, #3, #5 | #1, #2, #3, #5 | #1, #2, #3, #5 | #2, #3, #5 |
| | Rent. | #5 | #5 | #5 | #5 | #5 | #5 | #5 | #3 | #3 | #5, #3, #4 |
| Expansion Strategy | F. O. | RENT | - | - | - | BUY | - | - | - | BUY | - |
| | P. O. | RENT | - | - | - | NONE | - | - | - | NONE | - |
| | Rent. | NONE | - | - | - | NONE | - | - | - | NONE | - |

TABLE LXXII (Continued)

| Item | Land Equity[1/] | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Time Period | | | | | | | | | |
| Farm Size | F. O. | 3,840 | 3,840 | 3,840 | 4,160 | 4,160 | 4,160 | 4,160 | 4,480 | 4,480 | 4,480 |
| | P. O. | 3,200 | 3,200 | 3,200 | 3,520 | 3,520 | 3,520 | 3,520 | 3,840 | 3,840 | 3,840 |
| | Rent. | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 | 2,880 |
| Percent Owned | F. O. | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 93 | 93 | 93 |
| | P. O. | 45 | 45 | 45 | 50 | 50 | 50 | 50 | 54 | 54 | 54 |
| | Rent. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Worth | F. O. | $1,099,900 | $1,151,300 | $1,206,100 | $1,271,400 | $1,330,400 | $1,393,200 | $1,456,400 | $1,531,500 | $1,601,300 | $1,673,600 |
| | P. O. | $ 490,450 | $ 501,300 | $ 513,570 | $ 533,370 | $ 547,820 | $ 564,050 | $ 580,150 | $ 603,760 | $ 622,490 | $ 641,220 |
| | Rent. | ($ 107,330) | ($ 133,846) | ($ 161,630) | ($ 190,040) | ($ 225,980) | ($ 264,100) | ($ 307,230) | ($ 352,190) | ($ 404,130) | ($ 461,860) |
| Debt-Asset Ratio | F. O. | 0.11 | 0.08 | 0.02 | 0.02 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | P. O. | 0.07 | 0.00 | 0.01 | 0.12 | 0.07 | 0.16 | 0.16 | 0.21 | 0.23 | 0.22 |
| | Rent. | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dominant Goals[2/] | F. O. | #1 | #1 | #1, #6 | #1 | #1 | #1 | #1, #6 | #1 | #1 | #1 |
| | P. O. | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 | #6 |
| | Rent. | #6 | #3 | #3, #8 | #3 | #3 | #3 | #3, #6 | #3 | #3 | #3 |
| Restrictive Goals[3/] | F. O. | - | - | - | - | - | - | - | - | - | - |
| | P. O. | - | - | - | - | - | - | - | - | - | - |
| | Rent. | - | - | #2, #7 | - | - | - | #2, #7, #5 | - | - | - |
| Secondary Goals[4/] | F. O. | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| | P. O. | #1, #2, #3, #5 | #1, #2, #5, #3 | #1, #2, #5, #3 | #5, #2, #3 | #1, #3, #5, #2 | #1, #3, #5, #2 | #1, #3, #5, #2 | #1, #3, #5, #2 | #1, #3, #5, #2 | #4, #1, #3, #5, #2 |
| | Rent. | #5, #4 | #5, #4 | #5, #4 | #2, #1, #5, #4 | #4 | #4 | #4 | #4 | #4 | #4 |
| Expansion Strategy | F. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | P. O. | - | - | BUY | - | - | - | BUY | - | - | - |
| | Rent. | - | - | NONE | - | - | - | NONE | - | - | - |

NOTE: See reference A at end of appendix for explanation of footnotes and key to goal numbers. Net worth in parentheses refers to negative values NA means not applicable.

# REFERENCE A

## Footnotes to Tables of Results

Three initial land equity positions are evaluated. "F.O." means full owner or 100 percent ownership of land operated in period 1. "P.O." means part owner or 50 percent ownership of land operated in period 1. "RENT" means renter (tenant) or no ownership of land operated in period 1.

The dominant goal is the top-ranked goal in the hierarchy. If two or more are listed, the alternative dominant goals (successively lower ranked) indicate that one or more strategy decision values for alternative plans are tied for the higher reanked goals.

A restrictive goal is one which precludes using the dominant goal in selecting a strategy by imposing a restraint. Two basic formats are used: (1) no parentheses around the restrictive goal indicates that all alternative strategies are infeasible and (2) parentheses indicate that at least one or more alternatives are infeasible but not all of the alternatives. A secondary goal is one which is disregarded in the decision process, i.e. the strategy decision values for alternative plans do not have to meet the associated satisficing level for the goal.

Key to Goal Numbers

#1 - control more acreage;

#2 - avoid being forced out of business;

#3 - maintain or increase family living standard;

#4 - avoid years of low profits or losses;

#5 - increase leisure time;

#6 - increase net worth;

#7 - reduce borrowing needs; and

#8 - make the most profit.

APPENDIX C

RELATIONSHIPS USED IN THE MULTIPLE GOALS

ANALYSIS AND THE DECISION CRITERIA

# EQUATIONS FOR ESTIMATING SCALAR VALUES FOR GOAL OF THE FARM OPERATOR

The following set of equations are used to estimate the periodic scalar values for determining the hierarchy of goals of the farm operator. The estimates were based on linear and quadratic independent variables and linear cross products. The beta coefficients were required to be significantly different from zero at the 95 percent level by the step-down regression analysis. The definitions of the dependent and independent variables are followed by the equations.

Definition of Dependent Variables:

$Y_1$ = control more acres;

$Y_2$ = avoid being forced out of business;

$Y_3$ = maintain or increase family living;

$Y_4$ = avoid low profits or losses;

$Y_5$ = increase leisure time;

$Y_6$ = increase net worth;

$Y_7$ = reduce borrowing needs; and

$Y_8$ = make the most annual profit.

Definition of Independent Variables:

$X_1$ = age of farm operator in years;

$X_2$ = farming experience in years;

$X_3$ = tenure status of farm operator where 1 = owner operator, 2 = part owner, and 3 = full tenant;

$X_4$ = educational level of the farm operator where 0 = incomplete high school, 1 = incomplete high school and complete vocational school, 2 = complete high school only, 3 = complete high school and vocational school, 4 = completed one year of college, 5 = two years of college, 6 = three years of college, 7 = four years of college, and 8 = more than four years of college;

## DERIVATION OF STRATEGY DECISION VALUE FOR "AVOIDING YEARS OF LOW PROFITS OR LOSSES," GOAL #4

A. Variance of Net Returns Per Acre for Enterprise i:

$$\begin{aligned}
\mathrm{Var}\ (N.R.)_i &= E[NR - \overline{NR}]^2 \\
&= E\{[P_y Y - V.C.] - [P_y \overline{Y} - V.C.]\}^2 \\
&= E[P_y Y - P_y \overline{Y}]^2 \\
&= E[(P_y \,.\, Y)^2 - 2P_y^2 \,.\, Y \,.\, \overline{Y} + (P_y \,.\, \overline{Y})^2] \\
&= E[(P_y^2 \,.\, Y^2) - 2P_y^2 \,.\, Y \,.\, \overline{Y} + (P_y^2 \,.\, \overline{Y}^2)] \\
&= P_y^2\ E[Y^2 - 2Y \,.\, \overline{Y} - \overline{Y}^2] \\
&= P_y^2\ E[(Y - \overline{Y})^2] \\
&= P_y^2 \,.\, \sigma_y^2
\end{aligned}$$

B. Covariance of Net Returns Per Acre for Enterprises i and j:

$$\begin{aligned}
\mathrm{Cov}\ (N.R.)_{ij} &= E[(NR_i - \overline{NR}_i)\ (NR_j - \overline{NR}_j)] \\
&= E\ \{[(P_{y_i} Y_i - V.C.) - (P_{y_i} \overline{Y}_i - V.C.)]\ [(P_{y_j} Y_j - V.C.) \\
&\qquad -(P_{y_j} \overline{Y}_j - V.C.)] \\
&= E\{[P_{y_i} (Y_i - \overline{Y}_i)][P_{y_j} (Y_j - \overline{Y}_j)]\} \\
&= E[P_{y_i} P_{y_j} (Y_i - \overline{Y}_i)(Y_j - \overline{Y}_j)] \\
&= P_{y_i} P_{y_j} E(Y_i - \overline{Y}_i)(Y_j - \overline{Y}_j) \\
&= P_{y_i} P_{y_j} \sigma_{y_i y_j}
\end{aligned}$$

C. Variance of Net Returns for a Plan k:

$$\mathrm{Var}\ (N.R.)^k = \sum_{i=1}^{n} X_i^2 \mathrm{var}(N.R.)_i + 2 \sum_{\substack{i=1 \\ i \neq j}}^{n} \sum_{j=1}^{m} X_i X_j \mathrm{cov}(N.R.)_{ij}$$

$X_5$ = acres of cropland in the farming operation;

$X_6$ = acres of total land in the farming operation;

$X_7$ = total farm income where 0 = less than \$1,000, 1 = \$1,000 to \$4,999, 2 = \$5,000 to \$9,999, 3 = \$10,000 to \$19,999, 4 = \$20,000 to \$39,999, 5 = \$40,000 to \$69,999, 6 = \$70,000 to \$99,999, 7 = \$100,000 to \$139,999, 8 = \$140,000 to \$179,999, and 9 = \$180,000 and over;

$X_8$ = net off-farm income (coded like $X_7$);

$X_9$ = assets (coded in hundreds of dollars);

$X_{10}$= debts (coded in hundreds of dollars);

$X_{11}$= number of dependents;

$X_{12}$= acres of owned land;

$X_{13}$= acres of owned cropland;

$X_{15}$= net worth (or $X_9 - X_{10}$);

$X_{16}$= debt-asset ratio (or $X_{10}/X_9$);

$X_{17}$= proportion of land owned (or $X_{12}/X_6$); and

$X_{18}$= proportion of cropland owned (or $X_{13}/X_5$).

Regression Equations Used
to Estimate Scale Values:

$$\begin{aligned}\hat{Y}_1 = {} & 23.603 - 0.009X_1^2 - 1.079X_4^2 + 0.012X_6 + 0.038X_9 - 1.850X_{11}^2 \\ & - 0.033X_{12} - 0.036X_{15} + 39.162X_{17}^2 - 5.037X_3X_8 + 8.325X_3X_{11} \\ & + 4.170X_4X_8 - 0.006X_5X_{11} - 0.016X_8X_9 + 3.445X_8X_{11} + 0.019X_8X_{15} \\ & - 0.00000979X_9X_{12} + 0.004X_{11}X_{12} + 0.0000123X_{12}X_{15}\end{aligned}$$

$$\hat{Y}_2 = 73.334 - 0.007X_1 - 0.008X_5 - 0.00000016X_9^2 + 23.839X_{18}^2 - 5.531X_4X_{18}$$
$$+ 0.002X_5X_8$$

$$\hat{Y}_3 = 74.379 - 26.667X_8 + 0.045X_9 - 0.06X_{12} + 0.0000018X_{12}^2 - 0.031X_{15}$$
$$- 19.801X_{16} + 0.51X_1X_8 - 0.012X_3X_9 + 0.02X_3X_{12} + 0.002X_4X_{12}$$
$$+ 0.004X_{11}X_{13}$$

$$\hat{Y}_4 = - 43.445 + 25.327X_3 - 0.027X_9 + 0.00000969X_{10}^2 + 12.741X_{11} - 0.745X_{11}^2$$
$$+ 0.074X_{12} - 0.10X_{13} + 0.052X_{15} + 48.258X_{16} + 60.60X_{17} + 0.002X_1X_{12}$$
$$+ 0.002X_1X_{13} + 0.00001098X_5X_{13} + 0.00000419X_6X_9 + 0.00000X_6X_{13}$$
$$+ 0.012X_6X_{16} + 0.003X_9X_{11} + 0.00000419X_9X_{15}$$

$$\hat{Y}_5 = - 202.69 + 3.673X_2 - 0.045X_2^2 + 148.216X_3 - 30.859X_3^2 - 0.033X_5$$
$$+ 0.00000769X_5^2 + 12.498X_7 - 1.361X_7^2 + 0.008X_9 - 0.00000041X_9^2$$
$$- 97.646X_{17} + 112.092X_{17}^2 - 2.21X_2X_{16} + 11.067X_4X_{17} - 8.852X_4X_{18}$$
$$+ 7.593X_7X_{16} - 0.015X_9X_{17} + 0.014X_{15}X_{18}$$

$$\hat{Y}_6 = 85.985 - 1.321X_1 + 1.490X_2 + 19.512X_4 - 1.191X_4^2 + 0.009X_6 - 1.311X_8^2$$
$$- 216.732X_{16} + 55.888X_{16}^2 + 16.139X_{18}^2 - 0.221X_1X_{11} + 5.956X_1X_{16}$$
$$+ 0.0005056X_2X_5 - 0.0004322X_2X_6 + 0.0001906X_2X_9 - 6.029X_2X_{16}$$
$$- 3.755X_3X_4 + 2.786X_3X_{11} - 0.029X_5X_{17}$$

$$\hat{Y}_7 = 69.207 + 0.00000208X_5 - 0.01X_6 - 2.293X_8 + 0.018X_{12} - 0.005X_{15}$$
$$- 28.392X_{17}^2 + 0.004X_6X_8$$

$$\hat{Y}_8 = 158.33 - 38.38X_3 - 1.340X_7^2 - 13.950X_{11} + 1.3X_{11}^2 + 0.00000523X_{12}^2$$
$$- 208.47X_{17} + 232.41X_{17}^2 + 158.66X_{18} + 6.210X_3X_7 + 45.1X_8X_{17}$$
$$- 47.68X_8X_{18} + 0.00000223X_9X_{12} + 0.004X_{11}X_{12} - 213.35X_{17}X_{18}$$

$$= \sum_{i=1}^{n} \chi_i^2 P_{y_i}^2 \sigma_{y_i}^2 + \sum_{\substack{i=1 \\ i \neq j}}^{n} \sum_{j=1}^{m} \chi_i \chi_j P_{y_i} P_{y_j} \sigma_{y_i y_j}$$

D. Computation of the Strategy Decision Value for Plan K:

After developing the $\text{Var(N.R.)}^k$ for each plan, the following general equation is used to develop the strategy decision value:

$$\text{STRAT (K,4)} = \text{TRET} - \text{TCOST} - t_\alpha \sqrt{\text{Var(N.R.)}} - \text{PTAX} - \text{TINS} - \sum_{i=1}^{3} (\text{DEBT(I)} \times \text{RATE(I)})$$

where $t_\alpha$ = the value of t specified at the level of probability;

TRET = gross farm income;

TCOST = total variable costs;

PTAX = property taxes;

TINS = total insurance premiums;

DEBT(I) = principal balances of real estate, chattel and open debts;

RATE(I) = interest rates on the real estate, chattel and open debts; and

STRAT(K,4) = the returns to fixed resources for plan k and goal #4.

The decision criterion implicitly assumes that cash purchase transactions for the land purchase strategy will not occur. If such conditions occur, there is no opportunity cost attached to the use of that capital used for cash purchasing land. This may make the decision favorable to buying land relative to renting since the rental charges are included in the TCOST variable.

Several modifications of the above equation are also made depending on whether the farm is irrigated or dryland. If it is dryland, overhead costs of \$1,545 plus \$.425 per acre in excess of 960 acres are deducted. Under irrigation, \$2,815 plus \$1.04 per acre in excess of 1,280 acres is deducted. For both, an additional

$8,000 is deducted for an annual hired man if the total labor supply or total labor hired exceed 2,500 hours (operator's labor time).

TABLE LXXIII

SUMMARY OF VARIANCES AND COVARIANCES FOR CROP AND PASTURE YIELDS[1].

| Crop | Units | Irrigated | | | | | Dryland | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Corn | Sorghum | Wheat | Sm. Gr. I | Sm. Gr. II | Sorghum | Wheat | Sm. Gr. I | Sm. Gr. II | Native I | Native II |
| | | bu. | cwt. | bu. | AUM | AUM | cwt. | bu. | AUM | AUM | Aum | AUM |
| Irrigated: | | | | | | | | | | | | |
| Corn | bu. | 169 | 50.25 | 28.76 | .65 | 1.94 | 43.82 | 20.22 | .43 | 2.22 | | |
| Sorghum | cwt. | | 53 | 6.38 | .14 | .43 | 29.73 | 6.76 | .14 | .74 | | |
| Wheat | bu. | | | 57 | 1.28 | 3.85 | 3.74 | 26.62 | .57 | 2.93 | | |
| Sm. Gr. I | AUM | | | | .029 | .087 | .84 | .60 | .013 | .066 | | |
| Sm. Gr. II | AUM | | | | | .26 | .255 | 1.80 | .038 | .20 | | |
| Dryland: | | | | | | | | | | | | |
| Sorghum | cwt. | | | | | | 53 | 11.27 | .24 | 1.24 | .34 | 2.12 |
| Wheat | bu. | | | | | | | 57 | 1.21 | 6.27 | .06 | -.74 |
| Sm. Gr. I | AUM | | | | | | | | .026 | .105 | .021 | .076 |
| Sm. Gr. II | AUM | | | | | | | | | .69 | .013 | .395 |
| Native I | AUM | | | | | | | | | | .17 | .009 |
| Native II | AUM | | | | | | | | | | | .36 |

[1]Covariances are calculated by: $\sigma_{xy} = \rho_{xy} \cdot \sigma_x \cdot \sigma_y$ where $\rho_{xy}$ are correlation coefficients given in Table LXXIV.

TABLE LXXIV

SUMMARY OF CORRELATION COEFFICENTS FOR CROP AND PASTURE YIELDS

| Crop | Irrigated | | | | | Dryland | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corn | Sorg. | Wheat | Sm. Gr. I | Sm. Gr. II | Sorg. | Wheat | Sm. Gr. I | Sm. Gr. II | Native I | Native II |
| Irrigated: | | | | | | | | | | | |
| Corn | 1.0 | .531[a] | .293[a] | .293 | .293 | .463[a] | .206[a] | .206 | .206 | 0 | 0 |
| Sorg. | | 1.0 | .116[a] | .116 | .116 | .561[a] | .123[a] | .123 | .123 | 0 | 0 |
| Wheat | | | 1.0 | 1.0 | 1.0 | .068[a] | .467[a] | .467 | .467 | 0 | 0 |
| Sm. Gr. I | | | | 1.0 | 1.0 | .068 | .467 | .467 | .467 | 0 | 0 |
| Sm. Gr. II | | | | | 1.0 | .068 | .467 | .467 | .467 | 0 | 0 |
| Dryland: | | | | | | | | | | | |
| Sorg. | | | | | | 1.0 | .205[a] | .205 | .205 | .356[b,c] | .484[b,c] |
| Wheat | | | | | | | 1.0 | 1.0 | 1.0 | .061[b,c] | -.164[b,c] |
| Sm. Gr. I | | | | | | | | 1.0 | .79[d] | 1.0 | .79 |
| Sm. Gr. II | | | | | | | | | 1.0 | .12[b] | .79 |
| Native I | | | | | | | | | | 1.0 | .12 |
| Native II | | | | | | | | | | | 1.0 |

a
Compiled from results of synthesized data established by irrigated and dryland relationships: twenty replications for twenty years.

b
Pasture and Range Investigations, 1961 Annual Report, U.S. Southern Great Plains Field Station, Woodward, Oklahoma, Table 103a, p. 225.

c
Wallace G. Aanderud, et.al., "Income Variability of Alternative Plans, Selected Farm and Ranch Situations, Rolling Plains of Northwest Oklahoma", Oklahoma Experiment Station Bulletin 646, March, 1966, p. 37.

d
Charles E. Denman and James Arnold, "Seasonal Forage Production for Small Grain Species in Oklahoma," Oklahoma Experiment Station Bulletin 680, August, 1970, Table 27, p. 20.

VITA

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Doctor of Philosophy

Thesis: EVALUATING THE GROWTH POTENTIAL OR IRRIGATED FARMS WITH DIMINISHING WATER SUPPLIES: A MULTIPLE GOALS APPROACH TO DECISION-MAKING

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