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Optimum Wheat-Beef Farming Systems in North Central Oklahoma

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Optimum

Wheat-Beef Farming Systems in North Central Oklahoma*

By James S. Plaxico and Daniel Capstick**
Department of Agricultural Economics
Oklahoma State University

Determination of the most profitable long-term system of farming is one of the more important managerial problems facing farm managers. Problems of farm organization and management in north central Oklahoma have been intensified in recent years by the various allotment programs and by rapid technological development and economic changes. As a consequence of such rapid changes the question of optimum enterprise combinations requires periodical review.

The most profitable systems of wheat-beef farming for selected resource situations in north central Oklahoma are presented in this bulletin. It is recognized that the resource situations considered here are not entirely representative of any particular farming situation. However, the resource situations analyzed have been selected in such a manner as to approximate the typical resource combinations in the area studied.

The geographic area of interest in this analysis includes the rather homogeneous wheat farming area of north central Oklahoma. It includes all or parts of Alfalfa, Garfield, Grant, Kay, Woods, Kingfisher, Major and Noble counties (Figure 1). The soils in the area studied are of the Tabler and Kirkland series. Estimates indicate that these two soil series exhibit essentially the same relative yield characteristics for the crops grown in the area. Thus the inferences from the situations studied should apply rather directly to a large number of individual farm situations in north central Oklahoma.

Research Methods Used

The most profitable farming systems have been ascertained for the

*The research reported herein was carried out as a part of Southern Regional Project S-27, "An Economic Evaluation of Forage Production and Use on Beef and Dairy Farms." The cooperation and as istance of the cooperating states and agencies are acknowledged with appreciation.

**Al Barr, Graduate Assistant in Agricultural Economics, reviewed a preliminary version of this manuscript and made many important contributions.

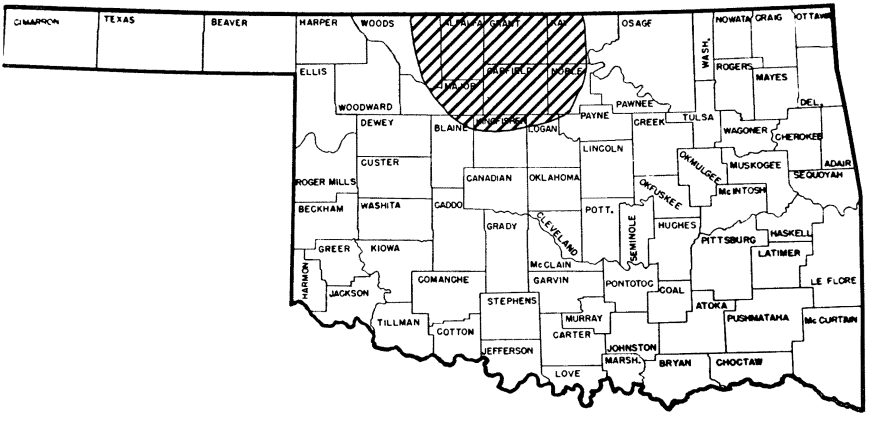

Figure 1. The general area of applicability of the results of this analysis.

various resource situations by the application of linear programming.[1] Information relating to typical farm resource situations is based on a survey of a sample of 82 producers in the area. Producers interviewed were selected on a probability sampling basis and the data enumerated relate to the calendar year 1955. The survey was made during late December, 1955 and early January, 1956.

Source of the Data

Yield expectations, production requirements and livestock production rates and practices were derived from farm interviews, experimental data, from records kept over a period of years by a group of farmers in Garfield county, and by interviews with scientists familiar with the area studied. The average of the 5-year period, 1951-55, was used to determine the relationship between prices received for individual products and for prices paid for individual production items. The level of product prices was adjusted so as to yield a relationship between prices received and prices paid equivalent to 80 percent of parity. The parity ratio during the years 1951-55 ranged from a high of 106 in 1951 to a low of 83 in 1955. On October 15, 1958 the ratio stood at 82. The prices used in the budgets are given in Appendix Table 1.

[1]Linear programming is a mathematical maximization procedure which assures maximum revenues for the resources available, given appropriate assumptions with regard to yields, rates of production, production requirements, prices, etc. For a discussion of linear programming methods, see Robert Dorfman, Paul A. Samuelson and Robert M. Solow, *Linear Programming in Economic Analysis,* McGraw-Hill Inc., New York, 1958.

Cropping Alternatives

The cropping alternatives considered in this analysis are wheat, barley, grain sorghum, alfalfa, and small grain pasture. Since oats and barley are competitive crops—that is, they require the same resources at essentially the same time—and analyses show barley to be more profitable than oats in the area, oats are ignored in this analysis.[2] In the preliminary stages, other crop alternatives were considered, but these were eliminated on the basis of budget comparisons. However, where for some reason, such as expected green bug hazard, oats are preferred to barley, such substitution may be made in the final results presented here.

Partial budgets showing the production requirements, cost and income expectations from the various crop enterprises considered are given in Appendix Tables 2-5. In all instances, the return figures presented are returns to operator and family labor, owned land, owned capital, risk and management. Production of alfalfa for sale was not considered, for purposes of this analysis, to be a suitable alternative because of the variability of alfalfa hay prices. Thus, alfalfa production is limited to the amounts required by the various livestock enterprises which are included in the farming system. This assumption seems to be consistent with the desires or personal preferences of the farmers interviewed.

The production practices used with respect to the various crops are those recommended by a team of production scientists familiar with the area. The inputs and costs associated with these practices are included in the budgets. It is recognized that yields of the various crops vary from farm to farm and between years on a given farm. However, the yields used are those which are considered to be normal or typical over a period of years for the typical farm units in the area.

Livestock Alternatives

Budgets of the livestock alternatives are presented in Appendix Tables 6-12. Three systems of cow and calf production were considered in this analysis. The first system (P_5) involves spring calving with the calves to be sold in the fall. The cows would utilize native pastures during the entire year. The second cow-calf system (P_6) involves fall calving with the calves to be sold during the spring and with the cows to utilize native range during the summer and winter pasture, provided

[2]Daniel C. Capstick, "Oats vs. Barley in North Central Oklahoma," *Oklahoma Current Farm Economics*, Vol. 30, No. 1, February, 1957.

by the wheat, barley and alfalfa, during the winter months. The third cow-calf system (P_7) involves fall calving with the calves to be sold in the spring and with the feed to be provided by native range, winter pasture provided by alfalfa, wheat and barley, and additional spring pasture to be provided by a mixture of small grains seeded and used exclusively for grazing. Hay would be fed during adverse weather and during periods of inadequate winter pasture under each of the three management systems. A reserve supply of hay would be accumulated during favorable years for use during adverse years.

Four buy-sell types of livestock operations were considered. The first of these (P_8) involves buying stocker steers in the fall and selling the following spring. The steers would utilize winter grazing from barley, wheat and alfalfa and spring grazing from small grain pasture. The second buy-sell operation (P_9) involves the fall purchase and spring selling of steers with the steers to utilize winter small grain pasture. These steers would be sold approximately March 10 directly off small grain pastures as compared to a May 31 selling date for the steers utilizing both winter and spring small grain grazing.

The third buy-sell operation (P_{10}) is a longer term operation involving buying steers in the spring to utilize native pasture during the summer. The following winter the cattle would graze on wheat, barley and alfalfa with the animals to be sold approximately March 10 directly off winter pasture. The fourth steer operation (P_{11}) is also a year-around operation with the steers to be bought approximately October 15 and to be sold a year later. Native range supplemented with cottonseed cake during the winter would constitute the feeding program. Hay would be fed during days of bad weather.

Summary of Enterprises

Input requirements and production rates and income and cost expectation for the various crop and livestock alternatives considered are presented in Table 1. These input requirements are in terms of resource requirements per acre of crops or per steer and per cow unit respectively. For example, one acre of wheat (P_1), requires one acre of cropland, one acre of wheat allotment, zero acres of range, zero tons of hay, and produces 0.7 Animal Unit Months[3] of winter grazing. The acre of wheat produces zero AUM's of spring pasture, requires $11.96

[3]An Animal Unit Month Grazing (A.U.M.) is a measure of grazing availability. It is the amount of grazing required by 1 animal unit for one month. An animal unit is 1 cow, 1 bull, 2 calves, 7 sheep, or 14 lambs.

in operating capital, and returns $24.44 for the one acre of land, one acre of wheat allotment, the labor required and the capital and management involved. In addition the acre of wheat produces 0.7 Animal Unit Months of grazing which is not credited in returns to the wheat enterprise. However, returns for such grazing are credited to the total farm business.

In the case of livestock, P_5 for example, each cow requires zero acres of cropland, zero acres of wheat allotment, 15.8 acres of rangeland, 0.1 ton of hay to be fed during bad weather, and produces a return of $35.95 to the rangeland, winter pasture, capital, and labor.

Table 2 presents a summary of the labor requirements assumed for the alternative crop and livestock enterprises. Preliminary analysis indicated that, for the resource situations to be studied, labor resources would not be expended in any month other than June. Consequently, for programming purposes, only June labor requirements are considered. For those interested in labor requirements for other months, Table 2 contains the information necessary to make such estimates. These estimates assume ownership of a self-propelled combine and other equipment necessary for harvesting small grains but assume custom harvesting of alfalfa hay.

Optimum Systems for the 320-Acre Unit

The primary sample survey data, as well as secondary sources such as the agricultural census, reveal that the 320-acre or one-half section unit is a typical size unit in the area studied. The survey suggests a wheat allotment of 125 acres, 204 acres of cropland, 102 acres of rangeland, and 1.0 man equivalent of labor on the typical 320-acre unit. No attempt was made to measure the availability of operating capital on the typical unit. Consequently, the cropland, wheat allotment, range land and labor were taken as given or fixed resources, and linear programming was used to determine the optimum enterprise organization from the alternatives considered.

It is assumed that 250 hours of family labor will be available each month. However, since June is the only month of critical labor requirements, restrictions for this month only were included in the programming analysis. Farmers in the area typically hire additional labor during June. This alternative was included in the programming model. Thus, when the 250 hours of family labor was expended during June, the programming model allowed the hiring of additional labor at the rate of $1 per hour so long as such labor could be used profitably.

Owner Operated, Unlimited Capital

In the initial programming, full ownership of a 320-acre unit with unlimited operating capital was assumed. Table 3 presents the optimum pattern of enterprise combinations for the 320-acre, owner-operated farm assuming unlimited capital. When each of the crop and livestock enterprises is considered as an admissable alternative, the profit maximizing enterprise combination is 125 acres of wheat, 70 acres of barley, 9 acres of alfalfa and 64 steers. This enterprise organization would require hiring 103 hours of June labor and would result in an expected return to operator and family labor, owned capital, owned land, risk and management of $6,391.

The crop organization which was determined to be optimum is essentially identical to that reported by the typical half section farmer surveyed. However, the indicated optimum livestock organization is quite different from the present typical in that the farmers surveyed typically kept 19 cows on a fall calving program. The maintenance of this size cow herd on the typical 320-acre unit requires feeding a substantial amount of hay during winter months. Consequently, the typical farmer reported 16 acres of alfalfa, with a corresponding reduction in either barley or oat acres. Farmers reporting were about equally divided between oats and barley as feed crops.

Since many of the farmers surveyed reported an aversion to the buy-sell type of livestock operation due to the expected price risk, the lack of knowledge required to buy and sell steers, and other reasons of personal preference, the buy-sell operations were, for purposes of further analyses, excluded as alternative enterprises. Linear programming analysis reveals that, when steers are excluded as an alternative, the cropping system remains almost identical to that indicated as optimum where no restriction was placed on alternatives. However, the 64 steers are replaced with a 13-cow herd on a fall calving program, selling calves in the spring, utilizing winter pasture and range. This enterprise organization would require hiring approximately 99 hours of June labor and would return $4,931 to operator and family labor, owned capital, owned land, risk and management. This program is almost identical to the present typical system reported by farmers with the exception that the typical program involves a larger number of cows at the expense of more acres of land devoted to hay production to support the cow herd. This analysis reveals that the practice of heavy winter feeding of alfalfa to the cow herd in order to maintain the typical sized herd is not profitable under the assumptions stated.

The preceding analysis indicates that returns to the system involving buying and selling steers is much more profitable than the cow-calf type of operation. Yet, farmers in the area apparently prefer a cow-calf plan. Thus, a third pattern of enterprise organization was programmed. This organization involves utilization of the native range by a cow-calf herd and the utilization of the winter pasture by steers. Some authorities have suggested that this type of operation might reduce the risk of buying feed to maintain a breeding herd during drought years and might also tend to reduce the price risk inherent in a buy-sell type of operation.

The estimated return to operator and family labor, owned capital, owned land, risk and management of the combination cow-calf buy-sell system is $6,021 and the livestock would consist of six cows to utilize the native range and 74 steers to utilize winter grazing. It is, of course, questionable whether the 6-cow unit would be an economic one, due to the relatively high cost of maintaining a herd bull and other facilities for this size cow herd. Nevertheless, if feasible, the system apparently provides almost the same return to the various factors as the buy-sell system.

To the extent that the assumptions inherent in the budgets used here are correct, it would appear profitable for the typical 320-acre farmer in north central Oklahoma to change from a cow-calf livestock program to the buy-sell program. This change would appear to result in an increase in income of approximately $1,500. In addition, such a livestock system would be more flexible with regard to feed requirements than the cow-calf program because livestock numbers could be readily adjusted from year to year to the feed base available for that particular year. Thus, during a year unfavorable for the production of wheat pasture, fewer steers would be purchased whereas if wheat pasture were particularly good, numbers purchased could be increased. On the other hand, a cow-calf plan does not allow this degree of flexibility with the consequence that during dry years hay must be fed in lieu of small grain pasture. Obviously during such a drought year local hay prices are likely to be quite high.

When the value of the brood cows and the purchase value of the steers are included in the operating capital estimate, the operating capital requirement for the buy-sell enterprise combination is $8,980, compared to $5,634 for the cow-calf system and $11,576 for the combination cow-calf buy-sell program. It should be noted, however, that the investment in steers would be committed for only six months or less, whereas the investment in the cows would be on a 12-month basis.

Owner Operated, Limited Capital

Limited capital is generally thought to be important in management decisions on many farms, thus optimum enterprise combinations were computed at all possible levels of capital availability. The capital optimum results for the 320-acre, owner operated farm are presented in Figure 2. This figure gives the number of units in the various enterprises which would be most profitable at various levels of capital availability along with the expected returns to operator and family labor, risk and management and capital from the various investment levels.

With very limited capital, farm enterprises would be limited to wheat. In fact, wheat would be the only enterprise considered on the 320 acre unit for operating capital amounts up to $1,495. At this point the allotted 125 acres of wheat would be produced at a return per acre of $24.44 for a total return to land, family labor, and capital of $3,055. At this point barley would be introduced and barley and wheat would comprise the total farm organization for variable capital inputs up to $1,790. June labor would become restricting beyond this point and with $2,652 of capital available, steers and alfalfa would be introduced into the program.

Given the information in Figure 2, one can determine the most profitable combination of farm enterprises, among the alternatives considered, for the 320-acre owner-operated farm for any level of operating capital availability. For example, if $4,000 of operating capital were available, the farm organization would consist of 125 acres of wheat, barley, hiring June labor, steers and alfalfa. Similar information could be derived from the chart for other levels of capital availability.

Figure 3 presents data relating to optimum enterprise organizations for various levels of operating capital availability where the buy-sell type of livestock enterprise is excluded from consideration. The data in this chart may be interpreted in exactly the same fashion as that in Figure 2. In a similar manner, Figure 4 provides the same information for the 320-acre owner-operated farm with a combination cow-calf buy-sell operation.

Part Owner, Unlimited Capital

Approximately 50 percent of the 320-acre farms surveyed were part-owner operations with 50 percent of the land being owned and 50 percent rented (Table 4). Optimum farm organizations were program-

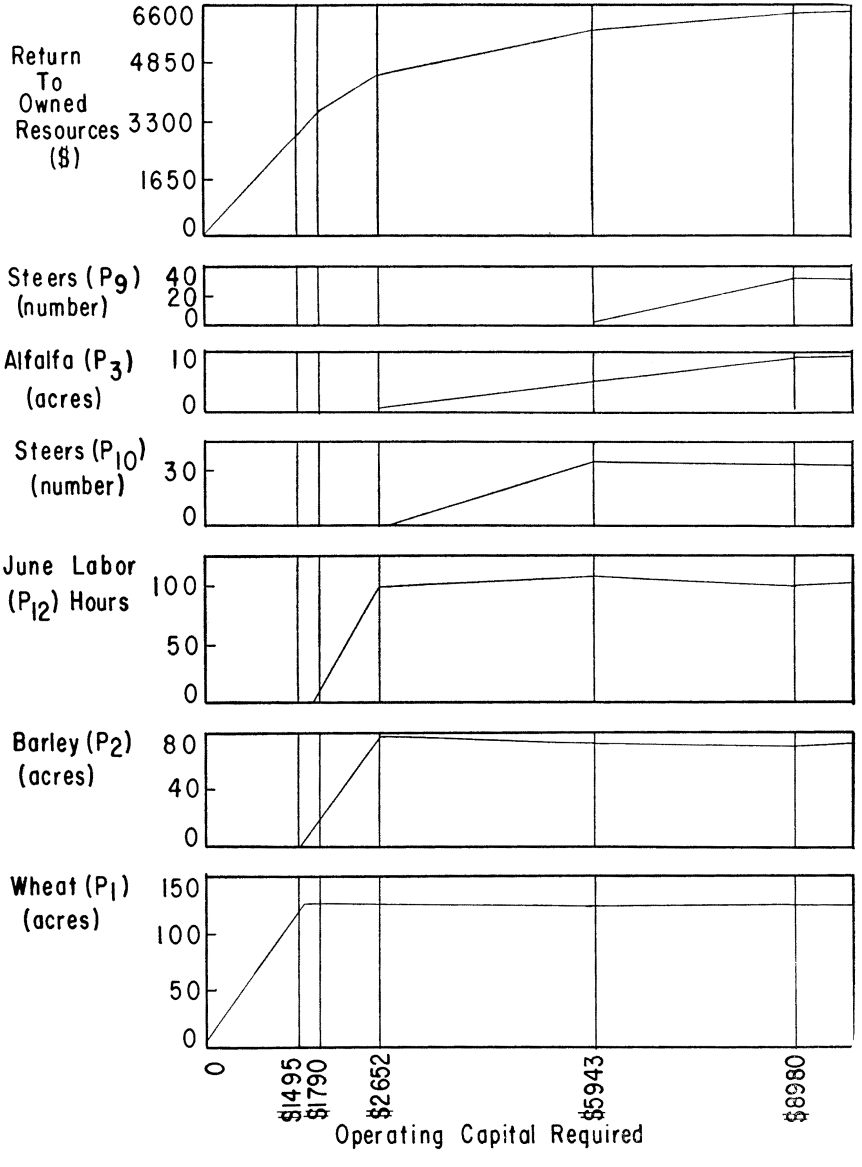

Figure 2. Farm organization for 320-acre owner-operated farms with wheat allotment restriction for all levels of operating capital input.

med for the part-owner operations. The results are very similar to that of the owner-operated unit in that the buy-sell type of livestock operation appears to be the most profitable under the assumptions. How-

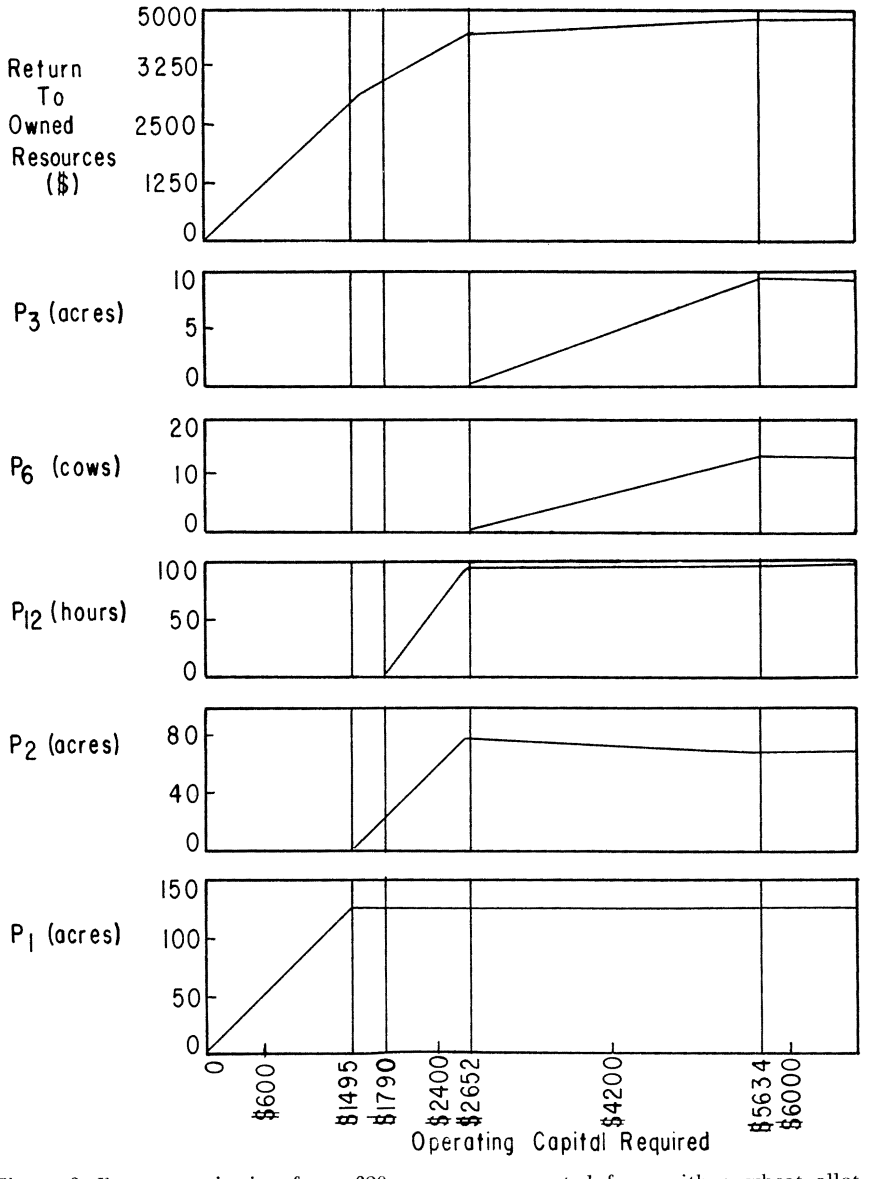

Figure 3. Farm organization for a 320-acre owner-operated farm with a wheat allotment and no buy-sell as enterprise restrictions for all levels of operating capital input.

ever, the operator income differential between systems is less in the case of the part-owner than in the case of the full-owner type of operation. In the case of the part-owner operation, the returns to owned

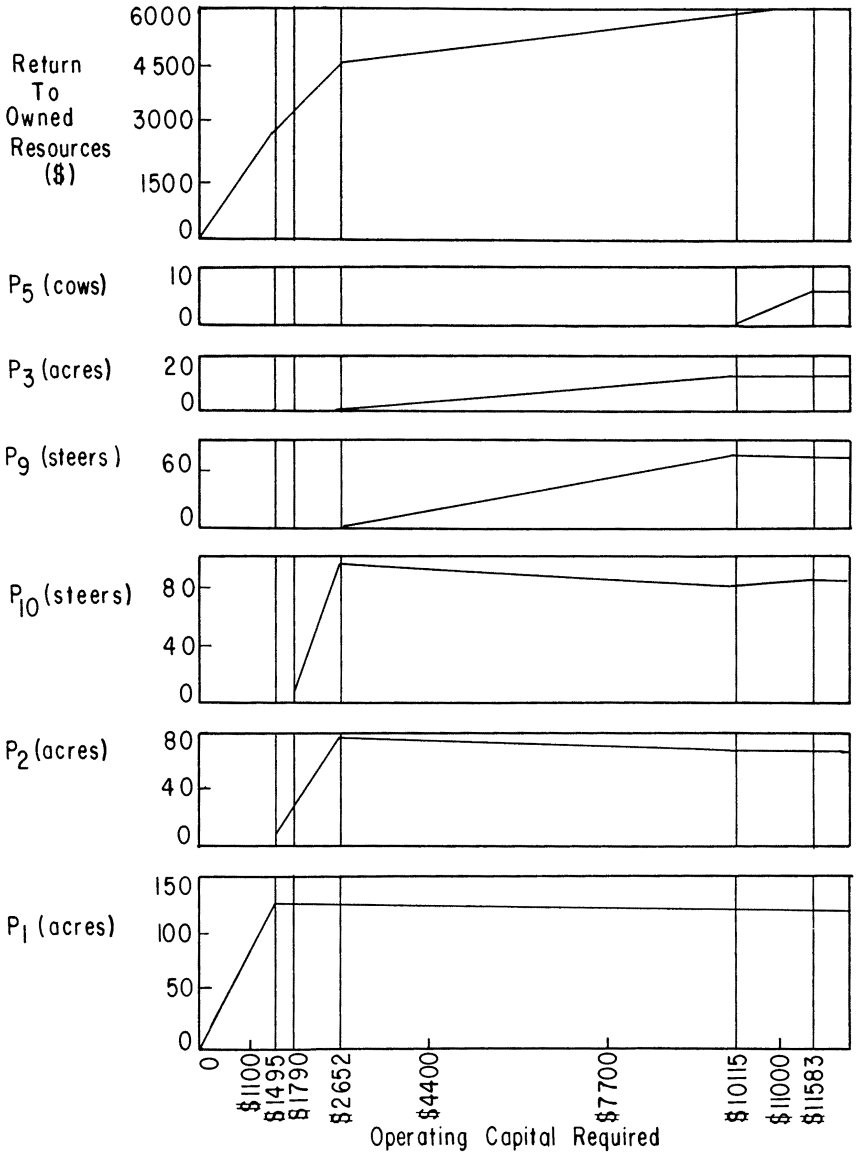

Figure 4. Capital optimum organizations for a 320-acre owner-operated farm with a wheat allotment with a cow-calf operation supplemented with a buy-sell enterprise.

resources were estimated to be $4,833 for the buy-sell type of program, $3,751 for the cow-calf program, and $4,486 for the combination buy-sell and cow-calf programs. The optimum enterprise combination was

essentially identical for the part-owner and for the full-owner situations.

Part Owner, Limited Capital

Figures 5, 6 and 7 present the optimum plans for various levels of operating capital availability on the part-owner farm situations. These data reveal that wheat makes the greatest returns per dollar of operating capital invested and that owned land is planted first followed by rented land. These charts are subject to the same interpretation as Figures 2, 3 and 4.

Rented Farm

The optimum combination for 320-acre rented farms is similar to that of the owner-operated unit with the exception that less livestock would be produced. (Table 5). The returns to operator and family owned labor, owned capital, owned land, risk, and management on the 320-acre rented farm with wheat allotment restrictions only are estimated to be $3,241, compared to $2,297 for the cow-calf unit and $2,895 for the combination cow-calf buy-sell unit. (Figure 10) The optimum organization for the 320-acre rented farm at different levels of operating capital availability are presented in Figures 7, 8, and 9 for the three alternative restrictions discussed earlier.

Farm Enlargement Alternatives

The machinery, family labor, and certain other resources on the typical 320-acre unit are sufficient to operate a considerably larger unit. Thus estimates of the increase in returns to family labor, capital, and management are presented for the different typical 320-acre units under the three sets of enterprise combinations (Table 6). In the case of the 320-acre owned unit, an additional 160 acres of owned land would increase returns to operator and family labor, owned land, owned capital, risk, and management by an estimated $3,048, if the buy-sell operation is acceptable to the operator. Basically the $3,048 would be returns to the additional capital invested in the additional quarter section of land and in cattle. In a similar fashion, if livestock enterprises are restricted to the cow-calf type of production, returns would be $2,331, compared to $2,884 for the combination cow-calf buy-sell operation.

The addition of 160 acres of rented land to the 320-acre owned unit would result in an increase of $1,474 in returns to family labor, and capital in the buy-sell type of livestock enterprise. Similar estimates are given for the 320-acre rented and for the part-owned operation. Each of these estimates assume unlimited operating capital.

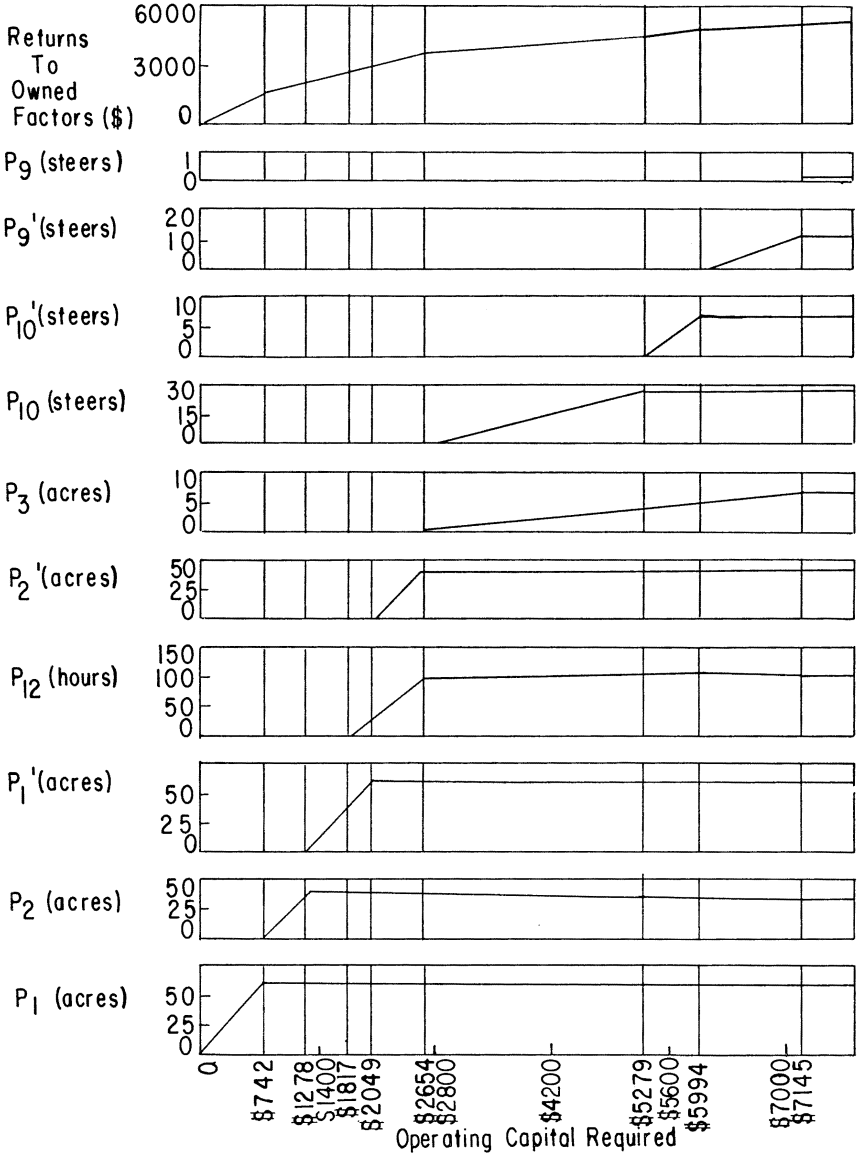

Figure 5. Farm organization for a 320-acre one-half owned and one-half rented farm with a wheat allotment restriction for all levels of operating capital.

Effect of Unfavorable Crop Yields

In the optimum programs derived so far, average crop yields and

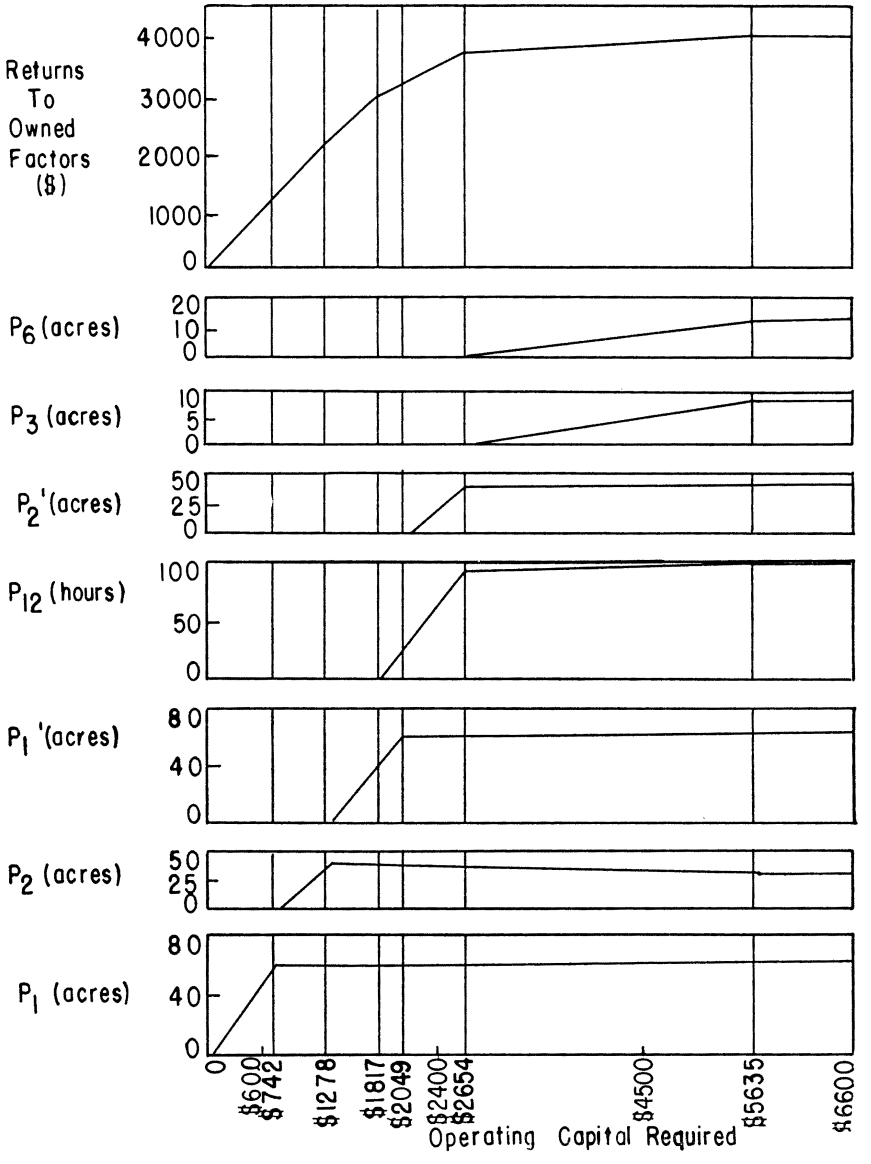

Figure 6. Farm organization for a 320-acre one-half owned and one-half rented farm with a buy-sell restriction for all levels of operating capital.

rates of livestock production have been assumed. It is recognized, however, that due to weather variations and other factors, crop yields are variable over years. Thus the effect on income of an assumed un-

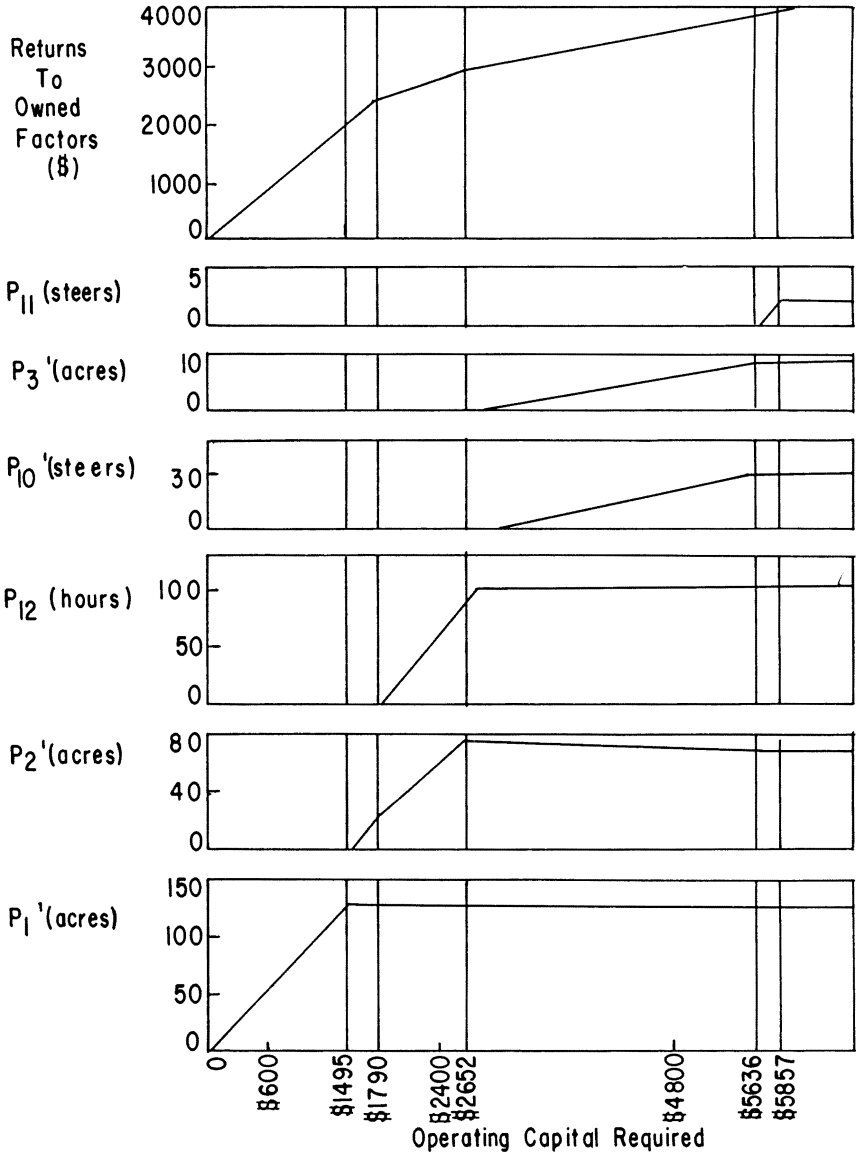

Figure 7. Farm organization for 320-acre rented farms with a wheat allotment restriction for all levels of operating capital input.

favorable crop year was evaluated. For this purpose it is assumed that the yields of all grain crops are one standard deviation below the mean.[4]

[4] The standard deviation is a measure of variability. Yields less than one standard deviation below the mean would not be expected to occur more frequently than one year out of 6.

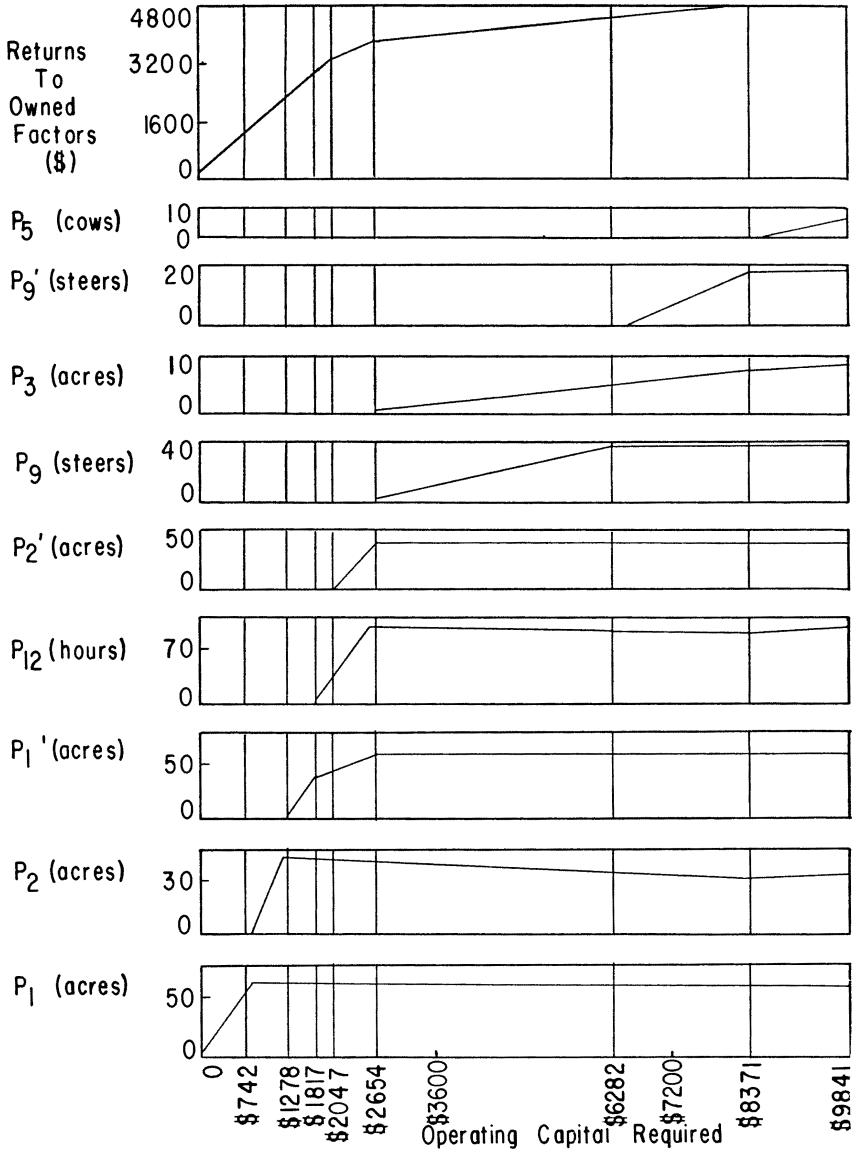

Figure 8. Capital optimum organization for a 320-acre ½ owned and ½ rented farm with a cow-calf operation supplemented with a buy-sell enterprise.

Yields of the different crops are not perfectly correlated. Consequently, it is unlikely that all yields would be unfavorable in a single year. Thus the results presented may be typical of exceptionally adverse crop con-

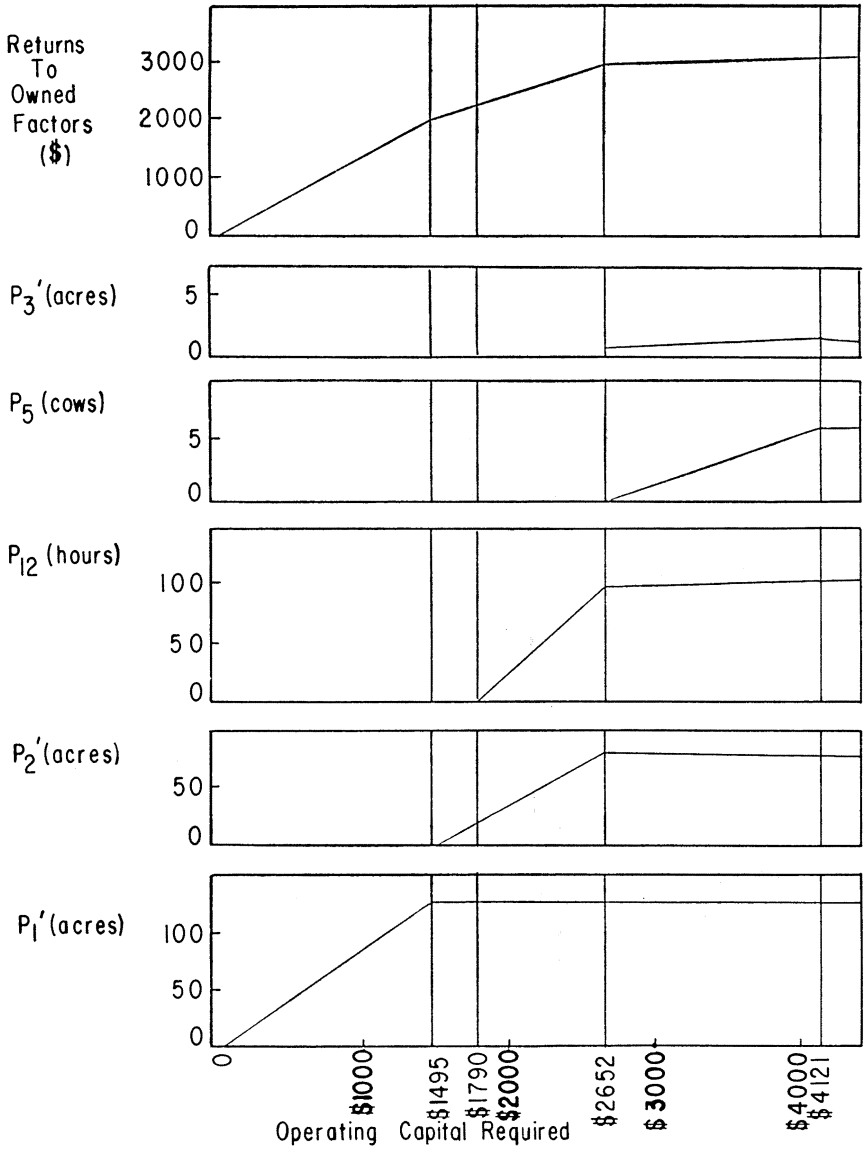

Figure 9. Farm organization for a 320-acre rented farm with a buy-sell restriction for all levels of operating capital.

ditions. Even if bad weather were to reduce alfalfa yields one standard deviation below the mean, additional costs are not considered for the livestock enterprises. This is because hay reserve for bad years has

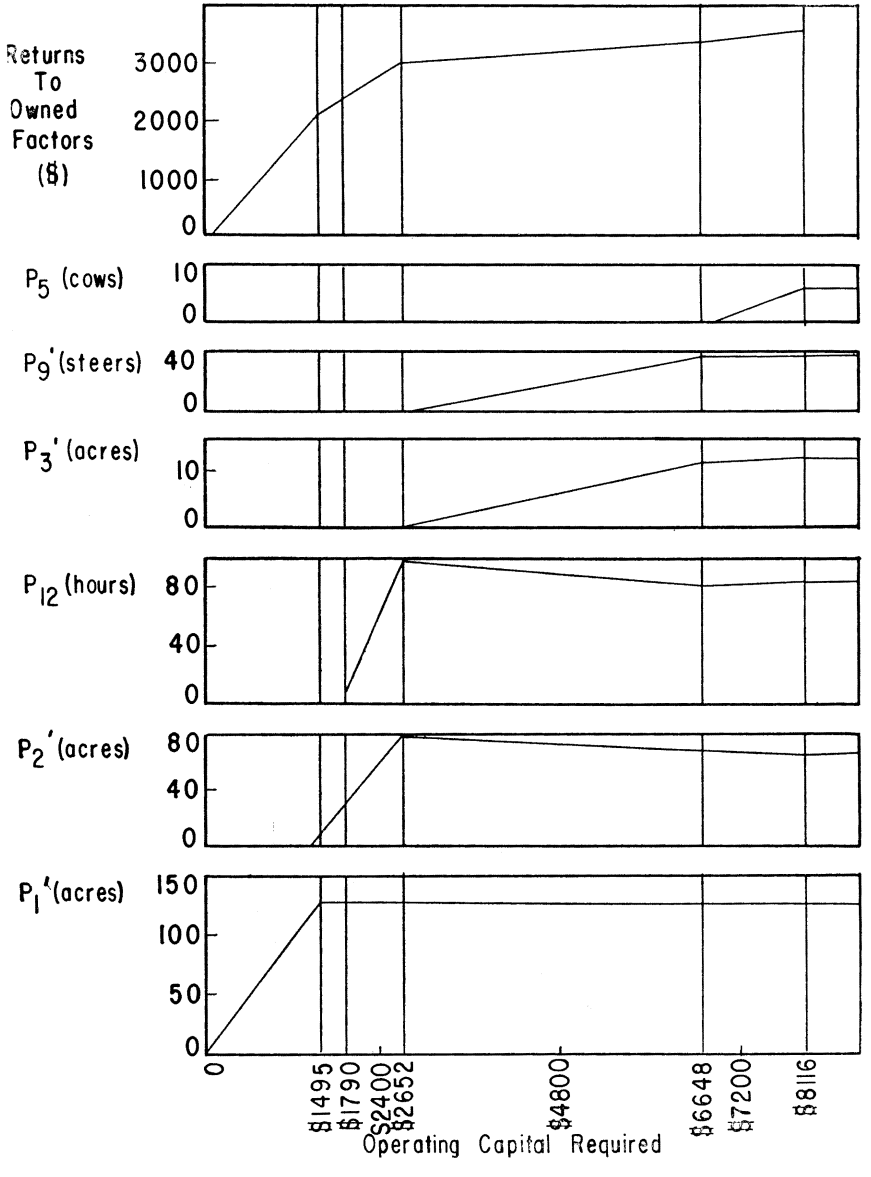

Figure 10. Farm organization for 320-acre farms with a cow-calf operation supplemented with a buy-sell enterprise for all levels of operating capital.

been considered in the normalized livestock budgets. Consequently, this reserve would be fed during this particular year.

Table 7 presents estimated returns under the three tenure conditions for the 320-acre farm unit for the year of unfavorable crop yields with the buy-sell livestock system. These computations are based on the optimum programs which were presented earlier using the same prices and the same costs, but simply taking the lower crop yields in computing returns to the fixed factors. These data show that returns to the owned 320-acre unit would decrease from $6,391 to $3,576 or a reduction due to unfavorable yields of $2,815.

Returns from the part-owner unit would be reduced by $2,434 and on those on the rented unit by $2,005. Thus, in terms of absolute magnitudes of change, the income of the owned unit would be most adversely affected. However, in terms of percentage income changes, the rented unit would be affected most.

Income Variabilities in Cattle Systems

Previous analysis has shown that the average income expectation from the buy-sell type of livestock operation is greater than the expected income from a beef cow-calf type system. However, the farmer survey revealed that a number of producers were aware of the greater average income expectations from a buy-sell type of program. Yet these producers were reluctant to undertake such a program due to an expected high year-to-year variability associated with the buy-sell system. Much of this variability is attributable to the price risk inherent in a buy-sell type of operation.

In order to analyze the nature of the year-to-year variability associated with the two types of livestock systems that may be attributed to price, the income expectations from the two systems over the period 1941-57 were reconstructed. This was accomplished by applying the actual prices from the Oklahoma City market for the different grades and classes of cattle sold from the different systems to the sales from each system. A summary of these results are presented in Appendix Table 15. This analysis shows that, with the exception of 1953, for each of the years 1941-57 the income would have been greater from the buy-sell type of program than that from the cow-calf program. The estimated difference in favor of the buy-sell type of program ranged from a loss of $583 in 1953 to $4,683 income in 1951. The average difference in favor of the buy-sell type operation for the period was $1,585. This compares with a difference in the normal budgets of $1,460. Thus, it would appear that the budget estimates are conservative in estimating the advantage in income expectation which might

accrue to the buy-sell as compared to the cow-calf type of operation.

Sources of risk other than prices are important in selecting a cattle system. For example, wheat pasture grazing is a highly variable and uncertain crop. Consequently, in any type of cattle system one would be forced to seek some way of providing feed or otherwise handling cattle in years that small grain grazing is not available. Basically the cow-calf type of operation is a rather inflexible system, since it is extremely difficult to adjust cattle numbers to feed supplies. On the other hand, the buy-sell type of operation is highly flexible, and it is easy to adjust cattle numbers to the actual or prospective feed supplies. Even though a person may buy cattle for prospective small grain grazing which fails to develop, the cattle will find a ready market at any time during the season. On the other hand, one is much more reluctant to dispose of breeding stock as a consequence of temporary variations in feed supplies.

The income expectation from the cow-calf type system, as compared to the buy-sell type of operation, is striking. However, when one compares the expected beef production per year from the two systems the income expectations appear to be reasonable. Expected yearly beef production from the cow system, including cull animals, is 5,603 pounds, compared to 16,106 pounds from the steer system. The difference is primarily attributed to the high feed requirements to maintain the breeding stock in the cow-calf system.

Effects of Price Levels on Cattle Systems

The preceding optimum enterprise combinations and earning expectations are based on expected long term "normal" or projected prices for livestock. However, since livestock prices tend to be highly variable, due to cyclical movements in numbers, weather and feed conditions, variations in consumer demand, etc., the impact of such variations in price on optimum systems and income expectations is of considerable importance.

Previous research[5] has shown that the prices of different classes and grades of livestock are highly correlated one with the other. That is, prices of the different classes and grades tend to move up and down together. For purpose of analysis it is assumed that prices of the different classes and grades are perfectly correlated. That is, it is assumed

[5] James S. Plaxico and Jackson L. James, *Beef Cattle Prices,* Bulletin B-486, Oklahoma Agricultural Experiment Station, February, 1957.

that as the price of one class or grade changes, the price of each other class and grade also change by a like percentage. Obviously, this is not strictly true. During periods of increasing livestock numbers, the prices for breeder stock and feeder-stocker animals ordinarily increase at a faster rate than slaughter animals. In a like manner, during periods of declining livestock prices the prices of breeder stock and feeder stocker animals ordinarily decline more than the slaughter classes and grades. Nevertheless, the relation is sufficiently close to make this a meaningful analysis.

Table 8 shows the effect on enterprise organization of 25 and 50 percent increases and decreases respectively in the long-term beef price projections on the optimum system. This analysis shows that for each of the levels of prices assumed, the optimum enterprise combination would include the 125 acres of wheat. In like manner, the most profitable organization would be precisely the same for the range of prices from the long run projected level downward to the -50 percent of the projected price. However, due to the postulated price changes the expected returns to the various factors would decline by $710, as compared to the long run normal for the 25 percent reduction in price and by $1,421 for the 50 percent decline from the long run expectations. The basic reason that a decline in prices from the long run projection does not change the optimum enterprise organization is because the cattle enterprise is essentially a supplemental one. That is, given unlimited capital, the cattle utilize the labor, feed and other resources which otherwise would not be utilized.

Given a price level for beef cattle 25 percent above the long run projection, other things remaining the same, the enterprise organization would change. Under this situation, the wheat acreage would remain the same, barley acreage would decline, alfalfa would increase, and 35 acres of small grain pasture would be introduced into the organization. At the same time, 51 steers utilizing winter and spring grazing would be introduced to utilize the small grain grazing. Beef production would increase to almost 25,000 pounds and expected return to operator and family labor, owned capital, owned land, risk, and management would increase to $7,344. In like manner, an increase in the price level of cattle 50 percent above the long run projection would result in 60 acres of small grain pasture, with 88 steers to utilize the winter and spring grazing. Beef production would increase to 27,152 pounds and income expectations would be $8,554.

Of the total change in income of $953, which would be expected to accrue to the 25 percent increase in prices, $715 would be a conse-

quence of price changes alone. If the manager maintained the same system that would be optimum under the long-term price projections, the income would increase by $715 if livestock prices increased by 25 percent. Thus $238 would accrue to the manager as a consequence of changing his cattle system to adjust to the higher price level. With a 50 percent increase, $1,430 of the $2,163 total increase would be due to the price change alone, while $733 would be the reward for management and the additional resources involved in changing the system as compared to the long-run normal system.

A similar analysis was made for the system assuming a restriction which prohibited the inclusion of the buy-sell type of operation in the farming system. This analysis showed that given 25 and 50 percent increases and decreases respectively in the price of cattle the optimum system would remain precisely the same as the long-run normal. Thus it would appear that persons with cow-calf herds would not adjust numbers of the production system to changes in livestock price levels.

Income Expectation Summary, 320-Acre Unit

Table 9 presents a summary of the income expectations of the three tenure situations and the three restrictions on alternatives for the 320-acre unit. These data show that the buy-sell program, which is the optimum livestock system, requires more capital than the cow-calf system but less than required under the combination buy-sell cow-calf program. Nevertheless, the income expectations are greatest for the buy-sell program. In a sense, the operating capital requirement for the buy-sell program and the combination program may be misleading, because capital requirements are not put on an annual basis. Rather, total capital outlay during the year is counted. Thus cattle which are on hand for a three-month period, under the assumption made here, require the same capital outlay as if they were kept for a 12-month period.

Alternative Systems for 640 and 960-Acre Units

In addition to the 320-acre typical unit two larger typical units were identified on the basis of the census and the sample survey. These are the 640-acre and the 960-acre units. The typical 640-acre unit consists of 390 acres of cropland, a 246-acre wheat allotment, and 226 acres of range land, with a full time man equivalent labor supply. In a similar

fashion, the 960-acre unit consists of 432 acres of cropland, a 280-acre wheat allotment, 488 acres of range land, and a two man equivalent labor supply. Thus it can be seen that the 640-acre unit is essentially similar to the 320-acre unit in that the cropland-range land ratio is very similar. On the other hand, the 960-acre unit has little more cropland than the 640-acre unit but has much more range land and the labor supply is greater.

In Table 10 the optimum enterprise combination for the 640-acre owner-operated farm is presented for alternative restrictions on enterprises. Again the buy-sell operation emerges as the most profitable operation with the combination buy-sell cow-calf program being next most profitable. The expected income difference between the buy-sell and the cow-calf operation on the 640-acre unit is approximately $3,000.

In Table 11 the optimum enterprise combination for the 960-acre unit is presented. Here again, the buy-sell type of operation is shown to be the most profitable system. However, the nature of the buy-sell operation is somewhat different from that for the 320-acre and the 640-acre unit. For the 320-acre unit, the steer operations are about equally divided, as to numbers, between the fall buy and spring sell following wheat pasture and the spring buy-spring sell operations. For the 640-acre unit about twice as many steers are handled on the year-round spring buy-spring sell system than on the fall buy-spring sell operation. On the other hand, for the 960-acre unit, 116 steers would be bought in the spring to be sold the following spring while 15 steers would be purchased in the fall for sale the following fall. Thus on the 960-acre unit, greater reliance is placed on the native range than in the case of the previous two units because the ratio of range to cropland is much greater on the 960-acre unit.

The results of a further analysis of the 640- and 960-acre situations, including alternative tenure and capital availability assumptions, are not presented here. However, this analysis revealed a pattern very similar to that exhibited in the case of the 320-acre situation.

Summary and Conclusions

A linear programming analysis indicates that the present typical pattern of crop organization in the area studied is essentially optimum. However, it appears that on many units income could be increased by better adjusting the livestock system to the feed base available. This analysis suggests that for the typical unit, a buy-sell type of operation

would be more profitable than the cow-calf type plan. Cow-calf systems are typical in the area.

On the basis of the assumptions made for purposes of this study it is more profitable to harvest small grain as a cash crop than to utilize the crop entirely for grazing. However, it is shown that at higher livestock prices it is slightly more profitable to "graze out" grains other than wheat.

Analysis indicates that the optimum livestock production system on the typical farm would remain the same despite large livestock price variations. In the cow-calf system, it would not be profitable to adjust the system even though prices were doubled. In the buy-sell operation, profits could be increased by adjusting production to the price situation, but the expected gain would be quite small.

Obviously, livestock enterprises other than beef are relevant on north central Oklahoma farms. This report is restricted to beef cattle because this is the class of livestock most common in the area. A subsequent report will consider sheep alternatives.

Farm planning and organization must be individualized because different farmers control different sets of resources, and the goals of farm families differ. Thus farmers in the area should consider the results presented here within the context of their own resource situations and family goals.

The research presented here deals primarily with the organizational aspects of farm management. Farmers who are considering changing their system of livestock production also must consider the operational details involved in the change. For example, careful buying, systematic health measures, and the provision of reserve hay supplies are essential to success in carrying out a livestock buy-sell type operation.

Table 1.—Summary of Input Requirements, Production Rates, and Income or Cost Expectations for the Crop and Livestock Alternatives Considered*

Resource	Unit	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}
Cropland	acre	1.0	1.0	1.0	1.0	0	0	0	0	0	0	0
Wheat allotment	acre	1.0	0	0	0	0	0	0	0	0	0	0
Range	acre	0	0	0	0	15.8	7.9	6.6	0	0	3.0	9.0
Winter pasture	AUM	-.7	-1.3	-.2	-.8	.1	1.4	1.0	.4	.3	.3	.2
Spring pasture	AUM	0	0	0	2.6	0	5.3	5.3	2.4	2.4	3.2	0
Hay	ton	0	0	-2.0	0	0	0	4.0	1.8	0	0	0
Operating capital	$	11.96	13.42	21.70	14.29	242.31	223.47	223.47	99.85	99.85	95.65	100.98
Return per unit	$	24.44	19.13	-21.70	-14.29	35.95	63.96	67.50	49.13	23.99	46.35	29.74

Process	Unit	Enterprise
P_1	Acre	Wheat
P_2	Acre	Barley
P_3	Acre	Alfalfa hay for feed only
P_4	Acre	Small grain pasture for grazing only
P_5	Cow	Cow-calf (spring born-fall sold calves) utilizing range
P_6	Cow	Cow-calf (fall born-spring sold calves) winter pasture and range
P_7	Cow	Cow-calf (fall born-spring sold calves) winter and spring pasture and range
P_8	Animal	Buy-sell (fall buy-spring sell) winter and spring small grain pasture
P_9	Animal	Buy-sell (fall buy-spring sell) winter small grain pasture
P_{10}	Animal	Buy-sell (spring buy-spring sell following year) native range and winter pasture
P_{11}	Animal	Buy-sell (fall buy-fall sell following year) native range

*One acre is the unit for all crop enterprises and one cow and one steer, respectively, is the unit for the livestock enterprises. The return per unit is the return to owned land, family and labor, operating loaned capital, risk and management and other resources which are not charged. The return for alfalfa and small grain pasture is negative because the crops are assumed to have value only when they are fed to livestock. Thus these values are reflected in the livestock budgets in that feed crops are not charged in the livestock budgets.

Table 2.—Estimated Monthly and Total Labor Requirements Per Enterprise Unit for Alternative Crop and Livestock Enterprises

Enterprise	Unit	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Wheat (P_1)	acre	—	.4	—	—	—	1.7	.2	.2	.6	—	—	—	3.1
Barley (P_2)	acre	—	.4	—	—	—	1.7	.2	.2	.6	—	—	—	3.1
Grain sorghum	acre	—	.8	—	.2	.2	.4	—	—	1.0	—	—	—	2.6
Alfalfa hay (P_3)	acre	—	—	—	.5	3.3	.2	3.4	.1	3.6	—	—	—	11.1
Small grain pasture (P_4)	acre	—	.4	—	—	—	.8	.2	.2	.6	—	—	—	2.2
Cow-calf—spring-range (P_5)	cow	5.7	5.2	3.9	1.4	1.2	1.2	1.2	1.2	1.4	2.1	5.0	5.5	35.0
Cow-calf—fall-range-winter pasture (P_6)	cow	5.7	5.2	3.9	1.4	1.2	1.2	1.2	1.2	1.4	2.1	5.0	5.5	35.0
Cow-calf—fall-range winter and spring pasture (P_7)	cow	5.7	5.2	3.9	1.4	1.2	1.2	1.2	1.2	1.4	2.1	5.0	5.5	35.0
Buy-sell steers (fall-spring) (P_8)	steer	1.7	1.0	1.0	.6	.6	—	—	—	—	.8	1.0	1.7	8.4
Buy-sell steers (fall-spring) (P_9)	steer	1.7	1.0	1.0	—	—	—	—	—	—	.8	1.0	1.7	7.2
Buy-sell steers (spring-spring) (P_{10})	steer	1.7	1.0	1.0	.6	.6	.6	.6	.6	.6	.8	1.0	1.7	10.8
Buy-sell steers (fall-fall) (P_{11})	steer	1.7	1.0	1.0	.6	.6	.6	.6	.6	.6	.8	1.0	1.7	10.8

Table 3.—Optimum Enterprise Combinations, 320-Acre Owner-Operated Farm, with Unlimited Operating Capital, With Selected Restriction on Alternatives

Enterprise	Unit	Restriction on Alternatives		
		Wheat Allotment Only	Without Buy-Sell	Cow-Calf and Buy-Sell
Wheat (P_1)	acre	125	125	125
Barley (P_2)	acre	70	70	68
Alfalfa (P_3)	acre	9	9	11
Small grain pasture (P_4)	acre	—	—	—
Cow-calf (P_5)	cow	—	—	6
Cow-calf (P_6)	cow	—	13	—
Cow-calf (P_7)	cow	—	—	—
Steer (P_8)	steer	—	—	—
Steer (P_9)	steer	30	—	74
Steer (P_{10})	steer	34	—	—
Steer (P_{11})	steer	—	—	—
June labor (P_{12})	hour	103	99	87
Return to operator and family labor, owned land, owned capital, risk and management*	$	6,391	4,931	6,021
Operating capital required	$	8,980	5,634	11,576

*To derive returns to operator and family labor, risk and management, it would be necessary to deduct depreciation, taxes, and interest from this figure.

Table 4.—Optimum Enterprise Combinations, 320-acre Part Owned (½ Owned and ½ Rented) Farm, with Unlimited Operating Capital, with Selected Restrictions on Alternatives*

Activity	Unit	Restrictions on Alternatives		
		Wheat Allotment	Wheat Allotment Without Buy-Sell	Wheat Allotment with Cow-Calf and Buy-Sell
Wheat (P_1)	acre	62	62	62
Wheat (P_1')	acre	62	62	62
Barley (P_2)	acre	33	31	31
Barley (P_2')	acre	40	40	40
Alfalfa (P_3)	acre	7	9	9
Cow-calf (P_5)	cow	—	—	6
Cow-calf (P_6)	cow	—	13	—
Steer (P_9)	steer	—	—	36
Steer (P_9')	steer	11	—	20
Steer (P_{10})	steer	27	—	—
Steer (P_{10}')	steer	7	—	—
Hired labor	hour	107	99	92
Returns to operator and family labor, owned land, owned capital, risk and management**	$	4,833	3,751	4,486
Operating capital required	$	7,072	5,635	9,769

*Crop enterprises on rented land are denoted by primes. For example, activity P_1 is wheat on rented land.

**To derive returns to operator family labor and management it would be necessary to deduct depreciation, taxes, and interest from this figure.

Table 5.—Optimum Enterprise Organization, 320-acre Rented Farm, for Selected Restriction on Alternatives

Activity	Unit	Restriction on Alternatives		
		Wheat Allotment	Wheat Allotment Without Buy-Sell*	Wheat Allotment With Cow-Calf and Buy-Sell
Wheat (P_1')	acre	125	125	125
Barley (P_2')	acre	70	78	67
Alfalfa (P_3')	acre	9	1	12
Cow-calf (P_5')	cow	—	6	6
Steer (P_9')	steer	—	—	38
Steer (P_{10}')	steer	29	—	—
Steer (P_{11}')	steer	2	—	—
Hired labor (P_{12})	hour	102	104	87
Returns to operator and family labor, owned capital, owned land and management*	$	3,241	2,297	2,895
Operating capital required	$	5,708	4,121	7,990

*To derive returns to operator and family labor and management it would be necessary to deduct depreciation, taxes, and interest from this figure.

Table 6.—Increase in Returns Resulting from a 160-acre Increase of Farm Size for 320-acre Farms*

Present Farm Size and Tenure	Acres Increase	Tenure	Increase in Returns to Operator and Family Labor, Owned Land, Owned Capital, Risk, and Management with Enterprise Restrictions		
			Wheat Allotment	Wheat Allotment Without Buy-Sell	Wheat Allotment With Cow-Calf and Buy-Sell
			$	$	$
Base: 320 acres (Owned)	160	owned	3,048	2,331	2,884
	160	rented	1,474	1,155	1,309
Base: 320 acres (Rented)	160	owned	3,416	2,467	3,225
	160	rented	1,400	1,065	1,235
Base: 320 acres (Part Owned)	160	owned	3,090	2,331	2,882
	160	rented	1,760	1,123	1,570

*It is assumed that the increase in farm size has same ratio of cropland, wheat allotment and range as the base of 320 acres.

Table 7.—Estimated Returns to Fixed Resources and Production Costs for 320-acre Farms Under Different Tenure Arrangements with a Wheat Enterprise Restriction Using Crop Production Costs and Returns When Crop Yields Are One Standard Deviation Below the Mean

Enterprise Process	Unit	Enterprise Level by Tenure		
		Owned	50% owned, 50% rented	Rented
Wheat (P_1)	acre	125	125	125
Barley (P_2)	acre	70	73	70
Alfalfa (P_3)	acre	9	7	9
Steer (buy-sell) (P_9)	steer	30	11	—
Steer (buy-sell) (P_{10})	steer	34	34	29
Steer (buy-sell) (P_{11})	steer	—	—	2
June labor hired	hour	103	107	102
Capital requirements	$	8,980	7,084	5,708
Returns to operator and family labor, owned land, owned capital, risk and management*		3,576	2,397	1,236.23
Average returns		6,391	4,851	3,241
Decrease in returns		2,815	2,434	2,005

*To derive returns to family labor and management, it would be necessary to deduct depreciation, taxes, and interest from this figure.

Table 8.—Effect of Various Beef Cattle Price Levels on the Optimum Enterprise Combination, 320-acre Owner-Operated Farm

Enterprise	Unit	Price of Beef				
		-50 Percent	-25 Percent	Long-Term Projection	+25 Percent	+50 Percent
		Enterprise Level				
Wheat	acre	125	125	125	125	125
Barley	acre	70	70	70	28	—
Alfalfa	acre	9	9	9	15	19
S. G. pasture	acre	—	—	—	35	60
Steers:	animal					
P_8	animal	—	—	—	51	88
P_9	animal	30	30	30	—	—
P_{10}	animal	34	34	34	34	—
P_{11}	animal	—	—	—	—	11
Beef production	pound	16,136	16,136	16,136	24,854	27,152
Returns to operator and family labor, owned capital, owned land, risk and management	$	4,970	5,681	6,391	7,344	8,554
Change due to price	$	-1,421	-710	0	715	1,430
Change due to change in system	$	0	0	0	238	733
Total Change	$	-1,421	-710	0	953	2,163

Table 9.—Estimated Returns and Operating Capital Requirements for 320-acre Farms Under Different Tenure Arrangements and Selected Enterprise Restrictions

Farm Tenure	Restrictions on Alternatives		
	Wheat Allotment	Wheat Allotment without Buy-Sell	Wheat Allotment with Cow-Calf and Buy-Sell
		Returns to Operator and Family Labor, Owned Capital, Owned Land and Management*	
Owned	$6,391	$4,391	$6,021
50% Owned-50% Rented**	4,833	3,751	4,486
Rented**	3,241	2,297	2,895
		Operating Capital Required	
Owned	$8,980	$5,634	$11,576
50% Owned-50% Rented**	7,072	5,635	9,769
Rented**	5,708	4,121	7,990

*To derive returns to family labor and management, it would be necessary to deduct depreciation, taxes, and interest from this figure.

**Returns to the part-owner and rented units is less than for the owned units, primarily because returns to rented land are not attributable to the operator.

Table 10.—Optimum Enterprise Combinations, 640-acre Owned-Operated Farm, With Unlimited Operating Capital, with Selected Restrictions on Alternatives

Activity	Unit	Restriction on Alternatives		
		Wheat Allotment	Wheat Allotment Without Buy-Sell	Wheat Allotment with Cow-Calf and Buy-Sell
Wheat (P_1)	acre	246	246	246
Barley (P_2)	acre	127	124	122
Alfalfa (P_3)	acre	17	20	22
Cow-calf (P_5)	cow	—	—	14
Cow-calf (P_6)	cow	—	29	—
Steer (P_9)	steer	41	—	140
Steer (P_{10})	steer	75	—	—
Hired labor (P_{12})	hour	432	417	398
(P_{13})	hour	82	84	69
Returns to operator and family labor, owned capital, owned land, risk and management*	$	12,019	9,304	11,264
Operating capital required	$	16,797	12,022	22,895

*To derive returns to family labor and management it would be necessary to deduct depreciation, taxes, and interest from this figure.

Table 11.—Optimum Enterprise Combinations, 960-acre Owner-Operated Farm, With Unlimited Operating Capital, with Selected Restrictions on Alternatives

Activity	Unit	Restrictions on Alternatives		
		Wheat Allotment	Wheat Allotment Without Buy-Sell	Wheat Allotment with Cow-Calf and Buy-Sell
Wheat (P_1)	acre	280	280	280
Barley (P_2)	acre	133	109	128
Alfalfa (P_3)	acre	19	43	24
Cow-calf (P_5)	cow	—	—	31
Cow-calf (P_6)	cow	—	62	—
Steer (P_9)	steer	—	—	153
Steer (P_{10})	steer	116	—	—
Steer (P_{11})	steer	15	—	—
Hired labor (P_{12})	hour	284	244	235
Returns to operator and family labor, owned capital, owned land, risk and management*	$	14,469	11,717	13,321
Operating capital required	$	18,440	19,844	28,611

*To derive returns to family labor and management, it would be necessary to deduct depreciation, taxes, and interest from this figure.

Appendix Table 1.—Product and Resource Price Assumptions

Item	Unit	Average 1951-55 (Dollars)	1951-55 Price Adjusted to 80 Percent Parity Ratio (Dollars)
Product Prices			
Wheat	bu.	2.12	1.82
Oats	bu.	.87	.75
Barley	bu.	1.21	1.04
Grain sorghum	bu.	1.30	1.12
Alfalfa hay	ton	30.55	26.27
Slaughter cows (utility)	cwt.	14.87	12.79
Slaughter heifers (utility)	cwt.	16.25	13.98
500 lb. Good-Choice stocker steers	cwt.	24.97	21.47
Slaughter heifer calves, 500 lb. Good-Choice	cwt.	23.55	20.25
Feeder steers, 500-800 lb. Good	cwt.	22.55	19.39
Resource Price			
0-45-0	ton	76.40	
Ammonium nitrate	ton	92.40	
Alfalfa seed	lb.	.43	
Limestone	ton	4.22	
Seed oats	bu.	1.65	
Seed wheat	bu.	2.94	
Orange sorgo seed	cwt.	10.40	
Atlas sorgo seed	cwt.	10.76	
Kafir seed	cwt.	6.72	
Milo seed	cwt.	6.62	
Vetch, hairy, seed	cwt.	16.46	
Rye, winter, seed	bu.	2.39	
Stock salt	cwt.	1.44	
Steamed bonemeal	cwt.	4.60	
Cottonseed meal	cwt.	4.46	
Milo	cwt.	2 33	
Whole oats	cwt.	2.72	
Molasses	cwt.	2.20	
Custom baling	bale	.18	
Custom spraying (2-4-D furnished)	acre	1.25	
Feed grinding	cwt.	.20	
Feed mixing	cwt.	.05	
Motor oil	gal.	.99	
Grease	lb.	.22	
Tractor gasoline	gal.	.20	

SOURCE: 1951-52, *Agricultural Prices*, Bureau of Agricultural Economics, USDA, Washington, D. C.
1953-55, *Agricultural Prices*, Agricultural Marketing Service, USDA, Washington, D. C.

Appendix Table 2.—Estimated Per Acre Requirements, Costs and Returns Wheat (Process P_2) North Central Oklahoma

Production	Unit	Amount	Price (Dollars)	Value (Dollars)
Wheat	bu.	20.0	1.82	36.40
Winter grazing	AUM	.705	—	—
Inputs:				
Seed-wheat	bu.	1.00	2.94	2.94
0-45-0	lb.	45.00	.038	1.71
Ammonium nitrate	lb.	91.00	.046	4.19
Variable machine cost	$	3.12	—	3.12
Wheat allotment	acre	1.00	—	—
Land	acre	1.00	—	—
Labor: February	hour	.37	—	—
June	hour	1.69	—	—
July	hour	.23	—	—
August	hour	.23	—	—
September	hour	.65	—	—
Total variable cost				11.96
Return to owned land, labor, capital, risk and management				24.44*

*On rented land the tenant's share is 67 percent of the gross grain crop, or a return of $12.43 and 50 percent of the grazing.

Appendix Table 3.—Estimated Per Acre Requirements, Costs and Returns Barley (Process P_2) North Central Oklahoma

Production	Unit	Amount	Price (Dollars)	Value (Dollars)
Barley	bu.	31.3	1.04	32.55
Winter grazing	AUM	1.338	—	—
Inputs:				
Seed-Barley	bu.	2.00	2.20	4.40
0-45-0	lb.	45.00	.038	1.71
Ammonium nitrate	lb.	91.00	.046	4.19
Variable machine cost	$	3.12	—	3.12
Land	acre	1.00	—	—
Labor: February	hour	.37	—	—
June	hour	1.69	—	—
July	hour	.23	—	—
August	hour	.23	—	—
September	hour	.65	—	—
Total variable cost				13.42
Return to owned land, labor, capital, risk and management				19.13*
67 percent for tenant's share equals $12.82				

*On rented land the tenant's share is 67 percent of the gross grain crops or a return of $8.38 and 50 percent of the grazing.

Appendix Table 4.—Estimated Per Acre Requirements, Costs, and Returns Alfalfa for Hay (Process P_3) North Central Oklahoma

Production	Unit	Amount	Price (Dollars)	Value (Dollars)
Hay	ton	2 0	—	—
Winter grazing	AUM	.200	—	—
Inputs:				
Seed-Alfalfa*	lb.	5.00	.43	2.15
Lime*	ton	.20	1.95	.39
0-45-0*	lb.	90 00	.038	3.42
Variable machine cost*	$	4.94	—	4.94
Custom bale	bale	60.00**	.18	10.80
Land	acre	1.00	—	—
Labor***				
April	hour	.51	—	—
May	hour	3.33	—	—
June	hour	.20	—	—
July	hour	3.39	—	—
August	hour	.06	—	—
September	hour	3.58	—	—
Total variable cost				21.70
Returns to owned land, labor, capital, risk, and management				-21.70

*Establishing cost normalized on a yearly basis figuring an average stand of four years. Seeding rate is 20 lbs. per acre. Lime is applied at the rate of one ton every five years. Ninety lbs. of 0-45-0 is applied at seeding time with 90 lbs. being applied each year except for the first year since it will be applied at seeding time.
**Thirty bales per ton.
***Includes seeding requirements normalized to a four-year stand.

Appendix Table 5.—Estimated Per Acre Requirements, Costs, and Returns Mixed Small Grain Pasture for Grazing (Process P_4) North Central Oklahoma

Production	Unit	Amount	Price (Dollars)	Value (Dollars)
Winter grazing	AUM	0.8	—	—
Spring grazing	AUM	2.6	—	—
Inputs:				
Seed: Vetch	lb.	15.00	.165	2.48
Rye	bu.	.59*	2.39	1.41
Barley	bu.	.58**	2.20	1.28
0-45-0	lb.	45.00	.038	1.71
Ammonium nitrate	lb.	91.00	.048	4.19
Variable machine cost	$	1.97	—	1.97
Land	acre	1.00	—	—
Labor: February	hour	.37	—	—
June	hour	.80	—	—
July	hour	.23	—	—
August	hour	.23	—	—
September	hour	.65	—	—
Custom spraying***	$	1.25	—	1.25
Total variable cost				14.29
Return to owned land, labor, capital, risk and management				-14.29

*Rye—33 lbs.
**Barley—28 lbs.
***Spray to kill vetch on wheat land.

Appendix Table 6.—Estimated Production Requirements and Income, Beef Cow Herd (25-Cow Unit), Utilizing Year Long Range Selling Good to Choice Feeder Calves Born March 15 and Sold Following October 15 (Process P_5)

Item	Unit	Number[1]	Animal Units	Estimated Value	Total Value
Capital:					
Brood cows	each	25	25	$150.00	$3750.00
Bull	each	1	1	300.00	300.00
Heifers > 1 yr.	each	4	4	120.00	480.00
Heifers < 1 yr.	each	6	3	90.00	540.00
Calves weaned[2]	each	22	—	—	—
			33		$5070.00

Production	Number	Weight	Price[8]	Value
Cull cows[3]	3	900	11.89	$321.03
Cull heifers	1	600	13.42	80.52
Heifer calves	5	450	18.63	419.18
Steer calves	11	475	20.40	1065.90
				1886.63

Annual Inputs:	Unit	Amount	Number	Total	Price	Cost
Range	acre	12.00	33	396.00	—	—
Hay[4]	ton	.09	33	2.97	—	—
C.S.M. (41 percent)[5]	cwt.	3.20	33	105.60	$4.46	$470.98
Minerals[6]	lb.	17.00	33	561.00	.03	16.83
Creep feed[7]	cwt.	6.50	16	104.00	2.91	302.64
Vet. and med.	$	2.00	33	66.00	—	66.00
Bull depr.	$	35.00	1	35.00	—	35.00
Hauling	$	1.00	18	18.00	—	18.00
Marketing cost	$	2.06	18	37.08	—	37.08
Tax	$	1.25	33	41.25	—	41.25
Total operating cost						$987.78
Returns to labor, capital, management and risk						$898.85

Per Cow Unit Labor Requirements (hours):

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5.7	5.2	3.9	1.4	1.2	1.2	1.2	1.2	1.4	2.1	5.0	5.5

[1] 3% death loss or one animal per year from brood and replacement stock.
[2] 90% calf crop weaned.
[3] 15% replacement rate.
[4] Hay fed at the rate of three bad days per month for five months (Nov. 1-April 1) with hay requirements at 12 lbs. per AU per day.
[5] Two lbs. per day for 160 days.
[6] Two parts salt and one part steamed bonemeal.
[7] 55% rolled milo, 30% whole oats, 10% C. S. M., 5% molasses.
[8] Prices are seasonally adjusted based on Oklahoma Experiment Station Bulletin No. B-486.

Appendix Table 7.—Estimated Requirements and Income for Beef Cow Herd (25-Cow Unit) Four Months Winter Pasture Supplemented with Hay, Selling Feeder Calves Born October 1 and Sold Following May 15 (Process P_6)

Capital Items	Unit	Number[1]	Total Animal Units	Estimated Value	Total Value
Brood cows	each	25	25	$150	$3750.00
Bulls	each	1	1	300	300.00
Heifers > 1 yr.	each	4	4	120	480.00
Heifers < 1 yr.	each	6	3	90	540.00
Calves weaned[2]	each	22	—	—	—
			33		$5070.00

Production:

Item	Number	Weight	Price[8]	Value
Cull cows[3]	3	900	$13.69	$369.63
Cull heifers	1	600	14.54	87.24
Heifer calves	5	450	21.87	492.08
Steer calves	11	475	22.33	1166.74
Total receipts				$2115.69

Annual Inputs:

Item	Unit	Rate	Number	Total	Price	Cost
Range	acre	6.00	33	198.00	—	—
Winter pasture[4]	AUM	4.00	33	132.00	—	—
Hay[5]	ton	1.05	33	34.65	—	—
Minerals[6]	lb.	17.00	33	561.00	$ .03	$16.83
Creep feed[7]	cwt.	6.50	16	104.00	2.91	302.64
Vet. and Med.	$	2.00	33	66.00	—	66.00
Bull Depr.	$	35.00	1	35.00	—	35.00
Hauling	$	1.00	18	18.00	—	18.00
Marketing cost	$	2.06	18	37.08	—	37.08
Tax	$	1.25	33	41.25	—	41.25
Total operating cost						$516.80
Returns to labor, capital, management and risk						$1598.89

Per Cow Unit Labor Requirements (hours).

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5.7	5.2	3.9	1.4	1.2	1.2	1.2	1.2	1.4	2.1	5.0	5.5

[1] 3% death loss or one animal per year from brood and replacement stock.
[2] 90% calf crop.
[3] 15% replacement rate.
[4] November 1 to March 1.
[5] Five bad days per month for four months at 20 lbs. per day = 400 lbs. Full hay requirements for March and April. 60 days x 20 = 1200 lbs.
[6] Two parts salt and one part steamed bonemeal.
[7] 55% rolled milo, 30% whole oats, 10% C. S. M., 5% molasses.
[8] Prices are seasonally adjusted.

Appendix Table 8.—Estimated Production Requirements and Income for Beef Cow Herd (25-Cow Unit) Utilizing Five Months Summer Range, Four Months Winter Pasture, and Three Months Spring Pasture Supplemented with Hay, Selling Feeder Calves, Born October 1 and Sold Following May 31 (Process P$_7$)

Capital Items	Unit	Number[1]	Total Animal Units	Estimated Value	Total Value
Brood cows	each	25	25	$150.00	$3750.00
Bull	each	1	1	300.00	300.00
Heifers > 1 yr.	each	4	4	120.00	480.00
Heifers < 1 yr.	each	6	3	90.00	540.00
Calves weaned[2]	each	22	—	—	—
			33		$5070.00

Production:

Item	Number	Weight	Price	Value
Cull cows[3]	3	900	$13.69	$369.63
Cull heifers	1	600	14.54	87.24
Heifer calves	5	475	21.87	519.40
Steer calves	11	500	22.33	1228.15
Total receipts				$2204.42

Annual Inputs:

Item	Unit	Rate	Number	Total	Price	Cost
Range[4]	acre	5.0	33	165.00	—	—
Winter pasture[5]	AUM	4.0	33	132.00	—	—
Spring pasture[6]	AUM	3.0	33	99.00	—	—
Hay[7]	ton	.78	33	25.74	—	—
Minerals[8]	lb.	17.0	33	561.00	$ .03	$16.83
Creep feed[9]	cwt.	6.5	16	104.00	2.91	302.64
Vet. and Med.	$	2.00	33	66.00	—	66.00
Bull Depr.	$	35.00	1	35.00	—	35.00
Hauling	$	1.00	18	18.00	—	18.00
Marketing cost	$	2.06	18	37.08	—	37.08
Taxes	$	1.25	33	41.25	—	41.25
Total operating cost						$516.80
Returns to labor, capital, management and risk						$1687.62

Per Cow Unit Labor Requirements (hours):

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5.7	5.2	3.9	1.4	1.2	1.2	1.2	1.2	1.4	2.1	5.0	5.5

[1] 3% death loss or one animal per year from brood and replacement stock.
[2] 90% calf crop weaned.
[3] 15% replacement rate.
[4] June 1 to October 31.
[5] Nov. 1 to Feb. 28.
[6] March 1 to May 31.
[7] Five bad days per month for seven months (Novmeber 1-May 31) at 20 lbs. per day = 700 lbs. Reserve for November 1 to February 29 = 491 lbs. Reserve for March 1 to May 31 = 367 lbs. (Based on farmer expectations for small grain grazing.)
[8] Two parts salt and one part steamed bonemeal.
[9] 55% rolled milo, 30% whole oats, 10% C. S. M., 5% molasses.

Appendix Table 9.—Estimated Production Requirements and Income, Fall Buy (October 15) Spring Sell (May 31), Good to Choice Feeder Steers, Utilizing Winter and Spring Small Grain Pasture (Process P_8)

Item	Unit	Amount	Price	Cost or Value
Process Inputs:				
Calf	lb.	450	$20.40	$91.80
Winter pasture[1]	AUM	2.4	—	—
Spring pasture[2]	AUM	1.8	—	—
Hay[3]	ton	0.4	—	—
Minerals[4]	lb.	8	.03	.24
Vet. and Med.	$	2.00	—	2.00
Hauling[5]	$	2.00	—	2.00
Buy-sell cost	$	3.06	—	3.06
Tax	$	.75	—	.75
Total operating cost				$99.85
Production:				
Calf[6]	lb.	718	20.75	148.98
Returns to labor, capital, management and risk				$49.13

Per Feeder Unit Labor Requirements (hours).

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.7	1.0	1.0	.6	.6	—	—	—	—	.8	1.0	1.7

[1] Nov. 1 to Feb. 29.
[2] March 1 to May 31.
[3] Hay fed five bad days per month for seven months at 10.2 TDN per day = 357 TDN. Alfalfa hay is 50% TDN, therefore 375 x 2 = 714 lbs. of hay.
[4] Two parts salt and one part steamed bonemeal.
[5] Based on cost of operating own truck with a two-way haul.
[6] Gain 1.33 lbs. per day for 229 days is 450 plus 305 = 755 lb. calf.

Appendix Table 10.—Estimated Production Requirements and Income, Fall Buy (October 15) Spring Sell (March 10), Good to Choice Feeder Steers, Utilizing Winter Small Grain Pasture (Process P_9)

Item	Unit	Amount	Price	Cost or Value
Process Inputs:				
Calf	lb.	450	$20.40	$91.80
Winter pasture[1]	AUM	2.4	—	—
Hay[2]	ton	0.3	—	—
Minerals[3]	lb.	8	.03	.24
Vet. and med.	$	2.00	—	2.00
Hauling[4]	$	2.00	—	2.00
Buy-sell cost	$	3.06	—	3.06
Tax	$	.75	—	.75
Total operating cost				$99.85
Production:				
Calf	lb.	614	20.17	$123.84
Returns to labor, capital, management and risk				$22.99

Per Feeder Unit Labor Requirements (hours):

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.7	1.0	1.0	—	—	—	—	—	—	.8	1.0	1.7

[1] October 15-March 10.
[2] Hay fed five bad days per month for five months at 10.2 TDN per day = 255 TDN. Alfalfa hay is 50% TDN, therefore 255 x 2 = 510 lbs.
[3] Two parts salt and one part steamed bonemeal.
[4] Based on cost of operating own truck with a two-way haul.
[5] Gain 1.33 lbs. per day for 147 days: 450 + 196 = 646 lbs. With 2 percent death loss: 646 x .98 = 633 lbs. With 3 percent shrinkage: 633 x .97 = 614 lbs.

Appendix Table 11.—Estimated Per Unit Production Requirements and Income Spring Buy (April 15) Spring Sell Following Spring (March 10) Good to Choice Feeder Steers, Utilizing Native Range and Winter Pasture (Process P_{10})

Item	Unit	Amount	Price	Cost or Value
Process Inputs:				
Calf	lb.	375	$22.97	$86.14
Range[1]	acre	3.0	—	—
Winter pasture[2]	AUM	3.2	—	—
Hay[3]	ton	.3	—	—
Minerals[4]	lb.	15	.03	.45
Vet. and med.	$	3.00	—	3.00
Hauling[5]	$	2.00	—	2.00
Buy-sell cost	$	3.06	—	3.06
Tax	$	1.00	—	1.00
Total operating cost				$95.65
Production:				
Calf[6]	lb.	704	20.17	142.00
Returns to labor, capital, management and risk				$46.35

Per Feeder Unit Labor Requirements (hours):

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.7	1.0	1.0	.6	.6	.6	.6	.6	.6	.8	1.0	1.7

[1] .5 AU for six months.
[2] .7 AU for 4.5 months.
[3] Hay fed five days per month for five months at 12.5 TDN per day = 312 TDN. Alfalfa hay is 50 percent TDN, therefore, 312 x 2 = 624 lbs.
[4] Two parts salt and one part steamed bonemeal.
[5] Based on cost of operating own truck with a two-way haul.
[6] Gain one lb. per day on range for 180 days: 375 + 180 = 555 lbs. Gain 1.33 lbs. per day on winter pasture for 145 days = 555 + 193 = 748 lbs. With 3% death loss: 748 x .97 = 726 lbs. With 3% shrinkage: 726 x .97 = 704 lbs.

Appendix Table 12.—Estimated Production Requirements and Income, Fall Buy (Oct. 15) Fall Sell Following Year (Oct. 15), Good to Choice Feeder Steers, Utilizing Native Range (Process P_{11})

Item	Unit	Amount	Price	Cost or Value
Inputs:				
Calf	lb.	450	$20.40	$91.80
Range[1]	acre	9.0	—	—
Hay[2]	ton	.2	—	—
Cottonseed Cake (41 percent)	cwt.	2.0	4.46	8.92
Minerals[3]	lb.	15.0	.03	.45
Vet. and med.	$	3.00	—	3.00
Hauling[4]	$	2.00	—	2.00
Buy-sell cost	$	3.06	—	3.06
Tax	$	.75		.75
Total operating cost				$109.98
Production:				
Calf[5]	lb.	750	18.23	136.72
Returns to labor, capital, management and risk				$26.74

Per Feeder Unit Labor Requirements (hours):

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.7	1.0	1.0	.6	.6	.6	.6	.6	.6	.8	1.0	1.7

[1] .75 animal units for 12 months.
[2] Hay fed 3 bad days per month for 6 months at 10.2 TDN per day = 184 TDN. Alfalfa hay is 50% TDN, therefore, 184 x 2 = 368 lbs.
[3] Two parts salt and one part steamed bonemeal.
[4] Based on co t of operating own truck with a two-way haul.
[5] Gain .95 lbs. per day for 365 days: 450 + 345 = 795 lbs. With 3 percent death loss: 795 x .97 = 771 lbs. With 3% shrinkage: 771 x .97 = 750 lbs.

Appendix Table 13.—Estimated Per Acre Requirements, Costs and Returns Grain Sorghums, North Central Oklahoma

Production	Unit	Amount	Price (Dollars)	Value (Dollars)
Grain sorghum	bu.	16.0	1.12	17.92
Winter grazing	AUM	.2	—	—
Inputs:				
Seed	lb.	6.00	.08	.48
Variable machine cost	$	2.65	—	2.65
Land	acre	1.00	—	—
Labor: February	hour	.80	—	—
April	hour	.23	—	—
May	hour	.23	—	—
June	hour	.42	—	—
September	hour	.99	—	—
Total variable cost				3.13
Return to land, labor, capital and management				14.79*

*On rented land the tenant's share is 67% of the gross crop, or a return of $6.78.

Appendix Table 14.—Estimated Production Requirements, Costs, and Returns Forage Sorghum, North Central Oklahoma

Production:	Unit	Amount	Price (Dollars)	Value (Dollars)
Hay - field cured	ton	2.25	—	—
Inputs:				
Seed	lb.	25.00	.08	2.00
0-45-0	lb.	45.00	.038	1.71
Ammonium nitrate	lb.	121.00	.046	5.57
Variable machine cost	$	3.17	—	3.17
Land	acre	1.00	—	—
Labor: February	hour	.80	—	—
April	hour	.23	—	—
May	hour	.65	—	—
June	hour	.37	—	—
August	hour	3.33	—	—
Custom bale	bale	68.0*	.18	12.24
Total variable cost				24.69
Return to land, labor, capital and management				-24.69

*30 bales per ton.

Appendix Table 15.—Estimated Returns Above Cash Costs to Alternative Cattle Systems by Years, 1941-57, 320-acre Farm

System and Class of Cattle	Grade	Date of Purchase or Sale	Lbs. Each	Lbs. Total	Price and Value by Years: 1957 Price	1957 Value	1956 Price	1956 Value	1955 Price	1955 Value
Cow Calf (P_5): 13 cow unit										
Cull cows	Utility	May	900	1404	$11.38	$159.78	$11.19	$157.11	$11.45	$160.76
Cull Heifers	Utility	May	600	312	15.44	48.17	13.42	41.87	12.25	38.22
Heifer Calves	Choice Slaughter	May	450	1170	21.34	249.68	19.61	229.44	20.00	234.00
Steer Calves	Good and Choice Stocker and Feeder	May	475	2717	21.25	577.36	18.67	507.26	19.94	541.77
Returns Above Cash Costs						766.28		666.97		706.04
Steer Buy and Sell System										
30 Steers P_9										
Stocker Steers	Good and Choice	October*	450	13,500	17.13	2312.55	19.33	2609.55	19.11	2579.85
Feeder Steers	Good and Choice	March	614	18,420	20.24	3728.21	18.77	3457.43	19.72	3632.42
Returns Above Cash Costs						1174.16		606.38		811.07
34 Steers P_{10}										
Stocker Steers	Good and Choice	April*	375	12,750	19.00	2422.50	21.00	2677.50	19.99	2548.72
Feeder Steers	Good and Choice	March	704	23,936	20.24	4844.65	18.77	4492.79	19.72	4720.18
Returns Above Cash Costs						2098.81		1491.95		1848.12
Total Returns Above Cash Costs from Steers						3272.97		2098.33		2659.19
Difference in Returns (Steers-Cows)						2507		1431		1953

Appendix Table 15. (Continued)—Estimated Returns Above Cash Costs to Alternative Cattle Systems by Years, 1941-57, 320-acre Farm.

Price and Value by Years													
1954		1953		1952		1951		1950		1949		1948	
Price	Value	Price	Value	Price	Value	Price	Value	Price	Value	Price	Value	Price	Value
12.13	170.31	11.77	165.25	21.21	297.79	23.87	335.13	18.03	252.14	16.06	225.48	17.90	251.32
14.38	44.87	13.72	42.81	22.75	70.98	26.11	81.46	20.93	65.30	19.29	60.18	20.73	64.68
20.56	240.55	20.60	241.02	33.50	391.95	34.55	404.24	27.15	317.66	24.80	290.16	26.58	310.99
20.48	556.44	19.78	537.42	35.00	950.95	36.58	993.88	27.20	739.02	25.50	692.84	27.00	733.59
	743.46		717.79		1442.96		1546.00		1105.41		999.95		1091.87
16.09	2172.15	24.70	3334.50	36.64	4946.40	30.55	4124.25	23.40	3159.00	24.81	3349.35	19.10	2578.50
17.12	3153.50	20.06	3695.05	31.19	5745.20	33.83	6231.49	24.36	4487.11	22.61	4164.76	23.58	4343.44
	739.85		119.05		557.30		1865.74		1086.61		573.91		1523.44
21.16	2697.90	35.00	4462.50	40.13	5116.58	26.75	3410.62	25.50	3251.25	26.00	3315.00	18.90	2409.75
17.12	4097.84	20.06	4801.56	31.19	7465.64	33.83	8097.55	24.36	5830.81	22.61	5411.93	23.58	5644.11
	1076.60		15.72		2025.72		4363.59		2256.22		1773.59		2911.02
	1815.85		134.77		2583.02		6229.33		3342.83		2347.50		4434.46
	1072		-583		1140		4683		2237		1348		3343

Appendix Table 15. (Continued)—Estimated Returns Above Cash Costs to Alternative Cattle Systems by Years, 1941-57, 320-acre Farm

Price and Value by Years													
1947		1946		1945		1944		1943		1942		1941	
Price	Value	Price	Value	Price	Value	Price	Value	Price	Value	Price	Value	Price	Value
12.63	177.33	8.78	123.27	8.49	119.20	8.22	115.41	9.51	133.52	7.51	105.44	6.29	88.31
14.50	45.24	10.80	33.70	9.65	30.11	9.90	30.89	10.50	32.76	8.87	27.67	7.28	22.71
20.95	245.12	14.46	169.18	13.75	160.88	12.58	147.19	13.14	153.74	11.98	140.17	9.85	115.24
19.38	526.55	15.76	428.20	13.75	373.59	12.67	344.24	14.75	400.76	13.00	353.21	11.50	312.46
	725.53		485.64		415.07		369.02		452.07		357.78		270.01
16.67	2250.45	12.90	1741.50	11.61	1567.35	11.14	1503.90	11.50	1552.50	11.56	1560.60	9.63	1300.05
17.95	3306.39	13.88	2556.70	12.00	2210.40	12.06	2221.45	13.08	2409.34	10.86	2000.41	9.68	1783.06
	814.44		573.70		401.55		476.05		615.34		198.31		241.51
15.69	2000.48	13.75	1753.12	13.00	1657.50	14.75	1880.62	12.76	1626.90	11.50	1466.25	9.47	1207.42
17.95	4296.51	13.88	3322.32	12.00	2872.32	12.06	2886.68	13.08	3130.83	10.86	2599.45	9.68	2317.00
	1972.69		1245.86		891.48		682.72		1180.59		809.86		786.24
	2787.13		1819.56		1293.03		1158.77		1795.93		1008.17		1027.75
	2062		1334		878		790		1344		650		758

*Price refers to the price the previous year.

Summary	Cow-Calf	Buy-Sell
Average returns	$757	$2,342
Standard deviation	$373	$1,447
Coefficient of variation	49%	62%