# LEASING ARRANGEMENTS FOR FARMS WITH IRRIGATION ENTERPRISES

by

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# INTRODUCTION

The development of irrigation in the arid and semi-arid sections of the west was an important factor in crop production. In these areas annual precipitation often was inadequate for the production of most domestic crops. Water is a necessary requisite for plant growth, so the development of irrigation systems which utilized surface and ground water was a logical consequence.

In Kansas, the farmers in the southwestern part of the state were the first to realize the need for supplemental irrigation water.[1] Widespread appropriation of surface water supplies began about 1860, and irrigation, on a limited scale, began to appear on farms adjacent to the creeks and rivers. Irrigation wells on Kansas farms were reported in 1899 by the Federal Census Bureau, and since that date there has been a continued growth of irrigated acreage in the state based primarily on water pumped from wells.

The historical development of irrigation in Kansas was difficult to trace, because measurements of the extent of irrigation (acreage irrigated, number of wells, etc.) were hard to find. The Census Bureau's definitions of many of the quantities measured changed regularly for the early reports. The most accurate data available for illustration of the growth of irrigation was found in the reports of the numbers of farms with irrigated land in Kansas for the period 1890 to 1955. These data are reproduced in Table 1.

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[1]Richard Pfister, Water Resources and Irrigation, School of Business, University of Kansas, p. 62.

Table 1. Number of farms with irrigated land in Kansas from 1890 to 1955.

| Year | Number of irrigated farms |
|---|---|
| 1890* | 519 |
| 1900 | 929 |
| 1910 | 1,006 |
| 1920 | 504 |
| 1930 | 683 |
| 1940 | 1,578 |
| 1950 | 1,166 |
| 1955** | 2,736 |

*U. S. Census of Agriculture 1950, Vol. III, pt. 7. p. 4.
**U. S. Census of Agriculture 1954, Vol. I, pt. 13, p. 2.

Of particular interest were the reports concerned with the recent development of irrigation. The census data presented in Table 1 revealed that irrigation enterprises were added on 1570 farms during the five year period from 1950 to 1955. This was an increase of 134 percent. During the same period of time the acreage of irrigated land expanded from 138,686 acres to 331,551 acres, an increase of 139 percent.[1] These data alone were sufficient to point out the great interest in irrigation which was expressed in new irrigation enterprises. But additional emphasis was provided when the Garden City Experiment Station reported 350,000 acres under irrigation in Western Kansas alone.[2] This reported acreage exceeded that published by the Bureau of the Census for the whole state by almost 20,000 acres. At the same time, reports by county agents and others from the central and

[1] U. S. Census of Agriculture 1954, Vol. I, pt. 13, p. 2.
[2] Andrew B. Erhart, Walter B. Meyer, and Ben L. Grover, Irrigation in Western Kansas, Kansas Agricultural Experiment Stations Circular 324, p. 5.

eastern parts of Kansas reflected great interest in and development of irrigation in their areas. These reports were so significant that the estimated irrigated acreage for the state of Kansas was set at 500,000 acres for 1956.

The role of the tenant in irrigation in Kansas has always been one of importance. Table 2 shows that tenants have in the past operated as much as 43 percent of all the farms in Kansas with irrigation enterprises. The prosperous war and post war years prior to 1950 brought about a reduction in tenancy which affected irrigated farms in about the same manner as it did all farms. The number of tenant-operated irrigated farms did not decrease (according to data in Table 2), but the total number of irrigated farms almost doubled. Tenant-operated irrigated farms accounted for 25 percent of the total in 1950.

Table 2. Number and percent of tenant-operated irrigated farms and tenant-operated all farms, 1930 and 1950.

| Year | Tenant Operated Irrigated Farms | Total Irrigated Farms | Percent of Total | Tenant Operated All Farms | Total All Farms | Percent of Total |
|---|---|---|---|---|---|---|
| 1930* | 292 | 683 | 43 | 70,326 | 166,042 | 42 |
| 1950** | 298 | 1,166 | 25 | 39,332 | 131,394 | 30 |

*Irrigation of Agricultural Lands, Fifteenth Census of the United States 1930, p. 127.

**U. S. Census of Agriculture 1950, Vol. 1, pt. 13, p. 50.

It was noted previously that after 1950 there was a big growth in irrigated acreage. It was not possible to determine how many of those farms were tenant operated, but the inquiries concerning leasing arrangements which were received by county

agents and the college were sufficient to indicate an increased importance of the tenant operated irrigated farm.

That interest in irrigation was not limited to owner-operators was attested to by the very existence of tenant-operated, irrigated farms. Some good reasons for interest in such a program of intensified agricultural production were advanced by tenants contacted through interviews. For some, irrigation created an outlet for initiative and ability. Several tenants found themselves limited as to the amount of land they could rent. Irrigation caused more efficient use of their labor and equipment. For others irrigation provided some insurance against crop failure. In some of those cases specialized livestock enterprises, such as dairying, were built around the irrigation enterprise. Landlords were not found to be in opposition to irrigation as long as adequate returns on their investments were probable. So the motives for establishing irrigation on farms apparently were present for both owner-operators and for landlords and tenants during the past few years of great growth.

## The Problem

The development of irrigation enterprises on tenant-operated farms has created leasing problems for many landlords and tenants. In the conversion of various portions of their farms to irrigation operations they have been faced with new and large investments, additional operating costs, new labor requirements, and new problems of management. These requisites for irrigation often have been of such magnitude that it has been necessary for them to be

shared by landlords and tenants. Only an occasional tenant has been willing or able to assume the financial or physical burden of this type of operation.

The necessity for sharing some of the costs associated with the development and operation of an irrigation enterprise has caused landlords and tenants to question the applicability of customary leasing arrangements to this new operation. Their concern has been reflected in the questions they have been asking about leases and irrigation, and the importance of the problem to them was testified to by the repeated inquiries received by county agents and others who have had occasion to work with leases and problems of tenure.

The question most often asked was one that was considered to be a good statement of the leasing problem. It was, "How should the costs and returns for irrigation be shared?"

A preliminary survey of tenant-operated irrigated farms in South Central Kansas revealed that landlords and tenants have established no particular plan or pattern for sharing the investment in the irrigation plant, the operating costs, or the labor and management responsibilities. Many individuals have applied the leasing arrangement for their dryland enterprise to the irrigation enterprise. Yet they have shared costs in varying ways, with no apparent attempt to actually evaluate the contribution each party has made to the irrigation operation.

The demand for information about leasing arrangements for farms with irrigation enterprises led to the initiation of this study.

## The Objectives

The ultimate objective of this study was to discover how costs and returns from irrigation enterprises should be shared. An investigation into this objective was preceded by an inquiry into certain ramifications of the problem. This was a leasing problem, therefore an understanding of the economic theory related to leasing was necessary before any further analysis was developed The examination of theory required that the goals of the irrigating farmer be defined and that the nature and complexities of the lease be observed. These were necessary requisites for the investigation of the specific problem concerning the sharing of costs and returns for irrigation enterprises, and they were regarded as associated objectives.

## Scope of Study

The analysis of leases, which was based upon criteria suggested in economic theory, was limited to an examination of sharing arrangements for sprinkler irrigation enterprises as they have affected resource use, returns, and distribution of returns from the irrigation enterprise and from the dryland enterprise. This limitation was a result of (1) the limited problem as it was expressed by landlords and tenants, and (2) the limited data which was available. It was assumed that the irrigation enterprises which were examined were located on farms with fair and equitable dryland leasing arrangements, and that the leasing problems have occured as a result of a lack of information as to

the applicability of the lease to the new and unfamiliar enterprise.

Most of the data used were obtained originally by Merton L. Otto for the purpose of examining the need for credit in the financing of sprinkler irrigation systems.[1] Costs and returns from the irrigated farms included in his study were somewhat incomplete, because many of those enterprises were recently organized, and the farmers could not supply accurate and adequate information.

Otto's sample included 69 farms in South Central Kansas. The names of the farmers who were interviewed were obtained from county agents and others who had knowledge of the farms on which there were irrigation enterprises. The survey was completed in the fall of 1954. The area chosen was of reasonably uniform soils, topography, and climatic conditions.

Eighteen of the 69 farms were used in this study. Costs and returns for these farms were most nearly complete and were adaptable to the computations and illustrations used in the analysis.

A survey of tenant operated irrigated farms was made by the author in January of 1956 for this study. The purpose of this limited survey (eight farms) was to gain an acquaintance with actual situations on leased farms with respect to methods of sharing costs and returns by landlords and tenants. An attempt was made at the same time to get expressions of satisfaction or dissatisfaction with existing leases and to get some recommendations for changes in leasing arrangements which would promote better

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[1]Merton L. Otto and Wilfred H. Pine, Sprinkler Irrigation Costs and Returns in South Central Kansas, Kansas Agricultural Experiment Stations Bulletin 381, p. 5.

utilization of labor and equipment.

## Procedure

An important phase of the investigation of the leasing problems on irrigated farms in Kansas consisted of an examination of existing sharing arrangements for the irrigation enterprises on some of those farms. This examination required that criteria be established upon which judgment of these sharing arrangements could be based. These criteria are suggested by production economic theory. It was necessary then that the actual investigation of the leasing problems be preceded by a review of economic theory related to tenancy and leases. This review included (1) the specification of the objectives of individuals in the use of resources in a farm business, (2) a study of the influence of leasing arrangements on the use and productivity of resources, and (3) the establishment of the incentive conditions which promote efficient resource use, maximization of profits, and equitable distribution of returns when those conditions are incorporated in the lease.

The investigation of the problem was accomplished by testing some existing sharing arrangements for their effectiveness in (1) providing the incentives for allocation of resources in an optimum manner, (2) promoting an optimum level of operation for the farm, and (3) distributing returns according to the contributions of each party or according to the sharing of inputs.

Further analysis of the problem included an examination of various assumed combinations of contributions of inputs for the

irrigation enterprises by landlords and tenants. These combinations were designed to reflect certain common or customary sharing arrangements which have grown up and been perpetuated over time. They were tested for their effectiveness in allocating resources within the irrigation enterprise.

The effects of different sharing arrangements for the dryland enterprise and the irrigation enterprise also were studied. An example of such a situation was developed to test these different arrangements for their effectiveness in distributing returns in an equitable manner.

Certain leasing arrangements which are possible alternatives for landlords and tenants who cannot develop a lease which incorporates all the desirable conditions were examined and their limitations were pointed out. Situations which make necessary relatively imperfect leases were described, and the best possible method for developing a lease to fit these situations was suggested.

In conclusion, the leasing conditions which are necessary to assure optimum resource use, an optimum level of operation, and an equitable distribution of the product, were reviewed, and the necessity for incorporation of these conditions into leases was emphasized.

## REVIEW OF ECONOMIC THEORY RELATED TO LEASES

The leasing problem which has been posed by landlords and tenants is an economic problem. It is of concern because it affects the use of resources and the users of resources. The problem must be examined in the light of economic theory, because

this theory contains the tools of analysis which are necessary for delineating the problem, studying it, and offering suggestions for its solution.

## Goal of Farm Operators

For the purpose of this study it was assumed that the major goal of farm operators was the realization of maximum profits from the farm operation. This goal was chosen with the realization that many farmers have not extended resource use to a point where maximum profits were realized. Often the farmer has not been able to reach this point of profit maximization because (1) he has not operated under perfect knowledge of relevant input-output relationships and cost structures, (2) he has been faced with uncertain future prices and yields, and (3) he usually has been limited in the amount of capital available to him.[1] Specification of the goal was necessary to provide a choice indicator to be used to determine the most desirable combination of resources for a farm unit and to indicate which of several alternatives in resource use is optimum, or will maximize the given end.

## Maximum Profits and the Owner-operator

The production problem which faces a farm operator whose desire is to maximize profits for his farm firm is to determine the combination of resources which will result in a level of production consistent with his goal. For the owner-operator, the

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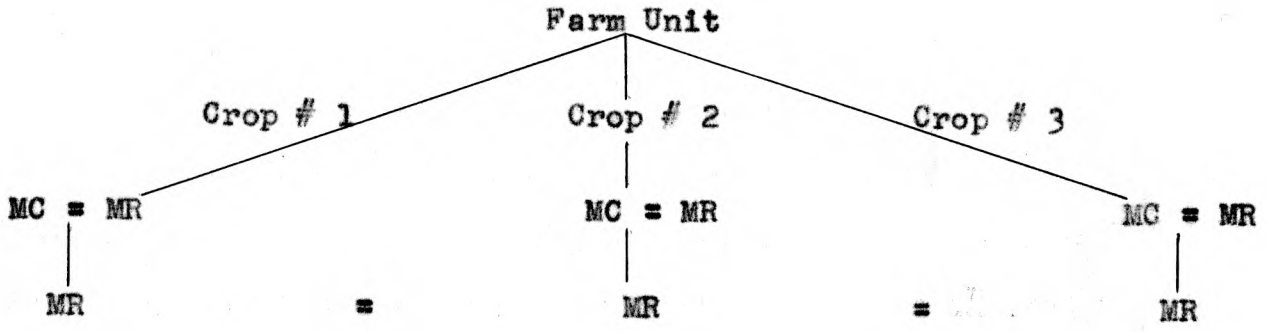
[1]Earl O. Heady, Economics of Agricultural Production and Resource Use, p. 115.

decision-making process is less complicated than it is for a landlord and tenant. He has control of the land, labor, and capital resources necessary for producing the products which provide his income. Having full control over the farming operations, he is able to make decisions with the knowledge that the returns attributable to his resources are entirely his. His management problem is to combine his land resource, which he may regard as a fixed input, with his capital and labor resources, which he may regard as variable inputs. It is necessary that only two conditions be fulfilled to maximize profits from his farm. These conditions are suggested in production economic theory and are related to the manner in which those resources which are regarded as variable inputs are combined with the land resource, which is the fixed or sunken input. The conditions are as follows: (1) Marginal costs and marginal returns for each crop (or enterprise) must be equated. (2) Marginal returns for all crops (or enterprises) must be equated.

When these conditions are fulfilled, then marginal costs are equal to marginal returns for the farm firm, and it is considered to be in equilibrium. Figure 1 is an illustration of a farm firm for which profits are maximized due to the fulfillment of these conditions. It is assumed for this illustration that there are three competing crops among which resources have been allocated. Marginal costs have been equated with marginal returns for each crop, and marginal returns have been equated for all crops. Marginal costs and marginal returns are then equated and the firm is in equilibrium. There is no problem of allocation of the income of the farm, because the owner-operator receives all of it.

For this individual it is necessary only that the firm reach the point of equilibrium where marginal costs equal marginal returns.




Therefore

MC = MR for the farm firm

Fig. 1. Illustration of a farm firm in equilibrium.

It is important to recognize that for the owner-operator it is not necessary to compute the costs and returns for the land resource. Land is considered to be a fixed input and is important only as the variable inputs are applied to it. The returns to the land resource are contained in the total returns received by the owner-operator. For his purpose, there is usually no reason for separating the returns to land from the total.

That output for the farm must be at a level at which marginal costs are equal to marginal returns can be illustrated as follows. Marginal cost and marginal return measures indicate additions to total costs and total returns respectively. When an addition of one unit of output results in marginal revenue which is greater than marginal costs, the addition is profitable.

When an addition of one unit of output results in marginal revenue which is less than marginal costs, the addition is unprofitable. The point of equilibrium, where marginal cost equals marginal revenue, is the point of maximum profits.

This example is applicable not only for a single acre, but for a farm as an economic unit. This principle is illustrated in Figure 2.[1]

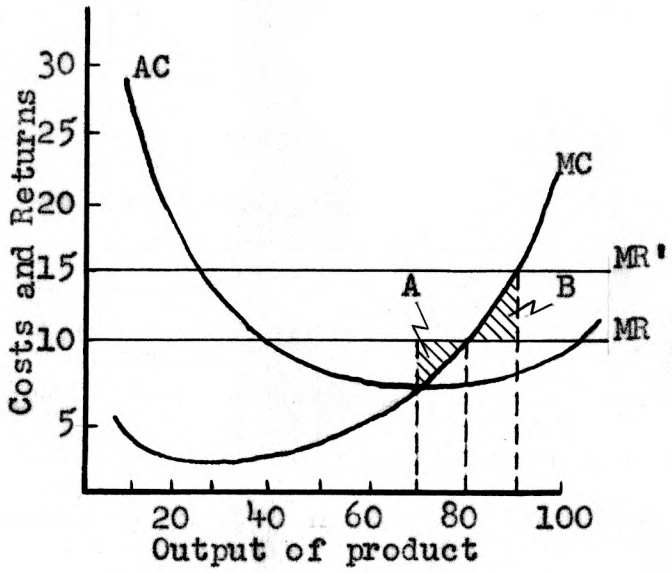



Fig. 2. Graphic representation of profit maximization.

With a price of $10, marginal cost and marginal revenue are equal at an output of 80, and at this point maximum profits are realized. If output drops back to 70, net profits will be decreased by the amount in shaded area A. If output is extended from 80 to 90, net profits will be decreased by the amount shaded in B. If the price changes to $15, the output should be extended

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[1]Earl O. Heady, op. cit., p. 329.

to 90, where profits are again maximized.

## Maximum Profits and the Landlord and Tenant

The production problem which faces a landlord and tenant on a single farm is more complex than it is for an owner-operator. On a tenant-operated farm, the ownership and control of resources is vested in two persons. The decisions relative to resource use and intensity of operations are shared (or divided) by two persons. And returns attributable to resource use are distributed to two persons. If the landlord and tenant are cooperative in their productive efforts, and if their efforts are directed toward the advancement of their mutual welfare, then the decision-making process is not overly complicated. It is in fact very similar to that for an owner-operator. If there is disagreement between parties, then the decision-making process becomes a problem. On tenant-operated farms where there are conflicting interests, decisions related to resource use may not be directed toward a level of production that will maximize profits for the farm and for the landlord and tenant.

It is often possible to find the source of the conflict between the landlord and tenant in the lease which applies to their farming operation. Many leases, for example, do not contain the incentives which are necessary to allow and encourage proper resource use. Returns may not be shared according to the sharing of costs, or the cost sharing arrangements may be insufficient, so that optimum use of resources is not achieved. Where interests

conflict, decision-making is divided, not shared. Each party strives to maximize returns for his resources, without regard for the interests of the other party.

Further illustration of this possible influence of leases on resource use and productivity is provided by a more detailed examination of the farm lease.

Hurlburt stated, "Essentially a lease is a contract between a landlord and a renter concerning use of resources for a given time period and for a specified payment."[1] It is an operating agreement between two parties for a farm business, which places certain responsibilities, limitations, and restrictions on the landlord and tenant. As a minimum it should provide (1) a basis for the combination of the resources of the two parties in production, and (2) an agreement as to the distribution of income to the resource owners.

The two general forms of leasing are cash and share leases.[2] The cash lease is one in which the tenant rents the land resource from the owner and pays cash for the services of the land. The share lease is one in which payment for the services of the land, and in many cases other resources, is a payment in kind, or a share of the products of the land. Share leases were used on most of the farms studied here. Because of the dominance of this form of lease, and for other reasons developed later, emphasis

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[1]Virgil L. Hurlburt, Farm Rental Practices in the Midwest, North Central Regional Publication 50, p. 86.

[2]Wilfred H. Pine, Farm Leasing Arrangements in Kansas, Kansas Agricultural Experiment Stations Bulletin 374, p. 11.

has been placed on study of the share lease.

Leases, especially share leases, may not include incentives to encourage operation at a point of maximum profits. This may affect farm size, intensity of operations, and decision-making factor-product and product-product relationships. Examples of the influence of leases on resource use and productivity are provided in Figures 3, 4, 5, and 6. These figures are graphic illustrations of the problems which arise out of the application of leases which are not adequate in terms of incentive conditions. In the development of these figures it was assumed that the landlord's contribution was limited to land and buildings, and the tenant provided all other inputs, including labor, management, machinery, and operating costs. For simplicity no sharing of the latter costs was considered.

Figure 3 illustrates the effect of cash and share leases on farm size.[1] Curve $MP_{1.0}$ represents the full marginal value product of the land; $MP_{.33}$ is the marginal cost of the land to a tenant (or the proportion of the total marginal value product given up as rent) operating under a one-third two-thirds share lease. This tenant would realize maximum profits when the marginal value product of land is driven to zero. At $OX_3$ acres in the figure, the marginal value productivity of land and its marginal cost to the tenant are equal.

The cash tenant faces a different situation which is also

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[1]Earl O. Heady, op. cit., p. 597.

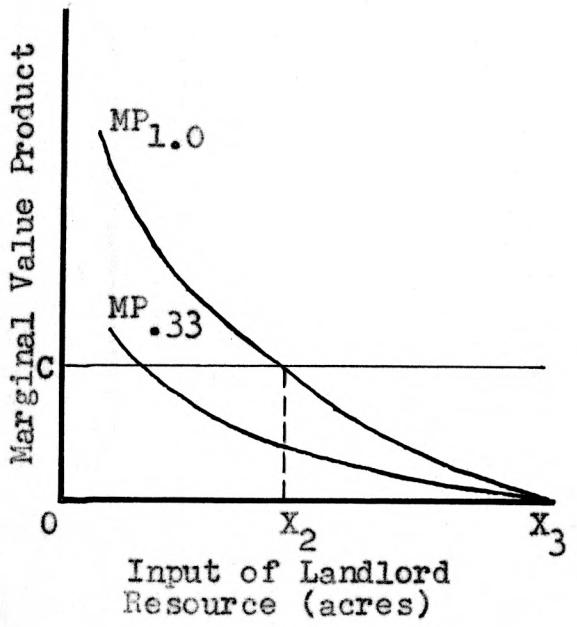



Fig. 3. Leases and farm size.

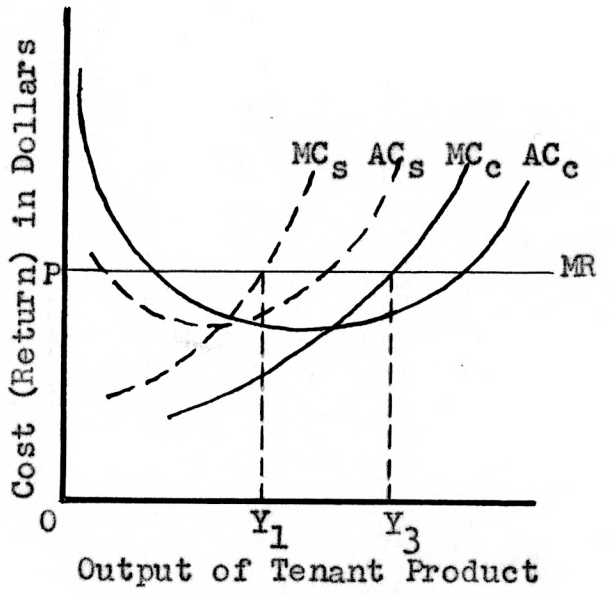
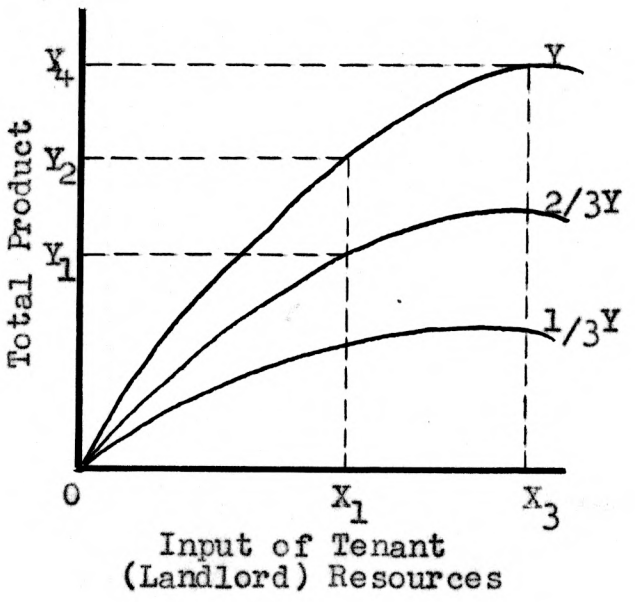
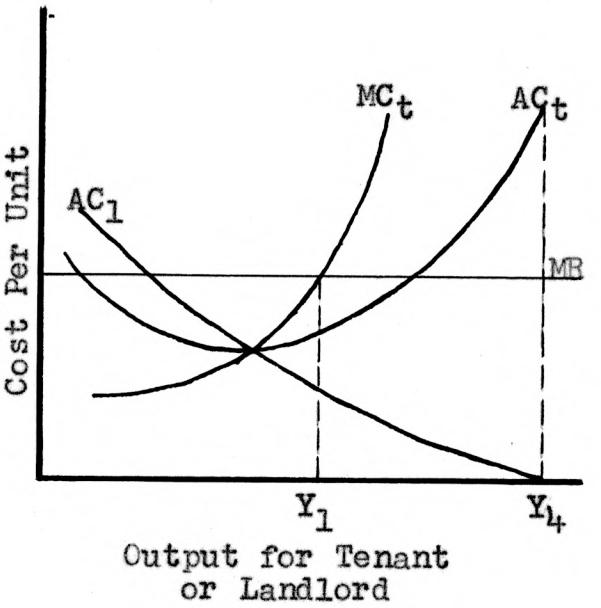



Fig. 4. Leases and short-run intensity




Figs. 5 and 6. Share leases and decision-making factor-product relationships.

illustrated in Figure 3. Cash rent per acre (represented by a horizontal line at C) represents the marginal cost of land for him. Marginal value product and marginal cost are equal at $OX_2$ acres, and a farm of this size will maximize profits.

Maximum profits are defined at the point where the marginal value product equals the marginal cost, and because of the effect each of these two leases has on marginal costs, there arises a difference in the optimum size unit for each lease. A farm of $OX_3$ acres maximizes profits, cet. par. for a share tenant, and a farm of $OX_2$ acres maximizes profits, cet. par. for a cash tenant.

These two leasing arrangements also might have resulted in different degrees of intensity of operations as is illustrated in Figure 4.[1] The production function in this case is of short-run nature and farm acreage is fixed. $AC_c$ and $MC_c$ are assumed to be the average and marginal cost curves for a farm under a cash lease and pertain to the full product of the farm. Given the same production function, $AC_s$ and $MC_s$ are the average and marginal cost curves for the farm under a share lease. They include all the variable costs but refer only to the tenant's two-thirds share of the total farm production. The cash tenant will be encouraged to strive for greater outputs because the cash rent is a fixed cost, not a function of output, and per unit cost will be less for large output. The share tenant will limit production to a point corresponding to $OY_1$, because his marginal cost will be equal to marginal revenue for an output of $OY_1$. This is a result of the share

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[1]Earl O. Heady, op. cit. p. 597.

rent arrangement in which he receives only two-thirds of the total product and pays all variable costs. Under both leasing arrangements, equal amounts of variable resources are assumed to be provided and used in production by tenants, but the cash tenant receives the full product and the share tenant receives only two-thirds of the total product. On the other hand, the share tenant probably operates a unit of larger size than does the cash tenant. The degree of intensive operation may be offset by the size of the unit when either leasing arrangement is considered.

A feature of the share lease that is important in decision-making factor-product relationships is illustrated in Figures 5 and 6.[1] The Y curve in Figure 5 represents a production function with the total product a result of a fixed input of landlord resources and varying levels of input of tenant resources. This Y curve is relevant for decision-making by owner-operators or by tenants operating under a cash lease. The relevant input-output curve for decision-making by a tenant operating under a one-third two-thirds share lease is the 2/3 Y curve. Given the fixed costs for both landlord and tenant and the price of the input factors, the average and marginal cost curves can be derived. $AC_l$ in Figure 6 represents the average cost curve for the landlord and it includes only fixed costs on land and buildings. It therefore approaches zero at $Y_4$ units of total product. Marginal costs for the landlord are zero because he does not share in the variable inputs. $AC_t$ represents the tenant's average cost curve. It

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[1]Earl O. Heady, op. cit., p. 597.

includes the variable costs needed to produce the tenant's two-thirds share plus a one-third share for the landlord (also including fixed costs associated with the tenant's resources). The tenant's marginal cost curve, $MC_t$, is derived from the total costs associated with both the tenant's two-thirds share and the landlord's one-third share.

If the tenant attempts to maximize profits without regard for the interest of the landlord, he will produce $OY_1$ units of product for himself (which corresponds to $OY_2$ units in Figure 5, including the landlord's share), at which point marginal cost is equal to marginal revenue for the tenant. The landlord, acting in his own interest, will desire to push production to the maximum, at $OY_4$, since his marginal cost for all levels of output is zero. The output for the farm unit will probably lie somewhere between $OY_1$ and $OY_4$. The tenant will be under pressure from the landlord to push production beyond $OY_1$, but he will not be encouraged to do so as long as he is required to provide all the variable inputs. There is clearly a conflict in interests in this situation, which can be resolved only when the landlord and tenant share in the costs of the operation.

This conflict was noted by Johnson as follows: "The stipulations of the crop share lease create circumstances in which both the tenant and landlord, when each views his interest separately, consciously attempt to violate the marginal conditions necessary for maximum output..... It is at once evident that, if both the tenant and landlord act as though the interest of one is

distinct from the interest of the other, the net product of the farm will be less than it could be."[1]

Decision-making for the cash lease tenant is not complicated in this manner. It was pointed out that the decision-making curve for the owner-operator and for the cash tenant is the Y curve of Figure 5. The cash tenant provides all variable inputs and receives the entire return. His decisions as to the allocation of resources are made with the knowledge that returns to him are directly related to the resources he employs. His lease affects farm size and intensity of operations, but decision-making related to factor-product relationships is the same for the cash tenant as it is for the owner-operator.

The share lease may also complicate decision-making product-product relationships. This is illustrated in Figure 7.[2] Curve NQ is a transformation function representing production possibilities from a given collection of resources. If the farm operator owns the land and provides all the variable factors, then curve NQ is the appropriate decision-making curve relative to the allocation of resources between two products. At B, where the iso-revenue curve $E_1R_1$ is tangent to the production possibility curve, the rate of substitution of $Y_1$ for $Y_2$ in production is equal to the rate of substitution of the two products in the market. At this point maximum profits are realized from the use of the given

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[1]D. Gale Johnson, "Resource Allocation Under Share Contracts", Journal of Political Economy, April, 1950, 59:111-123

[2]Earl O. Heady, op. cit., p. 605.

resources. Resources are allocated to produce OC output of $Y_1$ and OG output of $Y_2$. Given production and price relationships, any other combination of $Y_1$ and $Y_2$ would produce a lower total revenue.

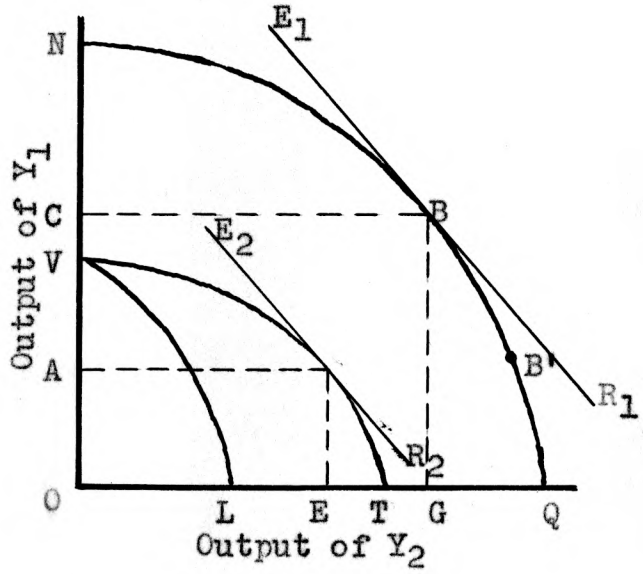



Fig. 7. Interfarm allocative patterns under different leasing systems.

A tenant who provides the variable inputs and pays cash rent for the land can also make decisions on the basis of the transformation function NQ. His profit will be at a maximum with production of OC of $Y_1$ and OG of $Y_2$. Since the cash rent paid for the land is the same regardless of the manner in which resources are allocated between competing products, the return to the landlord is the same in any case.

The decisions of the share tenant are made on the basis of a post-share possibility curve represented in Figure 7 by VT. The shape of this curve depends on the terms of the share lease.

Curve VT is a result of an assumed lease in which the tenant receives one-half of output $Y_1$ and two-thirds of output $Y_2$. Given the same price ratio as indicated previously (an iso-revenue curve with a slope equal to $E_1R_1$), maximum revenue for the share tenant is denoted by tangency of $E_2R_2$ to VT. This will result in post share outputs of OA of $Y_1$ and OE of $Y_2$ for the tenant. Maximum profits for the share tenant are possible only when resources are allocated in a manner suggested by point B' on the total production possibility curve NQ (which represents the tenant share plus the landlord share). Point B' includes a greater quantity of $Y_2$ and a smaller quantity of $Y_1$ than would be produced by an owner-operator. It is not located at the point of tangency (B) of curve NQ and iso-revenue curve $E_1R_1$. So the combination of products under differential share rents differs from that which would be produced by an owner-operator, and the pattern of resource allocation does not equate the marginal value productivity of resources between products.

## Leasing Conditions for Efficient Resource Use and Maximization of Profits

The characteristics of a lease which lead to inefficient resource use and a level of operation which results in less than maximum profits can be eliminated. It is possible to develop a sharing arrangement which will provide a framework within which farming efficiency can be as great under a share lease as under owner-operatorship. Production economics theory prescribes necessary conditions for profit maximizations, and leasing

arrangements which make use of these principles should lead to a decision-making climate in which both parties may more fully attain their common (assumed) goal.

Adaptation of these rules of production economics to leases requires that the land, labor, and capital resources be viewed in a different light than that which was adequate for the owner-operator situation. It was pointed out in a preceding section of this study that for the individual who owns the land he operates, it is not necessary to consider the annual services of the land in describing the maximization of profits for the farm and the returns which are paid to the owner-operator. This is not the case for the landlord and tenant situation. Each party contributes resources to the farming operation, and each expects to receive a return which is at least as great as that which would be realized if those resources were utilized in other productive enterprises. If these returns are to be realized it will be necessary that resources be efficiently utilized, that the level of operation approach that of a firm in equilibrium, and that the distribution of returns from the farming operation be based on the contributions of the landlord and tenant. All inputs must be regarded as variable inputs, and costs and returns must be calculated for each input.

The principles of production economics which should be incorporated in a share lease are: (1) The arrangements for sharing the marginal costs and the marginal returns for each particular crop must be the same. (2) The shares of marginal returns for

all crops must be the same. (3) The share of income going to each party must represent the product of the resources furnished by this individual.

Principles (1) and (2) above are necessary for bringing the level of the farming operation to a point of equilibrium. They are essentially the same rules or conditions which must be observed by an owner-operator if he is to use resources efficiently and realize maximum profits from his farm operation. Principle (1) specifies that if, for example, returns for a crop are to be divided on a 50-50 percent basis, then costs of the variable inputs should be shared on a 50-50 percent basis. The effect of this rule or condition is to assure that the tenant, or landlord, will invest an optimum amount of capital and other resources in an enterprise. It also assures that marginal inputs will be applied approximately to the point where prospective marginal revenue is only equal to marginal cost. Principle (2) specifies that if, for example, the rental share for one crop is 50-50 percent, then the rental shares for all other crops should be the same. If different sharing arrangements are established for different crops, the allocation of resources between these crops will not be such that maximum profits will result.

Principle (3) is a major premise of the free enterprise system. It specifies that the returns to the resource owners must represent the product of the resources furnished by these individuals. Specifically, the shares of return to landlord and tenant should be in line with the contributions of the two parties.

This rule or principle is necessary to assure that there is equitability in the sharing arrangement. It is the needed supplement to the rules which were applicable to the landlord-tenant situation.

Figure 8 is an illustration of a tenant-operated farm firm for which profits are maximized due to the fulfillment of the conditions or rules which have been developed. As in the example for an owner-operator, it has been assumed that there are three competing crops among which resources have been allocated. The shares of marginal costs have been equated with the shares of marginal return for each crop, and the shares of marginal returns have been equated for all crops. The firm is then in equilibrium. The distribution of product is made with the share of income to the landlord and tenant representing the product of the resources contributed by each party.

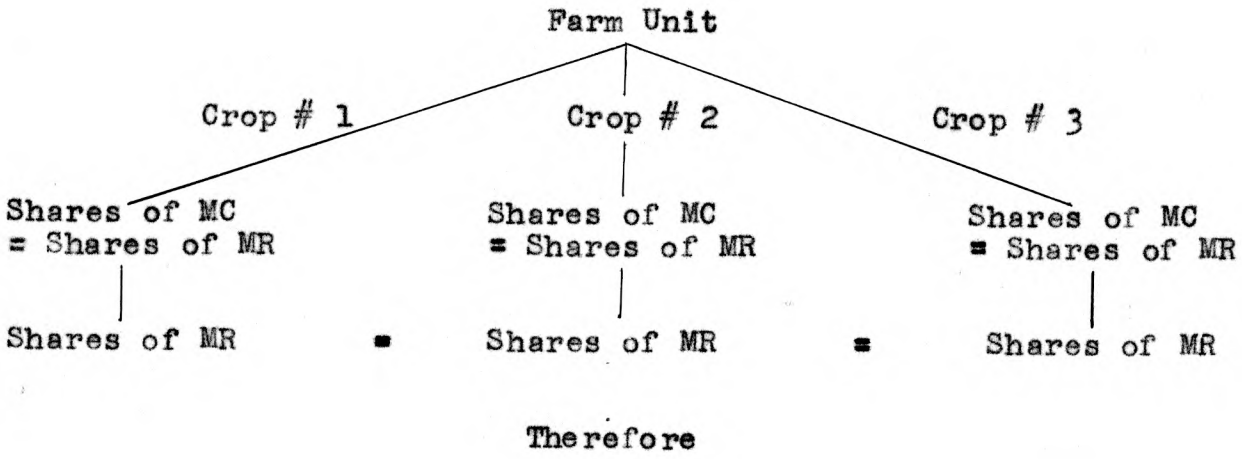



Fig. 8. Illustration of a tenant-operated farm firm in equilibrium.

To distribute shares, the quantities of the resource services, furnished separately by the landlord and tenant, are multiplied by their mean marginal products. The sum of these quantities are then determined for the farm as a whole. The computed share of the total product for the tenant is then:

$$\frac{(\Delta P/\Delta X_t)\ (X_t)}{S}$$

and the computed share for the landlord is:

$$\frac{(\Delta P/\Delta X_l)\ (X_l)}{S}$$

where $P$ = total product

$X_t$ = value of resource services furnished by tenant

$X_l$ = value of resource services furnished by landlord

$S$ = sum of the dollar value of all resource services for the farm

$(\Delta P/\Delta X_t)$ = marginal product of resources furnished by tenant

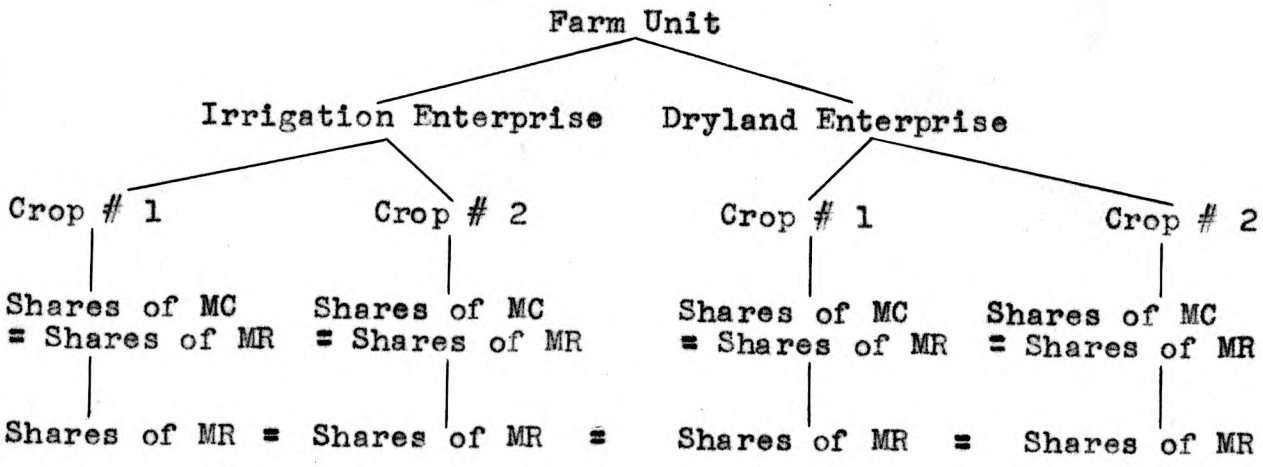
$(\Delta P/\Delta X_l)$ = marginal product of resources furnished by landlord

The three rules specified above, when incorporated in a leasing agreement, should result in efficient resource use, a maximum profit for a farm, and equitable distribution of returns to the landlord and tenant.

Production economic principles which are applicable to leasing arrangements in general may also be applied to the particular leasing arrangements necessary for a tenant-operated irrigated farm. These rules or conditions may also be used as criteria for the examination of existing leasing arrangements for dryland and

irrigation enterprises. Application of these rules to this particular situation can best be visualized if they are restated. For the irrigation enterprise (1) the arrangements for sharing marginal costs and marginal returns for each irrigated crop should be the same, and (2) the shares of marginal returns for all irrigated crops should be the same. For the dryland enterprise (1) the arrangements for sharing marginal costs and marginal returns for each dryland crop should be the same, and (2) the shares of marginal returns for all dryland crops should be the same. For the farm unit (1) the shares of marginal returns for the irrigated crops should be the same as the shares of marginal returns for the dryland crops, and (2) the share of income going to the landlord and tenant must represent the product of the resources furnished by each party.

Figure 9 is an illustration of a tenant-operated farm for which there is a lease which incorporates these rules. This lease has provided for a level of operation which maximizes profits and for equitable distribution of returns.



When the firm is in equilibrium, then the share of income going to landlord and tenant will represent the product of the resources furnished by each party.

These rules can be used as criteria for examining existing sharing arrangements for dryland and irrigation enterprises.

## HYPOTHESES

The hypotheses tested were: (1) Landlords and tenants have not shared the costs of irrigation according to the manner in which they have shared returns from irrigation. (2) The shares of returns from irrigation have not been based on the contributions of the landlord and tenant to the enterprise. (3) Landlords and tenants have not shared the returns from irrigation enterprises in the same proportion as they have shared returns from the dryland enterprises. (4) Sharing of costs attributable to irrigation according to the sharing of total returns from irrigation is not sufficient except where the costs and returns for the irrigation enterprise are shared in the same proportion as are the costs and returns for the dryland enterprise.

## TESTS OF HYPOTHESES

The testing of the hypotheses was accomplished by (1) examining some actual cost and return sharing arrangements for farms with irrigation enterprises, (2) examining some assumed cost sharing arrangements for irrigation enterprises, and (3) examining some different sharing arrangements for dryland and irrigation

enterprises. It was noted previously that the details for the existing leases were obtained in a survey which was conducted for the purpose of studying and delineating these problems. The data which were used to illustrate the effects of these leasing arrangements on resource use, the level of operation, and product distribution, came from the same area and represented the irrigation operations on 18 farms. The original source of this data was Otto's study, which has been described in a preceding section.

The data for each farm was assembled as follows: (a) acres irrigated, (b) crops irrigated, (c) increases in yields due to irrigation, (d) prices of products, (e) annual services of the irrigation system, (g) additional labor required by the irrigation enterprise, (h) additional fertilizer for the irrigated land, (i) insurance and taxes on the irrigation plant, and (j) additional miscellaneous costs.

These data for individual farms were then used in the computation of (1) the mean value of all annual inputs or resource services furnished by the landlords and tenants which contributed to the increases in yields and thus to total product, and (2) the mean value of the increase in production attributable to irrigation.

In the computation of the mean value for the annual inputs, the dollar value for each relevant input for the 18 farms was first calculated. The relevant inputs were:

(1) the services of the irrigation plant

(a) depreciation
(b) interest on investment
(c) repairs
(d) taxes
(e) special labor

(2) the cost of applying water

(a) fuel and oil (b) labor

(3) additional production costs

(a) fertilizer (b) increased harvesting and cultivating costs

(4) annual other costs (ten percent of all costs except additional production costs)

The dollar values for each kind of input were added for the farms and the sum divided by 18 to obtain the mean value for annual inputs.

The mean value for the increase in production was computed similarly. For each crop on the 18 farms, increases in yields were multiplied by the market price (also taken from Otto's study) for that crop. The dollar values for all crops were added for the farms and the sum divided by 18 to obtain the mean value for the increase in production.

The total and average values of annual inputs attributable to irrigation for the 18 farms are summarized in Table 3. Table 4 is a summary of the total and average values of the increased returns which were a result of irrigation on the 18 farms. The average values of annual inputs and increased returns were used to illustrate the eight sharing arrangements which were examined.

The eight sharing arrangements with the relevant data are illustrated in Tables 5, 6, 7, and 8. They represent agreements between landlords and tenants relative to the contributions each of the two parties made to the irrigation enterprise and to the distribution of returns from irrigation. It first appeared that

Table 3. Total and average values of annual inputs attributable to irrigation for 18 South Central Kansas farms.

| | Value of annual inputs | |
|---|---|---|
| | Total | Average |
| Irrigation system: | | |
| Well | $ 793 | $ 44 |
| Pump | 1,000 | 56 |
| Motor | 640 | 36 |
| Main line | 1,656 | 92 |
| Lateral line | 1,428 | 79 |
| Sprinklers | 246 | 14 |
| Other | 26 | 1 |
| Expenses: | | |
| Repairs | 1,640 | 91 |
| Fuel | 3,502 | 195 |
| Oil | 207 | 11 |
| Labor | 2,001 | 111 |
| Special labor | 165 | 9 |
| Fertilizer | 4,362 | 242 |
| Taxes | 899 | 50 |
| Additional production costs | 5,515 | 306 |
| Other costs | 2,158 | 120 |
| Depreciation | 8,821 | 490 |
| Totals | $35,059 | $1,947 |

Table 4. Total and average values of increases in returns attributable to irrigation for 18 South Central Kansas farms.

| Crop | Acres | Increased yield bu/T | Price | Value of increased returns | |
|---|---|---|---|---|---|
| | | | | Total | Average |
| Wheat | 219 | 3,405 | $ 2.04 | $ 6,946 | $ 386 |
| Grain sorghum | 328 | 10,642 | 1.21 | 12,876 | 715 |
| Forage sorghum | 134 | 1,003 | 6.00 | 6,018 | 334 |
| Alfalfa | 323 | 912 | 22.00 | 20,064 | 1,115 |
| Corn (silage) | 5 | 30 | 7.00 | 210 | 12 |
| Sudangrass* | 119 | | | 2,474 | 137 |
| Other temporary pasture* | 53 | | | 961 | 53 |
| Totals | | | | $49,549 | $2,752 |

*See Table 23 for explanation of the derivation of the increased returns.

the examination of these sharing arrangements was to be complicated by the provisions in them for the distribution of returns. The arrangements for sharing returns provided for distribution of the total returns from irrigation, not the increased returns actually attributable to irrigation. It was important that these provisions be recognized because (1) the data used in the analysis was related to costs and returns which were a result of irrigation, and (2) a part of total returns from irrigated land are returns which could have been realized without irrigation, and this part should not be considered when a comparison of irrigation costs and returns is made. However, in seven of the eight sharing arrangements considered, the returns from irrigation were distributed in the same proportion as were the returns from the dryland enterprise. It was therefore possible to impose on these seven sharing arrangements the cost and return data obtained for use in examining these sharing arrangements without further consideration of the complication related to distribution of returns. For the other sharing arrangement some adjustment was made so that it could be included in the analysis.

## Examination of Actual Cost and Return Sharing Arrangements for Eight Farms with Irrigation Enterprises

Test of Hypothesis (1). The first test of the eight sharing arrangements was to ascertain whether the variable costs related to the irrigation enterprise were shared in the same proportion as returns attributable to irrigation were shared. It has been pointed out that for an individual enterprise it is necessary

that marginal costs for each crop be equated with marginal returns, and that marginal returns for all crops must be equated if marginal costs and marginal returns for the enterprise are to be equated. It was not possible to study these irrigation enterprises on a crop by crop basis, but it was possible to look at the enterprise as a whole and to examine the arrangements for sharing costs and returns for the enterprise.

Sharing Arrangements 1 and 2 (in Table 5) were found to be identical. In these two cases returns were being shared on a one-third two-thirds basis and the cost of one input, fertilizer, was shared in the same proportion. These sharing arrangements did not provide for the fulfillment of the marginal conditions necessary for operation at maximum profits.

Sharing Arrangement 3 was one of the cases where returns for irrigation were distributed in proportions different from those for the dryland enterprise. Cash rent of eight dollars per acre was paid for the irrigated land. Of this amount approximately six dollars would have represented a fair return for the land if it were not irrigated ($150 per acre at four percent). It was assumed that a two dollar return was paid for the use of the land resource in the irrigation enterprise. This provided for the landlord five percent of the returns attributable to irrigation ($2.00 per acre for 65 acres). The costs of two inputs were shared. Fertilizer expense was shared on a one-third two-thirds basis, and additional harvesting costs were shared on a one-tenth nine-tenths basis. Incentives for more extensive use of resources

Table 5. Illustration of two sharing arrangements for sharing costs and returns for sprinkler irrigation in Kansas.

| Items | Annual costs and returns * | Sharing Arrangement 1 | | Sharing Arrangement 2 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| Irrigation System: | $ | $ | $ | $ | $ |
| Well | 44 | 44 | | 44 | |
| Pump | 56 | 56 | | 56 | |
| Motor | 36 | 36 | | 36 | |
| Main line | 92 | 92 | | 92 | |
| Lateral line | 79 | 79 | | 79 | |
| Sprinklers | 14 | 14 | | 14 | |
| Other | 1 | 1 | | 1 | |
| Operating Expenses: | | | | | |
| Repairs | 91 | | 91 | | 91 |
| Fuel | 195 | | 195 | | 195 |
| Oil | 11 | | 11 | | 11 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | 81 | 161 | 81 | 161 |
| Taxes | 50 | 50 | | 50 | |
| Additional production costs | 306 | | 306 | | 306 |
| Other costs | 120 | 60 | 60 | 60 | 60 |
| Depreciation | 490 | 490 | | 490 | |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $1,003 | $ 944 | $1,003 | $ 944 |
| Percent of Total Costs | | 51% | 49% | 51% | 49% |
| Increased Returns | $2,752 | | | | |
| Shares of Returns | | $ 917 | $1,835 | $ 917 | $1,835 |
| Percent of Increased Returns | | 33% | 67% | 33% | 67% |

*Based on data for 18 South Central Kansas farms.

Table 6. Illustration of two sharing arrangements for sharing costs and returns for sprinkler irrigation in Kansas.

| Items | Annual costs and returns * | Sharing Arrangement 3 | | Sharing Arrangement 4 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| Irrigation System: | $ | $ | $ | $ | $ |
| Well | 44 | | 44 | 44 | |
| Pump | 56 | | 56 | | 56 |
| Motor | 36 | | 36 | | 36 |
| Main line | 92 | | 92 | | 92 |
| Lateral line | 79 | | 79 | | 79 |
| Sprinklers | 14 | | 14 | | 14 |
| Other | 1 | | 1 | | 1 |
| Operating Expenses: | | | | | |
| Repairs | 91 | | 91 | | 91 |
| Fuel | 195 | | 195 | 65 | 130 |
| Oil | 11 | | 11 | 4 | 7 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | 81 | 161 | 121 | 121 |
| Taxes | 50 | | 50 | 7 | 43 |
| Additional production costs | 306 | 30 | 276 | 102 | 204 |
| Other costs | 120 | | 120 | | 120 |
| Depreciation | 490 | | 490 | 69 | 421 |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $ 111 | $1,836 | $ 412 | $1,535 |
| Percent of Total Costs | | 6% | 94% | 21% | 79% |
| Increased Returns | $2,752 | | | | |
| Shares of Returns | | $ 130 | $2,622 | $ 917 | $1,835 |
| Percent of Increased Returns | | 5% | 95% | 33% | 67% |

*Based on data for 18 South Central Kansas Farms.

Table 7. Illustration of two sharing arrangements for sharing costs and returns for sprinkler irrigation in Kansas.

| Items | Annual costs and returns * | Sharing Arrangement 5 | | Sharing Arrangement 6 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| | $ | $ | $ | $ | $ |
| Irrigation System: | | | | | |
| Well | 44 | | 44 | 44 | |
| Pump | 56 | | 56 | 56 | |
| Motor | 36 | | 36 | 36 | |
| Main line | 92 | | 92 | 92 | |
| Lateral line | 79 | | 79 | 79 | |
| Sprinklers | 14 | | 14 | 14 | |
| Other | 1 | | 1 | 1 | |
| Operating Expenses: | | | | | |
| Repairs | 91 | | 91 | | 91 |
| Fuel | 195 | | 195 | | 195 |
| Oil | 11 | | 11 | | 11 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | 121 | 121 | | 242 |
| Taxes | 50 | | 50 | 50 | |
| Additional production costs | 306 | 46 | 260 | | 306 |
| Other costs | 120 | | 120 | 60 | 60 |
| Depreciation | 490 | | 490 | 490 | |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $ 167 | $1,780 | $ 922 | $1,025 |
| Percent of Total Costs | | 9% | 91% | 47% | 53% |
| Increased Returns | $2,752 | | | | |
| Shares of Returns | | $1,134 | $1,618 | $ 917 | $1,835 |
| Percent of Increased Returns | | 41% | 59% | 33% | 67% |

*Based on data for 18 South Central Kansas farms.

Table 8. Illustration of two sharing arrangements for sharing costs and returns for sprinkler irrigation in Kansas.

| Items | Annual costs and returns * | Sharing Arrangement 7 | | Sharing Arrangement 8 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| | $ | $ | $ | $ | $ |
| Irrigation System: | | | | | |
| Well | 44 | 44 | | 44 | |
| Pump | 56 | 56 | | 56 | |
| Motor | 36 | 36 | | | 36 |
| Main line | 92 | 92 | | | 92 |
| Lateral line | 79 | 79 | | | 79 |
| Sprinklers | 14 | 14 | | | 14 |
| Other | 1 | 1 | | | 1 |
| Operating Expenses: | | | | | |
| Repairs | 91 | 46 | 45 | | 91 |
| Fuel | 195 | 97 | 98 | | 195 |
| Oil | 11 | 6 | 5 | | 11 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | 121 | 121 | | 242 |
| Taxes | 50 | 50 | | 15 | 35 |
| Additional production costs | 306 | 153 | 153 | | 306 |
| Other costs | 120 | 60 | 60 | | 120 |
| Depreciation | 490 | 490 | | 136 | 354 |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $1,345 | $ 602 | $ 251 | $1,696 |
| Percent of Total Costs | | 69% | 31% | 13% | 87% |
| Increased Returns | $2,752 | | | | |
| Shares of Returns | | $1,376 | $1,376 | $ 917 | $1,835 |
| Percent of Increased Returns | | 50% | 50% | 33% | 67% |

*Based on data for 18 South Central Kansas farms.

were absent, and the reasons for differences in cost sharing for the two inputs were not evident.

Sharing Arrangement 4 provided for a one-third two-thirds distribution of returns. Some cost sharing was being carried out. The costs for fuel and oil and the additional production costs were shared in the same proportion as returns were shared. Fertilizer costs were shared on a 50-50 percent basis, but all other costs were borne entirely by either the landlord or tenant.

For the irrigation enterprise illustrated by Sharing Arrangement 5, the sharing of returns from row crops was different from the sharing of returns from hay crops and temporary pasture. Here there was an incentive for the tenant to allocate his resources in such a manner that most of them would be utilized in producing row crops. He received two-thirds of the returns from row crops as opposed to one-half the returns from hay and pasture. Returns for the landlord and tenant were calculated by dividing the average returns for row crops for the 18 farms between landlord and tenant on a one-third two-thirds basis and by dividing the average returns for hay and temporary pasture for the 18 farms between them on a one-half one-half basis. This division corresponded to the sharing arrangement for returns from the dryland enterprise for this farm. The shares of returns finally amounted to 41 percent of the total for the landlord and 59 percent for the tenant. Fertilizer costs were shared on a 50-50 percent basis and additional production costs on a 15-85 percent basis. Again there was little apparent incentive for extending the use of resources.

The tenant logically applied his labor and other resources up to the point where marginal costs and marginal returns were equal for him.

Sharing Arrangement 6 provided for a one-third two-thirds distribution of the increased returns, and the costs for one input, the "other costs", were shared on a 50-50 percent basis. The incentives for providing optimum amounts of each resource were almost entirely lacking. The sharing agreement for the "other costs" was apparently an arbitrary one, because there was no sound reason for dividing the cost of this input in a proportion other than that used to distribute returns.

The irrigation enterprise which is represented by Sharing Arrangement 7 was different from the other seven enterprises studied. On this farm, every acre had been irrigated to some extent. Some crops had been rather intensively watered, while others had received only enough water to insure that initial growth would be adequate. The sharing arrangement provided for a 50-50 percent distribution of returns to landlord and tenant, and for cost sharing in that same proportion for all inputs except for the annual services of the irrigation system and labor. This agreement was based on the belief that the investment in the irrigation system (as it was reflected in annual services) was offset by the labor required for the operation. This sharing arrangement represents an attempt to equate or balance one group of inputs between two parties and then to share the other group of inputs in the same proportion as returns were shared. The lease actually

provided many of the incentive conditions needed to allow and encourage efficient resource use. In this respect it was the best lease of the eight which were examined.

The provision for distribution of returns from irrigation in Sharing Arrangement 8 was the more common one-third two-thirds division. None of the costs of the variable inputs were shared. The incentive conditions which would encourage the landlord and and tenant to make the most efficient use of their combined resources were absent from this sharing arrangement.

These eight sharing arrangements have not contained, in general, provisions for sharing costs of the variable inputs necessary for irrigation according to the given agreements for the sharing of returns from irrigation. The incentives for landlords and tenants to provide resources in quantities that would result in the most efficient use of the resources were not found in the sharing arrangements. It was not likely that any of the eight enterprises were operated at a level which would maximize profits, or where marginal costs would be equal to marginal revenue for the enterprise.

Test of Hypothesis (2). The second test of the eight sharing arrangements was to determine whether the returns for the various enterprises were distributed according to the contributions of the respective landlords and tenants. The leasing condition which is necessary to insure equitable division of returns is: the share of income going to each party must represent the product of the resources furnished by each individual. This condition provides

the criterion for testing the sharing arrangements.

Theoretically, it is impossible to separate efficiency in resource use and equitability in product distribution. Efficient resource use demands that factors of production be readily available for combination in such a manner that they can be employed to produce an optimum product. Conceptually when the marginal value product is imputed as a reward to each factor and the resource owners then receive a return based on the resources they control, then the incentives for making resources available are present and efficient utilization of the resources is the result.

This test of the sharing arrangements first required that the marginal value products be calculated for the resources furnished by the landlords and tenants.

To calculate these marginal value products a production function of the Cobb-Douglas least squares type was used. This function is linear in the logarithms and from it productivity coefficients may be estimated. The coefficients are actually elasticities of production. Each coefficient represents the percentage change in output associated with a one percent increase in a given input when other inputs are held constant. "The value of the marginal product may be obtained from the production function by differentiating the function with respect to a particular variable. When this partial derivative is evaluated at a point, say $(\bar{X}_1,\bar{Y})$ where $\bar{X}_1$ is the mean of the input used in the partial derivative and $\bar{Y}$ is the mean output, then the value of the output

for an additional unit of $X_1$ is obtained."[1]

The production function was of the following form:

$$Y = aX_1^{b_1}, X_2^{b_2}, X_3^{b_3}, X_4^{b_4}$$

where Y = the value of the increased production due to irrigation

$X_1$ = the annual services of the irrigation plant (interest, repairs, depreciation, taxes, and special labor)

$X_2$ = the annual cost of applying water (fuel, oil, and labor)

$X_3$ = the annual added production costs (fertilizer and increased cultivating and harvesting costs)

$X_4$ = the annual other costs (ten percent of all costs, except added production costs, for insurance, small tools, and other items of expense not classified above)

The coefficients $b_1$, $b_2$, $b_3$, $b_4$ were elasticities of production and "a" was a constant. The numerical values for the $b_i$'s, their standard errors, and the values for "t" are presented in Table 9. The "t" test was the appropriate statistical test which was applied to the regression coefficients to determine the likelihood of obtaining such relationships. Two of the coefficients were significant at the ten percent level or better; the other two were significant at the 20 percent level or better.

Table 9. Coefficients of function, standard errors, and values of "t".

| | a | : $b_1$ | : $b_2$ | : $b_3$ | : $b_4$ |
|---|---|---|---|---|---|
| Numerical value | .02020 | 1,38248 | .70199 | 1.08701 | -1.77171 |
| Standard error | | .65049 | .44035 | .25556 | 1.00473 |
| Value of "t" | | 2.125 | 1.594 | 4.253 | 1.763 |

[1]Paul L. Kelley, Henry Tucker, and Milton L. Manuel, Resource Returns and Productivity Coefficients in the Kansas Cooperative Grain Elevator Industry, Kansas Agricultural Experiment Stations Technical Bulletin 84, p. 10.

The required value of "t" for 13 degrees of frequency were:

at $\alpha$ = .1% = 4.221
at $\alpha$ = 1% = 3.012
at $\alpha$ = 5% = 2.160
at $\alpha$ = 10% = 1.771
at $\alpha$ = 20% = 1.350

Marginal value products were computed as follows:

$$MVP_i = \frac{\bar{y}_i}{\bar{x}_i} (b_i)$$

where antilogs of simple log means of $y_i$ and $x_i$ were used. These marginal value products were:

$X_1 = 3.37013$ $X_3 = 5.54335$

$X_2 = 5.01901$ $X_4 = -34.18272$

The illogical result in this derived function was the negative $b_4$ coefficient. This resulted in a negative marginal value product ($X_4 = -34.18272$) which was interpreted to mean that the addition of one dollar's worth of the $X_4$ resource returned a minus \$34.18. Such a conclusion was not acceptable for use in imputing returns.

A further attempt to obtain usuable marginal value products was the fitting of a second production function of the same type to reaggregated data. It was of the following form:

$$Y = aX_1^{b1}, X_2^{b2}, X_3^{b3}$$

where Y = the value of the increased production due to irrigation

$X_1$ = the annual services of the irrigation plant (interest, repairs, depreciation, taxes, and special labor)

$X_2$ = the annual cost of applying water (fuel, oil, and labor)

$X_3$ = the annual added production costs (increased cultivating and harvesting costs) and other costs (ten percent of all costs except added production costs)

The numerical values for the new $b_i$'s, their standard errors, and the values for "t" are presented in Table 10.

Table 10. Coefficients of function, standard errors, and values of "t".

| | a | : $b_1$ | : $b_2$ | : $b_3$ |
|---|---|---|---|---|
| Numerical value | 1.4175 | .28688 | -.03592 | .88710 |
| Standard error | | .31444 | .24599 | .22390 |
| Value of "t" | | .9124 | .1460 | 3.9620 |

The required value of "t" for 14 degrees of frequency were:

at $\alpha$ = 1% = 2.977
at $\alpha$ = 10% = 1.761
at $\alpha$ = 40% = .868
at $\alpha$ = 50% = .692

Only one coefficient was significant at a level better than ten percent. Marginal value products were:

$X_1$ = .69934 $\qquad$ $X_3$ = 3.48823

$X_2$ = -.25682

Again a negative coefficient was present and a negative marginal value product resulted. The negative marginal value product implies that the addition of one dollar's worth of the $X_2$ resource returned a minus $2.57. The total product (Y) would be decreased, and such a conclusion was not logical or acceptable. If returns were distributed according to the marginal value products, the party contributing the $X_2$ input would get nothing.

The poor results obtained were probably a result of inadequate data. Normally, a sample of at least 50 farms is considered to be necessary for fitting functions of the type used here. Reaggregation of data did not produce better results. The

combination of the $X_3$ and $X_4$ variables for the second function fitted apparently caused a marked change in the manner in which all the variables were estimated to affect output, and probably only introduced bias into the estimation. There are limitations here which include inadequate data, problems in aggregation, and problems in stratification.

In a study of tenant-operated farms in Iowa, Heady used this technique of analysis with better results.[1] His purpose was to compare the marginal product method of imputing shares to the average product method of imputing shares to landlord and tenant. Through the use of a Cobb-Douglas production function he was able to compute marginal value products for the inputs contributed by landlords and tenants which were usable for share imputation. He found, however, that the imputational shares computed under the marginal product method were very different from shares established under existing leasing arrangements and from shares computed under the average product method. For Iowa tenants the two methods actually yielded almost opposite results. The mean value of resource services contributed by Southern Iowa tenants was 67.7 percent and the mean value of crop production received by them was 51 percent. Returns imputed by the marginal product method for these tenants amounted to 36.3 percent. The mean value of resource services contributed by Northern Iowa tenants was 54.3 percent and the mean value of crop production received by them

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[1]Earl O. Heady, Marginal Productivity of Resources and Imputation of Shares for Cash and Share Rented Farms, Iowa Agricultural Experiment Stations Research Bulletin 433, p. 602.

was 53 percent. Returns imputed by the marginal product method for these tenants amounted to 24.6 percent.[1] These differences were so great that Heady found it doubtful that the marginal product method (1) could have been applied effectively, (2) would have been acceptable as a basis for allocating the total product, or (3) had close relationship to the relative market demand for various resources.

Heady found that the marginal productivity analysis applied in his study had limitations of three kinds.[2] One kind of limitation dealt with problems in estimation of coefficients. The Cobb-Douglas function, which is linear in the logarithms, imposed certain constraints on the estimates. One condition imposed by the logarithmic equation was that the elasticity of production was constant over the entire range of resources employed. Another condition was that the productivity curve for any single resource becomes asymptotic over extreme ranges of the variables.[3] This function was used however and was probably regarded as an acceptable estimating equation in terms of the funds available for research and in view of the fact that the computed productivities did not lie at extreme ranges of the observations.

The second limitation dealt with the use of marginal productivity coefficients in imputing shares of total production to

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[1]Earl O. Heady, op. cit., p. 611.
[2]Loc. cit.
[3]Earl O. Heady, Productivity and Income of Labor and Capital on Marshall Silt Loam Farms in Relation to Conservation Farming, Iowa Agricultural Experiment Stations Bulletin 401, p. 514.

landlord and tenant. Few production function estimates have yielded production elasticities which totaled exactly one. For this reason, the marginal product method has always given absolute shares for tenant and landlord which totaled more or less than the actual product. There has been no basis for distributing this surplus or deficit to the landlord and tenant.

The third limitation dealt with aggregation of inputs and stratification of samples. Heady's study was developed in terms of a single broad category of capital services. His sample did not allow a detailed analysis which would have shown how the productivity of particular forms of capital resources were affected by various leasing arrangements. He felt that samples were needed which would allow much more detail in stratification.

Because the marginal product method for imputing shares was not usable for this analysis, it was necessary to use the average product method for imputing shares to check the sharing arrangements for equitability in distributing returns. Actually, the productivity figure which ordinarily has been used is an average product rather than a marginal product. Heady found this to be true in his investigation of tenure and leases. "The average product of all resources aggregated into a simple input category is used by landlords and tenants when they compute the value of the resource services contributed by each and divide the year's production on the basis of the ratio $X_t / X_1$ where $X_t$ refers to the value of resource services contributed by the tenant and $X_1$ is the value of resource services contributed by the landlord.

The average product is used since the total product is, in effect, divided by the total input of services. The return to tenant and landlord, respectively, then is the average return for each one dollar of resource services furnished by each whether these resources are labor, capital, or land."[1] The average product method of imputing shares to two or more resource owners does not give the same result as the marginal product method in most cases. Only when the resources furnished by landlords and tenants are technical complements or substitute for each other at a constant rate, and when constant returns to scale hold true do the two methods of imputing shares give like results. The average product method of imputing shares was used, however, to check the eight sharing arrangements for their effectiveness in equitably distributing returns.

Sharing Arrangements 1 and 2 (Table 5) provided for the sharing of costs for irrigation on a 51-49 percent basis, while increased returns were shared on a 33-67 percent basis. These sharing arrangements, as they were illustrated by the cost and return data used, did not provide for returns to the landlords sufficient to cover their contributions to the enterprises. The tenants, on the other hand, realized returns which were almost 100 percent greater than their contributions. The arrangements for sharing costs were definitely not related to the provisions for distributing returns. For the irrigation enterprise alone, a 50-50

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[1]Earl O. Heady, Marginal Productivity of Resources and Imputation of Shares for Cash and Share Rented Farms, Iowa Agricultural Experiment Stations Bulletin 433, p. 607.

percent share of returns would be more equitable.

The landlord contributed only six percent of the variable costs attributable to the irrigation enterprise illustrated by Sharing Arrangement 3, while the tenant contributed 94 percent. The agreement for distribution of returns did correspond to the manner in which costs were shared. The landlord received five percent and the tenant 95 percent of the increased returns. While there was little sharing of costs, returns were based upon contributions, even if the result was an unconscious effort of the landlord and tenant.

Sharing Arrangement 4 provided for a 21-79 percent share of variable costs, and the shares of increased returns were made on a 33-67 percent basis. For both landlord and tenant, returns exceeded the contributions, but there was inequity in the distribution of the returns because the landlord got a greater proportionate share of returns than did the tenant.

There was considerable difference in the arrangement for sharing variable costs and increased returns in Sharing Arrangement 5. The costs were shared on a 9-91 percent basis, and the increased returns were distributed on a 41-59 percent basis. The share of costs for the tenant exceeded the share of returns paid to him by $162. The share of returns to the landlord exceeded his share of costs by approximately 700 percent, amounting to net returns of $967. There was not much incentive for the tenant to provide inputs such as labor, fuel, oil, and fertilizer in amounts that would bring the level of operation to a point

approaching that which would result in maximum profits for the enterprise.

Sharing Arrangement 6 did not exhibit equitability in the distribution of returns. The landlord provided 47 percent of the variable costs and received 33 percent of the increased returns. His compensation for the contribution he made to the enterprise was not sufficient to meet his actual expenditure. The tenant provided 53 percent of the variable costs and received 67 percent of the increased returns. He realized a net return of $810.

Sharing Arrangement 7 is an illustration of an attempt to develop an agreement for sharing costs and returns which would provide the incentives necessary to promote a level of operation that would be favorable for landlord and tenant. These two parties were of the opinion that the annual costs of the irrigation plant were offset by the labor required for irrigation. They then agreed to share operating costs on a 50-50 percent basis and to share increased returns on the same basis. The data used to illustrate this sharing arrangement did not support the hypothesis that the annual services of the irrigation plant were offset by the labor required for irrigation. The sharing of costs finally amounted to a contribution of 69 percent by the landlord and 31 percent by the tenant. The 50-50 percent sharing agreement for returns resulted in a net return to the landlord of only $31 and to the tenant $774.

Sharing Arrangement 8 provided for a 13-87 percent share of costs and a 33-67 percent share of increased returns. Both parties

realized returns which exceeded contributions, but the landlord received returns in excess of those earned by the resources which he contributed. The incentives for the tenant to provide resources in quantities which would be utilized efficiently were not present.

Only Sharing Arrangement 7 illustrated an attempt to share variable costs and to then pay to the resource owners a return vased on their respective contributions. In general, the shares of returns from irrigation have not been based on the contributions of the landlord and tenant.

Test of Hypothesis (3). The third test of the eight sharing arrangements for irrigation enterprises on farms in South Central Kansas consisted of a comparison of the sharing arrangements for returns from irrigation enterprises to the sharing arrangements for returns for the respective dryland enterprises. It has been pointed out that for a farm firm in equilibrium, the shares of marginal revenue for all enterprises must be the same. For this examination of returns it was necessary to deal with total returns from the two enterprises, because the attempt at marginal analysis was not successful. Comparison of sharing arrangements for total returns from the irrigation and dryland enterprises was useful and informative.

Table 11 represents the two sharing arrangements for each of the eight farms. Seven of the eight sharing arrangements for the irrigation enterprises contained the same provisions for distributing returns as did the respective sharing arrangements for dryland enterprises. One of this seven provided for different

shares of returns for hay and pasture than for row crop. So seven of the leasing arrangements studied were adequate in their provisions for sharing returns from irrigation in the same proportion that returns from dryland enterprises were shared, and six of them also provided for no differentiation in the shares of return received for various crops.

**Table 11.** Sharing arrangements for irrigation and dryland enterprises on eight farms in South Central Kansas.

| Farm Number | Type of Lease | Irrigation Enterprise: Landlord's Share | Irrigation Enterprise: Tenant's Share | Type of Lease | Dryland Enterprise: Landlord's Share | Dryland Enterprise: Tenant's Share |
|---|---|---|---|---|---|---|
| 1 | Crop share | 33% | 67% | Crop share | 33% | 67% |
| 2 | Crop share | 33% | 67% | Crop share | 33% | 67% |
| 3 | Cash | $8 per acre | 100% | Crop share | 33% | 67% |
| 4 | Crop share | 33% | 67% | Crop share | 33% | 67% |
| 5 | Crop share | 50% Hay<br>33% Row crop | 50% Hay<br>67% Row crop | Crop share | 50% Hay<br>33% Row crop | 50% Hay<br>67% Row crop |
| 6 | Crop share | 33% | 67% | Crop share | 33% | 67% |
| 7 | Crop share | 50% | 50% | Crop share | 50% | 50% |
| 8 | Crop share | 33% | 67% | Crop share | 33% | 67% |

The hypothesis that landlords have not shared the returns from irrigation enterprises in the same proportion as they have shared returns from dryland enterprises was repudiated.

## Examination of Assumed Cost Sharing Arrangements for Twelve Irrigation Enterprises

Test of Hypothesis (1). The preceding section was concerned with an examination of eight sharing arrangements for irrigation enterprises in South Central Kansas. These sharing arrangements may or may not have been representative of those which were applied on irrigation enterprises throughout the state. They were not a result of random sampling, and the number in the sample was small. This limitation prompted the development of some assumed sharing arrangements, designed to represent many common agreements between landlords and tenants relative to the use of resources. The intent was to examine these sharing arrangements for the effects they have on the sharing of costs. No attempt was made to examine the relationship of cost sharing to the sharing of returns. It was assumed that each party to the leasing contract would receive a return based on the contribution he made to the irrigation enterprise. Data from the 18 farms (described previously) was used in this analysis.

Tables 12,13,14,15,16, and 17 contain the 12 sharing arrangements which represent various possible and probable combinations of contributions.

Sharing Arrangements 1 through 4 were arranged to represent situations where the landlord provided the entire investment in the irrigation system. He was then liable for the property taxes on the plant and claimed the annual depreciation. The variations in these four sharing arrangements were in the manner in which

Table 12. Illustration of two arrangements for sharing costs of sprinkler irrigation in Kansas.

| Items | Annual cost * | Sharing Arrangement 1 | | Sharing Arrangement 2 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| Irrigation System: | $ | $ | $ | $ | $ |
| Well | 44 | 44 | | 44 | |
| Pump | 56 | 56 | | 56 | |
| Motor | 36 | 36 | | 36 | |
| Main line | 92 | 92 | | 92 | |
| Lateral line | 79 | 79 | | 79 | |
| Sprinklers | 14 | 14 | | 14 | |
| Other | 1 | 1 | | 1 | |
| Operating Expenses: | | | | | |
| Repairs | 91 | | 91 | | 91 |
| Fuel | 195 | | 195 | | 195 |
| Oil | 11 | | 11 | | 11 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | | 242 | 121 | 121 |
| Taxes | 50 | 50 | | 50 | |
| Additional production costs | 306 | | 306 | | 306 |
| Other costs | 120 | | 120 | | 120 |
| Depreciation | 490 | 490 | | 490 | |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $ 862 | $1,085 | $ 983 | $ 964 |
| Percent of Total Costs | | 44% | 56% | 50% | 50% |

*Based on data for 18 South Central Kansas farms.

Table 13. Illustration of two arrangements for sharing costs of sprinkler irrigation in Kansas

| Items | Annual cost * | Sharing Arrangement 3 | | Sharing Arrangement 4 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| Irrigation System: | $ | $ | $ | $ | $ |
| Well | 44 | 44 | | 44 | |
| Pump | 56 | 56 | | 56 | |
| Motor | 36 | 36 | | 36 | |
| Main line | 92 | 92 | | 92 | |
| Lateral line | 79 | 79 | | 79 | |
| Sprinklers | 14 | 14 | | 14 | |
| Other | 1 | 1 | | 1 | |
| Operating Expenses: | | | | | |
| Repairs | 91 | 46 | 45 | 31 | 60 |
| Fuel | 195 | 97 | 98 | 65 | 130 |
| Oil | 11 | 6 | 5 | 4 | 7 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | 121 | 121 | 81 | 161 |
| Taxes | 50 | 50 | | 50 | |
| Additional production costs | 306 | | 306 | | 306 |
| Other costs | 120 | 60 | 60 | 40 | 80 |
| Depreciation | 490 | 490 | | 490 | |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $1,192 | $ 755 | $1,083 | $ 864 |
| Percent of Total Costs | | 61% | 39% | 56% | 44% |

*Based on data for 18 South Central Kansas farms.

Table 14. Illustration of two arrangements for sharing costs of sprinkler irrigation in Kansas.

| Items | Annual cost * | Sharing Arrangement 5 | | Sharing Arrangement 6 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| Irrigation System: | $ | $ | $ | $ | $ |
| Well | 44 | 44 | | 44 | |
| Pump | 56 | 56 | | 56 | |
| Motor | 36 | | 36 | | 36 |
| Main line | 92 | | 92 | | 92 |
| Lateral line | 79 | | 79 | | 79 |
| Sprinklers | 14 | | 14 | | 14 |
| Other | 1 | | 1 | | 1 |
| Operating Expenses: | | | | | |
| Repairs | 91 | | 91 | | 91 |
| Fuel | 195 | | 195 | | 195 |
| Oil | 11 | | 11 | | 11 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | | 242 | 121 | 121 |
| Taxes | 50 | 15 | 35 | 15 | 35 |
| Additional production costs | 306 | | 306 | | 306 |
| Other costs | 120 | | 120 | | 120 |
| Depreciation | 490 | 136 | 354 | 136 | 354 |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $ 251 | $1,696 | $ 372 | $1,575 |
| Percent of Total Costs | | 13% | 87% | 19% | 81% |

*Based on data for 18 South Central Kansas farms.

Table 15. Illustration of two arrangements for sharing costs of sprinkler irrigation in Kansas.

| Items | Annual costs * | Sharing Arrangement 7 | | Sharing Arrangement 8 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| Irrigation System: | $ | $ | $ | $ | $ |
| Well | 44 | 44 | | 44 | |
| Pump | 56 | 56 | | 56 | |
| Motor | 36 | | 36 | | 36 |
| Main line | 92 | | 92 | | 92 |
| Lateral line | 79 | | 79 | | 79 |
| Sprinklers | 14 | | 14 | | 14 |
| Other | 1 | | 1 | | 1 |
| Operating Expenses: | | | | | |
| Repairs | 91 | 46 | 45 | 31 | 60 |
| Fuel | 195 | 97 | 98 | 65 | 130 |
| Oil | 11 | 6 | 5 | 4 | 7 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | 121 | 121 | 81 | 161 |
| Taxes | 50 | 15 | 35 | 15 | 35 |
| Additional production costs | 306 | | 306 | | 306 |
| Other costs | 120 | 60 | 60 | 40 | 80 |
| Depreciation | 490 | 136 | 354 | 136 | 354 |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $ 581 | $1,366 | $ 472 | $1,475 |
| Percent of Total Costs | | 30% | 70% | 24% | 76% |

*Based on data for 18 South Central Kansas farms.

Table 16. Illustration of two arrangements for sharing costs of sprinkler irrigation in Kansas.

| Items | Annual costs * | Sharing Arrangement 9 | | Sharing Arrangement 10 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| Irrigation System: | $ | $ | $ | $ | $ |
| Well | 44 | 44 | | 44 | |
| Pump | 56 | 56 | | 56 | |
| Motor | 36 | 36 | | 36 | |
| Main line | 92 | | 92 | | 92 |
| Lateral line | 79 | | 79 | | 79 |
| Sprinklers | 14 | | 14 | | 14 |
| Other | 1 | | 1 | | 1 |
| Operating Expenses: | | | | | |
| Repairs | 91 | | 91 | | 91 |
| Fuel | 195 | | 195 | | 195 |
| Oil | 11 | | 11 | | 11 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | | 242 | 121 | 121 |
| Taxes | 50 | 21 | 29 | 21 | 29 |
| Additional production costs | 306 | | 306 | | 306 |
| Other costs | 120 | | 120 | | 120 |
| Depreciation | 490 | 199 | 291 | 199 | 291 |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $ 356 | $1,591 | $ 477 | $1,470 |
| Percent of Total Costs | | 18% | 82% | 24% | 76% |

*Based on data for 18 South Central Kansas farms.

Table 17. Illustration of two arrangements for sharing costs of sprinkler irrigation in Kansas.

| Items | Annual cost * | Sharing Arrangement 11 | | Sharing Arrangement 12 | |
|---|---|---|---|---|---|
| | | Landlord | Tenant | Landlord | Tenant |
| Irrigation System: | $ | $ | $ | $ | $ |
| Well | 44 | 44 | | 44 | |
| Pump | 56 | 56 | | 56 | |
| Motor | 36 | 36 | | 36 | |
| Main line | 92 | | 92 | | 92 |
| Lateral line | 79 | | 79 | | 79 |
| Sprinklers | 14 | | 14 | | 14 |
| Other | 1 | | 1 | | 1 |
| Operating Expenses: | | | | | |
| Repairs | 91 | 46 | 45 | 31 | 60 |
| Fuel | 195 | 97 | 98 | 65 | 130 |
| Oil | 11 | 6 | 5 | 4 | 7 |
| Labor | 111 | | 111 | | 111 |
| Special labor | 9 | | 9 | | 9 |
| Fertilizer | 242 | 121 | 121 | 81 | 161 |
| Taxes | 50 | 21 | 29 | 21 | 29 |
| Additional production costs | 306 | | 306 | | 306 |
| Other costs | 120 | 60 | 60 | 40 | 80 |
| Depreciation | 490 | 199 | 291 | 199 | 291 |
| Total Costs | $1,947 | | | | |
| Shares of Costs | | $ 686 | $1,261 | $ 577 | $1,370 |
| Percent of Total Costs | | 35% | 65% | 30% | 70% |

*Based on data for 18 South Central Kansas farms.

operating expenses were shared.

In Sharing Arrangement 1, the tenant provided all operating costs (except taxes and depreciation). For the irrigation enterprise as it was reflected in this example, the landlord had provided a significant share of all costs, and his share of the returns should have been based upon his contribution to the enterprise. He should have therefore received 44 percent of the increase in returns which were attributable to irrigation.

Sharing Arrangement 2 presented a 50-50 percent share of costs situation. The landlord had contributed one-half of the cost of fertilizer in addition to the annual services of the irrigation plant, the taxes, and depreciation. In this case any share imputed to him other than 50 percent of the increased returns due to irrigation would have been inequitable.

In Sharing Arrangement 3, the landlord had provided the annual services of the plant, the taxes, depreciation, and one-half of all operating expenses except for the labor involved in the irrigation, the special labor or technical assistance which may have been needed, and the additional production costs. This combination of inputs has been a result of the belief that the additional labor required for irrigation offsets the investment, as it is reflected in the annual services of the plant. This particular case did not lend any support to that belief. The landlord actually supplied almost two-thirds of the costs. If he had received only 50 percent of the increased returns, he would have been little more than compensated for the inputs he contributed. The tenant, on

the other hand, would have received a high return on his contribution which was primarily labor.

Sharing Arrangement 4 was very similar to Sharing Arrangement 3. The landlord contributed the annual services of the irrigation system, the taxes, depreciation, and two-thirds of all operating expenses except for labor, special labor, and additional production costs. This arrangement approached the 50-50 percent arrangement of Sharing Arrangement 2, but the landlord's contribution was 56 percent, and any division of increased returns that differed from this would have been inequitable.

Sharing arrangements 5 through 8 were designed to represent situations where the landlord had contributed only part of the irrigation plant - the well and pump plus the taxes and depreciation related to them. Some farmers have expressed a belief that anything which is attached to the land (such as the well and pump) should be a contribution of the landlord, and that all transportable items should be a contribution of the tenant. This belief was incorporated in these sharing arrangements, at least inso-far as the investment in the irrigation plant was concerned. Examination of these four cost sharing possibilities revealed that a landlord's contribution to an irrigation enterprise was considerably reduced when he provided only the well and pump. The tenant involved in such a sharing arrangement should have been interested in an adequate return on his relatively large investment. Careful attention to the contributions of each party would have been necessary to assure a proper distribution of the increased returns.

Sharing Arrangements 9 through 12 represented situations where the landlord had contributed the well, pump, and motor, plus the taxes and depreciation related to them. There probably have been instances where the motor has been regarded as a fixed item along with the well and pump. For this reason this series of illustrations, which were similar to the previous ones, were developed so that these changed combinations of inputs could be observed.

One rather important observation which was made possible by this examination of the 12 possible cost sharing arrangements was that the manner in which the investment in the irrigation system was shared significantly affected the annual contribution by the landlord. When his investment included only the well and pump, his contribution became the annual services of these two items plus the related taxes and depreciation, and amounted to 13 percent of the total annual costs. If he increased his investment to include the motor, his contribution amounted to 18 percent. If his investment included the entire irrigation plant, his contribution of annual services of the plant, taxes, and depreciation rose to 44 percent. From this point little more cost sharing was necessary to bring the landlord's annual contribution up to a level where a 50-50 percent sharing of costs was realized. Sharing Arrangement 2 illustrated this situation. The landlord shared the cost of the fertilizer and brought his contributions up to 50 percent of the total. The manner in which the landlord shared in the investment in the irrigation plant thus became an important

factor in imputing returns to the two parties.

None of these sharing arrangements provided all the incentives necessary to encourage landlords and tenants to provide resources in such quantities that the most efficient use of them would be realized. Conceptually, all variable inputs should be shared. Practically, it is doubtful that cost sharing for each variable input can be achieved by and landlord and tenant. Such an arrangement would constitute a partnership, which would be intolerable in many cases. Many landlords have left the farm so that they could be relieved of some of the responsibilities of the farm manager and operator. Other landlords have business interests separate and different from those of the farm business, and they are not willing to devote much time and effort to the farming operation. Tenants often are limited in the amount of capital available to them and sometimes their supply of labor is inadequate for full time, year around farm operation. When these factors are considered, sharing arrangements similar to 3,4,7,8, 11, and 12 do not seem to be too far out of line with the "perfect" sharing arrangement which provides for maximum profits and efficient resource use.

## Examination of Different Sharing Arrangements for Dryland and Irrigation Enterprises

Test of Hypothesis (4). It was noted previously that the eight sharing arrangements for irrigation enterprises on South Central Kansas farms provided for the distribution of total returns from irrigation and not the increased returns from irrigation.

The preceding analyses dealt with the irrigation enterprises alone, and included an examination of costs and returns attributable to irrigation. For seven of the eight irrigation enterprises examined, these arrangements presented no problem, because the returns from irrigation were distributed in proportions paralleling the distribution of returns from the dryland portions of the farms. That part of the total returns from irrigation which would have been realized without irrigation, were shared in the same manner as were the returns actually attributable to irrigation. The sharing arrangements for returns from both enterprises for the seven farms were the same. For one of the irrigation enterprises however, the arrangement for distributing total returns from irrigation was not the same as the arrangement for distributing returns from the dryland enterprise. The consequences of this differential share lease may have been malallocation of resources and inequity in the distribution of returns.

The possible consequences of different sharing arrangements for the irrigation and dryland enterprises are illustrated in an example which was developed for this purpose. The following factors were taken as given in the example: (1) a 200 acre farm with the entire acreage devoted to the production of corn, (2) dryland yields amounting to 50 bushels per acre, (3) irrigated yields amounting to 100 bushels per acre, (4) a one-third two-thirds sharing arrangement for cost and returns for the dryland portion of the farm, and (5) a one-half one-half sharing arrangement for costs and returns for the irrigated portion of the farm.

Prior to irrigation this farm produced 10,000 bushels of corn. The tenant received 6,667 bushels return and the landlord received 3,333 bushels return. An irrigation operation was introduced into the farm operation and 50 acres of land were put under irrigation. Production then amounted to 7,500 bushels of corn from the dryland portion of the farm and 5,000 bushels of corn from the irrigated acreage. This was a total of 12,500 bushels of corn. If distribution of these quantities was made according to the given sharing arrangements, without any attempt to separate from the total production from the irrigated land the increment of corn production actually attributable to irrigation, the tenant and landlord would have received the following returns:

| | Tenant | Landlord |
|---|---|---|
| From the 150 acres of dryland | 5,000 bu. | 2,500 bu. |
| From the 50 acres of irrigated land | 2,500 bu. | 2,500 bu. |
| Total returns from 200 acres | 7,500 bu. | 5,000 bu. |

Of the total production of corn from the entire farm, the tenant received 60 percent and the landlord received 40 percent.

This distribution of production would not be equitable. The costs related to the irrigation enterprise were new or additional costs not included in the former dryland operation. The 5,000 bushels of corn produced on the irrigated land was not all attributable to irrigation; in fact only 2,500 bushels was produced as a direct result of the application of supplemental water (12,500 bushels total production with irrigation, minus 10,000 bushels prior to irrigation). The one-half one-half sharing arrangement for the irrigation enterprise was applied to the new or additional

costs, and to total returns, not increased returns.

Separation of the two increments of corn produced on the irrigated land and the proper imputation of shares resulted in the distribution of the 12,500 bushels as follows:

| | Tenant | : Landlord |
|---|---|---|
| From the 150 acres of dryland | 5,000 bu. | 2,500 bu. |
| From the 50 acres prior to irrigation | 1,667 bu. | 833 bu. |
| From the 50 acres due to irrigation | 1,250 bu. | 1,250 bu. |
| Total returns from 200 acres | 7,917 bu. | 4,583 bu. |

Of the total production of corn from the entire farm, the tenant received 63 percent and the landlord received 37 percent. The error in calculating shares amounted to 417 bushels, a significant amount to the hypothetical tenant of this example.

This problem could have been complicated by using a more realistic example, but the possibility for error in distributing returns was pointed out, and the possibility would still have existed in any realistic situation. This example was sufficient to illustrate the necessity for determining what the increase in yields is for an irrigation enterprise if different shares of returns for the dryland and irrigation enterprises are established and if the shares of returns (increased returns) from irrigation are to be distributed in accordance with the shares of costs related to irrigation.

The difficulty involved in separating increased yields, which are a result of the application of supplemental water, from total yields from an irrigated acreage, should not be overlooked. On most Kansas farms, the land which has been suitable for irrigation has been the better land, the most productive acreage. It is

likely that the irrigated acreage on these farms is different from and superior to the non-irrigated acreage with respect to topography, soil depth, and fertility. If average or annual yields from the non-irrigated acreage are used to estimate the production which can be expected from the acreage irrigated if no supplemental water is applied, and if this estimated production is then used to calculate increased yields which are attributable to irrigation, then the calculation must be expected to be in error to the extent of the differences in productivity of the land irrigated and the land not irrigated. The amount of error is dependent upon the differences in productivity of the two acreages involved, and it may be large or relatively insignificant.

This whole problem was avoided by seven of the eight farmers whose leases provided for the sharing of costs and returns for the irrigation enterprise in the same proportion as the costs and returns for the dryland portion of the farm were shared. There was no need for an attempted calculation of encreased returns, since all returns were shared in the same manner. There were inequities in those leases, but they came about because of the failure of landlords and tenants to properly evaluate their respective contributions. If errors in the distribution of returns can be reduced or eliminated by developing sharing arrangements for irrigation enterprises which provide for the distribution of returns in proportions paralleling those used for distributing returns from the dryland enterprise, it is only logical that such sharing arrangements be developed. Sharing of costs attributable to

irrigation according to the sharing of total returns from irrigation is not sufficient except where the costs and returns for the irrigation enterprise are shared in the same proportion as are the costs and returns for the dryland enterprise.

## THE DEVELOPMENT OF SHARING ARRANGEMENTS FOR FARMS WITH IRRIGATION ENTERPRISES

The development of sharing arrangements for farms with irrigation enterprises has been complicated by a lack of adequate cost and return data, a lack of understanding of the nature and function of a lease, and a lack of cooperation between many landlords and tenants. County agents and others who have been called upon for assistance in developing these leases have reported these complications. There have been instances where it has been difficult to get landlords and tenants to meet and to talk over the farm business. There have been discussions by landlords and tenants about irrigation and sharing arrangements which accomplished little or nothing because neither party had adequate knowledge of the financial and physical requirements of irrigation.

Data on costs and returns for sprinkler irrigation were made available with the publication of a bulletin by Otto and Pine.[1] Information about leasing arrangements in general can be found in Pine's bulletin concerning farm leasing arrangements in Kansas.[2] This study of sharing arrangements for farms with irrigation enterprises supplements these bulletins by providing some

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[1]Merton L. Otto and Wilfred H. Pine, op. cit. p. 8.
[2]Wilfred H. Pine, op. cit. pp. 10-47.

insight into the problems of landlords and tenants who are irrigating and by offering some suggestions for solving those problems. If landlords and tenants can now be encouraged to study and use these informative guides, better leases should be forthcoming.

There will probably continue to be situations where landlords and tenants will find themselves unable or unwilling to meet, to make an attempt to analyze the farm business, and to develop a lease which will reflect a high degree of cooperative effort by the two parties. These individuals are likely to ask for a short cut to the final leasing agreement. They will want to use rules of thumb in estimating costs, returns, shares, etc. If no assistance is offered to them, the lease may be more unfair and inequitable than if would be if some of those short cuts and rules of thumb are prepared for their use. There is no good substitute for a farm lease which has been developed after careful analysis of the farming operations and serious consideration of the contributions of the landlord and tenant. But a substitute can be developed by using averages, estimates, and approximations. Rules of thumb never actually fit given situations, and short cuts never account for all the variables involved in a productive enterprise. But both can be helpful to those persons who can not or will not spend the time and energy necessary to develop a fair and equitable lease. This section of the study is devoted to the discovery and illustration of a short cut to a sharing arrangement for a farm with an irrigation enterprise.

Tables 18, 19, 20, and 21 provide an estimate of the returns

which landlords should expect to receive from the whole farm operation when (1) an irrigation enterprise has been introduced, (2) a one-third two-thirds or two-fifths three-fifths dryland lease exists, and (3) when a specified portion of the farm (one-fourth, one-half, or all) is irrigated. For instance, if a landlord and tenant are operating with a one-third two-thirds share lease for a dryland farm, and they then introduce into the operation an irrigation enterprise involving one-fourth of the cultivated acreage, and the landlord pays 50 percent of the increased costs attributable to irrigation, and yields from the irrigated acreage are increased 100 percent, then he should receive 36.7 percent of the total returns from the whole farm operation.

The variables which must be specified for using the tables are: (1) the existing lease, (2) the landlord's share of the new costs, (3) the percent of land irrigated, and (4) the increase in irrigated yields.

Table 18. Landlord's share of total returns from the farm with (1) a specified percent of land irrigated, and (2) a specified share of costs of irrigation borne by the landlord, assuming a one-third two-thirds dryland lease and a 100 percent increase in irrigated yields.

| Percent irrigated | Landlord's share of irrigation costs | | | | | |
|---|---|---|---|---|---|---|
| | 20 | 33 | 40 | 50 | 67 | 75 |
| 25 | 30.7 | 33 | 34.7 | 36.7 | 40.0 | 41.7 |
| 50 | 28.9 | 33 | 36.2 | 38.9 | 44.4 | 47.2 |
| 100 | 26.7 | 33 | 36.7 | 41.7 | 50.0 | 54.2 |

Table 19. Landlord's share of total returns from the farm with (1) a specified percent of land irrigated, and (2) a specified share of costs of irrigation borne by the landlord, assuming a one-third two-thirds dryland lease and a 200 percent increase in irrigated yields.

| Percent irrigated | Landlord's share of irrigation costs | | | | | |
|---|---|---|---|---|---|---|
| | 20 | 33 | 40 | 50 | 67 | 75 |
| 25 | 28.9 | 33 | 36.2 | 38.9 | 44.4 | 47.2 |
| 50 | 26.7 | 33 | 36.7 | 41.7 | 50.0 | 54.2 |
| 100 | 24.5 | 33 | 37.8 | 44.4 | 55.5 | 61.1 |

Table 20. Landlord's share of total returns from the farm with (1) a specified percent of land irrigated and (2) a specified share of costs of irrigation borne by the landlord, assuming a two-fifths three-fifths dryland lease and a 100 percent increase in irrigated yields.

| Percent irrigated | Landlord's share of irrigation costs | | | | | |
|---|---|---|---|---|---|---|
| | 20 | 33 | 40 | 50 | 67 | 75 |
| 25 | 36.0 | 38.7 | 40 | 42.0 | 45.3 | 47.0 |
| 50 | 33.3 | 37.8 | 40 | 43.3 | 48.9 | 51.7 |
| 100 | 30.0 | 36.7 | 40 | 45.0 | 53.3 | 57.5 |

Table 21. Landlord's share of total returns from the farm with (1) a specified percent of land irrigated, and (2) a specified share of costs of irrigation borne by the landlord, assuming a two-fifths three-fifths dryland lease and a 200 percent increase in irrigated yields.

| Percent irrigated | Landlord's share of irrigation costs | | | | | |
|---|---|---|---|---|---|---|
| | 20 | 33 | 40 | 50 | 67 | 75 |
| 25 | 33.3 | 37.8 | 40 | 43.3 | 48.9 | 51.7 |
| 50 | 30.0 | 36.7 | 40 | 45.0 | 53.3 | 57.5 |
| 100 | 26.7 | 35.5 | 40 | 46.7 | 57.8 | 63.3 |

These tables were developed by using the example from a previous section of this study of a 200 acre farm which produced corn at the rate of 50 bushels per acre on dryland, and 100 bushels per acre on irrigated land. For the various portions of land irrigated (25, 50, and 100 percent), increases in yields were

first calculated. The basic dryland share for the landlord was then determined by multiplying either one-third or two-fifths (depending upon the sharing arrangement being considered) times the dryland production (50 bushels times 200 acres times one-third). The relevant landlord share of costs was then multiplied times the increase in yield and added to the landlord's dryland share. This sum was then calculated as a percent of total production from the farm. As an example, a situation was assumed with the following factors given:

(1) a one-third two-thirds share lease
(2) 50 percent share of irrigation costs by landlord
(3) 25 percent of land irrigated
(4) 100 percent increase in yields

| | bushels |
|---|---|
| Production from 150 dryland acres at 50 bushels per acre | 7,500 |
| Production from 50 acres prior to irrigation at 50 bushels per acre | 2,500 |
| Total dryland production in bushels | 10,000 |
| Increase in production from 50 irrigated acres, with a 100 percent increase in yields | 2,500 |
| Total production in bushels | 12,500 |

| | |
|---|---|
| Landlord's share - dryland | 3,333 |
| Landlord's share - irrigated land | 1,250 |
| Total landlord's share | 4,583 |

$$4{,}583 \div 12{,}500 = 36.7\%$$

These percentages are the same for any size farm as long as the percent of farm irrigated and increase in yields remains in the same proportions used in this illustration.

These tables were not regarded as sufficient for developing

a fair and equitable farm lease. Included in them are some arbitrary figures which probably are not representative of any irrigated farm in Kansas. These illustrations provide only a rule of thumb and should be used only when a detailed analysis of the farm operation is not possible. Their limitations are very apparent and should be considered when any use is made of them.

## SUMMARY AND CONCLUSIONS

The leasing problems of landlords and tenants who have developed irrigation enterprises on their farms were found to be very apparent. Some of these problems have arisen as a result of inadequate information about the required investment, the operating costs, the labor requirements, and the probable returns for an irrigation enterprise. Other problems have resulted from a lack of understanding of the application of a farm lease to the new enterprise.

The sharing arrangements for irrigation enterprises on rented farms in South Central Kansas which were examined in this study reflected the many and varied ideas of landlords and tenants concerning the sharing of costs and returns. Most of the sharing arrangements studied provided for a distribution of returns from irrigation enterprises in proportions which paralleled those for the dryland enterprises. In this respect they were adequate. But none of the sharing arrangements contained provisions for sharing variable costs to an extent that would promote efficient use of the combined resources of the landlord and tenant. The

shares of returns paid to the resource owners were not based upon their respective contributions, and they were therefore not encouraged to provide optimum amounts of resources for utilization in the irrigation operations.

Production economic theory suggests certain principles or conditions which must incorporated in a lease if the incentives for efficient resource use are to be present and if returns are to be equitably distributed. These principles were used as criteria for examining the leasing arrangements for farms with irrigation enterprises, and they are also usable as guides in reviewing present leases and in developing new ones. The conditions which should be recognized and considered by persons developing leases for farms with irrigation enterprises are as follows: For the irrigation enterprise (1) the arrangements for sharing costs and returns for each irrigated crop should be the same, and (2) the shares of returns for all irrigated crops should be the same. For the dryland enterprise (1) the arrangements for sharing costs and returns for each dryland crop should be the same, and (2) the shares of returns for all dryland crops should be the same. For the farm unit (1) the shares of returns for the irrigated crops should be the same as the shares of returns for the dryland crops, and (2) the share of income going to the landlord and tenant should represent the product of the resources furnished by each party.

An attempt was made to test some existing sharing arrangements for irrigation enterprises for their effectiveness in distributing returns by using the marginal product method of imputing

shares to calculate the shares of income which should have been received by each landlord and tenant on the respective farms. The productivity figure which usually is used is the average product rather than the marginal product, but the leasing conditions necessary for efficient resource use and equitable product distribution are stated in terms of marginal costs and marginal returns, and the shares of income should be based on the marginal value products for the inputs contributed by landlord and tenant. The attempt to test these sharing arrangements by using the marginal product method for imputing shares was unsuccessful. The sample was not adequate, and there were other limitations related to the method which complicated the analysis. The use of this method for imputing shares should be given further consideration in future studies. The leasing condition which insures equitable product distribution depends upon the successful use of the marginal product method for imputing shares. No other method may be substituted for it if the necessary conditions for profit maximization and equitable product distribution are to be fulfilled.

This investigation has been concerned primarily with problems related to the development of sharing arrangements for irrigation enterprises on farms in South Central Kansas. It is only a part of the research that will be necessary to satisfy the demand for information concerning leases and irrigation on farms in Kansas. Further work in this field of study should include an analysis of tenant-operated farms on which different water distribution systems are in use. Costs and returns for these farms may differ from those found on sprinkler-irrigated farms. Other parts of the state

should be included in further study of leases and irrigation too. Costs and returns may vary with soils, topography, depth of well, etc. An investigation of the productivity of resources used in irrigation would be valuable for further study of leasing problems.

Irrigation is being developed at a rapid rate, and a significant part of this development can be expected to take place on tenant-operated farms. The successful use of irrigation on these farms may well depend upon the effectiveness of the leasing arrangements. For this reason, efforts should be continually directed toward solving the problems of the landlord and tenant on irrigated farms.

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# APPENDIX

Table 22. Annual returns for 18 irrigation enterprises in South Central Kansas, 1954.

| Farm number | Repairs[1] | Fuel | Oil | Labor | Special labor | Fertilizer | Taxes[2] | Added production costs[3] | Other costs[4] | Depreciation | Interest on investment in system: Well | Pump | Motor | Main line | Lateral line | Sprinklers and other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | $ 160 | $ 127 | $ 8 | $ 97 | $ 10 | $ 298 | $ 77 | $ 245 | $ 159 | $ 813 | $ 105 | $ 105 | $ 55 | $ 219 | $ | $ 16 |
| 40 | 135 | 204 | 14 | 132 | | 388 | 85 | 500 | 171 | 754 | 45 | 65 | 70 | 175 | 172 | 23 |
| 42 | 235 | 50 | 29 | 78 | | 68 | 123 | 460 | 156 | 979 | 144 | 125 | 110 | 167 | 212 | 36 |
| 57 | 215 | 197 | 6 | 120 | | 1,320 | 123 | 300 | 318 | 1,195 | 70 | 140 | 75 | 230 | 249 | 32 |
| 2 | 37 | 149 | 9 | 133 | 2 | | 24 | 90 | 57 | 215 | 40 | 37 | | 35 | 30 | 13 |
| 3 | 10 | 96 | 3 | 81 | 20 | | 15 | 70 | 37 | 144 | 8 | 10 | | 40 | 30 | 7 |
| 5 | 34 | 160 | 10 | 182 | 83 | 9 | 19 | 120 | 84 | 342 | 32 | 32 | 2 | 52 | | |
| 6 | 52 | 386 | 10 | 200 | | | 28 | 150 | 89 | 218 | 25 | 50 | 2 | 100 | | |
| 10 | 69 | 465 | 21 | 128 | 30 | 152 | 49 | 400 | 139 | 461 | 57 | 72 | 17 | 117 | 40 | 10 |
| 34 | 31 | 182 | 5 | 110 | 20 | 86 | 24 | 550 | 78 | 323 | 7 | 11 | 20 | 37 | 62 | 11 |
| 37 | 97 | 204 | 7 | 191 | | 88 | 56 | 232 | 112 | 481 | 65 | 50 | 47 | 81 | 81 | 21 |
| 53 | 79 | 413 | 41 | 133 | | 1,011 | 44 | 410 | 208 | 358 | 50 | 65 | 14 | 73 | 68 | 32 |
| 20 | 100 | 145 | 18 | 82 | | 272 | 34 | 265 | 107 | 421 | 11 | 18 | 82 | 22 | 80 | 11 |
| 21 | 116 | 218 | 8 | 113 | | 341 | 56 | 451 | 146 | 611 | 24 | 62 | 54 | 72 | 125 | 20 |
| 22 | 86 | 247 | 8 | 32 | | 106 | 41 | 267 | 98 | 456 | 17 | 55 | 31 | 73 | 76 | 9 |
| 23 | 81 | 180 | 3 | 61 | | 36 | 37 | 225 | 83 | 433 | 41 | 75 | 6 | 39 | 65 | 11 |
| 27 | 60 | 32 | 5 | 57 | | | 38 | 150 | 50 | 310 | 32 | 5 | 55 | 69 | 69 | 11 |
| 44 | 23 | 47 | 2 | 71 | | 187 | 26 | 630 | 66 | 307 | 20 | 23 | | 55 | 69 | 3 |
| Totals | $1,640 | $3,502 | $ 207 | $2,001 | $ 165 | $4,362 | $ 899 | $5,515 | $2,158 | $8,821 | $ 793 | $1,000 | $ 640 | $1,656 | $1,428 | $ 272 |

[1]Estimated as 5 percent of installation costs.
[2]Computed at 31 mills (state average in 1954 on farm property) on 25 percent of installation costs.
[3]Estimated additional cultivating and harvesting costs.
[4]Estimated as 10 percent of all costs (except additional production costs).

Table 23. Annual returns for 18 irrigation enterprises in South Central Kansas, 1954.

| Farm number | Acres Irrigated | Wheat Acres | Wheat Increased yield bu. | Grain sorghum Acres | Grain sorghum Increased yield bu. | Forage Sorghum Acres | Forage Sorghum Increased yield T. | Alfalfa Acres | Alfalfa Increased yield T. | Corn Acres | Corn Increased yield T. | Sudangrass Acres | Sudangrass Total value | Sudangrass Increased value[2] | Other temporary pasture Acres | Other temporary pasture Total value | Other temporary pasture Increased value[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 50 | 30 | 10 | | | | | 20 | 3.0 | | | | | | | | |
| 40 | 80 | | | 40 | 28 | | | 40 | 1.0 | | | | | | | | |
| 42 | 80 | 40 | 33 | | | | | 40 | 3.7 | | | | | | | | |
| 57 | 120 | | | 120 | 40 | | | | | | | | | | | | |
| 2 | 25 | | | | | | | 9 | 1.7 | | | 4 | $ 114 | $ 76 | 12 | $ 348 | $ 232[3,4] |
| 3 | 15 | | | | | | | 7 | 0 | | | 5 | 176 | 117 | 3 | 59 | 39[5] |
| 5 | 29 | | | 1 | 7 | | | 12 | .7 | | | | | | 16 | 794 | 529[5] |
| 6 | 39 | | | | | | | 15 | 2.0 | | | 12 | 554 | 370 | 12 | (newly seeded) | |
| 10 | 52 | | | | | | | 40 | 3.0 | | | 12 | 449 | 299 | | | |
| 34 | 95 | | | | | 20 | 7.0 | 35 | 4.0 | | | 40 | 1,056 | 704 | | | |
| 37 | 82 | 25 | 17 | 30 | 52 | | | 12 | 1.5 | | | 15 | 429 | 286 | | | |
| 53 | 122 | 20 | 13 | 72 | 25 | | | 20 | 2.0 | | | | | | 10 | 242 | 161[6] |
| 20 | 47 | 10 | 5 | | | 10 | 5.5[1] | 15 | 4.0 | | | 12 | 343 | 229 | | | |
| 21 | 78 | 24 | 15 | 10 | 27[1] | 11 | 12.5[1] | 28 | 5.0 | | | 5 | 187 | 125 | | | |
| 22 | 53 | 10 | 31 | 21 | 37[1] | 8 | 4.5[1] | 12 | 5.0 | | | 2 | 44 | 29 | | | |
| 23 | 79 | 40 | 3 | 14 | 22[1] | 5 | 11.0[1] | 8 | 1.0[1] | 5 | 6.0[1] | 7 | 139 | 92 | | | |
| 27 | 55 | | | 20 | 0 | 20 | 2.0 | 10 | 2.4[1] | | | 5 | 220 | 147 | | | |
| 44 | 80 | 20 | 13 | | | 60 | 9.0 | | | | | | | | | | |
| Totals | 1,181 | 219 | 3,405 | 328 | 10,642 | 134 | 1,003.0 | 323 | 912.0 | 5 | 30.0 | 119 | $3,711 | $2,474 | 53 | $1,443 | $ 961 |
| Price | | | $2.04 | | $1.21 | | $6.00 | | $23.00 | | $7.00 | | | | | | |
| Value | | | $6,946 | | $12,876 | | $6,018 | | $20,064 | | $210 | | | $2,474 | | | $961 |

[1]Data were insufficient for calculating increased yields for these crops. Estimated increased yields were based on average yields from dryland and irrigated crops in South Central Kansas, 1954, as reported in Kansas Agricultural Extension Service Bulletin 381.

[2]Total value was computed by reducing the animal unit months per acre to a hay equivalent (AUM ÷ 3 = H. E.) and by multiplying the hay equivalent per acre times the number of acres times $22.00, the price of alfalfa. Increase in value was estimated at two-thirds of the total value.

[3]Twelve acres of other temporary pasture includes four acres of smooth brome, four acres of sweetclover, and four acres of rye.

[4]Rye used as temporary pasture.

[5]Smooth brome used as temporary pasture $616.00, 475 bales of brome hay @ $15 per ton $178.00, total $794.00.

[6]Smooth brome used as temporary pasture

# LEASING ARRANGEMENTS FOR FARMS WITH IRRIGATION ENTERPRISES

by

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AN ABSTRACT OF A THESIS

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1957

The purpose of this thesis was to examine the leasing problems that have arisen with the development of irrigation enterprises on tenant-operated farms. The necessary requisites for irrigation, which include the initial investment, additional operating costs, new labor requirements, and new problems of management, have been of such magnitude that it has been necessary for many landlords and tenants to share them. The manner in which these costs and responsibilities should be shared has been questioned by landlords and tenants, and they have requested assistance in developing sharing arrangements which would fit their particular situations and satisfy their needs. This study provides some insight into their problems and offers some suggestions which may answer some of the questions asked by these interested individuals.

Eight leasing arrangements for farms with irrigation enterprises and relevant cost and return data were obtained for this examination. The criteria upon which the study of these leases was based were suggested in production economic theory, and were as follows: For the irrigation enterprise (1) the arrangements for sharing marginal costs and marginal returns for each irrigated crop should be the same, and (2) the shares of marginal returns for all irrigated crops should be the same. For the dryland enterprise (1) the arrangements for sharing marginal costs and marginal returns for the dryland crops should be the same, and (2) the shares of marginal returns for all dryland crops should be the same. For the farm unit (1) the shares of marginal

returns for the irrigated crops should be the same as the shares of marginal returns for the dryland crops, and (2) the share of income going to the landlord and tenant must represent the product of the resources furnished by each party.

The examination of the leasing arrangements for the eight farms revealed (1) that provisions for sharing costs of the variable inputs necessary for irrigation according to the given agreements for the sharing of returns from irrigation have generally been lacking, (2) that the shares of returns from irrigation have not been based on the contributions of the landlord and tenant to the irrigation operation, and (3) that the provisions for sharing returns from irrigation enterprises in the same proportion that returns from dryland enterprises were shared have been sufficient. In general, the sharing arrangements have not contained the incentive conditions necessary to promote efficient use of the resources of landlords and tenants, and they have not provided for equitable distribution of returns from irrigation.

The criteria used for examining the eight existing leasing arrangements were also usable in suggesting conditions which should be incorporated in leases for farms with irrigation. A lease which provides for fulfillment of these conditions will be one which will promote efficient resource use, maximization of profits, and equitable distribution of returns.

The rapid development of irrigation in Kansas, a significant part of which is occuring on tenant-operated farms, demands that

further research be directed toward the solution of problems related to irrigation and to leasing arrangements.