Analysis of the Efficiencies of Alternative Farm Leasing Arrangements

(An Application of Linear Programming)

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SUMMARY

1. The objective of this study is to investigate various types of leases for leasing efficiency under specific farm resource situations. An efficient lease can be recognized as one under which the same farm plan is optimum for both the landlord and tenant and for the farm as a whole. The efficiency of various leases is investigated by using the linear programming technique to determine optimum farm plans for the landlord and tenant under different leasing and resource situations.

2. The two farms selected for study are 160-acre units which are judged to represent "typical" farm situations in the Clarion-Webster and Tama-Muscatine soil areas, repectively. The farm representing the Clarion-Webster soil area has 153 tillable acres, 1,176 square feet of cattle housing space and 364 square feet of hog farrowing space; the farm in the Tama-Muscatine soil area contains 154 tillable acres, 1,600 square feet of cattle housing space and 416 square feet of hog farrowing space. Both farms have adequate grain storage facilities and machinery. The labor supply on either farm is composed of both operator and family labor and is available by months as follows: 275 man-hours per month from November through February, 335 man-hours in March, 350 man-hours per month from April through August and 300 man-hours per month in September and October.

3. The following enterprises are considered in each soil area: three crop rotations with four alternative levels of fertilization each, one cattle feeding enterprise and one hog enterprise. The rotations included in the planning for each area are a corn-corn-soybeans (CCSb) rotation, a corn-soybeans-corn-oats-meadow (CSbCOM) rotation and a corn-corn-oats-meadow (CCOM) rotation. A two-litter hog system is considered in both areas. Pasture-fed steer calves are included in planning for the Clarion-Webster soil area, while a deferred-fed calf enterprise is considered in the Tama-Muscatine soil area. Long-run price relationships (adjusted to 1954 price levels) are used throughout.

4. Four alternative capital levels are considered for the landlord ($500, $1,200, $2,000 and unlimiting capital); two alternative capital levels are considered for the tenant ($3,000 and $10,000).

5. Under a typical crop-share lease in either soil area, the CCSb rotation yields the greatest return per dollar invested for both the landlord and the tenant when both are very limited on capital. The tenant with very limited capital finds it most profitable to use fertilizer, while leaving some acreage in "disposal" land; the landlord with very limited capital finds it most profitable to plant the entire farm to a rotation before applying fertilizer. Yet the landlord and tenant can reach agreement if both parties are limited to certain exact quantities of capital. A serious conflict of interests occurs, however, when the landlord has limited capital and the tenant has a high level of capital. In this case, the plan which is most profitable for the tenant includes a heavy livestock plan with CCOM and CSbCOM rotations; the most profitable plan for the landlord still is the CCSb rotation. These results indicate that a "standard" crop-share lease does not cause consistency of plans under all capital situations; the optimum lease varies with the resources of each party.

6. Increasing the cash rental on hay under a crop-share lease from $10 per acre to $16 and $25 per acre does not result in the optimum plans of the landlord and tenant becoming more consistent. The tenant still maximizes profits by paying the higher rent in order to obtain the meadow necessary for engaging in a livestock program; even with $25 per acre cash rent on hay, the landlord receives a larger return from CCSb than from the CSbCOM or CCOM rotations. In the Clarion-Webster soil area, cash rents on hay ranging from $39.85 to $48.64 per acre are needed to bring the landlord's return per acre from the meadow rotations up to the level of the return from the CCSb rotation. The tenant with $10,000 capital still maximizes profits by paying this cash rent and engaging in cattle and hog enterprises. In the Tama-Muscatine soil area, cash rents on hay ranging from $72.60 to $89.85 per acre are needed to bring the landlord equal returns from the CCSb and meadow rotations. The tenant with $10,000 capital maximizes profits by paying this rent on a few acres to engage in the hog enterprise but not the cattle enterprise. While these rental rates are out of line with customary rates in the areas, they do bring about consistency of optimum plans for the tenant and landlord.

7. A crop-share lease which specifies that the tenant pays all fertilizer and seed costs widens the gap between the most profitable landlord and tenant plans. At high levels of capital for the landlord and tenant this lease modification causes greater divergence of plans than a "typical" crop-share lease; the landlord finds the highest level of fertilization most profitable while the tenant finds only the second fertilizer level profitable. Thus, the plans of the parties differ with respect to fertilization levels as well as rotations.

8. A lease which divides all crop expenses (including operating expenses) on a 50:50 or 60:40 basis between the landlord and tenant also widens the gap between the most profitable plans for each party. The shift in expenses from the tenant to the landlord pushes the landlord's optimum plan toward lower fertilization levels on CCSb. At the same time, this shift allows the tenant to engage in a heavy livestock program requiring meadow rotations fertilized at high levels.

9. The landlord and tenant reach virtual agreement under a crop-share lease if the tenant does not raise livestock and each party has roughly the same relative capital limitations. Under these conditions both the landlord and the tenant find the CCSb rotation most profitable. However, while this leasing

arrangement brings about consistent plans for tenant and landlord, it is inconsistent with resource efficiency and maximum profit for the farm as a whole. Another plan can be found to increase farm returns and give more income to both tenant and landlord.

10. The common livestock-share lease is quite effective in removing conflicts between optimum landlord and tenant plans—provided the two parties have the same relative capital limitations. If a choice is allowed between the livestock and crop lease, however, the tenant who has sufficient capital finds it most profitable to enter into a crop-share lease and operate his own livestock program. The landlord with high levels of capital finds it most profitable to shift to a livestock-share lease in order to gain profitable uses for his capital. These differences are important in the sense that either party would sacrifice a sizeable profit by moving to the less profitable lease.

11. A cash lease, although it involves more risk for the tenant, removes leasing conflicts if the landlord and tenant are able to find a mutually satisfactory rental rate for the farm. By treating the cash rent as a fixed cost, the tenant is free to organize the farm in a manner to maximize his profits. This farm organization has little effect upon the landlord since his income is solely dependent upon the cash rent payment.

Analysis of the Efficiencies of Alternative Farm Leasing Arrangements[1]

(An Application of Linear Programming)

By Earl O. Heady, Gerald W. Dean and Alvin C. Egbert

Approximately half of Iowa's farms are operated under some form of leasing arrangement. The terms of these leasing arrangements play a vital role in determining how resources are allocated on these farms. Imperfections in leasing systems may reduce returns to landlords and tenants and restrict the total amount of product available to society. Under many leases in use, the farm plan which maximizes returns to the landlord's resources may not be the optimum farm plan from the tenant's standpoint, and vice versa. While the conditions of resource efficiency are not attained on many owner-operated farms, the leasing arrangement, ideally, should not contribute further to inefficiences in resource use.

Within an owner-operated farm, then, an optimum allocation of the owner's resources is reached when these resources are organized in a manner to maximize his profits. The problem is more difficult on rented farms, however, because specialized resources are separately furnished by the landlord and tenant. Resource efficiency on rented farms is achieved only when the combined resources of the landlord and tenant are organized into a farm plan which maximizes profits to their combined resources. An efficient lease should permit and encourage the adoption of this single farm plan by the landlord and tenant. In other words, an efficient lease is one which allows the same farm plan to be most profitable for both the landlord and the tenant; this plan should also be the one which is optimum for the farm as a whole, without regard to resource ownership. In any case where the lease leads to a plan which is most profitable for one party but not for the other, imperfections exist in the lease.

It is known that leasing arrangements do affect the efficiency with which resources are used on Iowa farms.[2] Customary leasing practices do not allow maximum profits for the landlord when the tenant uses a plan which maximizes his own profits. Hence, many landlords impose restrictions on the cropping and livestock programs which can be followed by tenants. For example, the landlord may permit the tenant to produce corn and soybeans, but no meadow in the crop rotation. Or, the tenant may be allowed to grow no more than a certain acreage of forage (e.g., 20 percent of the cropland) in the rotation. On other farms the landlord sometimes specifies a minimum quantity of forage.

OBJECTIVES

The primary objective of this study is to investigate the problems of leasing efficiency under specific Iowa farm situations. Hence, the analysis of the study is directed toward answering the following questions:

1. Do "typical" share leases[3] used on Iowa farms lead to allocative efficiency?
2. Which leasing arrangement most nearly allows an efficient use of resources under various resource situations for tenants and landlords?
3. What adjustments in leasing terms are needed for the common leases to bring about leasing efficiency?
4. Does the optimum lease depend on the resources controlled by each party, or can a "standard" lease be developed which will lead to allocative efficiency over a wide range of resource situations for both the tenant and landlord?
5. Does substitution of a cash lease or a livestock-share lease for a crop-share lease automatically lead to an optimum allocative arrangement?

PROCEDURE

The method used in attempting to answer the above questions is as follows: Two farms have been selected as typical of rented farms in each of two different soil areas. The linear programming technique[4] is then used to determine the farm plan (i.e., the crop selection, livestock program and farm practices) which will maximize returns to the tenant, given the capital and other resources available to him. Next, using the same empirical technique, an optimum plan is determined for the landlord relative to his resources.

If the most profitable plan for the tenant is also the most profitable one for the landlord and for the

[1]Project 1135 of the Iowa Agricultural Experiment Station.

[2]See: Heady, Earl O. and Kehrberg, Earl W. Relationship of crop-share and cash leasing systems to farming efficiency. Iowa Agr. Exp. Sta. Res. Bul. 386. 1952; and Heady, Earl O. and Jensen, Harald R. The economics of crop rotations and land use. Iowa Agr. Exp. Sta. Res. Bul. 383. 1951.

[3]"Typical" share leases refer to the most prevalent types of share leases in the areas studied. For example, throughout the text a typical crop-share lease will refer to the most common type of crop-share lease found in a specific area. Typical livestock-share and typical cash leases also refer, respectively, to the most prevalent forms of these two types of leases found in the areas studied.

[4]For details of the theory of linear programming see: Dorfman, Robert. Application of linear programming to the theory of the firm. University of California Press, Berkeley and Los Angeles. 1951.

farm, the lease arrangement is considered to be optimum. However, if optimum plans worked out separately for the tenant and landlord differ, the lease does not allow the most efficient farming arrangement.

These comparisons are made for situations where (1) the leasing arrangement is given but the tenant and landlord have different quantities of resources and (2) the quantity of resources for tenant and landlord is constant but the leasing arrangement is varied. The procedure is first applied to certain existing or typical crop-share leasing arrangements. Then adjustments are made in the lease to see if arrangements can be found where the most profitable plans for each of the two parties can be made to coincide. Finally, livestock-share and cash leases are compared as alternatives to crop-share leases.

BASIS FOR ANALYSIS

The analytical basis for the analysis can be illustrated by means of figs. 1 and 2. Curve PP′ in fig. 1 represents the production possibilities for a farm with a given collection of tenant and landlord resources.[5] If the farm were considered on an owner-operated basis, the optimum plan would include production of OB_3 of commodity B and OA_3 of commodity A: For this combination of products, the iso-revenue line, I_1R_1, is tangent to the iso-resource curve PP′, denoting that the marginal rate of substitution between the two products is equal to their price ratio; I_1R_1 represents the highest revenue possible with the total resources available to the farm.

[5]Actually, the production possibilities considered in this study do not form a continuous curve such as PP′ in fig. 1, but rather are a number of distinct points. The production possibility curve may then be represented by a number of linear segments joining these successive points. The "corners" of this new production possibility curve thus become the relevant production opportunities for consideration in farm planning. For additional discussion of this point see: Heady, Earl O. Economics of agricultural production and resource use. Prentice-Hall, Inc., New York. 1952. p. 255-258.

However, the total product represented by possibility curve PP′ must be divided on a rented farm. The plan which is optimum for the farm as a whole also will be optimum for tenant and landlord under the following condition: The division of costs and products must be such that the slopes of the production possibility curves for the tenant and landlord, along a straight line passing through the origin, are the same as the slope of the "total production" possibility curve PP′. In fig. 1, for example, assume that the two crops are divided on the basis of two-thirds to the tenant and one-third to the landlord. Consequently, tenant and landlord, respectively, are faced with production possibility curves TT′ and LL′. However, since the slopes of these two curves along line OM are the same as for PP′, the "total production" plan which is best for the farm is also best for the tenant and the landlord. In other words, the tenant maximizes profits when the plan for the farm as a whole combines crops to give shares of OB_2 of product B and OA_2 of product A to the tenant. Similarly, the landlord maximizes profits with a farm plan which gives him shares of OB_1 and OA_1. However, since the proportions OB_1/OA_1 and OB_2/OA_2 are equal, and both in turn are equal to the proportion OB_3/OA_3 for the farm as a whole, a single optimum plan exists for the tenant and landlord. The level of income for the farm as a whole, represented by iso-revenue line I_1R_1 in fig. 1, is the maximum income which can be divided between tenant and landlord.

An example of a lease arrangement which does not allow a consistent plan for tenant and landlord, with profit maximization as the criterion, is presented in fig. 2. Again, the production possibility curve for the farm as a whole is PP′. However, in this case, differential shares are given to the tenant and landlord. The tenant receives half of crop B and two-thirds of crop A. Hence, the tenant's production possibility curve, from the standpoint of the lease arrangement

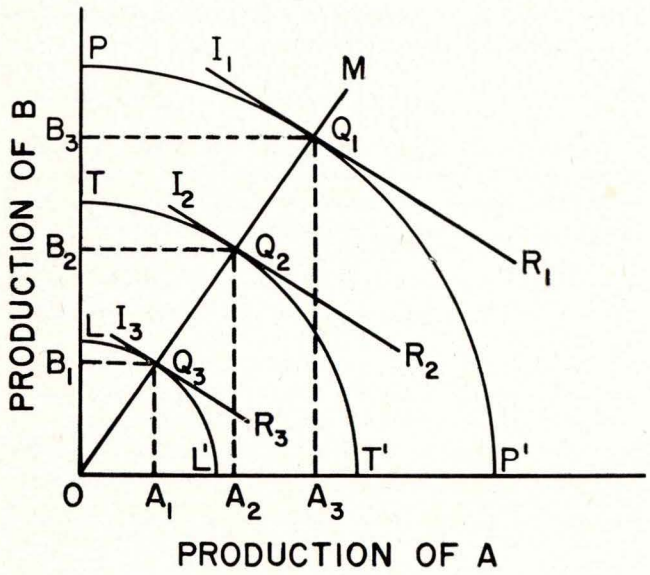

Fig. 1. Production possibilities from share rents which encourage efficiency.

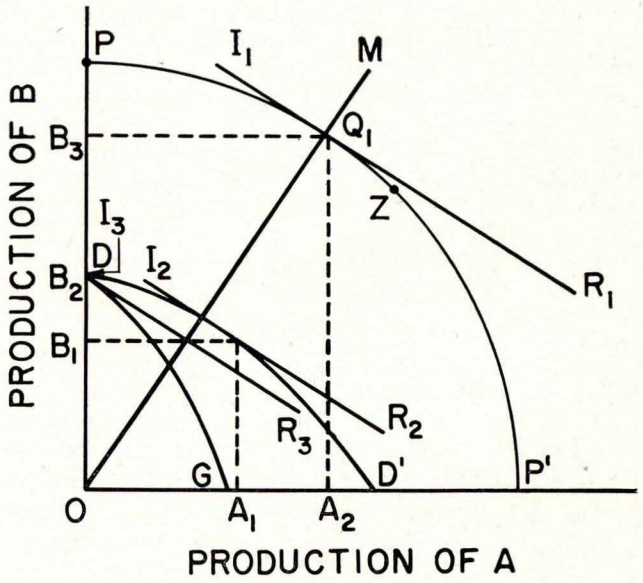

Fig. 2. Production possibilities from share rents which discourage efficiency.

and maximization of his own profit, is DD′. With the remaining shares going to the landlord, the landlord's production possibility curve is DG (i.e., PP′ is the summation of DD′ and DG). In this case, the three production possibility curves do not have equal slopes along a straight line through the origin. Hence, the plan which maximizes profit for the tenant will not maximize profit for the landlord and vice versa.

Given the same price ratio for the two products indicated previously, as noted by the slope of iso-revenue curve I_1R_1 (in fig. 2, I_2R_2 and I_3R_3 have the same slope as I_1R_1), the optimum plan for the tenant is OB_1 of product B and OA_1 of product A. For the farm as a whole, the optimum tenant plan would be that represented at point Z. This plan for the farm as a whole will produce less income (i.e., the iso-revenue curve passing through it is lower than I_1R_1) than the optimum plan Q_1.

If the landlord can specify the optimum program on the basis of his production possibility curve, he will select OB_2 of product B and none of A. For the farm as a whole, this is plan P at the upper extreme of the "total farm" production possibility curve. The iso-revenue line consistent with this point is again lower than I_1R_1, the maximum profit level for the farm. Hence, under the leasing arrangements of fig. 2, the plans which are optimum for the farm as a whole (Q_1), for the tenant alone (Z) and for the landlord alone (P) are conflicting and discourage efficiency.

Various leasing arrangements can cause the production possibility curves for the tenant and landlord to have slopes deviating from each other and from that for the farm as a whole. A few examples of such leasing arrangements are: (1) a low cash rent for forages, as compared with relatively higher share rents for grains; (2) a crop-share lease where the tenant has livestock but the landlord gets no share of the livestock return (e.g., a forage or grain crop which gives higher returns when processed through livestock may be profitable to the tenant, but less profitable than corn or soybeans sold for cash by the landlord); (3) differential share arrangements for costs and returns (e.g., payment of all the fertilizer cost but receipt of only half the crop return may cause livestock, and a rotation to go along with it, to be more profitable for the tenant than a cash grain rotation; payment of all the drainage costs but receipt of only half of the crops may cause nonfarm investments to be more profitable for the landlord). Since the details of these and other conditions have been outlined elsewhere, they need not be repeated here.[6]

That the optimum plans for tenant and landlord must be the same is only a *necessary* condition for leasing efficiency; it does not guarantee efficiency. In addition to this *necessary* condition must be added a *sufficient* condition: The optimum program for each leasing party must be the same as the optimum program for the farm as a whole. If the *necessary* condition is attained, but the *sufficient* condition is not, total income will not be maximized. A different lease and plan could always be found which would allow a greater total farm income, and, hence, a greater income for both the tenant and landlord.

For example, the lease could allow only a continuous corn or a continuous soybean cropping system and no livestock. The best plan for both parties might then be corn alone. However, leasing arrangements allowing other rotations and livestock could increase total farm returns and the share to each party. *Necessary* and *sufficient* conditions will be attained simultaneously, however, if the production possibility curves (all crops and livestock considered) for the tenant, landlord and farm have the same slope (see fig. 1).

LOCATION AND DESCRIPTION OF THE FARMS

The present study deals with farms located in two major soil areas of Iowa; the Clarion-Webster soil area and the Tama-Muscatine soil area. Together these two areas represent a large portion of the most fertile soils in the state of Iowa. In each of these two major soil areas a 160-acre farm, judged to be representative of farms of this size in the area, was chosen for study. The farm representing the Clarion-Webster soil area is located in Hardin County, while the farm representing the Tama-Muscatine soil area is located in Tama County, Iowa. Table 1 provides some of the background information for the two farms.

Adequate grain storage facilities and machinery are available on both farms. The labor supply on either farm is composed of (a) operator labor of 260 man-hours per month from November through February and 275 man-hours per month from March through October, plus (b) family labor equivalent to 15 man-hours per month from November through February, 60 man-hours in March, 75 man-hours per month from April through August, and 25 man-hours per month in September and October.

Farms were selected from two soil areas to determine whether leases have the same general effect when different yield values are used. The similarity of results of the study for the variations in yields between locations widens the applicability of the study.

TABLE 1. SELECTED RESOURCES OF THE TWO 160-ACRE FARMS STUDIED.

Item	Hardin County	Tama County
Predominant soil types	Clarion-Webster	Tama-Muscatine
Farm size (acres)	160	160
Tillable acres	153	154
Cattle housing space (sq. ft.)	1,176	1,600
Hog farrowing space (sq. ft.)	364	416
Labor (man-hours):		
January	275	275
February	275	275
March	335	335
April	350	350
May	350	350
June	350	350
July	350	350
August	350	350
September	300	300
October	300	300
November	275	275
December	275	275
Machinery available	adequate	adequate

[6]Heady, Earl O. and Kehrberg, Earl W. Relationship of crop-share and cash leasing systems to farming efficiency. Iowa Agr. Exp. Sta. Res. Bul. 386. 1952; Heady, Earl O. Marginal productivity of resources and imputation of shares for cash and share rented farms. Iowa Agr. Exp. Sta. Res. Bul. 433. 1955; Heady, Earl O. Economics of leasing systems. Jour. Farm Econ. 29: 659-678, 1947; Heady, Earl O. Economics of agricultural production and resource use. Prentice-Hall, Inc., New York. 1952. Ch. 15.

However, it should be recognized that the two areas studied are rather similar in respect to soil and other characteristics. The results of this study may not be applicable to areas which differ greatly from the areas studied.

Neither area studied has an extreme erosion hazard. Also, the rotations and fertilization practices used do not allow complementarity of forage in the rotation.[7] In areas where forage is complementary to grain, the landlord maximizes profits by growing the amount of forage consistent with this relationship.

ENTERPRISES CONSIDERED

Other linear programming studies[8] have determined the optimum combinations and sizes of crop and livestock enterprises for 160-acre farms in the two soil areas considered. Hence, since the purpose of the present study is to evaluate the effects of various leasing arrangements on optimal farm planning by the landlord and tenant, only a range of crop and livestock enterprises, proven previously to be profitable, are included in the present study.

CROP ENTERPRISES

Previous studies indicate that only three crop rotations ordinarily enter into the most profitable farm plans for the two soil areas. Thus, the rotations included as possibilities for this study are a corn-corn-soybeans rotation (CCSb), a corn-soybeans-corn-oats-meadow rotation (CSbCOM) and a corn-corn-oats-meadow rotation (CCOM). Four fertilization levels are considered for each rotation (table 2). Hereafter, fertilization levels for a given rotation are noted by a subscript following the abbreviated form of the rotation (e.g., $CCSb_1$, $CCOM_4$, $CSbCOM_3$). Crop yields for the three rotations at each fertilization level are shown in table 3. The possibilities of these several rotations and fertilization levels are used to determine such things as: (a) whether a landlord with limited capital prefers a grain rotation while a tenant with ample capital prefers a forage rotation for livestock;

[7]See: Heady, Earl O. and Jensen, Harald R. The economics of crop rotations and land use. Iowa Agr. Exp. Sta. Res. Bul. 383. 1951.

[8]Heady, Earl O., Loftsgard, Laurel D. and Paulsen, Arnold. Optimum farm plans for beginning farmers on Tama-Muscatine soils. Iowa Agr. Exp. Sta. Res. Bul. 440; Mackie, Arthur B. and Heady, Earl O. Income opportunities for beginning farmers on crop-share rented farms in central Iowa. Production Economics No. 14. (Preliminary bulletin). Iowa State College. 1956.

TABLE 2. POUNDS PER ACRE OF AVAILABLE NUTRIENTS SUPPLIED BY COMMERCIAL FERTILIZER FOR DIFFERENT ROTATIONS AND FERTILIZATION LEVELS.*

		Fertilization levels											
		First			Second			Third			Fourth		
Soil area	Rotation	N	P	K	N	P	K	N	P	K	N	P	K
Clarion-Webster	Corn	0	0	0	15	20	10	45	50	20	75	60	20
	Corn	0	0	0	30	20	10	50	25	20	70	30	20
	Soybeans	0	0	0	0	0	0	0	0	0	0	20	0
	Corn	0	0	0	5	20	10	10	50	20	40	60	20
	Soybeans	0	0	0	0	0	0	0	0	0	0	10	0
	Corn	0	0	0	15	20	10	45	50	20	75	60	20
	Oats	0	0	0	10	20	0	15	10	0	20	10	40
	Meadow	0	0	0	0	0	0	0	0	0	0	0	0
	Corn	0	0	0	5	20	10	10	50	20	40	60	20
	Corn	0	0	0	30	20	10	60	25	20	80	30	20
	Oats	0	0	0	10	20	0	15	20	0	20	35	30
	Meadow	0	0	0	0	0	0	0	0	0	0	0	0
Tama-Muscatine	Corn	0	0	0	10	15	20	30	20	10	50	40	20
	Corn	0	0	0	30	15	10	60	20	10	100	20	20
	Soybeans	0	0	0	0	0	0	0	0	0	0	40	0
	Corn	0	0	0	10	15	20	30	20	10	50	40	20
	Soybeans	0	0	0	0	0	0	0	0	0	0	20	0
	Corn	0	0	0	30	15	10	60	20	10	100	40	20
	Oats	0	0	0	10	20	0	20	40	0	0	20	0
	Meadow	0	0	0	0	0	0	0	0	0	0	0	0
	Corn	0	0	0	10	15	10	30	20	10	50	40	20
	Corn	0	0	0	30	15	10	60	20	10	100	20	20
	Oats	0	0	0	10	20	0	20	40	0	0	40	0
	Meadow	0	0	0	0	0	0	0	0	0	0	0	0

*The fertilization rates in this table were furnished in February and May, 1955 by the Agronomy Department, Iowa State College, Ames, Iowa. The yield estimates in table 3 are based upon these fertilization rates.

TABLE 3. ESTIMATED CROP YIELDS FOR VARIOUS LEVELS OF FERTILIZATION.*

	Clarion-Webster soil area Fertilization levels†				Tama-Muscatine soil area Fertilization levels†			
Rotation	First	Second	Third	Fourth	First	Second	Third	Fourth
Corn	40	50	57	59	50	63	68	72
Corn	32	42	49	51	45	60	67	71
Soybeans	19	21	23	24	28	28	28	32
Corn	58	65	67	68	60	69	74	77
Soybeans	20	22	24	25	26	28	28	32
Corn	50	56	59	61	55	65	71	75
Oats	32	38	41	43	35	45	48	45
Meadow	1.9	2.2	2.4	2.5	2.1	2.5	2.8	3.0
Corn	58	65	67	68	60	70	75	78
Corn	48	54	57	59	52	67	71	72
Oats	32	38	41	43	35	45	48	45
Meadow	1.9	2.2	2.4	2.5	2.1	2.5	2.8	3.0

*Source: Agronomy Department, Iowa State College, Ames, Iowa, February and May, 1955. Yields are in bushels per acre for grain crops and tons per acre for meadow.

†See table 2 for the quantities of fertilizer applied at each fertilization level.

(b) whether a landlord with ample capital prefers a heavy level of fertilization while a tenant with limited funds prefers a low level of fertilization with part of his capital invested in livestock; (c) whether the method of sharing fertilizer costs and crop returns affects the level of fertilization desired by each party.

LIVESTOCK ENTERPRISES

For the purposes of this study only two livestock enterprises are considered in the planning for each farm and are explained below. These two enterprises include the most profitable hog system and cattle feeding programs for average conditions (determined from the studies cited previously). Dairy and poultry enterprises are not included since they were found to enter the optimum program infrequently and then with only minor changes in income.

Livestock enterprises are included to determine whether situations exist where the tenant under a crop-share lease would prefer to invest in livestock and accompanying rotations, rather than a fertilization plan and cropping system which is optimum for the landlord. Livestock enterprises also are included to determine if a shift from a crop-share to a livestock-share lease causes the same plan to be optimum for the tenant and landlord; or, whether relative differences in capital available to the two parties still cause divergencies in plans.

Two-litter hog system. Under the two-litter hog system, the spring litter is farrowed in April and marketed the following October and November; the fall litter is farrowed in October and marketed in March and April. Fall litters are fed entirely on drylot while spring litters use pasture. Gilts are kept from the fall litters to be used as sows the following year; hence, annual hog sales include the remainder of the fall litter, all of the spring litter and one sow. With an assumed average of 13.5 pigs weaned per sow (two litters) the annual production of pork per sow is 3,051 pounds. The two-litter system is the only hog system considered in each soil area.

Pasture-fed steer calves. In this beef enterprise, 430-pound good to choice steer calves are purchased in October and sold at 990 pounds the following September (a death loss of 2.5 percent is assumed). The calves are wintered in drylot on roughage and a limited amount of grain. From May to July the calves are placed on pasture while grain feeding is increased. Intensive grain feeding in drylot starts in July and continues until the finished cattle are sold in September. The pasture-fed steer calf enterprise is the only beef enterprise included in planning for the Clarion-Webster soil area.

Deferred-fed steer calves. With this beef enterprise, good to choice steer calves are purchased in October at an initial weight of 402 pounds. These calves are wintered on roughage and put on pasture without grain feeding from May to August. Intensive grain feeding begins when the cattle are taken off pasture in August and continues until the latter part of November when the cattle are marketed at an average weight of 1,056 pounds. Death loss is estimated to be 3 percent. The deferred-fed steer calf enterprise is the only beef enterprise included in farm planning for the Tama-Muscatine soil area.

CAPITAL LEVELS AND COSTS

The optimum farm plans for the landlord and tenant are expected to vary considerably with different levels of available capital. Four capital levels are assumed for the landlord; $500, $1,200, $2,000 and unlimiting capital. The $500 capital level was chosen because it represents approximately the quantity of capital required to pay the landlord's share of the expenses associated with planting the entire farm to a rotation. Capital levels above $2,000 are usually required only when the landlord enters into a livestock-share lease. Only two capital levels are considered for the tenant—$3,000 and $10,000 available capital. With a $3,000 capital level, the tenant can pay approximately his share of the expenses of putting the entire farm into rotation; at a $10,000 capital level the tenant has sufficient capital to engage in a sizeable livestock program.

The quantities of capital available to the landlord and tenant are used only to pay variable costs, i.e., those costs which vary with production. Table 4 shows the variable costs (or capital requirements) associated with the various livestock enterprises. Included in the variable costs are the items of feed costs, cost of the livestock, breeding and veterinary fees, depreciation on livestock equipment and other miscellaneous expenses. While depreciation on livestock equipment is ordinarily treated as a fixed cost, it is included here as a variable cost because investment in livestock equipment does not occur unless livestock are included in the farm plan.

Total variable costs or capital requirements (for shares of both tenant and landlord and not including fixed expenses) associated with various crop rotations are listed in table 5. The cost figures in table 5 are the total variable costs of growing 1 acre of a particular rotation, i.e., a sum of the variable costs

TABLE 4. RESOURCE REQUIREMENTS PER UNIT OF LIVESTOCK OUTPUT.*

Resources	Unit	Two-litter hog-system	Pasture-fed steer-calves	Deferred-fed steer calves
Capital†:	dollars	8.16	137.80	133.95
Feed:				
Corn equivalent‡	lbs.	458.4	2,800	3,007.2
Hay equivalent§	lbs.	47.8	1,766	2,267
Protein supplement	lbs.	45.1	229	268.1
Building space:	sq. feet	2.40727	20	20
Labor:	man-hours			
January		0.17220	1.082	0.225
February		0.14950	1.063	0.225
March		0.15664	1.063	0.225
April		0.14360	1.492	0.225
May		0.12836	2.417	0.112
June		0.12662	2.417	0.112
July		0.12478	2.417	0.112
August		0.15939	2.417	0.112
September		0.20789	1.074	2.175
October		0.20140	1.063	3.100
November		0.18433	1.063	2.975
December		0.17837	1.082	2.862

*A unit of hogs is 100 lbs. pork, all other livestock units on a per-head basis. For greater detail and sources of the inputs in this table, see tableA-1, Appendix A.

†Capital required for total variable costs.

‡Oats are converted to corn equivalent on the basis of 2 bushels oats = 1 bushel corn.

§Includes hay fed in drylot plus hay consumed on pasture.

TABLE 5. TOTAL VARIABLE COSTS* FOR CROPS, 1954 PRICES.

Rotation and fertilizer rate†	Total variable costs per acre of rotation: Clarion-Webster soil area (dollars)	Tama-Muscatine soil area (dollars)
CCSb1	20.52	21.02
CCSb2	24.93	25.13
CCSb3	29.27	28.23
CCSb4	33.03	33.03
CSbCOM1	22.12	22.46
CSbCOM2	25.35	27.02
CSbCOM3	29.29	30.54
CSbCOM4	32.68	32.90
CCOM1	22.20	22.52
CCOM2	25.11	26.09
CCOM3	27.64	29.05
CCOM4	30.63	31.25

*Includes all variable costs normally divided between the tenant and landlord under a crop-share lease. For sources and breakdown of these costs, see tables A-2 and A-3, Appendix A.

†Subscripts to the rotations refer to the fertilizer rates shown in table 2.

normally paid separately by the landlord and tenant. Therefore, the crop rotation expenses include seed and fertilizer costs, fuel, oil and repairs on machinery used in crop production, hired machinery or hired labor for crop production, and repairs on buildings used for grain and hay storage.[9] The machinery investment for crop production has been treated as a fixed cost since a given amount of machinery must be available for use by the tenant before the farm can be planted to any rotation.

In general, items which are normally considered as fixed costs are treated as such in this study.[10] Hence, they do not enter the capital requirements for farm planning. Fixed costs include depreciation and insurance on farm machinery and buildings, property taxes and miscellaneous items such as telephone and electricity. However, these fixed costs have no effect on the plan which is optimum under a particular capital or lease situation. Since the capital requirements do not include fixed costs, the return computed for various farm plans is merely a return above annual expenses (i.e., annual variable costs, but not fixed costs or capital investment, are considered in computing the net prices used in linear programming). The true net return for each plan could thus be computed by subtracting fixed costs from the income quantities shown.

PRICES USED IN PLANNING

The price relationships used throughout this study are summarized in table 6. The pricing methods used in this study attempted to maintain the average historical price relationships among inputs and outputs, while adjusting all prices to the general price level prevailing in 1954: First, the average price of each item was determined for the period 1950-54, except that hog and feeder cattle prices were computed for the periods 1947-54 and 1935-54[11], respectively. Second, the product of the 1954 average corn price times

[9]Repairs on grain and hay storage buildings are treated as variable rather than fixed costs because these repairs would be unnecessary if the buildings were not used for storage.

[10]The exceptions of (1) depreciation on livestock equipment and (2) repairs on grain and hay storage buildings are noted in the previous paragraph.

[11]The longer period was considered to allow greater certainty that the price ratios used were consistent with the average of the intra-cycle range for the various commodities.

TABLE 6. AVERAGE ADJUSTED PRICES OF THE INPUTS AND OUTPUTS USED IN THIS STUDY.*

Item	Unit	Purchase price	Selling price
Seed and fertilizer:			
Corn	bu.	11.50	...
Soybeans	bu.	4.30	...
Oats	bu.	1.00	...
Nitrogen (N)	lb.	0.15	...
Phosphorus (P_2O_5)	lb.	0.11	...
Potassium (K_2O)	lb.	0.06	...
Feed and grain:			
Corn	bu.	1.43	1.43
Oats	bu.	0.78	0.78
Soybeans	bu.	...	2.74
Mixed hay	ton	17.40	...
Cattle supplement	cwt.	4.80	...
Hog supplement	cwt.	5.60	...
Livestock and livestock products:			
Deferred-fed steer calves	cwt.	24.10	26.61
Pasture-fed steer calves	cwt.	24.10	25.98
Pigs sold in October and November	cwt.	...	19.15
Pigs sold in March and April	cwt.	...	20.15
Sow	cwt.	19.47	18.75
Composite hog price†	cwt.	....	19.83

*The prices used were obtained by computing the 1950-54 average prices, then adjusting to the 1954 price level.

†Composite hog price is the weighted composite price per cwt. of fall pigs, spring pigs and the sow.

the average price of the item over a given period was divided by the average corn price over that same period; the resulting figure is the adjusted average price of the item. The calculation is illustrated below for hogs:

$$\text{Average adjusted price of hogs} = \frac{\text{Average corn price, 1954} \times \text{Average hog price, 1947 to 1954}}{\text{Average corn price, 1947 to 1954}}$$

The linear programming technique requires that a net price be determined for each activity. A gross price for each activity is computed by multiplying the various products produced per unit of this activity (which may or may not include livestock products) by the individual product prices. From this gross price is subtracted the annual expenses (variable costs) involved in producing one unit of this activity. The resulting figure is the net price per unit of an activity or the return per activity above annual expenses. Every unit of this activity which enters the optimum farm plan is assumed to have this same net price.

TYPES OF LEASES

The analysis in this study revolves around the use of various types of leasing and resource situations. Outlined below are the terms of the different leases considered in the study. Optimum plans are computed for each of the leasing situations with various combinations of capital levels for the tenant and the landlord[12] (see table 7 following for the combinations of capital situations under one lease). Of the crop-share leases considered, lease A_1 is the most prevalent or typical crop-share arrangement existing in the two areas. Leases A_3 and A_4 are variations of

[12]In other words, two sets of plans (one set for the tenant and one for the landlord) have been worked out by the linear programming technique for each combination of capital situations under each lease arrangement.

the typical crop-share lease (A_1); these leasing variations are also frequently used in the areas studied. Crop-share leases A_2, A_5 and A_6 are leasing arrangements which have been suggested as possible alternatives to existing crop-share leases. The typical or "most common" livestock-share lease is considered to determine whether a consistent optimum plan can be determined under this leasing arrangement when a crop-share lease does not lead to consistent plans. A cash lease provides the final type of lease to be tested for leasing efficiency.

CROP-SHARE LEASES

A_1. Typical crop-share lease

Item	Receipts or expenses: Tenant share (%)	Landlord share (%)
Corn	50	50
Soybeans	50	50
Oats	60	40
Fertilizer and seed expenses[13]	50	50
Operating expenses	100	0
Real estate expenses	0	100
Labor, including hired	100	0
Feeder cattle and hogs (receipts and expenses)	100	0
Cash rent on hay and rotation pasture land[14]		

A_2. Same as A_1 except that, for each rotation and fertilizer level, the landlord receives a sufficiently large cash rent on hay and pasture land to give him a return equal to that received from his most profitable rotation (where the capital of the landlord is not limiting).

A_3. Same as A_1 except that the tenant pays all fertilizer and seed expenses.

A_4.

Item	Receipts or expenses: Tenant share (%)	Landlord share (%)
All grain crops	50	50
Value of hay or pasture[15]	50	50
Fertilizer and seed expenses	50	50
Operating expenses (including hired labor)	50	50
Real estate expenses	50	50
Labor (operator labor)	100	0
Feeder cattle and hogs (receipts and expenses)	100	0

A_5. Same as A_1 except that the landlord allows no livestock production by the tenant.

TYPICAL LIVESTOCK-SHARE LEASE

Item	Receipts or expenses: Tenant share (%)	Landlord share (%)
Livestock receipts	50	50
Investment in livestock and livestock equipment	50	50
Livestock expenses	50	50
Crop receipts (if any)	50	50
Fertilizer and seed	50	50
Operating expenses (including hired labor)	100	0
Real estate expenses	0	100
Labor (operator)	100	0

[13]Landlord furnishes all of the grass and legume seed while tenant furnishes all of the seed oats.

[14]Cash rents on hay of $10, $16 and $25 per acre are studied.

[15]It is assumed that the tenant purchases the landlord's share of the hay and pasture at the market price for hay.

CASH LEASE

Item	Receipts or expenses: Tenant share (%)	Landlord share (%)
Real estate expenses	0	100
All other receipts and expenses[16]	100	0

ANALYSIS OF RESULTS

This section presents the most profitable farm plans, as determined by the linear programming technique, for the landlord and tenant under various leasing and resource situations. Major emphasis is placed upon the conflict of interests or divergence of plans which arises between landlord and tenant because of leasing restrictions and capital limitations.

The method of presentation will consist of separately discussing each type of lease analyzed in this study. The discussion of each lease will be further divided into sections dealing with situations in (a) the Clarion-Webster soil area and (b) the Tama-Muscatine soil area. Within each soil area the most profitable landlord and tenant farm plans for various levels of capital will be considered. An attempt will be made to explain divergencies or consistences which occur between landlord and tenant plans when leasing arrangements and capital levels are allowed to vary. Since two soil areas have been used to determine whether lease arrangements cause differences between localities, comparisons between soil areas will also be made where such comparisons appear useful.

CROP-SHARE LEASE A_1

Lease A_1 is the typical crop-share lease outlined earlier. In the discussion which follows, a cash rent of $10 per acre is assumed for hay and rotation pasture land. The results of increasing the cash rental to $16 and $25 per acre also are presented.

Clarion-Webster soil area. Table 7 summarizes the most profitable landlord and tenant plans under typical crop-share lease A_1 for various combinations of landlord and tenant capital levels. The plans presented in table 7 are based on a $10 per acre cash rent on hay and rotation pasture. With very limited capital ($500 under A and B in table 7) under crop-share lease A_1, the landlord would be unable to pay his share of the expenses necessary for planting the entire farm in a crop rotation. Therefore, he would find it most profitable to select the rotation and the fertilizer level which gives him the highest return per dollar invested. Accordingly, the landlord's optimum program would be 130 acres of CCSb without fertilizer ($CCSb_1$) with 23 acres remaining unplanted or in "disposal land." Inclusion of disposal land in the program, however, does not necessarily mean that a portion of the farm would remain idle. In practice, disposal land would probably be hay or pasture land (seeded in a previous year) for which the landlord would likely charge a cash rent.

[16]Landlord receives a fixed cash rent for the entire farm.

TABLE 7. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA UNDER TYPICAL CROP-SHARE LEASE A1*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation					Tenant's livestock program		Return†† (dollars)
		$CCSb_1$	$CCSb_3$	$CCOM_3$	$CSbCOM_3$	disposal land‡	calves§ (no.)	hogs** (litters)	
A (Landlord	500	130	...	...	...	23	...	...	2,854
(Tenant	3,000	...	147	...	...	6	...	...	2,242
B (Landlord	500	130	...	...	...	23	...	...	2,854
(Tenant	10,000	...	15	6	132	...	40	10	4,397
C (Landlord	1,200	...	153	...	...	...	...	...	4,331
(Tenant	3,000	...	147	...	...	6	...	...	2,242
D (Landlord	1,200	...	153	...	...	...	...	...	4,331
(Tenant	10,000	...	15	6	132	...	40	10	4,397
E (Landlord	2,000	...	153	...	...	...	...	...	4,331
(Tenant	3,000	...	147	...	...	6	...	...	2,242
F (Landlord	2,000	...	153	...	...	...	...	...	4,331
(Tenant	10,000	...	15	6	132	...	40	10	4,397
G (Landlord	Unlimiting	...	153	...	...	...	...	...	4,331
(Tenant	3,000	...	147	...	...	6	...	...	2,242
H (Landlord	Unlimiting	...	153	...	...	...	...	...	4,331
(Tenant	10,000	...	15	6	132	...	40	10	4,397

*With $10 per acre cash rent on hay and rotation pasture.

†Capital available for use in the farm business.

‡In practice, the disposal land would probably be used for hay and pasture.

§Choice steer calves, full-fed on pasture.

**Total litters per year (equal numbers of spring and fall litters).

††Return above annual expenses, with fixed costs still to be deducted. Cash rent on hay is not yet deducted from the tenant's return.

The tenant's most profitable program with $3,000 capital (A in table 7) is 147 acres of $CCSb_3$ with 6 acres in disposal land. Thus, when the tenant has $3,000 and the landlord has $500 to invest in the year's cropping program (A in table 7), the same rotation is optimum for the two but a difference arises in the level of fertilization which is optimum. The landlord prefers the first level of fertilization (no commercial fertilizer) while the tenant prefers the third level.

It may at first appear to be more profitable for the tenant, as would be the case for an owner-operator with very limited funds, to plant the entire 153 crop acres to CCSb and fertilize some of the acres at a rate lower than the third level. However, the tenant's position can be explained as follows: Under the typical crop-share lease the tenant pays 50 percent of the fertilizer cost and receives 50 percent of the increase in crop yields; he pays 100 percent of the operating expenses (except seed) needed for growing the crops, but receives only 50 percent of the crop yields. Therefore, the tenant receives a relatively high return on fertilizer as compared with the return from growing the crops.

This reasoning shows why the tenant with very limited capital maximizes his net return by using his limited capital in applying heavier rates of fertilizer and planting fewer acres (A in table 7). Conversely, this same reasoning shows why the landlord, if he is to maximize profits, should reject fertilizer use until the more profitable alternative of putting the entire farm into rotation has been exploited. The landlord pays little of the cost but gets half of the product in the normal field operations in growing crops; he receives half of the yield increase from fertilizer but also must pay half of the cost of fertilizer. (The landlord's share of the seed is far less than half of the cost of growing the crops.)

When the landlord's capital is increased to $1,200 or more, his most profitable plan is $CCSb_3$ for the entire farm (C through H in table 7). The landlord maximizes profits by specifying the CCSb rotation because it has a higher per-acre net return than the CSbCOM and CCOM rotations when cash rent on hay is $10 per acre. Relatively lower incomes for the landlord from the meadow rotations can be attributed primarily to (a) the presence of oats (a low income crop) in the rotation and (b) a low return on hay when it has a cash rent of only $10 per acre. Fertilizer use is not extended beyond the third rate, because the added cost of the fourth rate of fertilizer is greater than the added returns from the increased yields under the price relationships used. Decreasing net returns for the fourth fertilizer rate are found for all three rotations in the Clarion-Webster soil area.

A greater conflict in optimum plans arises when the tenant's capital is increased to $10,000 and the landlord's capital for annual expenses remains at $500 (B in table 7). Whereas the optimum cropping program is 130 acres of $CCSb_1$ for the landlord, it is primarily $CSbCOM_3$ for the tenant. The tenant's most profitable plan with $10,000 capital includes a large proportion of the meadow rotations to support a sizeable livestock program (B in table 7).[17] From the tenant's standpoint, the capital requirements and the net returns per acre of the meadow rotations with livestock are higher than the capital requirements and the net returns per acre from cash crop rotations such as CCSb. Returns per dollar invested, however, are highest under the CCSb cash crop rotation.

As noted earlier, with only $3,000 capital (A in table 7) the tenant engages in the CCSb rotation where returns on capital are highest. With $10,000 capital (B in table 7), however, the tenant maximizes

[17]It is assumed throughout the study that the hay requirements of the livestock enterprises must be supplied by the quantity of forage produced on the farm, i.e., no hay or pasture is purchased or rented in the situations considered.

his over-all return (i.e., to both capital and labor) by investing in livestock and meadow rotations, even though these activities bring lower returns on capital than the CCSb rotation. Hence, if the landlord specifies the optimum program for himself under B in table 7, it will depress profits to the tenant who needs meadow for his livestock. Similarly, if the tenant specifies his optimum program, it will depress profits to the landlord who receives a low return on the hay produced.

When the capital of the landlord is increased to $1,200 and the capital of the tenant is restricted to $3,000 (C in table 7), the cropping and fertilization plan for the two parties are almost identical. The landlord's greater funds allow him to invest in the third level of fertilization; the tenant's restricted capital position causes a cash crop rotation with a high level of fertilization to be more profitable than a forage rotation for livestock. However, an increase in the tenant capital level to $10,000, while the landlord capital level remains at $1,200, causes the optimum plans (D in table 7) to again diverge: It becomes more profitable for the tenant to use a forage rotation which can be converted to a greater return through livestock; the landlord maximizes profit with heavy fertilization of a strictly grain rotation, since he does not gain from conversion of forage to livestock products. Similarly, when the tenant has limited capital while the landlord has unlimiting capital (G in table 7), the two plans are again quite parallel. However, as the tenant's capital is increased to $10,000 (H in table 7), the plans of the two parties again become divergent.

Differentials, then, in relative amounts of capital for tenant and landlord under a crop-share lease can cause optimum plans for the two parties to be quite different. It is apparent from table 7 that the tenant and landlord programs are most nearly parallel when the tenant is limited to $3,000 capital while the landlord has $1,200 or more of capital (C, E and G in table 7). The most serious conflict of interests occurs when the landlord has only $500 capital while the tenant has $10,000 capital (B in table 7). Hence, it appears that, unless landlord and tenant have approximately the same relative capital limitations, a crop-share lease cannot be found which gives a single best plan for both leasing parties and for the farm (i.e., the maximum profit plan such as that indicated at Q_1 in figs. 1 and 2).

The above plans have been computed for a typical crop-share lease with a $10 per acre cash rent on hay and rotation pasture. Since considerable variation in hay rentals may be found in the areas studied, optimum plans also were computed for a typical crop-share lease with the hay rent increased to $16 and $25 per acre. Details of these plans may be found in table B-1, Appendix B. The optimum landlord and tenant plans were exactly the same for a crop-share lease with $16 and $25 per acre cash rent on hay and pasture. These plans also differed only slightly from the optimum plans for each party when the rent was $10 per acre. The $25 hay rental was still too low to discourage the tenant from entering into a livestock program built around a meadow rotation; it was also too low to induce the landlord to change from CCSb to a meadow rotation.

Tama-Muscatine soil area. Table 8 summarizes the most profitable landlord and tenant programs under typical crop-share lease A_1 for various levels of landlord and tenant capital. A cash rent of $10 per acre is assumed for hay and rotation pasture. In the Tama-Muscatine soil area, as in the Clarion-Webster soil area, the CCSb rotation yields (a) the greatest return per dollar invested for both the landlord and tenant, and (b) the highest net return per acre of rotation at the higher rates of fertilization for the landlord.[18] Thus, with only $500 capital (A and B

[18]The tenant's return per acre is highest, of course, when he is allowed to have livestock with the meadow rotations.

TABLE 8. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA UNDER TYPICAL CROP-SHARE LEASE A_1*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation							Tenant's livestock program		Return†† (dollars)
		CCSb1	CCSb2	CCSb3	CCSb4	CSbCOM4	CCOM4	disposal land‡	calves§ (no.)	hogs** (litters)	
A (Landlord	500	129	...	...	...	...	...	25	...	...	4,058
(Tenant	3,000	...	78	76	...	...	...	...	...	...	3,699
B (Landlord	500	129	...	...	...	...	...	25	...	...	4,058
(Tenant	10,000	...	...	...	...	136	18	...	40	12	5,867
C (Landlord	1,200	...	...	106	48	...	...	...	...	...	5,903
(Tenant	3,000	...	78	76	...	...	...	...	...	...	3,699
D (Landlord	1,200	...	...	106	48	...	...	...	...	...	5,903
(Tenant	10,000	...	...	...	...	136	18	...	40	12	5,867
E (Landlord	2,000	...	...	...	154	...	...	...	...	...	6,055
(Tenant	3,000	...	78	76	...	...	...	...	...	...	3,699
F (Landlord	2,000	...	...	...	154	...	...	...	...	...	6,055
(Tenant	10,000	...	...	...	...	136	18	...	40	12	5,867
G (Landlord	Unlimiting	...	...	...	154	...	...	...	...	...	6,055
(Tenant	3,000	...	78	76	...	...	...	...	...	...	3,699
H (Landlord	Unlimiting	...	...	...	154	...	...	...	...	...	6,055
(Tenant	10,000	...	...	...	...	136	18	...	40	12	5,867

*With $10 per acre cash rent on hay and rotation pasture.
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay and pasture.
§Deferred-fed steer calves, good to choice grade.
**Total litters per year (equal numbers of spring and fall litters).
††Return above annual expenses, with fixed costs still to be deducted. Cash rent on hay is not yet deducted from the tenant's return.

in table 8), the landlord's most profitable plan is 129 acres of CCSb without fertilizer (i.e., $CCSb_1$ with 25 acres in disposal land). As the landlord's capital is increased to $1,200 (C and D in table 8), his optimum plan is the entire farm planted to CCSb; 106 acres receive the third rate of fertilization, and 48 acres receive the fourth rate of fertilization. With $2,000 or more in capital (E, F, G and H in table 8), the landlord plants the entire farm (154 crop acres) to CCSb and fertilizes at the highest rate, if he is to maximize profits.

One minor difference between the two soil areas should be noted at this point. It was observed above that a change from the third to the fourth level of fertilization in the Clarion-Webster soil area decreases net returns. However, in the Tama-Muscatine soil area, the marginal yield from the fourth level of fertilizer is great enough to increase net returns. Thus, with sufficient capital, the fourth rate of fertilization is profitable in the Tama-Muscatine soil area.

When the tenant's capital is limited to $3,000 (A, table 8), his most profitable program is 78 acres of $CCSb_2$ and 76 acres of $CCSb_3$. Hence, at a low capital level for both tenant and landlord (A in table 8), the separate plans call for the same rotation but different levels of fertilization. It is most profitable for the landlord, with only $500 to spend on seed and fertilizer costs, to get as many acres as possible planted to row crops without fertilizer, rather than to plant fewer acres and fertilize at a high rate. The reason is that explained earlier: The landlord pays only a small fraction of the cost of planting, growing and harvesting the yield of an unfertilized acre, but he receives half of the yield; he receives half of the yield from fertilizer, but also must pay half of the cost. For a limited capital level, the tenant gets a relatively higher return on the yield from fertilizer since he pays only half of the fertilizer cost and receives half of the increase in yield; on an unfertilized acre, the tenant pays the majority of the cost, but still receives only half of the yield.

The optimum plans for the two parties differ even more when the tenant's capital is increased to $10,000 and the landlord's capital remains restricted to $500 (B in table 8). The tenant's profit maximizing plan then includes 136 acres of $CSbCOM_4$ and 18 acres of $CCOM_4$ with 40 deferred-fed steer calves and 12 litters of pigs per year. The landlord maximizes profits with a grain rotation (129 acres in $CCSb_1$) since he gains none of the product from forage fed to livestock; the tenant maximizes profits with a rotation containing forage since he does realize this gain when he has sufficient capital for livestock. Because of the restrictions on the space available for hogs, no more than 12 litters per year can be raised under the two-litter system considered. Thus, hog building space, as well as capital and land, become limiting resources at a $10,000 tenant capital level.

In the Tama-Muscatine soil area, the tenant with $10,000 capital prefers rotations of CCOM and CSbCOM fertilized at the highest rates (table 8). Even at the highest levels of capital, the optimum landlord plan never includes a rotation with meadow, although the highest level of fertilization is attained. Hence, it should be repeated: The typical crop-share lease brings about inconsistent plans and, thus, results in inefficient tenure arrangements when tenant and landlord have different relative capital limitations. Of course, the landlord can specify a leasing restriction, or the two parties can include a clause in the lease which guarantees that a single cropping and fertilization plan is used. However, even though this single plan is used, it does not allow the most efficient use of the total farm resources as long as a different plan would allow one of the persons to have a greater income (see discussion of figs. 1 and 2). Neither will this "agreed upon plan" result in the maximum income to the farm firm described by the designated collection of resources: Other plans can be found which permit a greater income with each party receiving a greater absolute profit.

The greatest consistency of landlord and tenant plans for Tama-Muscatine soils occurs when both parties are limited on capital (A and C in table 8). When both parties have larger amounts of capital, the optimum plans diverge because the crop-share lease, under which the tenant is allowed to produce livestock, causes the production possibility curves for the tenant and/or landlord to have slopes differing from the slope of the production possibility curve for the farm as a whole. For example, if axis A in fig. 2 refers to livestock and axis B refers to crops, PP′ is the production possibility curve for the farm as a whole. However, the production possibility curve for the landlord is identical with the B axis; the curve for the tenant runs from point P′ to point D (curve P′D is not drawn in fig. 2). With this distortion of the production possibility curve for the tenant and landlord relative to that for the farm as a whole, optimum plans for each party will be changed accordingly.

Optimum plans were also computed for the typical crop-share lease where cash rents on hay were increased to $16 and $25 per acre in the Tama-Muscatine soil area. These optimum plans do not differ from the plans for the crop-share lease with $10 per acre hay rent shown in table 8. Hence, it appears that adjusting the cash rental on hay and pasture between $10 and $25 per acre does nothing to resolve the difference in optimum plans for the two parties under a typical crop-share lease. This same conclusion was reached for the Clarion-Webster soil area.

CROP-SHARE LEASE A_2

Increasing the cash rent on hay and pasture to $25 per acre does not cause the landlord and tenant plans to be consistent under a crop-share lease where the tenant receives the full return from livestock. Hence, this question arises: What level of cash rent will cause a meadow rotation, which is best for the tenant's livestock program, to be most profitable for the landlord who does not realize part of the livestock return? To answer this question, the situations for lease A_2 have been included.

Lease A_2 is a typical crop-share lease with the following important exception: From each rotation and fertilizer level the landlord receives a sufficiently large

cash rent on hay and pasture to give him a return per acre of rotation equal to that received from his most profitable rotation (i.e., when the landlord is assumed to have at least $2,000 available for use in the farm business). Lease A_2 is devised to insure that the two leasing parties will find the same plan to be optimum. Regardless of the plan chosen by the tenant, this same plan should be satisfactory to the landlord since he receives an equal net return per acre from all rotations and fertilization levels.[19]

Clarion-Webster soil area. In the Clarion-Webster soil area, the most profitable rotation for the landlord (when cash rents on hay range from $10 to $25 per acre) is $CCSb_3$. Cash rents on hay ranging from $39.85 to $48.65 per acre are needed to raise the landlord's returns per acre from the meadow rotations to the level of his returns from the $CCSb_3$ rotation.

Table 9 summarizes the most profitable programs for the landlord and tenant at various capital levels under crop-share lease A_2 (typical crop-share lease with equal returns to the landlord from all rotations). With only a $3,000 capital level, the tenant's optimum program is 147 acres of $CCSb_3$ with 6 acres in disposal land, while the landlord's optimum program is 153 acres of $CCSb_3$ (A in table 9). However, when the tenant's capital level is $3,132 or more (B and C in table 9) the landlord and tenant can reach complete agreement, i.e., the landlord is indifferent between $CCSb_3$ and any of the meadow rotations (ignoring the slight differences in capital requirements noted above). It is interesting to observe that the tenant's optimum program with $10,000 under lease A_2 (table 9) differs only slightly from the tenant's optimum program for lease A_1 (table 7) when the cash rent on hay is only $10 per acre. Apparently the tenant is able to pay a rather high price on hay for the opportunity to engage in livestock enterprises. The acreage of meadow for the tenant's optimum plan with $10,000 under lease A_2 is quite small; approximately 28 acres for a 160-acre farm. The total cash rent required thus would be only about $1,120 for the farm. Many landlords charge this total amount of cash rent for "privilege" rent or as rent on buildings, lots and hay. Whether the tenant could be induced to pay such a high rental under all conditions is somewhat doubtful.

An alternative to paying the high rent on hay would be for the tenant to engage in some form of drylot livestock enterprise, such as hogs, with the farm in a CCSb rotation. Actually, many landlords restrict their tenant from producing hay and hence allow only drylot hog production. A major income effect of the high cash rent on hay is to decrease profits to the tenant and to increase profits to the landlord.

In interpreting the income figures in all tables, the following point should be remembered: *The arrangements examined in this study are in terms of leasing and resource efficiency and not in terms of an equitable distribution of the income of a particular magnitude.* It is possible that the relative income division might be equitable but that the lease is not efficient in terms of the resource and total income conditions outlined earlier. In the case where a new leasing arrangement brings about resource efficiency but distorts the pattern of income division, other adjustments could be made to restore the previous levels of tenant and landlord income.

Tama-Muscatine soil area. In the Tama-Muscatine soil area, the most profitable rotation for the landlord (when cash rents on hay range from $10 to $25 per acre) is $CCSb_4$. Cash rents ranging from $72.60 to $89.85 per acre are needed to bring about equal returns to the landlord from the $CCSb_4$ and meadow rotations. Table 10 indicates that with only $3,000 the tenant is too limited on capital to reach the landlord's optimum plan of 154 acres of $CCSb_4$; the tenant's optimum plan includes 78 acres of $CCSb_2$ and 76 acres of $CCSb_3$ (A in table 10). However, with $3,532 or more in capital for the tenant the leasing partners once again can reach full agreement on the plan to be followed (B and C in table 10).

One important difference is apparent between the two soil areas studied. In the Clarion-Webster soil area, as pointed out earlier, the optimum programs for the tenant with $10,000 capital are almost identical, regardless of the level of cash rent charged on hay (compare C, table 9 and H, table 7). In the Tama-Muscatine soil area, however, the tenant's optimum program with $10,000 capital changes greatly at the high cash rent level (compare C, table 10 and

[19]In the following discussion the differences in landlord capital requirements for the various rotations will be ignored; presumably the landlord will prefer the rotation with the lowest capital requirement.

TABLE 9. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA UNDER CROP-SHARE LEASE A_2*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation			Tenant's livestock program		Return†† (dollars)
		$CCSb_3$	$CSbCOM_3$	disposal land‡	calves§ (no.)	hogs** (litters)	
A (Landlord‡‡	2,000	153	...	...	...	...	4,331
(Tenant	3,000	147	...	6	...	...	2,242
B (Landlord‡‡	2,000	153	...	...	...	...	4,331
(Tenant	3,132	153	...	...	...	...	2,333
C (Landlord‡‡	2,000	14	139	...	...	...	4,331
(Tenant	10,000	14	139	...	40	10	3,293

*"Typical" crop-share lease except that for each rotation and fertilizer level the landlord receives a sufficiently large cash rent on hay and pasture to give him a return equal to that received from his most profitable rotation ($CCSb_3$).
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay and pasture.
§Choice steer calves, full-fed on pasture.
**Total litters per year (equal numbers of spring and fall litters).
††Return above annual expenses, with fixed costs still to be deducted.
‡‡Under this lease, the landlord receives an equal net return from each rotation. However, he will probably prefer that rotation which has the lowest capital requirement.

TABLE 10. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA UNDER CROP-SHARE LEASE A2*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation				Tenant's livestock program	Return§ (dollars)
		$CCSb_2$	$CCSb_3$	$CCSb_4$	CSbCOM	hogs‡ (litters)	
A(Landlord**	2,000	...	...	154	...	...	6,055
(Tenant	3,000	78	76	...	...	...	3,699
B(Landlord**	2,000	...	...	154	...	...	6,055
(Tenant	3,532	...	...	154	...	...	3,932
C(Landlord**	2,000	...	...	147	7	...	6,055
(Tenant	10,000	...	...	147	7	12	4,332

*Typical crop-share lease except that for each rotation and fertilizer level the landlord receives a sufficiently large cash rent on hay and pasture to give him a return equal to that received from his most profitable rotation ($CCSb_4$).

†Capital available for use in the farm business.

‡Total litters per year (equal numbers of spring and fall litters).

§Return above annual expenses, with fixed costs still to be deducted.

**Under this lease, the landlord receives an equal net return from each rotation. However, he will probably prefer the rotation which has the lowest capital requirement.

H, table 8). The major change in the tenant's program, resulting from the high rent on hay, is a shift away from the meadow rotations and cattle to less meadow in the rotation and only hogs in the livestock program. This change in the tenant's optimum plan can be explained as follows: Since, in the Tama-Muscatine soil area, the grain yields from the $CCSb_4$ rotation are nearly as high as the grain yields from the CSbCOM and CCOM rotations, an extremely high rent on meadow is needed for the landlord to be indifferent between $CCSb_4$ and the meadow rotations. It is not profitable for the tenant to pay this high cash rent in order to carry on the cattle enterprise.

The crop-share lease just discussed (equal landlord returns from all rotations) allows both parties to adopt the same optimum program, providing the tenant has at least enough capital to put the entire farm into the landlord's most profitable rotation ($CCSb_3$ in the Clarion-Webster soil area; $CCSb_4$ in the Tama-Muscatine soil area). However, the cash rental rates on hay which would be needed to bring the landlord equal returns from all rotations are far above customary rental rates and would probably be viewed as "unfair" by tenants and landlords alike.[20] Perhaps a more practical approach toward bringing the landlord and tenant together would be to include a compromise on hay rental rates with some other "offsetting" arrangement; or to permit the alternative of drylot livestock activities, such as drylot hog system. Such alternatives would permit the tenant to raise livestock without demanding meadow in the rotation. It is possible, however, that the meadow-livestock activities would out-compete the drylot livestock activities even with the extremely high hay prices assumed under crop-share lease A_2 (equal landlord returns from all rotations). The possibility of drylot feeding, in relation to pasture and forage production with high cash rental rates, has not been studied.

In the two soil areas studied, the cash rents on hay must be extended to relatively high levels before the landlord finds it profitable to adopt a meadow rotation (and hence bring about consistency in plans for the landlord and tenant). It should be recognized, however, that these relationships assume that the alternative of heavy fertilization is available. Thus, grain yields are maintained at high levels with a relatively low percentage of hay in the rotation (or with no hay in the case of CCSb). If only low fertilization rates are available, however, grain yields are maintained at relatively higher levels in the rotations containing a larger proportion of meadow. Hence, when lower fertilization rates are assumed, a much lower cash rental rate on hay is needed to induce the landlord to adopt a meadow rotation and thereby permit leasing efficiency. When hay is complementary with grain over some range, the landlord can increase profits by raising at least a complementary amount of hay.

CROP-SHARE LEASE A_3

Lease A_3 is a typical crop-share lease except that the tenant pays all fertilizer and seed costs instead of half of the cost of these items. Since this particular cost sharing arrangement is a common variation of the typical crop-share lease, it is examined here to determine the effects upon the optimum plans of the two parties.[21]

Clarion-Webster soil area. Table 11 summarizes the most profitable plans for the landlord and tenant under crop-share lease A_3 (tenant pays all the seed and fertilizer costs) with various levels of capital for the landlord and tenant. A cash rent on hay of $16 per acre is assumed for the plans in table 11. The landlord's optimum program at all capital levels is now 153 acres of CCSb at the highest rate of fertilization ($CCSb_4$). As noted previously, the added cost of the fourth level of fertilization for the Clarion-Webster soil area is greater than the added return from the increase in yields. It is, with the prices used, an uneconomic level of fertilization even on an owner-operated farm. However, because the landlord pays no fertilizer or seed expenses but receives half of the increase in returns under the present lease, he finds

[20]A leasing arrangement also was considered for which the cash rental rate for all rotations was based on the second most profitable landlord rotation. It was expected that this lease might reduce the cash rental rate needed to bring the landlord and tenant to consistent plans. However, this change in cash rental did not move either the landlord or the tenant from the "corners" of the production possibility curves which were optimum for each under the typical crop-share lease.

[21]Division of the soybeans on a 40-60, instead of a 50-50 basis between the landlord and the tenant is another common variation of the typical crop-share lease which was examined. The resulting plans for the Clarion-Webster soil area (with $25 hay rental per acre) were exactly the same as the plans where soybeans were divided on a 50-50 basis (see table B-1, Appendix B). The plans for the 40-60 arrangement on soybeans in the Tama-Muscatine soil area were also the same as for the typical crop-share lease (table 7), except for a slight shift toward more soybeans in the rotation at the $10,000 tenant capital level. For details of these plans, see table B-2, Appendix B.

the fourth level of fertilization to be optimum even though this level of fertilization is uneconomic for the farm as a whole.

The tenant's most profitable plan with $3,000 in capital is now 65 acres of $CCSb_1$ and 88 acres of $CCSb_2$ (A in table 11). When seed and fertilizer expenses are shared 50-50 (see A in table 7) the tenant finds it most profitable to fertilize fewer acres (147 acres) at a higher rate and leave 6 acres in disposal land. When the tenant must pay all fertilizer and seed costs, the above plan is no longer most profitable because the tenant loses his relative advantage in fertilizer use; he must now pay all fertilizer and seed expenses while receiving only 50 percent of the return.

When the tenant's capital is increased to $10,000 under the present lease (e.g., see B, table 11) his most profitable plan is only slightly different from his optimum plan with $10,000 when fertilizer and seed expenses are divided on a 50-50 basis (see B, table 7). The major change in the tenant's plan is that fertilizer use now extends only to the first and second levels instead of to the third level of application. Because the tenant's costs are increased to include all fertilizer and seed expenses under the present lease, such a result is quite reasonable.

Plans were also computed for crop-share lease A_3 (where the tenant pays all seed and fertilizer expenses) with the cash rent on hay increased to $25 per acre. However, the increase in rent did not alter the optimum plans for the landlord and tenant from those with a $16 per acre rent on hay (see discussion in the previous paragraphs and the results in table 11).

Tama-Muscatine soil area. Table 12 indicates the optimum plans for the landlord and tenant under crop-share lease A_3 (where the tenant pays all fertilizer and seed costs) with various levels of capital. Once again a cash rent of $16 per acre on hay is assumed. As in the Clarion-Webster soil area, the cost-sharing arrangement under the present lease allows the landlord's most profitable plan at all capital levels to be a $CCSb_4$ rotation for the entire farm (table 12).

Table 12 shows that the increased per-acre cost for the tenant under lease A_3 forces a restriction on fertilizer use at both the $3,000 and $10,000 capital levels. Under the usual 50-50 sharing of fertilizer and seed expenses, the tenant with $3,000 capital can fertilize at the second and third levels on CCSb (see A, table 8). Under the present cost-sharing arrangement, however, the tenant can fertilize only 72 acres of CCSb at the second level, with the remaining acreage receiving no fertilizer (A in table 12). A similar restriction of fertilizer use occurs when the tenant has $10,000 capital. Previously the tenant's optimum plan with $10,000 capital specified the highest level of fertilizer use on the entire farm (see H, table 8); under the present lease, only the second level of fertilization is profitable (see H, table 12).[22]

An increase in the tenant's expenses from 50 percent to 100 percent of the fertilizer and seed costs causes the gap between the most profitable programs for the landlord and tenant to widen. This shift in expenses causes the plans for the tenant and landlord to differ with respect to rates of fertilization, as well as to the rotation used.

When the cash rent on hay is increased from $16 to $25 per acre under the present lease (A_3), no change in tenant plans occurs except for the $10,000 capital level. The increase in hay rent causes a shift to less meadow in the rotation and thus reduces the cattle enterprise slightly. For details of these plans see table B-3, Appendix B.

[22]In the Tama-Muscatine soil area a delicate balance, in terms of profitability, exists between the CCOM and CSbCOM rotations. For example, when the tenant has $10,000 in capital, a change from lease A_1 to A_3 (tenant's fertilizer and seed expenses increased from 50 percent to 100 percent) shifts almost the entire farm from a CSbCOM to a CCOM rotation (see B, table 8 and B, table 12). The shift occurs as a result of slightly higher fertilizer and seed costs for the CSbCOM rotation. Despite this shift in rotation, the tenant's livestock program remains essentially unchanged between the two leases.

TABLE 11. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA UNDER CROP-SHARE LEASE A_3*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation				Tenant's livestock program		Return** (dollars)
		$CCSb_1$	$CCSb_2$	$CCSb_4$	$CSbCOM_2$	calves‡ (no.)	hogs§ (litters)	
A (Landlord	500	...	...	153	...	...	...	5,301
(Tenant	3,000	65	88	...	...	...	...	1,452
B (Landlord	500	...	...	153	...	...	...	5,301
(Tenant	10,000	8	...	...	145	38	10	3,743
C (Landlord	1,200	...	...	153	...	...	...	5,301
(Tenant	3,000	65	88	...	...	...	...	1,452
D (Landlord	1,200	...	...	153	...	...	...	5,301
(Tenant	10,000	8	...	...	145	38	10	3,743
E (Landlord	2,000	...	...	153	...	...	...	5,301
(Tenant	3,000	65	88	...	...	...	...	1,452
F (Landlord	2,000	...	...	153	...	...	...	5,301
(Tenant	10,000	8	...	...	145	38	10	3,743
G (Landlord	Unlimiting	...	...	153	...	...	...	5,301
(Tenant	3,000	65	88	...	...	...	...	1,452
H (Landlord	Unlimiting	...	...	153	...	...	...	5,301
(Tenant	10,000	8	...	...	145	38	10	3,743

*Typical crop-share lease with $16 per acre cash rent on hay and pasture, except that tenant pays all fertilizer and seed expenses.
†Capital available for use in the farm business.
‡Choice steer calves, full-fed on pasture.
§Total litters per year (equal numbers of spring and fall litters).
**Return above annual expenses, with fixed costs still to be deducted. Cash rent on hay is not yet deducted from the tenant's return.

TABLE 12. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA UNDER CROP-SHARE LEASE A_3*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation				Tenant's livestock program		Return** (dollars)
		$CCSb_1$	$CCSb_2$	$CCSb_4$	$CCOM_2$	calves‡ (no.)	hogs§ (litters)	
A (Landlord	500	...	...	154	...	...	...	7,109
(Tenant	3,000	82	72	...	...	...	...	2,939
B (Landlord	500	...	...	154	...	...	...	7,109
(Tenant	10,000	...	6	...	148	39	12	4,978
C (Landlord	1,200	...	...	154	...	...	...	7,109
(Tenant	3,000	82	72	...	...	...	...	2,939
D (Landlord	1,200	...	...	154	...	...	...	7,109
(Tenant	10,000	...	6	...	148	39	12	4,978
E (Landlord	2,000	...	...	154	...	...	...	7,109
(Tenant	3,000	82	72	...	...	...	...	2,939
F (Landlord	2,000	...	...	154	...	...	...	7,109
(Tenant	10,000	...	6	...	148	39	12	4,978
G (Landlord	Unlimiting	...	...	154	...	...	...	7,109
(Tenant	3,000	82	72	...	...	...	...	2,939
H (Landlord	Unlimiting	...	...	154	...	...	...	7,109
(Tenant	10,000	...	6	...	148	39	12	4,978

*Typical crop-share lease with $16 per acre cash rent on hay and pasture, except that tenant pays all fertilizer and seed expenses.
†Capital available for use in the farm business.
‡Deferred-fed steer calves, good to choice grade.
§Total litters per year (equal numbers of spring and fall litters).
**Return above annual expenses, with fixed costs still to be deducted. Cash rent on hay is not yet deducted from the tenant's return.

CROP-SHARE LEASE A_4

Lease A_4 is a crop-share leasing arrangement sometimes suggested as an alternative to the more common crop-share arrangements. Under lease A_4 all crop expense (including operating and building expense) and crop production is divided equally between landlord and tenant. The tenant, however, retains full ownership and responsibility for the livestock enterprises. According to the 50-50 division of the crop, the landlord receives half of the value of the hay and rotation pasture produced. It is assumed that the tenant purchases the landlord's share of the hay and rotation pasture at the market price for hay and uses this roughage in his livestock program. This arrangement is examined to determine whether giving the landlord and tenant identical production possibility curves on crops causes consistent plans. However, in comparisons between crops and livestock, the tenant and landlord still are faced with different production possibility curves (i.e., curves which have slopes differing from that for the farm as a whole).

Clarion-Webster soil area. The major change in the present lease (A_4) from a typical crop-share lease is that operating and building expenses are now divided on a 50-50 basis between landlord and tenant. Operating expenses are considerably greater than building expenses, hence, there is a shift in total expenses from the tenant to the landlord. Therefore, with very limited capital ($500, A in table 13), the landlord's optimum program contains only 43 acres of $CCSb_2$ with 110 acres in disposal land. The landlord does not maximize profits by planting more than 43 acres

TABLE 13. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA UNDER CROP-SHARE LEASE A_4*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation					Tenant's livestock program		Return†† (dollars)
		$CCSb_2$	$CCSb_3$	$CSbCOM_3$	$CCOM_3$	disposal land‡	calves§ (no.)	hogs** (litters)	
A (Landlord	500	43	...	...	...	110	...	...	868
(Tenant	3,000	...	149	4	...	...	...	6	3,530
B (Landlord	500	43	...	...	...	110	...	...	868
(Tenant	10,000	...	...	122	31	...	46	10	4,750
C (Landlord	1,200	104	...	...	...	49	...	...	2,082
(Tenant	3,000	...	149	4	...	...	...	6	3,530
D (Landlord	1,200	104	...	...	...	49	...	...	2,082
(Tenant	10,000	...	...	122	31	...	46	10	4,750
E (Landlord	2,000	24	129	...	...	...	...	...	3,372
(Tenant	3,000	...	149	4	...	...	...	6	3,530
F (Landlord	2,000	24	129	...	...	...	...	...	3,372
(Tenant	10,000	...	...	122	31	...	46	10	4,750
G (Landlord	Unlimiting	...	153	...	...	...	...	...	3,430
(Tenant	3,000	...	149	4	...	...	...	6	3,530
H (Landlord	Unlimiting	...	153	...	...	...	...	...	3,430
(Tenant	10,000	...	..	122	31	...	46	10	4,750

*Receipts and expenses on all crops are divided 50-50 between landlord and tenant.
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay and pasture.
§Choice steer calves, full-fed on pasture.
**Total litters per year (equal numbers of spring and fall litters).
††Return above annual expenses, with fixed costs still to be deducted.

of CCSb without fertilizer because, for the Clarion-Webster soil area, the initial yield response for fertilizer is high enough to allow a slightly higher return per dollar invested under $CCSb_2$ than under $CCSb_1$. (The "net return/capital requirement" ratio per acre is greater for $CCSb_2$ than for $CCSb_1$.)[23] With an increase in the landlord capital level, more acres are planted to $CCSb_2$ and $CCSb_3$ until, with unlimiting capital, the landlord's optimum program is once again $CCSb_3$ for the entire farm (H in table 13).

Because of the shift in expenses from the tenant to the landlord under the present leasing alternative (A_4), it is possible for the tenant to plant the entire farm to rotation even with limited capital ($3,000, A in table 13). Such a plan for the tenant is not possible under the usual cost-sharing arrangement (see A in table 7). Also, with a high capital level, the tenant is able to produce more acres of the meadow rotations and maintain a larger livestock program than was possible under the common cost-sharing arrangement (compare B, table 13 and B, table 7).

For the Clarion-Webster soil area, the 50-50 method of sharing crop costs and returns (lease A_4, table 13) is no more successful in reducing leasing frictions than the typical crop-share lease (table 7). In fact, if the landlord is very limited on capital and the tenant is not, the optimum programs for the two parties are more diverse than under a typical crop lease (compare B, table 13 and B, table 7). The shift in expenses toward the landlord does not change the landlord's optimum rotation from CCSb (B in tables 7 and 13); the increased expense merely permits the landlord to plant a smaller acreage of this rotation. Reduced tenant expenses, on the other hand, allow the tenant to proceed even further in the direction of more meadow in the rotation as a means of obtaining a profitable use of his capital through livestock production (see B in tables 13 and 7). Hence, because the landlord does not receive a share of the livestock, the plans still do not become consistent: Equal production possibilities for crops are attained but production possibilities (see figs. 1 and 2) still differ between crops and livestock for the two parties.[24]

A slight variation of the 50-50 cost-sharing arrangement discussed above is also studied for the Clarion-Webster soil area. Under this particular variation, the tenant pays $25 per acre cash rent on hay instead of half of the market value of hay. The details of the plans for this variation are given in table B-5, Appendix B. The only change from the plans under the 50-50 arrangement discussed above (see table 13) is for the low landlord capital levels: $CSbCOM_1$ replaces $CCSb_2$ as the rotation with the highest landlord return per dollar invested.

Tama-Muscatine soil area. Table 14 indicates the optimum plans for the landlord and tenant under crop-share lease A_4 (with a 50-50 division of crop receipts and expenses) for the Tama-Muscatine soil area. The 50-50 cost-sharing arrangement of lease A_4 shifts more of the expenses to the landlord than is the case under the typical crop-share arrangement. Hence, with limited quantities of capital, the landlord is forced to leave more acres in disposal land than is necessary under the usual cost-sharing arrangement (compare A, B, C and D in tables 14 and 8).

The decrease in tenant expenses under the 50-50 cost-sharing arrangement allows the tenant with limited capital to use higher fertilizer rates than was possible under a typical crop-share lease (compare

[23]The return per dollar invested from the $CCSb_2$ rotation is so little higher than the return per dollar invested from the $CCSb_1$ rotation that the difference is probably unimportant in practice. Also, the above results are applicable over a very narrow range of capital limitations. However, the results do indicate that under certain situations a landlord, or even an owner-operator, may receive greater returns per dollar invested from an acre of fertilized rotation than from an acre of unfertilized rotation.

[24]Plans also were computed for an arrangement under which crop expenses and receipts were divided on a 60-40 basis between the landlord and tenant. This arrangement caused greater divergence in plans than did the 50-50 sharing arrangement. For details of the plans under the 60-40 sharing arrangement on Clarion-Webster soils, see table B-4, Appendix B.

TABLE 14. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA UNDER CROP-SHARE LEASE A_4*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation							Tenant's livestock program		Return†† (dollars)
		$CCSb_1$	$CCSb_2$	$CCSb_3$	$CCSb_4$	$CSbCOM_4$	$CCOM_4$	disposal land‡	calves§ (no.)	hogs** (litters)	
A(Landlord	500	50	...	...	...	...	...	104	...	...	1,272
(Tenant	3,000	...	...	...	151	3	...	...	...	4	5,144
B(Landlord	500	50	...	...	...	...	...	104	...	...	1,272
(Tenant	10,000	...	...	...	...	39	115	...	46	12	5,909
C(Landlord	1,200	120	...	...	...	...	...	34	...	...	3,052
(Tenant	3,000	...	...	...	151	3	...	...	...	4	5,144
D(Landlord	1,200	120	...	...	...	...	...	34	...	...	3,052
(Tenant	10,000	...	...	...	...	39	115	...	46	12	5,909
E(Landlord	2,000	...	71	83	...	...	...	...	...	...	4,722
(Tenant	3,000	...	...	...	151	3	...	...	...	4	5,144
F(Landlord	2,000	...	71	83	...	...	...	...	...	...	4,722
(Tenant	10,000	...	...	...	...	39	115	...	46	12	5,909
G(Landlord	Unlimiting	...	...	...	154	...	...	...	...	...	5,013
(Tenant	3,000	...	...	...	151	3	...	...	...	4	5,144
H(Landlord	Unlimiting	...	...	...	154	...	...	...	...	...	5,013
(Tenant	10,000	...	...	...	...	39	115	...	46	12	5,909

*Receipts and expenses on all crops are divided 50-50 between landlord and tenant.
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay and pasture.
§Deferred-fed steer calves, good to choice grade.
**Total litters per year (equal numbers of spring and fall litters).
††Return above annual expenses, with fixed costs still to be deducted.

A, table 14 and A, table 8). The 50-50 cost-sharing arrangement allows the tenant with $10,000 capital to plant more areas of meadow and raise more livestock than was possible under the typical crop-share lease (compare B, table 14 and B, table 8).

From the above discussion, it appears that changing from a typical crop-share lease to crop-share lease A_4 (50-50 division of crop returns and expenses) consistently widens the gap between the most profitable programs for the landlord and tenant in both soil areas. The shift in expenses from the tenant to the landlord forces the landlord's optimum program in the direction of lower fertilizer levels on the CCSb rotation; simultaneously it allows the tenant to maximize profits by engaging in a heavy livestock program requiring meadow rotations fertilized at high levels. While crop-share lease A_4 (with 50-50 division of crop expenses and returns) attains consistency of production possibilities between crops, it apparently widens the nature of production possibilities between crops and livestock for both tenant and landlord. The tenant gains more than previously from meadow rotations; the landlord still gains nothing from forage processed through livestock and has more pressure on his limited capital.[25]

As for the Clarion-Webster soil area, a slight variation of the 50-50 cost-sharing arrangement is also studied for the Tama-Muscatine soil area. With this leasing variation, the tenant pays a cash rent of $25 per acre on hay instead of half of the market value of the hay. The optimum plans for the tenant and landlord with this leasing variation are exactly the same as the plans for the 50-50 cost-sharing arrangement (see table 14 for these plans). Apparently, both the landlord and tenant are located at the "corners" of discontinuous production possibility curves: Small changes in price ratios (due to slightly changing the value of hay above) are not great enough to cause the iso-revenue lines to be tangent to the production possibility curves at different points for given capital levels (see discussion of figs. 1 and 2).[26]

CROP-SHARE LEASE A_5

Under all previous leases the tenant is allowed to operate an independent livestock program. However, in all of the leasing variations examined, changes to cause tenant and landlord production possibilities for crops to be similar does not bring about complete consistency of plans (see discussion of figs. 1 and 2). This is true because differences in production possibilities between crops and livestock are still different for the tenant and landlord, or for each party as compared to the farm as a whole (see discussion under typical crop-share lease A_1). Since the landlord does not realize part of the gain in value of the forage processed through livestock, he gains from a meadow rotation only when hay has a sufficiently high rental or price to cause hay returns to compare favorably with corn and soybeans. In contrast, the tenant realizes the full gain from forage for a livestock program and, if he has sufficient capital, maximizes profit with a forage rotation. Hence, crop-share lease A_5, which does not allow livestock, is examined as an alternative to bring about consistency of plans. A cash rent of $10 per acre on hay is assumed for lease A_5.

Clarion-Webster soil area. Table 15 summarizes the most profitable plans for the landlord and tenant at various levels of capital when the tenant is not permitted to raise livestock. An attempt was made to determine the quantity of capital for the landlord which would give both parties the "same relative capital limitations" based on the $3,000 and $10,000 tenant capital levels. The procedure for arriving at these figures consisted of (1) computing a ratio between the landlord and tenant capital requirements for each activity (only non-livestock activities were included in these computations), then (2) multiplying the simple mean of these ratios by each of the tenant's capital levels ($3,000 and $10,000) to obtain the two capital figures for the landlord. The computed capital levels for the landlord are shown in A and B, table 15.

When the alternative of raising livestock is omitted from farm planning, neither the landlord nor the tenant find it profitable to include meadow in the rotation. Though the CCSb rotation is now most profitable for both parties at all capital levels, the specialized sharing of resources (such as labor and machinery) still prevents complete agreement on fertilization rates (see A in table 15). The tenant, because he has a relative advantage in fertilizer use, maximizes his profits by fertilizing 147 acres at the third level with 6 acres in disposal land. The landlord, of course, maximizes his profits by having the entire farm in rotation and fertilizing to the limits of his capital. Hence, in the Clarion-Webster soil area,

[25]Plans also were computed for an arrangement under which crop expenses and receipts were divided on a 60-40 basis between the landlord and tenant. As in the Clarion-Webster soil area, this arrangement caused greater divergence in plans than did the 50-50 sharing arrangement. For details of the plans under the 60-40 sharing arrangement for the Tama-Muscatine soil area, see table B-6, Appendix B.

[26]Also see Heady, Economics of agricultural production and resource use, op. cit. p. 255-6.

TABLE 15. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA UNDER CROP-SHARE LEASE A_5*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation			Return§ (dollars)
		CCSb2	CCSb3	disposal land‡	
A (Landlord	1,166**	20	133	...	4,224
(Tenant	3,000	...	147	6	2,242
B (Landlord	3,888††	...	153	...	4,269
(Tenant	10,000	...	153	...	2,341

*Typical crop-share lease with $10 per acre cash rent on hay and pasture, but tenant cannot have livestock.
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay and pasture.
§Return above annual expenses, with fixed costs still to be deducted.
**Same relative capital as the tenant, based on $3,000 tenant capital.
††Same relative capital as the tenant, based on $10,000 tenant capital.

TABLE 16. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA UNDER CROP-SHARE LEASE A_5*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of Rotation			Return‡ (dollars)
		$CCSb_2$	$CCSb_3$	$CCSb_4$	
A (Landlord	939§	107	47	...	5,683
(Tenant	3,000	78	76	...	3,699
B (Landlord	977	78	76	...	5,724
(Tenant	3,000	78	76	...	3,699
C (Landlord	3,130**	...	...	154	6,055
(Tenant	10,000	...	...	154	3,932

*Typical crop-share lease with $10 per acre cash rent on hay and pasture, but tenant cannot have livestock.
†Capital available for use in the farm business.
‡Return above annual expenses, with fixed costs still to be deducted.
§Same relative capital as the tenant, based on $3,000 tenant capital.
**Same relative capital as the tenant, based on $10,000 tenant capital.

the landlord and tenant cannot reach complete agreement upon an optimum program (even without livestock) until both parties have enough capital to plant the entire farm to $CCSb_3$.

Tama-Muscatine soil area. Table 16 shows the most profitable landlord and tenant plans at various levels of capital when the tenant is not allowed to produce livestock. Because yields without fertilizer are relatively high in the Tama-Muscatine soil area, the tenant with $3,000 capital finds no advantage in leaving some acreage in disposal land (see A, table 16). Thus, the difficulty of bringing about consistent plans for the landlord and tenant at limited capital levels is avoided in the Tama-Muscatine soil area.[27]

Tables 15 and 16 demonstrate that the plans of the landlord and tenant reach virtual agreement if (1) the tenant is prohibited from raising livestock and (2) each party has roughly the same relative capital limitation. Perhaps few tenants would agree to a lease which prohibits livestock production; a tenant would agree to such a lease at a sacrifice in income under the prices assumed for this study.

While the restriction on livestock forces the two plans to become consistent, this point should be emphasized: The single plan which maximizes profits for the tenant and landlord is not the optimum plan for the farm as a whole. Greater income can be attained, for given collections of resources, if livestock are allowed to be produced. Thus, while the *necessary* condition between tenant and landlord is attained (see earlier discussion), the *sufficient* condition between leasing parties and the farm as a whole is not attained. Another plan could be found which allows a greater income for the farm as a whole and, therefore, which allows greater profits to both tenant and landlord.

For example, under crop-share lease A_5 (no livestock allowed) in the Clarion-Webster soil area, the combined return of the landlord and tenant with unlimiting capital is $6,610 (B in table 15). However, by combining the resources of the two parties and allowing livestock production, the return from the optimum plan for the entire farm is $7,618; an increase of $1,008. Likewise, income from the optimum farm plan in the Tama-Muscatine soil area is increased by $400 when the resources of the two parties are pooled and livestock production is permitted.[28] Thus, while the two parties find consistent plans when livestock production is prohibited, another plan including livestock can be found which increases the total income for the farm.

[27]The divergence in tenant and landlord programs at limited capital levels in table 16 can be attributed to the manner in which the "same relative capital level" is determined. Since an average ratio between landlord and tenant capital requirements is used, any particular activity chosen will have a slightly different ratio. Thus, if the landlord has $977 capital, both parties will desire exactly the same program (B in table 16).

TYPICAL LIVESTOCK-SHARE LEASE

Under the typical livestock-share lease, all livestock investment, expenses and returns are shared equally between the landlord and tenant. However, the tenant furnishes all machinery and pays the operating expenses while the landlord pays all real estate expenses. The livestock-share lease is included as a possible basis for consistency of plans since the following has been apparent throughout the analysis: The higher profits to the tenant from engaging in livestock enterprises causes his optimum plan to differ from that of the landlord.

It was pointed out in the previous discussion that virtually complete agreement between leasing parties can be reached if the tenant is prohibited from raising livestock (providing the two parties have roughly the same relative capital limitations). However, such an arrangement precludes attainment of the *sufficient* condition outlined at the outset. (Also, many tenants object to a lease prohibiting them from engaging in livestock enterprises.) An alternative more nearly in line with both *necessary* and *sufficient* conditions is a lease under which livestock is jointly owned. The following discussion is based upon the analysis of the most common form of such a livestock-share lease.

Clarion-Webster soil area. Table 17 summarizes the most profitable programs for the landlord and tenant under a typical livestock-share lease at various capital levels. Complete agreement between landlord and tenant is reached when the landlord has $2,000 capital and the tenant has $4,000 capital (roughly the same relative capital limitations for each party, A in table 17). Because operating expenses and real estate expenses are paid individually, the net return and capital requirement for each activity is somewhat different for the two parties. Yet the same activities hold a relative advantage for both parties, thus permitting identical optimum programs. Further, if the capital resources of the two parties are combined (a total of $6,000 = $2,000 + $4,000) the optimum plan

[28]While the details of these plans are not shown in tabular form, the input-output relationships used are the same as those used in computing the plans for lease A_5 (no livestock allowed).

TABLE 17. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA UNDER A TYPICAL LIVESTOCK-SHARE LEASE*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation					Farm livestock program		
		CCSb1	CCSb3	CSbCOM3	CCOM3	disposal land‡	calves§ (no.)	hogs** (litters)	Return†† (dollars)
A(Landlord	2,000	...	146	7	...	...	...	10	4,435
(Tenant	4,000	...	146	7	...	...	...	10	2,398
B(Landlord	500	129	...	...	...	...	...	...	2,854
(Tenant	Unlimiting	...	...	...	153	...	55	10	2,814
C(Landlord	Unlimiting	...	...	153	...	...	44	10	4,818
(Tenant	3,000	...	140	...	...	13	...	...	2,025
D(Landlord	Unlimiting	...	...	153	...	...	44	10	4,818
(Tenant	Unlimiting	...	...	...	153	...	55	10	2,814

*Tenant furnishes labor and operating expenses; landlord pays real estate expenses. All other receipts and expenses shared 50-50.
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay and pasture.
§Choice steer calves, full-fed on pasture.
**Total litters per year (equal numbers of spring and fall litters).
††Return above annual expenses, with fixed costs still to be deducted.

for the farm as a whole is exactly the same as that for each party individually (A in table 17). Also, the return from this optimum farm plan equals the sum of the returns to the individual parties. Thus, both the *necessary* and *sufficient* conditions for leasing efficiency are met in this case.

When both the landlord and tenant have unlimiting capital, their most profitable programs are somewhat different (D in table 17). This difference is slight, however, since additional computations (not shown here) reveal that the landlord can shift to the tenant's optimum plan with a decrease of only $14 in over-all net return; the tenant can shift to the landlord's optimum plan with a decrease of less than $50 in net returns. Such small differences can be easily resolved. The variance in optimum plans can again be attributed to the specialized payment of expenses associated with the machinery and real estate resources.

The landlord and tenant interests are nearly parallel under a livestock-share lease when each party has roughly the same relative capital limitations. Table 17 indicates, however, that conflict still exists if the two parties have widely different capital resources (B and C in table 17). This finding provides further evidence that leasing shares must be allowed to vary with the capital resources of the parties involved if leasing efficiency is to be attained relative to profit maximization by both parties.

Tama-Muscatine soil area. Table 18 again reveals a high measure of consistency in planning for the Tama-Muscatine soil area when the two parties are (1) subject to roughly the same relative capital limitations or (2) have unlimiting capital. As examples, when both parties have approximately the same relative capital limitations (A in table 18), the landlord can adopt the tenant's optimum plan with only $33 sacrifice in income; when both parties have unlimiting capital the tenant can shift to the landlord's optimum program with less than $5 sacrifice in income.[29]

The following conclusion is apparent from the analysis of the livestock-share lease: If the *necessary* conditions for leasing efficiency are attained under the livestock-share lease, the *sufficient* conditions will be simultaneously satisfied. In other words, if a single plan is optimum for both leasing parties, this same plan will be optimum from the standpoint of the farm as a unit. If the optimum plans of the parties differ only slightly, a compromise plan may be worked out which deviates little from the optimum plan for the farm as a whole.

While the livestock-share lease is effective in removing leasing conflicts when the two parties have the same relative capital limitations, considerable differences do exist for cases in which the capital resources of the two parties are greatly divergent[30] (B and C in table 18). Also, to be successful, the livestock-share

[29]The details of these computations are omitted here.

[30]An important difference between the two soil areas is that a cattle enterprise never enters into the optimum program in the Tama-Muscatine soil area under a livestock lease, table 18, while cattle are included in the programs for the Clarion-Webster soil area, table 17. This difference can be explained as follows: In the Tama-Muscatine soil area, the net returns from CCSb4 are higher than the returns from any of the meadow-cattle feeding activities; capital requirements are also lower for the CCSb4 activity than for the meadow-cattle feeding activities. Therefore, a cattle feeding activity never enters into the optimum program.

TABLE 18. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA UNDER A TYPICAL LIVESTOCK-SHARE LEASE*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation								Farm livestock program	
		CCSb1	CCSb2	CCSb3	CCSb4	CSbCOM4	CCOM3	CCOM4	disposal land‡	hogs§ (litters)	Return** (dollars)
A(Landlord	2,000	...	...	...	148	6	...	...	...	10	6,217
(Tenant	4,000	...	...	...	150	...	4	...	...	8	4,070
B(Landlord	500	129	...	...	...	...	...	...	25	...	4,058
(Tenant	10,000	...	...	...	148	...	...	6	...	12	4,135
C(Landlord	Unlimiting	...	...	...	147	7	...	...	...	12	6,255
(Tenant	3,000	...	78	76	...	...	...	...	...	...	3,699
D(Landlord	Unlimiting	...	...	...	147	7	...	...	...	12	6,255
(Tenant	Unlimiting	...	...	...	148	...	...	6	...	12	4,135

*Tenant furnishes labor and operating expenses; landlord pays real estate expenses. All other receipts and expenses shared 50-50.
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay and pasture.
§Total litters per year (equal numbers of spring and fall litters).
**Return above annual expenses, with fixed costs still to be deducted.

lease requires a landlord with a relatively high capital level and livestock managerial ability. The tenant, on the other hand, must not object to "caring for the landlord's livestock." If such obstacles can be surmounted, it appears that the livestock-share lease can serve to reduce friction in farm rental agreements.

CHOICE BETWEEN TYPES OF LEASES

The most common share leasing arrangements in the areas studied are the typical crop-share lease and the typical livestock-share lease. Conflicts between landlord and tenant may arise, not only within the framework of a given lease, but with respect to the type of lease which should be used in renting the farm. Accordingly, the following analysis allows the tenant and landlord a choice of the most profitable type of lease at various capital levels. This phase of the study is used to determine whether an arrangement which gives consistency of plans and maximum returns for the farm is the "optimum choice," from the standpoint of level of income, for either party. Conflicts which arise within leases and between lease types are then discussed. Choice of leases is restricted to the typical crop-share lease and the typical livestock-share lease.

Clarion-Webster soil area. Table 19 summarizes the most profitable lease type and farm plans for the landlord and tenant at various capital levels. Lines A, B and C in table 19 indicate the same conflicts, due to sharing arrangements and different capital levels, which arise under the typical crop-share lease (see previous discussion under the crop-share lease A_1, table 7). Lines D, E, F and G in table 19, however, indicate conflict of a different nature; conflict in regard to the most profitable type of lease for each party. This conflict appears to be particularly serious since the negotiation of a mutually satisfactory compromise is often extremely difficult. The tenant suffers a large reduction in net return if forced to accept a livestock-share lease rather than a crop-share lease. Conversely, the landlord with $2,000 or more in capital (D, E, F and G in table 19) realizes less net return if a crop-share rather than a livestock-share lease is used. Of course, only landlords with sufficient capital can use a livestock-share lease.

The landlord with a high capital level prefers the livestock-share lease because it provides him with profitable investment alternatives for more capital resources (i.e., under the livestock-share lease the landlord can invest in livestock production as well as crop production). At all capital levels the tenant finds it most profitable to enter into a crop-share lease and operate his own livestock program. He realizes a higher return under the crop-share lease because he receives all of the return from livestock. Under a livestock-share lease the tenant not only divides the crop returns, but also divides the livestock returns with the landlord. The landlord, however, finds the livestock lease more profitable at higher levels of landlord capital (D, E, F and G in table 19).

Tama-Muscatine soil area. Table 20 sets forth the optimum lease type and farm plan for the landlord and tenant at various capital levels. The general pattern for the Tama-Muscatine soil area (table 20) is the same as for the Clarion-Webster soil area (table 19). At all capital levels, the tenant finds it most profitable to operate under a crop-share lease, while organizing his livestock program independent of the landlord. As in the Clarion-Webster soil area, the landlord with $2,000 or more in capital (D, E, F and G in table 20) finds it most profitable to shift to a livestock-share lease in order to gain profitable uses for his capital. Again the conflict of interests cannot be easily resolved; either party sacrifices large returns by moving to the less profitable type of lease.

The results of allowing a choice between lease types show a high degree of consistency for both loca-

TABLE 19. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA WHEN THE TWO PARTIES HAVE A CHOICE BETWEEN A TYPICAL LIVESTOCK-SHARE LEASE* AND A TYPICAL CROP-SHARE LEASE†, WITH VARIOUS LEVELS OF CAPITAL.

Party	Capital level‡ (dollars)	Most profitable lease§	Acres of rotation					Farm livestock program		Return§§ (dollars)
			CCSb1	CCSb3	CSbCOM3	CCOM3	disposal land**	calves†† (no.)	hogs‡‡ (litters)	
A(Landlord	500	Crop	130	...	...	...	23	...	...	2,854
(Tenant	3,000	Crop	...	147	...	...	6	...	...	2,242
B(Landlord	1,200	Crop	...	153	...	...	...	...	...	4,331
(Tenant	3,000	Crop	...	147	...	...	6	...	...	2,242
C(Landlord	1,200	Crop	...	153	...	...	...	...	...	4,331
(Tenant	10,000	Crop	...	15	132	6	...	40	10	4,119
D(Landlord	2,000	Livestock	...	146	7	...	...	...	10	4,435
(Tenant	3,000	Crop	...	147	...	...	6	...	...	2,242
E(Landlord	2,000	Livestock	...	146	7	...	...	...	10	4,435
(Tenant	5,000	Crop	...	139	14	...	...	2	10	2,854
F(Landlord	2,000	Livestock	...	146	7	...	...	...	10	4,435
(Tenant	10,000	Crop	...	15	132	6	...	40	10	4,119
G(Landlord	7,107***	Livestock	...	...	153	...	...	44	10	4,818
(Tenant	10,000	Crop	...	15	132	6	...	40	10	4,119

*Tenant furnishes labor and operating expenses; landlord pays real estate expenses. All other receipts and expenses shared 50-50.
†With $10 per acre cash rent on hay and pasture.
‡Capital available for use in the farm business.
§If each party could separately specify the lease. Of course, two different leases could not be used simultaneously on the same farm.
**In practice, disposal land would probably be used for hay and pasture.
††Choice steer calves, full-fed on pasture.
‡‡Total litters per year (equal numbers of spring and fall litters).
§§Return above annual expenses, with fixed costs still to be deducted.
***Same relative capital as the tenant, based on $10,000 tenant capital.

TABLE 20. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA WHEN THE TWO PARTIES HAVE A CHOICE BETWEEN A TYPICAL LIVESTOCK-SHARE LEASE° AND A TYPICAL CROP-SHARE LEASE†, WITH VARIOUS LEVELS OF CAPITAL.

Party	Capital level‡ (dollars)	Most profitable lease§	Acres of rotation							Farm livestock program		Return§§ (dollars)
			CCSb1	CCSb2	CCSb3	CCSb4	CSbCOM4	CCOM4	disposal land°°	calves†† (no.)	hogs‡‡ (litters)	
A(Landlord	500	Crop	129	...	...	...	...	...	25	...	...	4,058
(Tenant	3,000	Crop	...	78	76	...	...	...	...	...	...	3,699
B(Landlord	1,200	Crop	...	...	106	48	...	...	...	...	...	5,903
(Tenant	3,000	Crop	...	78	76	...	...	...	...	...	...	3,699
C(Landlord	1,200	Crop	...	...	106	48	...	...	...	...	...	5,903
(Tenant	10,000	Crop	...	...	...	...	136	18	...	40	12	5,550
D(Landlord	2,000	Livestock	...	...	...	148	6	...	...	...	10	6,217
(Tenant	3,000	Crop	...	78	76	...	...	...	...	...	...	3,699
E(Landlord	2,000	Livestock	...	...	...	148	6	...	...	...	10	6,217
(Tenant	5,000	Crop	...	...	...	145	9	...	...	1	12	4,436
F(Landlord	2,000	Livestock	...	...	...	148	6	...	...	...	10	6,217
(Tenant	10,000	Crop	...	...	...	...	136	18	...	40	12	5,550
G(Landlord	6,000°°°	Livestock	...	...	...	147	7	...	...	...	12	6,255
(Tenant	10,000	Crop	...	...	...	...	136	18	...	40	12	5,550

°Tenant furnishes labor and operating expenses; landlord pays real estate expenses. All other receipts and expenses shared 50-50.
†With $10 per acre cash rent on hay and pasture.
‡Capital available for use in the farm business.
§If each party could separately specify the lease. Of course, two different leases could not be used simultaneously on the same farm.
°°In practice, disposal land would probably be used for hay and pasture.
††Deferred-fed steer calves, good to choice grade.
‡‡Total litters per year (equal numbers of spring and fall litters).
§§Return above annual expenses with fixed costs still to be deducted.
°°°Same relative capital as the tenant, based on $10,000 tenant capital.

tions. While it was shown previously that a livestock-share lease is effective in reducing leasing problems, it becomes apparent that if the tenant has a choice between leases he will reject the livestock-share lease in favor of the crop-share lease. One situation under which the tenant can gain, or can be made no worse off, is where he does not have capital for a large livestock program. In this case, investment in livestock by the landlord, up to the limits of the tenant's capital and building space permits the tenant to obtain an income at least as high as under a crop-share lease. Also, the tenant sometimes may benefit from a livestock-share lease where the landlord has superior managerial ability.

A livestock-share lease is most often found on farms where the landlord has (a) sufficient capital and (b) greater bargaining power than the tenant or the tenant has very limited funds for livestock. Also, in some cases the tenant must accept a livestock-share lease or go without renting the farm, even though he would make more profit if he could have the entire livestock investment.

CASH LEASE

The cash lease is another type of leasing arrangement found in the areas studied which is examined in respect to efficiency. Under a cash lease the tenant pays a fixed per-acre cash rent for the entire farm; he also pays all expenses except real estate expenses but, in turn, receives all returns from crop and livestock sales from the farm.

The cost structure of the farm firm for a cash renter is the same as for an owner-operator except for fixed costs. Since both an owner-operator and a cash renter pay all variable costs, they are faced with the same marginal cost curve.[31] Hence, the cash tenant with security of tenure can be expected to organize his farm in essentially the same manner as an owner-operator with like capital limitations. The results in this section can, therefore, be extended to the owner-operator category with little prospect of error.

Table 21 summarizes the most profitable programs for the tenant under a cash lease for the two soil areas studied. When the tenant is limited to $3,000 capital (A and C in table 21), his optimum program for both areas is the CCSb rotation fertilized at the first

[31]For details on this point, see: Heady, Earl O. Economics of agricultural production and resource use. Prentice-Hall, New York. 1952. Ch. 20.

TABLE 21. MOST PROFITABLE TENANT PROGRAMS IN THE CLARION-WEBSTER AND TAMA-MUSCATINE SOIL AREAS UNDER A CASH LEASE°, WITH TWO LEVELS OF TENANT CAPITAL.

Party	Soil area	Capital level† (dollars)	Acres of rotation						Tenant's livestock program		Return°° (dollars)
			CCSb1	CCSb2	CCSb3	CCSb4	CSbCOM3	CCOM4	calves‡ (no.)	hogs§ (litters)	
A(Tenant	Clarion-Webster	3,000	58	95	...	...	...	...	...	...	5,543
B(Tenant	Clarion-Webster	10,000	...	...	34	...	119	...	33	10	7,802
C(Tenant	Tama-Muscatine	3,000	82	72	...	...	...	...	...	...	8,879
D(Tenant	Tama-Muscatine	10,000	...	...	...	148	...	6	...	12	10,640

°Tenant pays a fixed rent for the farm; he pays all variable costs but also receives all crop and livestock sales from the farm.
†Capital available for use in the farm business.
‡Choice steer calves, full-fed on pasture.
§Total litters per year (equal numbers of spring and fall litters).
°°Return above annual expenses (not including the cash rent payment), with fixed costs still to be deducted.

and second levels. With this limited quantity of capital the cash tenant (or owner-operator) will maximize profits from the CCSb rotation since it gives the greatest return per dollar invested.

With $10,000 capital the optimum program for the tenant differs considerably between the two soil areas (B and D in table 21). Capital, hog space and land become limiting resources in the Clarion-Webster soil area. Hogs are produced to the capacity of hog building space; the remaining land and capital is divided optimally between the $CSbCOM_3$ and $CCSb_3$ rotations and the cattle enterprise (B in table 21). In the Tama-Muscatine soil area only land and hog space are limiting resources at the $10,000 tenant capital level (D in table 21). Because yields from the CCSb rotation are relatively high in the Tama-Muscatine soil area, the $CCSb_4$ rotation has a higher net return per acre under the cash lease than any of the meadow rotation–cattle activities. Therefore, hogs are produced to the limits of space restrictions, and the major portion of the land (148 acres) is planted to $CCSb_4$.

Only the tenant plans need to be examined under cash leasing because the landlord receives a specified rental regardless of the plan followed by the tenant. The optimum program for the tenant aside from uncertainty and length of tenure aspects, is the optimum program for the farm as a whole, given the amount of capital possessed by the tenant. (The tenant has the same optimum program as an owner-operator with the same capital available for variable costs.)

A cash lease entirely removes conflict between the landlord and tenant if the two parties can find a mutually satisfactory rental rate for the farm. Under a cash lease the landlord has no direct concern over the organization of the farm (within the limits of acceptable conservation practices, etc.) since his income is dependent only upon the amount of the cash rental payment. The tenant, by treating the cash rent as a fixed cost, is free to organize the farm in any manner which maximizes his profits. Under a cash lease, the tenant assumes greater risk from price and yield fluctuations than he would under a crop-share lease. For this reason, the tenant ordinarily realizes a somewhat higher income over a period of time; the landlord usually realizes less income because he takes less year-to-year weather risk.

Capital limitations, and the inherently greater risk, on the part of the tenant probably explain why the cash lease is not more widely adopted. However, the above findings indicate that the cash lease holds great promise for reducing leasing friction where the landlord and tenant are willing to enter into such an arrangement. Perhaps a system of flexible cash rents is needed to allow tenants with lower capital levels to rent farms on a cash basis and lessen certain of the risk of uncertainty problems associated with cash renting.

APPENDIX A

BASIC DATA

TABLE A-1. BASIC INPUT-OUTPUT DATA FOR THE LIVESTOCK ENTERPRISES CONSIDERED.

Item	Unit	Two litter hog system*	Pasture-fed steer calves†	Deferred-fed steer calves†
Feed fed per unit‡				
Corn equivalent	bu.	8.2	50.0	53.7
Supplement	lb.	47.8	299.0	268.1
Hay	lb.	.....	1,766.0	2,267.0
Pasture	acre	0.013	0.7	1.2
Hay equivalent	lb.	45.1	3,206.0	6,907.0
Labor	man-hours	1.93§	18.7**	12.5
Annual expenses	dollars			
Protein		2.70	10.94	12.87
Power		0.74	2.40	2.74
Equipment		0.76	2.46	2.88
Miscellaneous		1.09	2.30	2.68
Death loss		.....	2.59	2.42
Feeder stock purchases		.....	103.61	96.86
Total annual expense		5.29	124.30	120.45
Capital investment		2.87	13.50	13.50
Total capital outlay		8.16	137.80	133.95

*Source: Minnesota Reports 206, 214, 215. University of Minnesota. 1947-51; Detailed cost report for central Illinois. 1952-53. AE 2969. Dept. of Agr. Econ., University of Illinois. 1953.

†Source: Beresferd, Rex. One hundred fifty-one questions on cattle feeding and marketing. Iowa Agr. Exp. Sta. and Iowa Agr. Ext. Serv. Bul. P99. 1949; Malone, Carl C. Guides to profits for cattle feeders. Iowa Agr. Ext. Serv. Pamphlet 127. 1950; Annual feeder cattle reports. Ill. Agr. Exp. Sta. 1938-54.

‡One unit refers to 100 lbs. of pork produced for hogs and one head for calves.

§Adapted from: An appraisal of agricultural production capacity in Iowa. Iowa Agr. Ext. Bul. AN153. 1952.

**Adapted from: Heady, E. O. and Olsen, R. O. Substitution relationships, resource requirements and income variability in the utilization of forage crops. Iowa Agr. Exp. Sta. Res. Bul. 390. 1954.

TABLE A-2. CONSTANT PER-ACRE COST FOR CROPS USED IN STUDY.*

Item	Crops			
	Corn	Oats	Soybeans	Meadow
Tractor overhead	2.64	2.73	2.63	2.64
Tractor operating†	3.03	1.55	2.96	2.74
Machinery overhead	6.57	4.34	5.61	3.08
Seed	1.92	2.05	4.30	5.87
Building repair	3.01	2.44	1.56	2.84
Total constant cost	17.17	13.11	17.06	17.17

*These costs are estimates of those expenses normally required to seed and cultivate the specified crops. For costs that vary with rate of fertilizer applications, see table A-3. These data are adapted from: Bowlen, Bernard J. Production planning of crops for Iowa farms. Unpublished Ph.D. thesis. Iowa State College Library, Ames, Iowa. 1954.

†Includes fuel, grease and repairs.

TABLE A-3. TOTAL ANNUAL COST PER ACRE OF ROTATION CROPS.*

Type of cost	Rotation and fertilization level†											
	CCSb				CCOM				CSbCOM			
	1	2	3	4	1	2	3	4	1	2	3	4
	Clarion-Webster soil area											
Constant‡	17.13	17.13	17.13	17.13	16.16	16.16	16.16	16.16[a]	16.34	16.34	16.34	16.34
Fertilizer	....	3.97	8.01	11.68	....	2.62	6.19	9.37	....	2.39	4.85	7.80
Harvesting	3.39	3.83	4.13	4.22	5.96	6.57	6.94	7.15	5.86	6.38	6.45	6.49
Total	20.52	24.93	29.27	33.03	22.12	25.35	29.29	32.68	22.20	25.11	27.64	30.63
	Tama-Muscatine soil area											
Constant	17.13	17.13	17.13	17.13	16.16	16.16	16.16	16.16	16.34	16.34	16.34	16.34
Fertilizer	....	3.50	6.36	10.97	....	3.55	6.62	8.22	....	2.84	5.30	7.02
Harvesting	3.89	4.50	4.76	4.93	6.30	7.31	7.76	8.52	6.18	6.91	7.41	7.89
Total	21.02	25.13	28.23	33.03	22.46	27.02	30.54	32.90	22.52	26.09	29.05	31.25

*Adapted from:Bowlen, Bernard J. Production planning of crops for Iowa farms. Unpublished Ph.D. thesis. Iowa State College Library, Ames, Iowa. 1954.
†For commercial fertilizer rate at each fertilization level referred to by 1, 2, 3 and 4 above, see table 2.
‡Calculated from the data in table A-2.

APPENDIX B

SUPPLEMENTARY TABLES OF RESULTS

TABLE B-1. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA UNDER TYPICAL CROP-SHARE LEASE A1*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation				Tenant's livestock program		Return†† (dollars)
		CCSb1	CCSb3	CSbCOM3	disposal land‡	calves§ (no.)	hogs** (litters)	
A(Landlord	500	130	...	...	23	...	...	2,854
(Tenant	3,000	...	147	...	6	...	...	2,242
B(Landlord	500	130	...	...	23	...	...	2,854
(Tenant	10,000	...	14	139	...	40	10	4,481
C(Landlord	1,200	...	153	...	...	...	...	4,331
(Tenant	3,000	...	147	...	6	...	...	2,242
D(Landlord	1,200	...	153	...	...	...	...	4,331
(Tenant	10,000	...	14	139	...	40	10	4,481
E(Landlord	2,000	...	153	...	...	...	...	4,331
(Tenant	3,000	...	147	...	6	...	...	2,242
F(Landlord	2,000	...	153	...	...	...	...	4,331
(Tenant	10,000	...	14	139	...	40	10	4,481
G(Landlord	Unlimiting	...	153	...	...	...	...	4,331
(Tenant	3,000	...	147	...	6	...	...	2,242
H(Landlord	Unlimiting	...	153	...	...	...	...	4,331
(Tenant	10,000	...	14	139	...	40	10	4,481

*With $16 and $25 per acre cash rent on hay and rotation pasture.
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay or pasture.
§Choice steer calves, full-fed on pasture.
**Total litters per year (equal numbers of spring and fall litters).
††Return above annual expenses, with fixed costs still to be deducted. Cash rent on hay is not yet deducted from the tenant's return.

TABLE B-2. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA UNDER A TYPICAL CROP-SHARE LEASE* WHERE THE LANDLORD RECEIVES ONLY 40 PERCENT OF THE SOYBEANS, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation						Tenant's livestock program		Return†† (dollars)
		CCSb1	CCSb2	CCSb3	CCSb4	CSbCOM4	disposal land‡	calves§ (no.)	hogs** (litters)	
A(Landlord	500	129	...	...	...	...	25	...	...	3,729
(Tenant	3,000	...	78	76	...	...	...	...	...	4,093
B(Landlord	500	129	...	...	...	...	25	...	...	3,729
(Tenant	10,000	...	...	...	...	154	...	38	12	5,322
C(Landlord	1,200	...	...	106	48	...	...	...	...	5,494
(Tenant	3,000	...	78	76	...	...	...	...	...	4,093
D(Landlord	1,200	...	...	106	48	...	...	...	...	5,494
(Tenant	10,000	...	...	...	...	154	...	38	12	5,322
E(Landlord	2,000	...	...	...	154	...	...	...	...	5,606
(Tenant	3,000	...	78	76	...	...	...	...	...	4,093
F(Landlord	2,000	...	...	...	154	...	...	...	...	5,606
(Tenant	10,000	...	...	...	...	154	...	38	12	5,322
G(Landlord	Unlimiting	...	...	...	154	...	...	...	...	5,606
(Tenant	3,000	...	78	76	...	...	...	...	...	4,093
H(Landlord	Unlimiting	...	...	...	154	...	...	...	...	5,606
(Tenant	10,000	...	...	...	...	154	...	38	12	5,322

*With $25 per acre cash rent on hay and pasture.
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay or pasture.
§Deferred-fed steer calves, good to choice grade.
**Total litters per year (equal numbers of spring and fall litters).
††Returns above annual expenses, with fixed costs still to be deducted.

TABLE B-3. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA UNDER CROP-SHARE LEASE A[3]*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation					Tenant's livestock program		Return** (dollars)
		CCSb[1]	CCSb[2]	CCSb[4]	CSbCOM[4]	CCOM[3]	calves‡ (no.)	hogs§ (litters)	
A (Landlord	500	...	...	154	...	...	...	...	7,109
(Tenant	3,000	82	72	...	...	...	...	...	2,939
B (Landlord	500	...	...	154	...	...	...	...	7,109
(Tenant	10,000	...	18	...	130	6	34	12	4,105
C (Landlord	1,200	...	...	154	...	...	...	...	7,109
(Tenant	3,000	82	72	...	...	...	...	...	2,939
D (Landlord	1,200	...	...	154	...	...	...	...	7,109
(Tenant	10,000	...	18	...	130	6	34	12	4,105
E (Landlord	2,000	...	...	154	...	...	...	...	7,109
(Tenant	3,000	82	72	...	...	...	...	...	2,939
F (Landlord	2,000	...	...	154	...	...	...	...	7,109
(Tenant	10,000	...	18	...	130	6	34	12	4,105
G (Landlord	Unlimiting	...	...	154	...	...	...	...	7,109
(Tenant	3,000	82	72	...	...	...	...	...	2,939
H (Landlord	Unlimiting	...	...	154	...	...	...	...	7,109
(Tenant	10,000	...	18	...	130	6	34	12	4,105

*With $25 per acre cash rent on hay and pasture, except that tenant pays all fertlizer and seed expenses.
†Capital available for use in the farm business.
‡Deferred-fed steer calves, good to choice grade.
§Total litters per year (equal numbers of spring and fall litters).
**Return above annual expenses, with fixed costs still to be deducted.

TABLE B-4. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA WHEN ALL CROP RECEIPTS AND EXPENSES ARE DIVIDED 60-40 BETWEEN THE LANDLORD AND TENANT, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level* (dollars)	Acres of rotation						Tenant's livestock program		Return** (dollars)
		CCSb[2]	CCSb[3]	CSbCOM[2]	CSbCOM[3]	CCOM[3]	disposal land†	calves‡ (no.)	hogs§ (litters)	
A (Landlord	500	36	...	...	...	...	117	...	...	868
(Tenant	3,000	...	147	...	6	...	...	...	8	2,979
B (Landlord	500	36	...	...	...	...	117	...	...	868
(Tenant	10,000	...	...	8	73	72	...	50	10	4,244
C (Landlord	1,200	87	...	...	...	...	66	...	...	2,084
(Tenant	3,000	...	147	...	6	...	...	...	8	2,979
D (Landlord	1,200	87	...	...	...	...	66	...	...	2,084
(Tenant	10,000	...	...	8	73	72	...	50	10	4,244
E (Landlord	2,000	145	...	...	...	...	8	...	...	3,473
(Tenant	3,000	...	147	...	6	...	...	...	8	2,979
F (Landlord	2,000	145	...	...	...	...	8	...	...	3,473
(Tenant	10,000	...	...	8	73	72	...	50	10	4,244
G (Landlord	Unlimiting	...	153	...	...	...	...	...	...	4,113
(Tenant	3,000	...	147	..	6	...	...	...	8	2,979
H (Landlord	Unlimiting	...	153	...	...	...	...	...	...	4,113
(Tenant	10,000	...	...	8	73	72	...	50	10	4,244

*Capital available for use in the farm business.
†In practice, disposal land would probably be used for hay and pasture.
‡Choice steer calves, full-fed on pasture.
§Total litters per year (equal numbers of spring and fall litters).
**Return above annual expenses, with fixed costs still to be deducted.

TABLE B-5. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE CLARION-WEBSTER SOIL AREA UNDER CROP-SHARE LEASE A4*, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level† (dollars)	Acres of rotation						Tenant's livestock program		Return†† (dollars)
		CCSb2	CCSb3	CSbCOM1	CSbCOM3	CCOM3	disposal land‡	calves§ (no.)	hogs** (litter)	
A (Landlord	500	...	...	49	...	...	104	...	...	881
(Tenant	3,000	...	149	...	4	...	...	...	6	3,527
B (Landlord	500	...	...	49	...	...	104	...	...	881
(Tenant	10,000	...	...	...	122	31	...	46	10	4,618
C (Landlord	1,200	...	...	117	...	...	36	...	...	2,114
(Tenant	3,000	...	149	...	4	...	...	...	6	3,527
D (Landlord	1,200	...	...	117	...	...	36	...	...	2,114
(Tenant	10,000	...	...	...	122	31	...	46	10	4,618
E (Landlord	2,000	24	129	...	...	...	...	...	...	3,372
(Tenant	3,000	...	149	...	4	...	...	...	6	3,527
F (Landlord	2,000	24	129	...	...	...	...	...	...	3,372
(Tenant	10,000	...	...	...	122	31	...	46	10	4,618
G (Landlord	Unlimiting	...	153	...	...	...	...	...	...	3,430
(Tenant	3,000	...	149	...	4	...	...	...	6	3,527
H (Landlord	Unlimiting	...	153	...	...	...	...	...	...	3,430
(Tenant	10,000	...	...	...	122	31	...	46	10	4,618

*Receipts and expenses on all crops are divided 50-50 between landlord and tenant, except that tenant pays $25 per acre cash rent for hay and pasture instead of half the value of the hay or pasture.
†Capital available for use in the farm business.
‡In practice, disposal land would probably be used for hay and pasture.
§Choice steer calves, full-fed on pasture.
**Total litters per year (equal numbers of spring and fall litters).
††Return above annual expenses, with fixed costs still to be deducted.

TABLE B-6. MOST PROFITABLE LANDLORD AND TENANT PROGRAMS FOR THE TAMA-MUSCATINE SOIL AREA WHEN ALL CROP RECEIPTS AND EXPENSES ARE DIVIDED 60-40 BETWEEN THE LANDLORD AND TENANT, WITH VARIOUS LEVELS OF LANDLORD AND TENANT CAPITAL.

Party	Capital level* (dollars)	Acres of rotation						Tenant's livestock program		Return** (dollars)
		CCSb1	CCSb2	CCSb4	CSbCOM4	CCOM4	disposal land†	calves‡ (no.)	hogs§ (litters)	
A (Landlord	500	42	...	...	...	...	112	...	...	1,272
(Tenant	3,000	...	...	149	5	...	...	...	8	4,320
B (Landlord	500	42	...	...	...	...	112	...	...	1,272
(Tenant	10,000	...	...	...	...	154	...	49	12	5,211
C (Landlord	1,200	100	...	...	...	...	54	...	...	3,052
(Tenant	3,000	...	...	149	5	...	...	...	8	4,320
D (Landlord	1,200	100	...	...	...	...	54	...	...	3,052
(Tenant	10,000	...	...	...	...	154	...	49	12	5,211
E (Landlord	2,000	94	60	...	...	...	...	...	...	5,027
(Tenant	3,000	...	...	149	5	...	...	...	8	4,320
F (Landlord	2,000	94	60	...	...	...	...	...	...	5,027
(Tenant	10,000	...	...	...	...	154	...	49	12	5,211
G (Landlord	Unlimiting	...	...	154	...	...	...	...	...	6,015
(Tenant	3,000	...	...	149	5	...	...	...	8	4,320
H (Landlord	Unlimiting	...	...	154	...	...	...	...	...	6,015
(Tenant	10,000	...	...	...	...	154	...	49	12	5,211

*Capital available for use in the farm business.
†In practice, disposal land would probably be used for hay and pasture.
‡Deferred-fed calves, good to choice grade.
§Total litters per year (equal numbers of spring and fall litters).
**Return above annual expenses, with fixed costs still to be deducted.