Effects of Varying Management Levels of Crops and Livestock on Optimal Farm Organizations

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CONTENTS

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INTRODUCTION

Variations in the quality and quantity of factors of production alter resource use and production possibilities. Management is a major factor of production warranting rigorous definition and attempts to measure the impact of various levels of it on farm organization.

Much of the research and extension effort in farm management is devoted to collection, development, and compiling of input-output data. Much less effort has been directed toward relating these data explicitly to management levels; hence, a certain vagueness with respect to management often surrounds the published input-output coefficients or "standards." A more useful product would be forthcoming if the work in data collection were more sharply focused on its relationship to management and attendant resource allocation.[1]

Farm management personnel sometimes can be justly accused of studying the productivity of all resources other than management Studies give estimates representing the productivity of labor, land, and capital but rarely is anything noted regarding management's productivity. At best, management is the "residual claimant" after other resources have been allotted their share of the total product and the residual method has well-known disadvantages which are serious if not disabling in research.

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[1] Data sources include surveys, farm records, enterprise records, detailed cost records and experimental results. Considerable controversy surrounds the methods of obtaining and developing input-output data and most of the criticism alludes to the proposition that management levels are not accurately depicted. A few of these common criticisms include:

(1) The data do not represent "reasonable levels" of achievement for farmers: e.g. data derived from experiments cannot be transplanted directly from the experiment station to farms since farm conditions are more variable (including management) as compared to experimental conditions. (2) Input-output data as usually given are single-valued without regard to variance around the measure. (3) Surveys are limited in many cases by the farmers' memory as to what actually occured. (4) Farm records are biased since the more efficient farmers cooperate in the record project. (5) Standards developed from records and surveys are descriptive representing what has been achieved rather than what is the optimum achievements.

THE PROBLEM

A critical issue facing farm management personnel is that so much time, effort, and funds may be spent on the development of input-output standards that little time and funds remain for economic analysis. Record projects are probably the main source of input-output data. These projects have come and gone (and perhaps come again) in the agricultural colleges of the United States and a primary reason for their abandonment in the past has been that they were too costly to maintain in relation to other research and extension activities needed.

Differences in management ability are difficult to appraise and isolate since economies associated with funds and amounts of other resources confound generalizations and obscure differences (e.g. large farms earn more than small farms). Relevant questions are: How much of the success or failure of a firm can be attributed to differences in management while holding other resources constant? How can differences in management be portrayed?

For illustrative purposes, management differences can be portrayed by differences in:

a. Buying and selling abilities.
b. Labor use.
c. Yields (crop and livestock).

This indicates that the differences in management abilities can be reflected through input-output relationships. Buying and selling differences are reflected in the price and cost coefficients. Differences in labor efficiencies are reflected by the amount of labor used to produce a given amount of product.

Observation and study of records indicate wide variations among farms in crop and livestock efficiencies. Many factors contribute to efficiency variation-- timeliness of operation, feed wastage, and skill in crop and animal production are but a few of the many influences that affect management, and consequently income. Some farmers are excellent "crop" men and average or poor livestock producers; the reverse is also found. Gradients are found ranging from superior managers in all phases of farm production to those who are inferior in all phases. In view of the different management efficiencies the purposes of this report are:

1. To determine how different management levels affect farm organization, structure, and income.
2. To ascertain if the degree of difference resulting from various efficiencies invalidates general organizational recommendations made for all management levels.

PROCEDURES

Optimum farm organizations were determined by linear programming for the 25 management situations of crops and livestock presented in Table 1.

Computations were performed with the IBM 1620 computer at the University of Missouri. With the exception of management, all technologies and resources were assumed to be constant (amount and distribution of labor, land acreage, production possibilities, etc.). Management levels for crop and livestock activities were allowed to vary from 20 percent above average in both crops and livestock enterprises to 20 percent below average in both crops and livestock enterprises.

To study the effects of different crop management levels, percentage increases and decreases were made for both the grain and forage yield coefficients. For example, in Plan F, crop yields were assumed to be 110 percent of those in Plan A. The management levels for livestock were expressed as percent increases and decreases of grain and forage input coefficients. For example, grain and forage requirements for livestock in Plan B were 90 percent of those in Plan A. All other requirements were assumed constant.

Description of Farm Situation

The case farm which was chosen to represent the various managerial assumptions was developed by Utter and Justus from survey data in Lafayette County, Mo. [2]   Farm size is 200 acres of tillable land; land was terraced and would support any of the crop sequences indicated on pages 6 and 7. Monthly labor supply was estimated from the Utter-Justus bulletin and other data and is presented in Appendix Table 1.

Assumptions

Sufficient machinery, storage, and housing facilities were available for the cropping and livestock systems. No change in inventories of grain and hay occur through time. Further, the scope of the study was confined by the assumptions of the linear programming technique. [3]

2/ For further details of the problem area see Howard D. Utter and Fred E. Justus, Jr., "Determining Maximum Net Returns For Cropping Systems on Marshall Soil Using Linear Programming", Research Bulletin 780, Mo. Agric. Experiment Station, October, 1961.

3/ See Earl O. Heady and Wilfred Candler, Linear Programming Methods. Iowa State College Press, 1959 or A. Charnes, W. W. Cooper, and A. Henderson, An Introduction to Linear Programming, John Wiley and Sons, Inc., 1953.

TABLE 1 -- MANAGEMENT SITUATIONS ASSUMED FOR 25 PLANS

| Plan | Management Efficiency* | |
	Crops	Livestock
A	Average	Average
B	Average	10 percent above average
C	Average	20 percent above average
D	Average	10 percent below average
E	Average	20 percent below average
F	10 percent above average	Average
G	20 percent above average	Average
H	10 percent below average	Average
I	20 percent below average	Average
J	10 percent above average	10 percent above average
K	10 percent above average	20 percent above average
L	10 percent above average	10 percent below average
M	10 percent above average	20 percent below average
N	20 percent above average	10 percent above average
O	20 percent above average	20 percent above average
P	20 percent above average	10 percent below average
Q	20 percent above average	20 percent below average
R	10 percent below average	10 percent above average
S	10 percent below average	20 percent above average
T	10 percent below average	10 percent below average
U	10 percent below average	20 percent below average
V	20 percent below average	10 percent above average
W	20 percent below average	20 percent above average
X	20 percent below average	10 percent below average
Y	20 percent below average	20 percent below average

*Management efficiency (or level) refers to changes in yields of grain and forage for crops or feed input for livestock. Occasionally management efficiencies or levels will be referred to as: O, average; -, below average; +, above average. For example, management in Plan F may be indicated as:

Crops	Livestock
+10	0

Enterprises Considered

Crop Activities: The crop enterprise data were developed from estimates by Utter and Justus. Nine rotations or crop sequences were chosen as relevant cropping alternatives; any single or combination of rotations can be produced. The rotations considered and their abbreviations are:

Rotation	Abbreviation
Continuous Corn	Cont. Corn
Corn - Soybeans	C-Sb
Corn - Soybeans - Oats (x)*	C-Sb-O $_x$
Corn - Corn - Oats (x)*	C-C-O $_x$

*/ (x) = legume catch crop grown with small grain.

Rotation	Abbreviation
Corn - Corn - Soybeans - Wheat - Clover	C-C-Sb-W-Cl
Corn - Oats - Alfalfa - Alfalfa - Alfalfa	C-O-A-A-A
Soybeans - Wheat - Alfalfa - Alfalfa - Alfalfa	Sb-W-A-A-A
Soybeans - Wheat - Clover	Sb-W-Cl
Corn - Oats - Clover	C-O-Cl

All grain yields were converted to "grain equivalents" and pasture yields were calculated in "pasture days." (See Appendix Table 2 .) Operating costs and monthly labor requirements for crops and hay-making are found in Appendix Tables 3 and 4.

Livestock Activities

Only livestock enterprises commonly found in the area were considered. Included were six activities involving cattle feeding and one hog activity. The following brief summaries of these activities are supplemented by details of the input-output data found in Appendix Tables 5, 6, and 7.

Steer Calf, Wintered, Grazed, and Fed: Calves are purchased in later October or early November, fed primarily on roughage during the winter, grazed and fed on pasture, finished in drylot, and sold in October at approximately 1050 pounds.

Heifer Calf, Wintered and Fed: Heifer calves weighing 400 pounds are bought in late fall and fed during the winter, spring, and early summer. An average gain of 1.6 pound per day is anticipated. Cattle are sold in June at approximately 800 pounds.

Plain Steer, Wintered and Fed: Plain long yearling steers weighing 700 pounds are bought in late October or early November, wintered on a high roughage, low grain ration, and sold in mid-summer weighing 1,000 pounds.

Yearling Steer, Drylot; Low Roughage--Full Grain: Yearling steers weighing 650 pounds are purchased in mid-fall, fed in drylot for seven months on a low roughage, liberal grain ration. Steers are sold in late May or early June weighing 1,000 pounds.

Yearling Steer, Drylot; High Roughage--Medium Grain: Yearling steers weighing 650 pounds are purchased in mid-fall and fed in drylot for eight months on a high roughage, medium grain ration. Steers are sold in late June or early July weighing 1,150 pounds.

Two-Year Old Steer, Drylot: Two-year old steers weighing 900 pounds are purchased in October, fed in drylot on a high grain ration,

and sold in late January or early February weighing 1,150 pounds.

Sow and Two Litters: Sows farrow in March and September; 14 pigs are raised (average 7 pigs per litter); 13 hogs and one cull sow are sold, one gilt is saved for replacement. Market hogs weigh 225 pounds and the cull sow, 400 pounds.

For simplicity, the livestock enterprises will be abbreviated as follows:

Livestock Enterprise:

Steer calf, wintered, grazed and fed
Heifer calf, wintered and fed
Plain steer, wintered and fed
Yearling steer; drylot; low roughage, full grain
Yearling steer; drylot; high roughage, medium grain
Two-year old steer, drylot
Sow and 2 litters

Abbreviation:

Steer calf
Heifer calf
Plain steer
Yearling steer (low roughage)
Yearling steer (high roughage)
2-year old steer
Hogs

OPTIMUM ORGANIZATIONS FOR VARYING MANAGEMENT LEVELS

In the first set of plans optimal resource allocation and farm organization are determined with the assumption that no hay or grain can be purchased. Grain can be sold, however, at $1.00 per bushel in any amount subject only to the capacity of the farm unit. These plans are referred to as the first set or the original plans.

In the second set of 25 plans, the optimum organizations are presented where there is an opportunity to purchase additional grain and/or hay. Grain is assumed to be purchased at $1.10 per bushel and hay at $20 per ton. The plans where additional grain and/or hay can be purchased will be called the second set.

In the third set of plans the most profitable farm organizations are determined where it is assumed that grain, but not hay, can be purchased. Grain can be purchased at the same price as set

forth for the second set of plans. The term "income" will refer to income above variable costs or stated another way. returns primarily to fixed factors, labor, land, and capital. [4]

Optimum Organizations for the First Set of Plans

The "base" plan (A), the plan with average management for both crops and livestock assumed, is presented in Table 2. The land is about equally divided between an intensive rotation, continuous corn, and an extensive rotation, C-O-A-A-A. With the high amount of roughage produced, a high number of high roughage consuming livestock are included in the optimum plan; 79 head of steer calves and 18 yearling steers (high roughage). Expansion limits on crop and livestock enterprises were primarily the labor restrictions in September and October. Livestock enterprises which use relatively more grain were not only restricted by labor but also by grain. Grain production· could be increased, of course, by shifting part of the acreage devoted to the rather extensive rotation C-O-A-A-A to one where more grain is produced; however, decreasing acreage of C-O-A-A-A would reduce roughage and, consequently, roughage-consuming livestock.

TABLE 2 -- OPTIMUM ORGANIZATION FOR PLAN A; FIRST SET OF PLANS

Activity	Level
Continuous Corn	106 acres
C-O-A-A-A	94 acres
Steer calves	79 head
Yearling steers (high roughage)	18 head
2 year old steers	16 head
Hogs	39 litters
Income $13, 411	

The most restrictive resources appear to be : land; labor in May, September, and October; hay; and corn. The extent of the shortage of these items is reflected in their respective marginal value products (MVP):[5]

4/ The fixed factor cost on this farm might range from $5,000 to $10,000 annually depending upon farm organizations, land prices, equipment and machinery investment, taxes, opportunity cost of unpaid operator and family labor and miscellaneous costs. For example assume the following:

Land investment (200 acres @ $250/acres)	$50,000
Machinery, buildings and equipment investment	30,000
Total assumed investment	$80,000
Annual fixed factor costs	
Investment ($80,000 @ 5%)	$ 4,000
Depreciation*	1,000
Land taxes* (200 acres @ $2.70/acre)	540
Unpaid operator and family labor	3,000
Total	$ 8,540

*Some depreciation and personal taxes are partially accounted for in crop and livestock cost and income coefficients.

5/ Hereafter, the term "marginal value product" will usually be abbreviated to "MVP".

	Unit	MVP
Land	Acre	$22.47
Labor:		
May	Hour	9.73
September	Hour	5.44
October	Hour	4.27
Corn	Bushel	1.20
Hay	Ton	22.77

The MVPs of corn and hay are, of course, related to the MVP of land. If the land resource were increased, more feed would be produced and the MVPs of corn and hay would decrease. On the other hand, with an increase in land, the MVPs of labor would increase since these resources would be in still shorter relative supply.

One reason that a large number of steer calves is included in the plan is found in their low labor requirement in May (see Appendix Table 6). May is a critical month for many of field activities and, consequently, labor use for crops is high. While yearling steers (high roughage), on the other hand, have a rather high May labor requirement, this factor is balanced off by zero labor requirements in the other critical months, September and October. The presence of the 2-year old steer activity in the optimal plan presents an interesting situation with respect to resource use; this enterprise gives a high return to resources since it requires only two hours of labor in a critical period; other labor requirements occur at a time when labor is in surplus and hence carries MVP of zero. The yearling steer enterprise "operates" in a similar manner--it uses labor in only one of the critical months. It appears that these two enterprises complement each other with respect to resource use.

The hog enterprise is fairly stable in the solution at a relatively high level. The hog enterprise as constructed in this model, makes fairly even use of labor during the year except for March and September when farrowing increases labor requirements. The large amount of labor used by the enterprise in March does not affect the plan since labor is in surplus in this month; the high labor requirements in the fall months, however, do have considerable effect since these are labor shortage months.

Plans Under Varying Management Levels

Table 3 sets forth the profit maximizing plans for each of the 25 different management situations. Several striking similarities are present among the plans even though management levels vary widely. First, in most of the plans the continuous corn and C-O-A-A-A

TABLE 3 -- OPTIMUM FARM ORGANIZATIONS FOR VARYING LEVELS OF MANAGEMENT; FIRST SET OF PLANS

	Unit	A	B	C	D	E	F	G	H	I	J	K	L	M
Crops:														
Cont. Corn	acre	106	94	81	117	125	93	81	119	131	81	56	104	123
C.Sb.W$_x$	acre	---	---	---	---	---	---	---	---	---	---	---	---	---
C.C.O.$_x$	acre	---	---	---	---	---	---	---	---	---	---	21	---	---
C.O.A.A.A.	acre	94	106	119	83	39	107	119	81	14	119	123	96	77
Sb.W.A.A.A.	acre	---	---	---	---	36	---	---	---	55	---	---	---	---
Livestock:														
Steer calves	head	79	94	115	68	59	93	109	67	51	112	129	79	67
Yearling steer high roughage	head	18	33	52	5	---	33	48	3	---	49	67	19	---
2-year old steer	head	16	22	27	9	2	28	37	4	---	33	36	21	6
Hogs	Litter	39	28	13	49	54	25	9	52	58	11	---	36	50

TABLE 3 -- (CONT.) OPTIMUM FARM ORGANIZATIONS FOR VARYING LEVEL OF MANAGEMENT;
FIRST SET OF PLANS

	Unit	N	O	P	Q	R	S	T	U	V	W	X	Y
Crops:													
Cont. Corn	acre	56	1	92	130	107	94	128	133	122	109	137	142
C.Sb.W.$_x$	acre	---	24	---	---	---	---	---	---	---	---	---	---
C.C.O.$_x$	acre	23	66	---	---	---	---	---	---	---	---	---	---
C.O.A.A.A.	acre	121	109	108	31	93	106	24	67	78	91	63	58
Sb.W.A.A.A.	acre	---	---	---	39	---	---	48	---	---	---	---	---
Livestock:													
Steer calves	head	123	122	92	68	78	96	55	46	64	78	41	34
Yearling steer high roughage	head	63	80	33	---	17	34	---	---	---	16	---	---
2-year old steer	head	42	45	33	---	11	17	---	---	1	7	---	---
Hogs	Litter	---	---	21	47	43	30	56	56	56	46	57	55

TABLE 4 -- PERCENT OF CROPLAND IN VARIOUS ROTATIONS;
FIRST SET OF PLANS

Plan	Cont. Corn	C.Sb.W.$_x$	C.C.O.$_x$	C.O.A.A.A.	Sb.W.A.A.A.
A	53.0	--	--	47.0	--
B	47.0	--	--	53.0	--
C	40.5	--	--	59.5	--
D	58.5	--	--	41.5	--
E	62.5	--	--	19.5	18.0
F	46.5	--	--	53.5	--
G	40.5	--	--	59.5	--
H	59.5	--	--	40.5	--
I	65.5	--	--	.7.0	27.5
J	40.5	--	--	59.5	--
K	28.0	--	10.5	61.5	--
L	52.0	--	--	48.0	--
M	61.5	--	--	38.5	--
N	28.0	--	11.5	60.5	--
O	.5	12.0	33.0	54.5	--
P	46.0	--	--	54.0	--
Q	65.0	--	--	15.5	19.5
R	53.5	--	--	46.5	--
S	47.0	--	--	53.0	--
T	64.0	--	--	12.0	24.0
U	66.5	--	--	33.5	--
V	61.0	--	--	39.0	--
W	54.5	--	--	45.5	--
X	68.5	--	--	31.5	--
Y	71.0	--	--	29.0	--

TABLE 5 -- PERCENT OF GROSS INCOME* FROM VARIOUS ENTERPRISES;
FIRST SET OF PLANS

Plan	Steer Calves	Yearling Steers (high roughage)	2-Year Old Steers	Hogs	Cash Grain
A	50.2	12.7	11.2	25.9	
B	51.2	19.8	13.3	15.7	
C	53.7	26.4	13.8	6.1	
D	50.6	4.4	7.3	37.7	
E	49.8	--	2.2	48.0	
F	50.3	19.6	16.3	13.7	
G	51.1	24.8	19.9	4.2	
H	51.8	2.7	3.4	42.1	
I	46.1	--	--	53.9	
J	52.3	25.5	16.8	5.3	
K	53.3	30.3	16.4	--	
L	49.2	13.2	14.6	23.0	
M	51.9	--	5.2	40.2	2.7
N	51.5	29.0	19.5	--	
O	46.8	34.0	19.2	--	
P	49.3	19.5	19.5	11.7	
Q	52.9	--	--	37.7	9.4
R	51.0	12.0	7.9	29.1	
S	52.3	20.4	10.3	17.0	
T	48.7	--	--	51.3	
U	43.9	--	--	56.1	
V	52.1	.7	--	47.2	
W	52.0	11.7	4.8	31.5	
X	41.4	--	--	58.6	
Y	37.4	--	--	62.6	

*Use of gross income is probably the best single indicator of livestock organization. It does have a disadvantage, however, in that the importance of the cattle feeding activities may be slightly exaggerated. For example, the cost of purchased livestock which is included in gross income, amounts to a considerable portion for cattle feeding activities as compared to a nominal portion in the hog enterprise. However, if use of gross income is made to indicate relative importance of various livestock enterprises of plans within a set or relative importance among sets of plans, then much of the objection to using the gross income as an indicator is removed.

rotations dominated the cropping system (Table 4). Secondly, the
activity, steer calves, was included at a high level when expressed
in terms of percent of gross income in every plan. In 16 of the
25 plans over 50 percent of the gross income is derived from this
enterprise and in 20 of the 25 plans the enterprise was the dominant
one (Table 5).

Hogs as an enterprise were very important in many plans (Table 5).
In five plans this enterprise produced over 50 percent of the gross
income. In 11 of the 25 plans more than a third of the gross income
was from hogs. In three organizations, however, the hog activity
was not included in the optimal organization.

The five plans in which hogs furnished 50 percent or more of the
gross income were:

	Management	
	Percent Above or Below Average	
Plans	Crops	Livestock
I	-20	0
T	-10	-10
U	-10	-20
X	-20	-10
Y	-20	-20

The 11 plans having more than one-third of gross income from hogs
included the five plans above plus the following:

	Management	
	Percent Above or Below Average	
Plans	Crops	Livestock
D	0	-10
E	0	-20
H	-10	0
M	10	-20
Q	20	-20
V	-20	10

In general, plans having a high gross income from hogs are below
average in at least one management aspect and particularly below

average in overall livestock management. The competitive position of the hog enterprise improves when the livestock feed efficiency declines since feed comprises a smaller portion of total costs as compared to the cattle feeding enterprise. Feed costs for hogs amount to 70-75% of total cost while feed is 80-85% of the cost of feeding cattle. Hence, the effect of a change in amount of feed required per unit will not be the same for hogs and cattle but will affect the competitive position of cattle more.

The presence of the yearling steers (high roughage) and the two-year old steers in the optimal plan varies inversely with presence of the hog enterprise. The enterprises yearling steers (high roughage) and two-year old steers usually are of secondary importance to the other cattle feeding activity but do assume major importance especially when favorable management relationships prevail for livestock and crops; however neither activity is included in the following six plans:[6]

	Management	
	Percent Above or Below Average	
Plans	Crops	Livestock
I	-20	0
Q	20	-20
T	-10	10
U	-10	-20
X	-20	-10
Y	-20	-20

These plans are below average in at least one management aspect and with one exception are average or below in livestock management. Usually, both yearling steers (high roughage) and two-year old steers appear together in optimal plans. For example, in the 19 plans where one or both enterprises are included, 16 plans include both enterprises and in the three plans where only one of the enterprises is selected, the enterprise is relatively unimportant (in terms of gross income).

Marginal Value Products of Limiting Resources

An analysis of the MVPs of the various limiting resources of the various plans reveals some interesting relationships (see Table 6). When comparing and analyzing the productivity of a resource it must be kept in mind that the MVP of one resource is affected by the abundance or scarcity of others. Most plans were limited in

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6/ For practical purposes, neither activity is present in a seventh organization, Plan V. The optimum plan for V calls for only .8 unit of 2-year old steers.

varying degrees by: land; May, September, and October labor; grain; and hay. Plans M and Q were not limited by grain since some excess grain was sold. November labor was completely utilized in only one plan, O.

MVP of land ranges from $35.87 in Plan C to $14.22 in Plan N. On first glance, Plans C and N appear quite similar. Both are high income plans with only $445 difference separating them. However, other differences exist. Plan N represents more intensive use of labor. The cropping system of Plan N is not quite as intensive as that of Plan C but, since yields of N are 20 percent above average, total grain production exceeds that of C by 14 percent. With a highly productive cropping system, more livestock can be included in Plan N. Gross income is over $5,000 more in Plan N (even though the net is only $445 more). In Plan N labor is used more intensively and, in fact, is in shorter supply relative to land. Note in Plan N the MVPs of labor in May, September, and October are quite high while the MVPs of labor in the same periods in Plan C are comparatively modest. If more labor were available in the critical months, the MVP of land would increase.

In terms of income the plans range from $19,244 in Plan O to $8,049 in Plan Y. In Table 7, the plans are ranked according to income and the incomes of the various management plans are presented as percentages of the base Plan A's income. The income range was from a high of 143.5 percent (Plan O) to a low of 60 percent (Plan Y). Certain characteristics affecting income are common to various plans and are designated in Table 8.

Optimum Organizations for the Second Set of Plans

In the previous set of plans, the assumption was that grain could be sold at $1 per bushel but the farm must be self sufficient in that no hay or grain could be purchased. While this assumption does have some validity, it may inhibit maximum earnings. In the following set of plans, all 25 management levels were considered and the resource restrictions and technical coefficients remain the same; the only change was the addition of grain buying and a hay buying activity. Grain could be purchased at $1.10 per bushel and hay at $20 per ton.

Some indication of the changes in the plan appropriate for a situation can be found in observing the MVP of grain and hay in the original plans. It appears that plans such as C and R, which have high MVPs for both grain and hay, will be materially altered by the buying activities while plans such as E, L, and M should be little affected. At first glance, it might appear that in plans such as E, L, and M, with

TABLE 6 -- MARGINAL VALUE PRODUCTS OF LIMITING RESOURCES; FIRST SET OF PLANS
(Dollars Per Unit)

Resource	Unit	A	B	C	D	E	F	G	H	I	J	K	L	M
Land	acre	22.47	28.75	35.87	17.52	16.58	23.64	24.63	21.08	23.80	30.56	15.88	18.19	15.18
Labor:														
May	hr.	9.73	10.32	11.11	9.14	9.32	10.77	11.74	8.61	6.70	11.34	16.20	10.21	10.01
Sept.	hr.	5.44	5.11	4.88	5.72	4.96	5.52	5.60	5.35	--	5.18	7.74	5.82	5.65
Oct.	hr.	4.27	4.69	5.25	3.87	2.27	5.23	6.13	3.24	5.83	5.62	8.96	4.86	3.97
Nov.	hr.	--	--	--	--	--	--	--	--	--	--	--	--	--
Corn	bu.	1.20	1.32	1.45	1.11	1.07	1.15	1.11	1.26	1.43	1.26	1.26	1.06	1.00
Hay	T	22.77	24.89	27.44	21.07	20.32	22.88	23.00	22.64	19.89	24.99	24.27	21.20	20.09

TABLE 6 -- (CONT.) MARGINAL VALUE PRODUCTS OF LIMITING RESOURCES; FIRST SET OF PLANS
(Dollars Per Unit)

Resource	Unit	N	O	P	Q	R	S	T	U	V	W	X	Y
Land	acre	14.22	16.14	18.65	18.87	26.75	33.15	22.72	27.33	27.82	30.21	27.61	23.71
Labor:													
May	hr.	15.48	15.66	11.21	11.55	9.23	10.04	7.34	8.56	7.40	8.87	7.70	6.89
Sept.	hr.	7.49	8.97	5.91	4.64	5.04	4.82	--	--	--	4.75	--	--
Oct.	hr.	8.74	7.50	5.79	4.09	3.68	4.27	6.15	--	6.59	3.20	--	--
Nov.	hr.	--	2.94	--	--	--	--	--	--	--	--	--	--
Corn	bu.	1.12	1.16	1.02	1.00	1.37	1.52	1.28	1.28	1.55	1.58	1.41	1.31
Hay	T	22.97	24.66	21.32	20.60	24.77	27.33	18.55	20.17	21.84	27.21	21.26	19.39

TABLE 7 -- INCOME, RANKINGS, AND RELATIVE INCOMES OF
FIRST SET OF PLANS

| Plan | Rank | Income | Income as Percent of Plan A | Management (% above or below avg.) | |
				Crops	Livestock
O	1	$19,244	143.5	+20	+20
K	2	18,247	136.1	+10	+20
N	3	17,390	129.7	+20	+10
C	4	16,945	126.4	0	+20
J	5	16,286	121.4	+10	+10
G	6	15,704	117.1	+20	0
S	7	15,427	115.0	-10	+20
B	8	14,995	111.8	0	+10
F	9	14,609	108.9	+10	0
P	10	14,235	106.1	+20	-10
W	11	13,775	102.7	-20	+20
R	12	13,588	101.3	-10	+10
A	13	13,411	100.0	0	0
L	14	13,211	98.5	+10	-10
Q	15	13,134	97.9	+20	-20
H	16	12,101	90.2	-10	0
D	17	12,086	90.1	0	-10
M	18	12,046	89.8	+10	-20
V	19	12,043	89.8	-20	+10
E	20	10,940	81.6	0	-20
T	21	10,797	80.5	-10	-10
I	22	10,565	78.8	-20	0
U	23	9,573	71.4	-10	-20
X	24	9,216	68.7	-20	-10
Y	25	8,049	60.0	-20	-20

TABLE 8 -- GENERAL CHARACTERISTICS OF VARIOUS INCOME
GROUPINGS OF PLAN; FIRST SET

Income as a Percent of Plan A	Plan	General Characteristics of Group
60.0 - 69.9	X, Y	Below average in both measures of efficiency. 20% below average in at least one measure.
70.0 - 79.9	I, U	20% below average in at least one measure. Average or below in other measure.
80.0 - 89.9	D, E, M, T, V	Average or below in at least one measure. Average or above in at least one measure.
90 - 99.9	H, L, Q	Average or below in livestock efficiency. Management level for crops mixed.
100.0	A	Average in both measures.
100.1 - 110.0	F*, P, R, W	Below in at least one measure. Above in at least one measure.
110.1 - 120.0	B, G, S**	Average in one measure. Above in one measure.
120.1 - 130.0	C***, J, N	Usually above average in both measures.
> 130.1	K, O	Above average in both measures. 20% above average in livestock efficiency.

*Plan F deviates from the general characteristics of the category in that it is above average in crops (10%), but average in livestock.

**Plan S is below average in crops (10%) but above average in livestock (20%).

***Plan C is average in crops but 20% above average in livestock.

the purchase price, thus indicating that some hay will be purchased. Since hay and grain are used in fixed proportions in the livestock activities, it is reasonable to suppose that the MVP of grain will be enhanced by purchase of hay and, consequently, some grain may be bought. Since opportunities were limited to amounts of feed produced on the farm in the previous plans, expansion limits were rather narrow, especially for those plans which had low crop returns paired with high livestock management (e.g. Plan W).

The ''base'' plan (A), the plan where average management prevails for both livestock and crops, is set forth in Table 9.

MVPs of grain of $1.07, $1.06, and $1.00, respectively, no grain would be purchased, since the price of grain purchased ($1.10) is greater than the MVPs. However, in each of these plans the MVP of hay exceeds

TABLE 9 -- OPTIMUM ORGANIZATION FOR PLAN A;
SECOND SET OF PLANS

Activity	Level
Continuous corn	19 acres
C.C.O$_x$	75 acres
C.O.A.A.A.	106 acres
Steer calves	168 head
Yearling steers (high roughage)	90 head
Grain purchased	4039 bushels
Hay purchased	213 tons
Income $14,152	

Compared to the plan in which no feed could be purchased (see Table 2) the organization is not greatly changed in activities or income. The cropping system is somewhat more extensive (e.g. more roughage produced). Compared to the original base plan, grain produced in Plan A decreased about 13 percent and forage (pasture days) increased more than 18 percent (Table 13). The shift to a less intensive cropping system released more labor for the livestock production. However, two livestock enterprises, 2-year old steers and hogs, present in the original base plan are absent in Plan A in the second set. Levels of the other livestock activities, steer calves and yearling steers (high roughage), increased, greatly reflecting the increased roughage produced and "freeing" of labor formerly used for crop production and other livestock. Income, however, increased rather moderately-- $14,152 as compared to $13,411 or an increase of about 5.5 percent.

The MVPs of scarce resources for Plan A are presented below:

Resource	Unit	MVP
Land	Acre	$ 6.05
Labor:		
May	Hour	11.97
September	Hour	8.19
October	Hour	5.72
November	Hour	2.59
Grain	Bushel	1.10
Hay	Ton	20.00

Note that the MVP of land has decreased from $22.77 in the original base plan (see page 10) to $6.05 per acre, indicating the decreased importance of land resulting from the opportunity to buy feed. Both grain and hay were limiting resources in the previous plan but now have MVPs which are equal to the purchase price of these items. The marginal productivity of May, September, and October labor increased, indicating the relative shortage of these resources with respect to others, especially land. November labor was a limiting resource in this plan whereas it was not in Plan A in the first set.

Plans Under Varying Management Levels

As indicated earlier, situations which will show most benefit from the opportunity to buy grain and hay will be those where the MVPs of these factors are high. On the other hand, plans having low MVPs of grain and hay will be little affected. The organizational structures of the plans are presented in Table 10. In many of the plans, income was little affected while in others substantial increases occurred. Table 11 shows the percentage changes in income for the 25 plans in which hay and grain could be purchased as compared to those where no such purchases could be made. Incomes increased 10 percent or more in seven plans -- H, I, R, S, V, W and X. Income increased less than 5 percent in 13 situations -- D, E, F, G, J, K, L, M, N, O, P, Q, and U. In general, a common characteristic of the plans where income increased most was below average crop efficiency

TABLE 10 -- OPTIMUM FARM ORGANIZATIONS FOR VARYING LEVELS OF MANAGEMENT; SECOND SET OF PLANS

	Unit	A	B	C	D	E	F	G	H	I	J	K	L	M
Crops:														
Cont. Corn	acre	19	--	--	77	125	2	57	--	--	--	--	86	126
C.Sb.	acre	--	--	--	--	--	--	--	--	--	--	--	--	--
C.Sb.W.$_x$	acre	--	53	45	--	--	--	--	31	48	--	62	--	--
C.C.O.$_x$	acre	75	--	--	--	--	105	47	58	--	106	--	--	--
C.O.A.A.A.	acre	106	70	112	123	46	93	96	111	152	85	114	114	74
Sb.W.A.A.A.	acre	--	--	7	--	29	--	--	--	--	--	--	--	--
Sb.W.Cl.	acre	--	--	36	--	--	--	--	--	--	--	--	--	--
C.O.Cl.	acre	--	77	--	--	--	--	--	--	--	9	24	--	--
Livestock:														
Steer calves	head	168	162	164	161	62	168	157	166	143	168	165	157	72
Yearling steer low roughage	head	--	--	--	--	--	--	--	--	--	--	--	--	--
Yearling steer high roughage	head	90	115	132	75	--	90	68	105	117	90	121	66	--
2-year old steer	head	--	3	--	--	--	--	--	--	20	--	--	--	--
Hogs	litter	--	--	--	--	54	--	--	--	--	--	--	--	49
Hay Bought	ton	213	214	215	200	9	213	148	241	181	180	198	172	16
Grain Bought	bu.	4039	4435	4493	3952	--	3035	--	5759	7900	1771	3055	2073	--
Grain Sold	bu.	--	--	--	--	--	--	--	--	--	--	--	--	1051

	Unit	N	O	P	Q	R	S	T	U	V	W	X	Y
Crops:													
Cont. Corn	acre	--	--	96	128	--	--	63	117	--	--	8	57
C.Sb.	acre	--	--	--	--	--	--	--	--	--	17	--	--
C.Sb.W.$_x$	acre	--	53	--	--	55	47	--	--	43	--	--	--
C.C.O.$_x$	acre	119	--	--	--	--	--	--	--	--	--	--	--
C.O.A.A.A.	acre	81	38	104	72	95	68	137	83	108	183	192	143
Sb.W.A.A.A.	acre	--	--	--	--	50	85	--	--	--	--	--	--
Sb.W.Cl.	acre	--	--	--	--	--	--	--	--	--	--	--	--
C.O.Cl.	acre	--	109	--	--	--	--	--	--	49	--	--	--
Livestock: Steer calves	head	165	163	148	76	164	163	161	56	162	160	131	52
Yearling steer low roughage	head	--	--	--	--	--	7	--	--	--	18	--	--
Yearling steer high roughage	head	83	111	55	--	132	132	87	--	135	135	116	45
2-year old steer	head	--	--	--	--	--	--	7	8	--	3	28	60
Hogs	litter	--	--	3	46	--	--	--	58	--	--	--	45
Hay Bought	ton	162	176	140	14	252	223	218	--	243	232	141	--
Grain Bought	bu.	176	1027	--	--	6527	5700	6274	2004	7535	7637	10,000	8307
Grain Sold	bu.	--	--	--	2418	--	--	--	--	--	--	--	--

TABLE 11 -- INCOME COMPARISONS OF SECOND
SET AND FIRST SET OF PLANS

Plan	Income, First Set	Income, Second Set	Income, Second Set As Percent of Income, First Set
A	$13,411	$14,152	105.5
B	14,995	16,149	107.7
C	16,945	18,311	108.1
D	12,086	12,323	102.0
E	10,940	10,943	100.0
F	14,609	15,047	103.0
G	15,704	16,012	102.0
H	12,101	13,308	110.0
I	10,565	12,582	119.1
J	16,286	16,981	104.3
K	18,247	18,994	104.1
L	13,211	13,333	100.9
M	12,046	12,048	100.0
N	17,390	17,875	102.8
O	19,244	19,788	102.8
P	14,235	14,417	101.3
Q	13,134	13,143	100.1
R	13,588	15,432	113.6
S	15,427	17,650	114.4
T	10,797	11,404	105.6
U	9,573	9,736	101.7
V	12,043	14,769	122.6
W	13,775	17,080	124.0
X	9,216	10,578	114.8
Y	8,049	8,670	107.7

coupled with above average livestock efficiency. Plans where income was little changed were characterized by having above average crop efficiency. Several exceptions to these general features are to be found but a combination of a high crop efficiency and low MVP for grain and/or hay most certainly contributed to a small increase in income.

Slight to major changes occurred in the optimal cropping systems of the plans. Note in Tables 12 and 13 the tendency for plans with low crop efficiency to shift out of a more intensive cropping system to one involving more forage. Apparently it was more economical to purchase than to raise grain in these situations. However, only a moderate tendency was noted in the plans involving the highest crop efficiency (+20%) to increase grain production and one such plan

(Q) decreased grain production slightly. Three plans--B, F, and J -- showed a decrease in both grain and forage production, indicating the desirability of buying feed and conserving labor for the expansion of livestock levels.

Optimal livestock systems changed considerably. The most obvious changes were the decline in importance of hogs and 2 year-old steers and an increased importance of both steer calves and yearling steers (high roughage). Whereas 22 of the plans where no feed was purchased included hogs, in the present set of plans only six included the enterprise, Further, in the six plans with hogs, the importance of this enterprise as measured in percentage of gross income declines (see Table 14). Thus the opportunity to buy feed (especially hay) generally resulted in a decline in high grain consuming livestock and favored roughage consuming enterprises.

Some narrowing of the range of income between the high and low plans occurred (Table 15). In the previous set of plans income as a percent of the plan with average efficiencies ranged from 60.0 percent (Plan Y) to 143.5 percent (Plan O) (see Table 7), while in the present set of plans the range was from 61.3 percent (again, Plan Y) to 139.8 (again, Plan O).

Marginal Value Products of Limiting Resources

The greatest change in MVPs of limiting resources occurred in land (Table 16). Compared to the first set of plans, MVP of land was usually much lower and in some cases, zero. The provision of opportunity to purchase feed severely reduced the value of land's contribution in the farm organization complex. On the other hand, the MVPs of labor were usually enhanced, reflecting this resource's relative scarcity and, in some cases, the opportunity to transfer some of this resource from inefficient crop production to more efficient livestock production. Also more intensive use of labor was manifest--for example, some plans completly utilize the supply of labor in April and November whereas there was surplus labor in each of these months in every plan in the first set.

In Table 17 plans are ranked according to income. Incomes of the plans range from $19,788 in Plan O to $8,670 in Plan Y.

The general characteristics of the various income groupings are summerized in Table 18. As noted previously, a low level of management in crop production (if accompanied by high livestock management) is less effective in restraining the income potential (compare Table 18 with Table 8).

TABLE 12 -- PERCENT OF CROPLAND IN VARIOUS ROTATIONS; SECOND SET OF PLANS

Plan	Cont. Corn	C-Sb	C-Sb-W$_X$	C-C-O$_X$	C-O-A-A-A	Sb-W-A-A-A	Sb-W-Cl	C-O-Cl
A	9.6			37.5	52.9			
B			26.3		35.2			38.6
C			22.4		56.0	3.7	17.9	
D	38.7				61.3			
E	62.7				23.1	14.2		
F	.9			52.5	46.6			
G	28.7			23.4	47.9			
H			15.3	29.3	55.6			
I			24.1		75.8			
J				53.2	42.5			4.3
K			31.1		57.2			11.8
L	42.9				57.1			
M	62.9				37.1			
N				59.7	40.3			
O			26.6		19.1			54.2
P	47.9				52.1			
Q	63.8				36.2			
R			27.6		47.7	24.8		
S			24.5		33.9	47.7		
T	31.4				68.7			
U	58.7				41.3			
V			21.6		53.9	24.6		
W		8.5				91.6		
X	4.0				96.0			
Y	28.3				71.7			

TABLE 13 -- PERCENT OF GRAIN AND FORAGE PRODUCTION IN
OPTIMAL PLANS IN SECOND SET OF PLANS AS
COMPARED TO FIRST SET OF PLANS

| Plan | Percent of Production in First Set of Plans | |
	Grain	Forage (Pasture Days)
A	82.8	118.5
B	80.8	93.7
C	77.7	111.5
D	79.8	146.9
E	100.3	99.1
F	91.5	95.0
G	106.5	83.8
H	73.3	146.2
I	55.1	224.4
J	98.9	81.2
K	88.3	101.9
L	90.2	118.6
M	101.5	96.0
N	109.4	73.4
O	101.2	66.5
P	102.4	96.2
Q	98.6	103.0
R	65.7	156.5
S	67.5	145.0
T	68.4	189.1
U	91.9	123.8
V	56.3	205.9
W	51.5	201.0
X	40.2	302.4
Y	61.2	245.0

TABLE 14 -- PERCENT OF GROSS INCOME FROM VARIOUS
ENTERPRISES; SECOND SET OF PLANS

Plan	Steer Calves	Yearling Steers (Low Roughage)	Yearling Steers (High Roughage)	2-Year Old Steers	Hogs	Cash Grain
A	62.8	--	37.2	--	--	--
B	55.5	--	43.4	1.1	--	--
C	52.9	--	47.1	--	--	--
D	66.0	--	34.0	--	--	--
E	52.6	--	--	--	47.4	--
F	62.8	--	37.2	--	--	--
G	67.9	--	32.1	--	--	--
H	58.9	--	41.1	--	--	--
I	48.7	--	43.9	7.4	--	--
J	62.9	--	37.1	--	--	--
K	55.2	--	44.8	--	--	--
L	68.2	--	31.8	--	--	--
M	56.5	--	--	--	40.0	3.5
N	64.2	--	35.8	--	--	--
O	57.1	--	42.9	--	--	--
P	70.0	--	28.4	--	1.6	--
Q	57.0	--	--	--	35.4	7.6
R	52.9	--	47.1	--	--	--
S	51.6	2.2	46.2	--	--	--
T	60.9	--	36.3	2.8	--	--
U	44.4	--	--	7.3	48.3	--
V	52.3	--	47.7	--	--	--
W	48.3	5.6	45.0	.9	--	--
X	45.2	--	44.0	10.8	--	--
Y	24.4	--	23.1	30.8	21.7	--

TABLE 15 -- INCOME   OF PLANS RELATIVE TO PLAN A;
SECOND SET OF PLANS

Plan	Income as Percent of A	Plan	Income as Percent of A
A	100.0	N	126.3
B	114.1	O	139.8
C	129.4	P	101.9
D	87.1	Q	92.9
E	77.3	R	109.1
F	106.3	S	124.9
G	117.2	T	80.6
H	94.0	U	68.8
I	88.9	V	104.6
J	120.0	W	121.2
K	134.2	X	74.7
L	94.2	Y	61.3
M	85.1		

TABLE 16 -- MARGINAL VALUE PRODUCTS OF LIMITING RESOURCES; SECOND SET OF PLANS
(Dollars Per Unit)

Resource:	Unit	A	B	C	D	E	F	G	H	I	J	K	L	M
Land	acre	6.05	1.73	0	13.60	17.12	9.81	12.84	1.94	.32	2.84	.14	19.88	15.14
Labor:														
April	hr.	--	2.56	2.32	--	--	--	--	--	--	2.00	5.16	--	--
May	hr.	11.97	13.82	11.14	10.00	9.17	13.28	14.15	11.00	8.59	16.07	16.32	10.03	9.95
June	hr.	--	--	1.78	--	--	--	--	--	.26	--	--	--	--
Sept.	hr.	8.19	9.14	9.10	5.68	4.40	6.19	4.91	10.39	12.00	7.08	7.68	3.74	5.59
Oct.	hr.	5.72	7.04	6.60	5.26	2.74	8.43	10.20	3.20	--	10.71	10.69	6.59	4.12
Nov.	hr.	2.59	2.66	9.51	--	--	.67	--	3.93	7.00	--	1.80	--	--
Hay	T.	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Grain	bu.	1.10	1.10	1.10	1.10	1.08	1.10	1.08	1.10	1.10	1.10	1.10	1.10	1.00

TABLE 16 -- (CONT.) MARGINAL VALUE PRODUCTS OF LIMITING RESOURCES; SECOND SET OF PLANS
(Dollars Per Unit)

Resource:	Unit	N	O	P	Q	R	S	T	U	V	W	X	Y
Land	acre	6.35	2.85	21.92	18.56	0	0	9.10	14.84	0	0	6.84	11.46
Labor:													
April	hr.	--	4.81	--	--	--	1.16	--	--	1.21	7.52	--	--
May	hr.	17.48	17.83	10.81	11.14	10.37	5.99	9.09	7.94	5.18	3.07	6.47	5.87
June	hr.	--	--	--	--	.64	4.09	--	--	2.93	5.15	.54	--
Sept.	hr.	5.19	5.99	3.27	4.20	10.88	9.91	7.68	5.19	11.74	10.64	9.12	6.42
Oct.	hr.	13.46	13.40	7.73	5.10	3.14	3.57	2.96	1.61	--	1.38	--	.52
Nov.	hr.	--	--	--	--	9.23	11.93	1.34	--	12.18	11.02	4.30	1.26
Hay	T	20.00	20.00	20.00	20.00	20.00	20.00	20.00	19.94	20.00	20.00	20.00	19.39
Grain	bu.	1.10	1.10	1.07	1.00	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10

TABLE 17 -- INCOME OF SECOND SET OF PLANS AND COMPARATIVE
RANKINGS OF INCOME

Plan	Income	Rank	Previous Rank (First Set)	Management (% above or below average) Crops	Livestock
O	$19,788	1	1	+20	+20
K	18,994	2	2	+10	+20
C	18,311	3	4	0	+20
N	17,875	4	3	+20	+10
S	17,650	5	7	−10	+20
W	17,080	6	11	−20	+20
J	16,981	7	5	+10	+10
B	16,149	8	8	0	+10
G	16,012	9	6	+20	0
R	15,432	10	12	−10	+10
F	15,047	11	9	+10	0
V	14,769	12	19	−20	+10
P	14,417	13	10	+20	−10
A	14,152	14	13	0	0
L	13,333	15	14	+10	−10
H	13,308	16	16	−10	0
Q	13,143	17	15	+20	−20
I	12,582	18	22	−20	0
D	12,323	19	17	0	−10
M	12,048	20	18	+10	−20
T	11,404	21	21	−10	−10
E	10,943	22	20	0	−20
X	10,578	23	24	−20	−10
U	9,736	24	23	−10	−20
Y	8,670	25	25	−20	−20

TABLE 18 – GENERAL CHARACTERISTICS OF VARIOUS INCOME
GROUPINGS OF PLANS; SECOND SET

Income as a percent of Plan A	Plan	General Characteristics of Group
60 – 69.9	U,Y	Below average in both measures of efficiency. 20 percent below average in livestock efficiency.
70 – 79.9	E,X	Below average in livestock efficiency. Average or below in crop efficiency.
80 – 89.9	D,I*,M,T	Below average in livestock efficiency. Management level for crops mixed.
90 – 99.9	H,L,Q	Below average in one measure.
100	A	Average in both measures.
100.1 – 110.0	F,P,R,V	Above average in one measure.
110.1 – 120.0	B,G,J	Average or above in both measures.
120.1 – 130.0	C,N,S,W	Above average in livestock efficiency.
> 130.1	O,K	Above average in both measures. 20 percent above average in livestock efficiency.

*Plan I deviates from the general characteristics of this category in that it is average in livestock efficiency; however, the plan is 20 percent below average in crop efficiency.

Income Comparisons of Various Management Levels
From Given vs. Optimal Farm Orgainzations[7]

While some organizational differences are observed there are
definite threads of homogeniety among plans. Hence a question
arises concerning the stability of plans; that is, if one given or-
ganization is imposed on all of the various management situations,
what will be the outcome with respect to income? Certainly, since
a suboptimal organization is used income will be lower, but how
much lower? To answer this query, assume that the cropping and
livestock system optimum for Plan A was established for each of the
24 other plans. The plans show a high degree of homogeniety in
cropping and livestock systems; for example, all plans include steer
calves ranging from 168 head in Plans O, A, F and J to 52 head in
Plan Y. Also, all but four plans include yearling steers (high roughage).
On the other hand, only six plans included hogs. Hence, it is reason-
able to expect that plans approximating the cropping and livestock
systems of Plan A will be little changed. Of course, those plans
involving higher (lower) crop and/or livestock efficiency will tend
to purchase less (more) feed than the average plan to maintain the
livestock enterprise levels. Table 19 presents a comparison of
optimal income with income resulting from using the organization
of Plan A.

The largest decline in income was in Plan Y with 12 percent and
the smallest was in Plans F and J with 0.4 percent. This is not
particularly surprising when the organizational structures of those
plans are studied and compared to Plan A. For Plans F and J, the
livestock systems are identical to those in Plan A and the cropping
patterns are almost the same. However, the cropping system in
Plan Y differs considerably from Plan A while still larger differences
are found in the levels and kinds of livestock included.

Only six plans had incomes of less than 93 percent of plan A.[8]
Furthermore, five of the six plans having the largest decrease in in-
come were ones where a very important enterprise was hogs. In
fact, all but one of the plans which included hogs in the optimum
organization are most affected by use of Plan A organization.[9]

Unfortunately, the major declines in income occurred in plans having
a low optimum income (e. g. Plans E, M, Q, X, Y) and thus, while
a standard plan based on average management had little effect
upon most plans, a general recommendation for all levels of manage-
ment must be qualified.

As previously noted, many plans (especially those of average and

7/   A question may be raised concerning the reasons for choosing the assumptions
associated with the second set of plans for this analysis rather than those of the first or
third set.   The reason is simply that for the organizations of Plan A and O, plans with
below average management could not be implemented without purchase of grain and/or
hay.

8/ Plans E, M, Q, V, X, Y.

9/   Plan P included hogs as an enterprise but at a very low level; also, income for
this plan was not affected greatly by the set organization.

TABLE 19 - INCOME COMPARISONS OF PLANS INVOLVING PLAN A
ORGANIZATION VS. OPTIMAL ORGANIZATION

Plan	Optimal Income	Income w/ Plan A Org.	Income w/Plan A Org. as % of Optimal Income
A	$14,152	$14,152	100.0
B	16,149	16,072	99.5
C	18,311	17,995	98.3
D	12,323	12,053	97.8
E	10,943	9,954	91.0
F	15,047	14,984	99.6
G	16,012	15,817	98.8
H	13,308	12,990	97.6
I	12,582	11,828	94.0
J	16,981	16,905	99.6
K	18,994	18,828	99.1
L	13,333	13,063	98.0
M	12,048	11,116	92.3
N	17,875	17,738	99.2
O	19,788	19,661	99.4
P	14,417	13,896	96.4
Q	13,143	11,977	91.1
R	15,432	15,087	97.8
S	15,650	17,101	96.9
T	11,404	10,892	95.5
U	9,736	8,804	90.4
V	14,769	13,925	94.3
W	17,080	15,940	93.3
X	10,578	9,730	92.0
Y	8,670	7,632	88.0

above income) have a great deal of similarity in organizational structure. Fitting all plans to the average management plan revealed interesting relationships but gave rise to another question: "What would be the consequences of fitting all plans to the organization presented as optimal for the highest management plan, O?" Again a survey of organizational structures of the plans reveals that many plans are fairly similar to Plan O. Interestingly however, the optimal cropping and livestock combination in Plan O is not as intensive as several others although its income is highest. For example, more livestock are present in Plans K and R but income is less. Plan O's chief advantage appears to be in its efficiency rather than in its great volume.

Table 20 summarizes the income relationships derived by using the Plan O organization. Since optimal organizations for Plan O and Plan A do not differ greatly it would be reasonable to expect no great changes in income of plans using the Plan O vs. Plan A organization. The income range is somewhat greater, however. Income from Plan K decreased less than 2 percent from optimal while Plan Y's income decreased almost 23 percent. As in the case when plans were based on Plan A organization, the plans which included hogs were most affected with respect to incomes [10] while those bearing

_____
10/ Again plan P is an exception.

TABLE 20 - INCOME COMPARISONS OF PLANS INVOLVING PLAN O
ORGANIZATION VS. OPTIMAL ORGANIZATION

Plan	Optimal Income	Income with Plan O Org.	Income with Plan A Org. as % of Optimal Income
A	$14,152	$13,297	94.0
B	16,149	15,505	96.0
C	18,311	17,718	96.8
D	12,323	11,089	90.0
E	10,943	8,882	81.2
F	15,047	14,334	95.3
G	16,012	15,368	96.0
H	13,308	12,263	92.1
I	12,582	11,227	89.2
J	16,981	16,540	97.4
K	18,994	18,753	98.7
L	13,333	12,126	90.9
M	12,048	9,917	82.3
N	17,875	17,576	98.3
O	19,788	19,788	100.0
P	14,417	13,161	91.3
Q	13,143	10,951	83.3
R	15,432	14,470	93.8
S	15,650	16,683	94.5
T	11,404	10,055	88.2
U	9,736	7,847	80.6
V	14,769	13,435	91.0
W	17,080	15,648	91.6
X	10,578	8,994	85.0
Y	8,670	6,712	77.3

closest relation to Plan O were little changed (e.g. Plan N). Average
income declined somewhat more when Plan O organization was used
compared to Plan A since, as previously noted, there was a tendency
for Plan O to have somewhat fewer livestock than some other plans.

The last of the given plans involved basing all plans on the optimal
organization of the least efficient plan, Plan Y. Plan Y, in spite of
its overall inefficiency, is a fairly intensive plan, in both cropping
and livestock systems. The plan includes a fairly balanced program
of four fivestock enterprises -- steer calves, yearling steers (high
roughage), two year old steers and hogs, The level of two year old
steers exceeds all other plans both in absolute number and contri-
bution to gross income. This activity provides a high volume of gross
income with a limited amount of labor and "fits" rather well with
the high volume of hogs.

Using the Plan Y organization, income ranges from 96.8 percent
of optimum in Plan U to a low of 82.3 percent in Plan W. As noted
in Table 21, optimal income for Plan U ranks just above that for
Plan Y and the two are similar in organization. Plan W, on the
other hand, is a high optimum income plan specialized in steer calves
and yearlings (high roughage); also the cropping system of Plan W
tends to be more extensive than that of Plan Y. In general, Plan W
typifies the high income plans which are the plans which suffer severest
income declines.

TABLE 21 -- INCOME COMPARISONS OF PLANS INVOLVING PLAN Y
ORGANIZATION VS. OPTIMAL ORGANIZATION

Plan	Optimal Income	Income with Plan Y Org.	Income with Plan Y Org. as % of Opt. Inc.
A	$14,152	$12,848	90.8
B	16,149	14,192	87.9
C	18,311	15,537	84.9
D	12,323	11,504	93.4
E	10,943	10,159	92.8
F	15,047	13,587	90.3
G	16,012	14,326	89.5
H	13,308	12,109	91.0
I	12,582	11,369	90.4
J	16,981	14,931	87.9
K	18,994	16,276	85.7
L	13,333	12,243	91.8
M	12,048	10,898	90.5
N	17,875	15,670	87.7
O	19,788	17,015	86.0
P	14,417	12,982	90.0
Q	13,143	11,637	88.6
R	15,432	13,453	87.2
S	15,650	14,798	83.4
T	11,404	10,765	94.4
U	9,736	9,420	96.8
V	14,769	12,713	86.1
W	17,080	14,059	82.3
X	10,578	10,025	94.8
Y	8,670	8,670	100.0

Optimum Organization for the Third Set of Plans

The third major set of plans involves all of the assumptions pre-
viously set forth for the second set of plans except that no hay buying
is permitted. While some hay can always be purchased in a community
it may not be entirely realistic to base a long term plan on the
assumption that 150 to 200 tons of hay must be purchased. Furthermore,
quality of hay may be more heterogeneous than that of grain. On the
other hand, grain is readily available for purchase in large amounts
at most country points and is usually of consistant quality.

With the assumption that only grain can be purchased, many plans
will be greatly altered while some such as Plans U and Y will not
be affected at all since the optimal organization in these plans did
not include hay purchase (see Table 10). Similarly unaffected will be
other plans where little hay was purchased (second set) and/or those
that had a low MVP for grain.

Table 22 presents optimal organization for plans with the grain-
buying-only assumption. As noted previously when both feedstuffs
could be purchased, the trend in livestock production was unfavorable
to livestock that consumed more concentrate, such as two year old
steers and hogs. But, with the grain-buying-only assumption, the
situation has changed considerably (Table 23). Although steer calves,

TABLE 22 -- OPTIMUM FARM ORGANIZATIONS FOR VARYING LEVELS OF MANAGEMENT;
THIRD SET OF PLANS

Crops:	Unit	A	B	C	D	E	F	G	H	I	J	K	L	M
Crops:														
Cont. Corn	acre	47	49	5	59	125	54	68	20	3	26	--	104	123
C.Sb.W.$_X$	acre	--	--	60	--	--	--	--	--	--	34	44	--	--
C.C.O.$_X$	acre	--	--	--	--	--	--	--	--	--	6	36	--	--
C.O.A.A.A.	acre	90	92	134	141	39	110	132	180	197	134	120	96	77
Sb.W.A.A.A.	acre	63	59	--	--	36	36	--	--	--	--	--	--	--
C.O.Cl.	acre	--	--	1	--	--	--	--	--	--	--	--	--	--
Livestock:														
Steer calves	head	96	111	113	83	59	108	116	98	88	112	117	79	67
Yearling steer low roughage	head	--	1	12	--	--	--	--	--	4	--	2	--	--
Yearling steer high roughage	head	77	81	84	54	--	73	60	91	97	81	86	19	--
2-Year old steer	head	62	55	52	58	2	59	49	55	55	55	50	21	6
Hogs	litter	7	--	--	21	54	--	--	7	13	--	--	36	50
Grain Bought	bu.	4601	3375	2807	4959	--	3213	1141	6979	8816	2382	1432	--	--
Grain Sold	bu.	--	--	--	--	--	--	--	--	--	--	--	--	809

TABLE 22 -- (CONT.) OPTIMUM FARM ORGANIZATIONS FOR VARYING LEVELS OF MANAGEMENT;
THIRD SET OF PLANS

Crops:	Unit	N	O	P	Q	R	S	T	U	V	W	X	Y
Crops:													
Cont. Corn	acre	39	--	92	130	23	--	41	117	--	--	5	57
C.Sb.W.$_x$	acre	--	25	--	--	--	39	--	--	--	--	--	--
C.C.O.$_x$	acre	39	66	--	--	--	5	--	--	--	--	--	--
C.O.A.A.A.	acre	122	109	108	31	177	156	74	83	200	200	195	143
Sb.W.A.A.A.	acre	--	--	--	39	--	--	85	--	--	--	--	--
C.O.Cl.	acre	--	--	--	--	--	--	--	--	--	--	--	--
Livestock:													
Steer calves,	head	121	121	92	68	114	115	70	56	108	119	73	52
Yearling steer low roughage	head	--	--	--	--	1	11	--	--	11	9	--	--
Yearling steer high roughage	head	68	81	33	--	95	92	75	--	101	107	93	45
2-year old steer fed	head	48	46	33	--	48	47	70	8	46	39	61	60
Hogs	litter	--	--	21	47	--	--	20	58	3	--	20	45
Grain Bought	bu.	615	34	--	--	5648	4460	7117	2004	7739	6674	9906	8307
Grain Sold	bu.	--	--	--	2864	--	--	--	--	--	--	--	--

TABLE 23 -- PERCENT OF GROSS INCOME FROM VARIOUS ENTERPRISES; THIRD SET OF PLANS

Plan	Steer Calves	Yearling Steers Low Roughage	Yearling Steers High Roughage	Two Year Old Steers	Hogs	Cash Grain
A	37.5	--	33.0	26.8	2.7	--
B	42.6	.3	34.0	23.2	--	--
C	41.2	4.5	33.5	20.8	--	--
D	36.3	--	26.2	28.0	9.6	--
E	49.8	--	--	2.2	48.0	--
F	42.7	--	31.7	25.6	--	--
G	49.0	--	28.0	23.0	--	--
H	36.9	--	37.6	22.8	2.6	--
I	32.4	1.7	39.0	22.2	4.8	--
J	42.7	--	34.1	23.2	--	--
K	43.4	1.0	35.3	20.3	--	--
L	49.2	--	13.2	14.6	23.0	--
M	51.9	--	--	5.2	40.2	2.7
N	48.8	--	30.1	21.1	--	--
O	46.5	--	34.2	19.3	--	--
P	49.3	--	19.5	19.5	11.7	--
Q	52.9	--	--	--	37.7	9.4
R	41.9	.3	38.3	19.5	--	--
S	41.1	4.2	36.2	18.6	--	--
T	28.0	--	32.8	30.9	8.3	--
U	44.4	--	--	7.3	48.3	--
V	38.1	3.9	39.2	17.7	1.0	--
W	41.0	3.4	40.7	14.9	--	--
X	27.8	--	39.0	25.5	7.8	--
Y	24.4	--	23.1	30.8	21.7	--

a high roughage consuming enterprise, still maintain a prominent position in most plans, the hog enterprise becomes much more competitive and is included in 14 plans (compared to only six in the second set). The major change, however, is in the increased importance of the two year old steers. In 14 plans they contribute more than 20 percent of gross income while in no plan in the first set did the enterprise contribute 20 percent to gross income and in only one plan in the second set. Compared to the other sets of plans, the cropping sequence contained significantly more roughage (Tables 24 and 25). The more extensive rotations result from the assumption that only grain could be purchased.

On the average income was increased less than five percent compared to the first set of plans. Optimal income in five plans did not change while in eight other plans, income changes amounted to less than two percent. Nevertheless, substantial income changes of 10 percent and more occurred in five plans. These were plans where the MVP of grain in the original set had been high, usually as a result of average or higher livestock management and below average crop management. In plans where income was not increased, the organization which was optimum in the first set was still optimum. The reason for this happening can be found by examining the MVPs of grain for the first set:

Plans which had no income change (Third Set)	MVP for grain (First Set)	Plans which had nominal income change (<2%) (Third Set)	MVP for grain (First Set)
E	$1.07	D	$1.11
L	1.06	F	1.15
M	1.00	G	1.11
P	1.02	J	1.26
Q	1.00	K	1.26
		N	1.12
		O	1.16
		U	1.28

Plans which had a large increase in income (>10%) (Third Set)	MVP of grain (First Set)
I	$1.43
R	1.37
V	1.55
W	1.58
X	1.41

TABLE 24 -- PERCENT OF CROPLAND IN VARIOUS ROTATIONS; THIRD SET OF PLANS

Plan	Cont. Corn	C.Sb.W.$_x$	C.C.O.$_x$	C.O.A.A.A.	Sb.W.A.A.A.	C.O.Cl.
A	23.5	--	--	45.0	31.5	--
B	24.5	--	--	46.0	29.5	--
C	2.5	30.0	--	67.0	--	.5
D	29.5	--	--	70.5	--	--
E	62.5	--	--	19.5	18.0	--
F	27.0	--	--	55.0	18.0	--
G	34.0	--	--	66.0	--	--
H	10.0	--	--	90.0	--	--
I	1.5	--	--	98.5	--	--
J	13.0	17.0	3.0	67.0	--	--
K	--	22.0	18.0	60.0	--	--
L	52.0	--	--	48.0	--	--
M	61.5	--	--	38.5	--	--
N	19.5	--	19.5	61.0	--	--
O	--	12.5	33.0	54.5	--	--
P	46.0	--	--	54.0	--	--
Q	65.0	--	--	15.5	19.5	--
R	11.5	--	--	88.5	--	--
S	--	19.5	2.5	78.0	--	--
T	20.5	--	--	37.0	42.5	--
U	58.7	--	--	41.3	--	--
V	--	--	--	100.0	--	--
W	--	--	--	100.0	--	--
X	2.5	--	--	97.5	--	--
Y	28.3	--	--	71.7	--	--

TABLE 25 -- PERCENT OF GRAIN AND FORAGE PRODUCTION IN OPTIMAL
PLANS IN THIRD SET OF PLANS AS COMPARED TO
FIRST SET OF PLANS

| Plan | Percent of Production in First Set of Plans | |
	Grain	Forage (pasture days)
A	69.1	162.1
B	74.8	142.3
C	81.4	117.2
D	70.5	168.9
E	100.1	99.6
F	77.9	136.3
G	91.8	111.0
H	50.0	222.5
I	39.0	283.9
J	85.4	115.7
K	92.4	101.6
L	100.2	99.7
M	100.2	99.5
N	96.5	101.7
O	99.8	100.2
P	98.7	99.7
Q	100.1	99.6
R	54.8	191.1
S	65.0	151.1
T	58.8	219.0
U	91.9	123.8
V	39.4	256.7
W	42.1	219.5
X	38.8	307.1
Y	61.2	245.0

Marginal Value Products of Limiting Resources

MVPs of land generally were somewhat lower in the third set of plans compared to the first set of plans but were higher than those for the second set (Table 26). This is reasonable since the grain buying activity partially supplants land, although not to the extent that an addition of both forage and grain purchasing activities made possible.

MVPs of labor are variable. In general, one might hypothesize that labor MVPs should be intermediate between the first set and second set. While taking account of the fact that the optimal organization usually varies, the above is generally true. However, exceptions are found, particularly in comparison of May and October labor MVPs between the third and first set of plans. Nonetheless, the third set of plans makes fuller use of labor in other periods. In the third set of plans, November labor is fully used in 18 instances compared to one in the first and 14 in the second set. Also, June labor is fully used in 12 situations compared to seven cases in the second set and none in the first. In four plans all the January labor is utilized. In the third set, June and September labor MVPs are usually higher than any previous MVP.

TABLE 26 -- MARGINAL VALUE PRODUCTS OF LIMITING RESOURCES; THIRD SET OF PLANS

(Dollars Per Unit)

Resource	Unit	A	B	C	D	E	F	G	H	I	J	K	L	M
Land	acre	17.11	14.59	5.95	17.27	16.58	20.48	23.50	12.76	7.83	9.77	9.61	18.19	15.18
Labor:														
Jan.	hr.	--	--	1.15	--	--	--	--	--	3.11	--	--	--	--
May	hr.	7.65	7.09	10.40	9.02	9.32	9.94	12.00	5.57	6.36	13.25	11.41	10.21	10.01
June	hr.	.86	2.00	1.99	--	--	--	--	2.08	2.28	.19	1.96	--	--
Sept.	hr.	8.21	10.50	13.06	5.92	4.96	7.18	5.75	9.16	10.43	9.49	11.52	5.82	5.65
Oct.	hr.	1.31	.17	1.59	3.62	2.27	3.35	6.28	--	--	5.46	3.64	4.86	3.97
Nov.	hr.	4.99	8.57	8.17	.39	--	2.96	--	6.33	1.61	3.64	7.82	--	--
Hay	T.	22.80	24.27	24.57	21.07	20.32	22.78	22.87	22.68	22.89	22.64	24.72	21.20	20.09
Grain	bu.	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.06	1.00

TABLE 26 -- (CONT.) MARGINAL VALUE PRODUCTS OF LIMITING RESOURCES; THIRD SET OF PLANS

(Dollars Per Unit)

Resource	Unit	N	O	P	Q	R	S	T	U	V	W	X	Y
Land	acre	13.55	9.90	18.65	18.87	5.98	1.13	14.23	14.84	7.59	--	9.65	11.46
Labor:													
Jan.	hr.	--	--	--	--	--	1.64	--	--	5.68	--	--	--
May	hr.	15.10	16.20	11.21	11.55	7.21	9.57	6.90	7.94	8.79	9.08	4.67	5.87
June	hr.	--	--	--	--	2.29	2.11	.22	--	1.78	2.23	1.91	--
Sept.	hr.	8.00	10.11	5.91	--	11.97	14.54	7.32	5.19	12.14	14.40	8.19	6.42
Oct.	hr.	7.98	7.37	5.79	4.64	--	--	.84	1.61	--	--	--	.52
Nov.	hr.	1.05	4.21	--	4.09	9.04	9.15	3.18	--	--	11.70	4.05	1.26
Hay	T.	22.98	24.11	21.32	20.63	22.94	23.93	20.99	19.94	25.25	25.35	20.89	19.39
Grain	bu.	1.10	1.10	1.02	1.00	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10

SUMMARY AND IMPLICATIONS

Summary

A purpose of this study was to examine the effects on income and farm organization resulting from varying levels of crop and livestock management. The case farm chosen to represent the different managerial assumptions was the one developed from survey data obtained from 65 farmers on Marshall soil in Lafayette County. Secondary data were used when necessary in the development of input-output coefficients.

Optimum plans were developed for 25 different management situations with three assumed conditions with respect to opportunities for buying hay and/or grain. The three conditions were:

1. Optimal organizations when no hay or grain could be purchased.
2. Optimal organizations when both hay and grain could be purchased.
3. Optimal organizations when only grain could be purchased.

Also, a sub-set of plans considered the effects of imposing certain optimal organizations on all other plans.

Optimum Organizations When No Hay or Grain Could Be Purchased

Several organizational similarities were apparent among the 25 plans in spite of widely varying management levels. In all plans steer calves were included. Furthermore, in almost two-thirds of the plans over half of the gross income was contributed by this activity and in the Plan (Y) which included the fewest number of wintered steer calves, the contribution was still over 37 percent. Hogs were also an important enterprise being included in all but three plans. In 44 percent of the plans more than a third of the gross income was derived from hogs. It should be noted, however, when a large portion of income came from hogs, plans were characterized by below average management levels, especially in livestock.

As would be expected, cropping systems tended to be somewhat extensive (i. e. more forage produced relative to grain), reflecting the need for pasture and hay for the calf wintering enterprise. Two cropping sequences dominated, C-O-A-A-A and continuous corn. These crop sequences were included in every plan.[11]

The limiting resources for most plans included land; labor in May, September, and October; and grain and hay. The MVPs of land were in excess of $25 per acre in about two-thirds of the plans, reflecting the shortage of grain and hay which also have high MVPs. Labor shortage is most critical in May when crop labor requirements compete with livestock for labor.

Incomes varied considerably from plan to plan. The highest income plans were Plan O ($19,244) and Plan K ($18,247). Management

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11/ However, in Plan O, continuous corn is included at a nominal level.

levels were 20 percent above in both crop and livestock for Plan O and 10 percent above in crops and 20 percent above in livestock for Plan K. The two lowest income plans were Plan Y ($8,049) and Plan X ($9,216); management levels were 20 percent below for both crop and livestock in Plan Y and 20 percent below in crops and 10 percent below in livestock for Plan X.

Optimum Organizations Where Hay and Grain Could Be Purchased

In the second set of plans the model was the same except provision was made to include the purchase of additional grain at $1.10 per bushel and hay at $20 per ton.

With opportunity provided to purchase feed, optimal livestock systems changed considerably. Wintering steer calves, which had been an important and often dominant enterprise, generally increased even more in importance. Yearling steers fed on a high roughage ration, which never exceeded a contribution of 20 percent to gross income in previous plans, now exceeded 30 percent in 80 percent of the plans. On the other hand, the opportunity to purchase grain on hay caused a decline in the importance of the hog enterprise. Only six plans included the hog enterprise under these conditions compared to 22 previously.[12] Further, in no plan did hog sales amount to 50 percent of the gross income and in only one plan were they the dominant enterprise.

There was a general tendency for cropping systems to become more extensive. In the previous plans continuous corn was included in all plans while now only about half included continuous corn. The rotation, C-O-A-A-A, again was included in every plan and in most cases at a higher level. The shift to less grain and more forage production was particularly noted in plans where the crop management level was 10 to 20 percent below average.

The limiting resources were usually land and labor in May, September, and October and occasionally in April, June, and November. More intensive use of labor is manifest both in extent of use during the year [13] and in an average increase in the labor MVPs. The MVP of land, however, decreased sharply and in five cases was zero. The opportunity to purchase feed was reflected in making the land's contribution of somewhat less importance to the productivity of the farm unit.

Income increased an average of about seven percent but wide variation in the increase existed, ranging from less than 0.1 percent (Plan M) to 24 percent (Plan W). Plans with the largest income increases were those where livestock efficiency was high while crop efficiency was low. The opportunity to purchase part of the feed greatly enhanced income potential since the MVP of the feed was high due to the efficiency of livestock.

12/ Also, in Plan P hogs account for only 1.6 percent of the gross income.

13/ In the previous set of plans, a shortage of labor occurred only once in November and in April and June surplus labor existed in every case.

Optimum Organizations Where Only Grain Could Be Purchased

The third major set of plans was different from the second set only in that no hay could be purchased. Grain could still be purchased at $1.10 per bushel. Hence, the plan which had a MVP of grain of $1.10 or less was not affected.

Enterprises using a smaller amount of forage relative to grain were benefited in this situation. Steer calves still maintained a prominent position but their contribution to gross income was reduced considerably. Conversely, the contribution of yearling steers (high roughage) and two year old steers increased. Also, a few head of yearling steers fed on low roughage entered some optimal plans. The competitive position of hogs improved, compared to the set of plans where both hay and grain could be purchased.

Generally, the cropping systems tended to include more forage and less grain.

The MVPs of land increased on the average, compared to the second set of plans, and were intermediate between the first and second set of plans. In three cases a zero MVP of land was noted; however, in plans where hay and grain could be purchased, five plans had a zero MVP for land.

In general, the MVPs of labor were intermediate between the first and second sets of plans, although many exceptions were noted. More intensive use of labor exists compared to other sets of plans, however. Notable instances are in the more intensive use of labor in January, June, and November.

Income increased only moderately, compared to the first set of plans; average income was about five percent higher but the range of income increase was from less than one percent in ten plans to over 19 percent in two plans. As in the second set, plans having low crop efficiency and high livestock efficiency benefited most from the opportunity to purchase grain.

Consequences of Imposing a Given Cropping and Livestock System to Plans of Varying Management Levels

Since no two plans are exactly alike, the question was posed: What would be the effect upon income if a given organization was assumed for all management levels? Using the assumption set forth in the second set of plans that grain could be purchased in any quantity at prices of $1.10 per bushel and hay at $20 per ton, effects on income of plans were examined under the following organization structures:

1. Plan A
2. Plan O
3. Plan Y

these organizations represent conditions of (1) average management,

(2) highest management, and (3) lowest management.

Use of the organization of Plan A did not greatly effect income of the other 24 plans. Incomes were reduced compared to optimal incomes but the weighted average of incomes derived with the Plan A organization was 96.5 percent of optimal incomes. The range was from 99.6 percent to 88 percent of optimal income.

When plans were based on the optimal organization of Plan O, the most efficient management level and the plan with the highest income, the weighted average income was 92.1 percent of optimal income with a range from 98.3 to 77.3 percent.

When plans were based on the organization for the least efficient plan, Plan Y, weighted average income was 89.0 percent of optimal and the range was from 96.8 to 82.3 percent of optimum. Plans having highest incomes as a result of efficiency had the greatest income declines.

Implications

To the question, "Is too much time spent in developing and refining imput-output data for use in farm management?", the answer must be a qualified yes. In general, more similarities than differences were observed in optimal organizational structures for widely varying management levels. Incomes changed considerably with changes in management but organizational structures remained similar. The similarities would be even more pronounced if the management variations were of a narrower range (e. g. ±10 percent rather than±20 percent).

Farm management personnel are often faced with the necessity of making "bench mark" estimates of organizational possibilities for farmers having considerable range in management potential. Much controversy surrounds what the general recommendation should be. There appear to be at least two "schools of thought" regarding these recommendations -- the first approach is to make recommendations on the basis of average performance while the other approach advocates use of standards indicating achievable goals. The analysis based on imposing a given organization upon all management levels gives some insight into this problem. Under the conditions presented it appears that general recommendations made on the basis of average management will be most feasible and result in a minimum opportunity cost. Plans formulated on an average basis resulted in an average income of 96.5 percent of optimal.

Plans adjusted to the most efficient and profitable plan averaged 92.1 percent of optimum and the disparity range increased. For example, adjusting the least efficient Plan (Plan Y) to the optimal organization for the most efficient plan resulted in almost a 23 percent decline from an already small income.

General recommendations based on the least efficient plan are not recommended since such plans averaged only 89 percent of optimum.

LIMITATIONS OF THE STUDY AND RECOMMENDATIONS
FOR FURTHER INVESTIGATION

The present model is sufficient to examine the general aspects of the problem of adequacy of input-output data. Nonetheless, several items should be examined to determine their effects on optimal organization. These include:

1. Optimal programs with various degrees of capital rationing.
2. Introduction of time as a variable.
3. Some consideration of the riskiness of optimal programs.

Also, the example used throughout the analysis represents a rather specific case and not all cropping and livestock alternatives have been considered. The concept of efficiency was with reference to crop yields and feed inputs. A more inclusive measure of efficiency would include variations in such items as labor per unit of output and price-cost data. Although it is possible that some of the "refinements" mentioned above might change some of the general implications, a strong possibility exists that the implications might be further reinforced.

APPENDIX

APPENDIX TABLE 1 -- AVAILABLE LABOR PER MONTH FOR LIVESTOCK AND CROP PRODUCTION

	Available Labor (hour)		Available Labor (hour)
Jan.	440**	July	504*
Feb.	440**	Aug.	504**
March	440**	Sept.	432*
April	440**	Oct.	444*
May	480*	Nov.	440**
June	504*	Dec.	440**

*Estimates by Utter and Justus, Table 7.
**Estimated by Authors.

APPENDIX TABLE 2 -- GRAIN EQUIVALENT AND PASTURE DAYS
PER ROTATION ACRE

Rotation	Grain Equivalent*	Pasture Days **
	(bu.)	
Continuous Corn	69.0	0
C-Sb	59.5	0
C-Sb-W_X	57.5	17
C-C-O_X	55.6	17
C-C-Sb-W-Cl	48.3	40
C-O-A-A-A	19.6	210
Sb-W-A-A-A	20.7	210
Sb-W-RCl	34.5	67
C-O-RCl	32.6	67

* Grain equivalent is based on relative prices among crops:

Corn=1.0
Soybeans=2.0
Oats=.6
Wheat=1.73

** Pasture days calculated on basis of 1 ton hay equivalent=100 pasture days.

Source: Adapted from prices and yields presented in the Utter and Justus bulletin
and "Farm Business Planning Guide", B.F. 6103, University of Missouri
College of Agriculture and USDA Cooperating, January, 1961.

APPENDIX TABLE 3 -- OPERATING COSTS PER ROTATION ACRE FOR
VARIOUS CROP COMBINATIONS**

Rotation	Cost per Rotation Acre*
Continuous Corn	$34.08
C-Sb	30.59
C-Sb-W_X	31.38
C-C-O_X	31.56
C-C-Sb-W-Cl	25.64
C-O-A-A-A	12.12
Sb-W-A-A-A	12.61
Sb-W-Cl	21.02
C-O-Cl	20.20

* Does not include hay harvesting costs.

** Adapted from Utter and Justus, Table 10.

APPENDIX TABLE 4 -- MONTHLY LABOR REQUIREMENT FOR VARIOUS CROP COMBINATIONS*

	Continuous Corn	C-Sb	C-Sb-W$_x$	C-C-O$_x$	C-C-Sb-W-Cl	C-O-AAA	Sb-W-AAA	Sb-W-Cl	C-O-Cl	Haymaking
	(hours per rotation acre)**									(Hours per ton)
January	--	--	--	--	--	--	--	--	--	--
February	--	--	--	--	--	--	--	--	--	--
March	.2	.1	.07	.47	.08	.24	--	--	.4	--
April	.4	.2	.13	.6	.16	.28	--	--	.47	--
May	2.1	1.8	1.2	1.4	1.14	.42	.3	.5	.7	.5
June	1.0	.95	1.27	.67	.96	.20	.56	.93	.33	.85
July	.8	.75	1.13	1.4	.84	.68	.52	.87	1.13	1.12
August	--	.25	.33	.33	.20	.20	.20	.33	.33	--
September	.15	.38	.5	.10	.33	.03	.27	.45	.05	.76
October	1.2	1.5	1.25	.8	.99	.24	.51	.85	.4	--
November	1.0	.5	.33	.67	.4	.20	--	--	.33	--
December	.5	.25	.17	.33	.2	.10	--	--	.17	--

*Adapted from Utter and Justus; Bernard Bowlen and Earl O. Heady, "Optimum Combinations of Competitive Crops", Research Bulletin 426, Iowa Agric. Exp. Station, 1955.

**Excluding haymaking labor.

Enterprise	Wintered, Grazed & Fed Steer Calves		Wintered and Fattened Heifers		Wintered, Fed Plain Steers
	1050# @ 23¢ = $241.50		800# @ 22¢ = $176.00		1000# @ 17¢ = $170.00
	Less 2% death loss	4.83	Less 2% death loss	3.52	
1. Gross receipts		236.67		172.48	170.00
Cost Items					
2. Purchase cost	450# @ 23¢	103.50	400# @ 21¢	84.00	700# @ 14¢ 98.00
3. Protein, salt and mineral		14.00		12.25	8.00
4. Veterinary and Drugs		2.00		2.00	.30
5. Taxes and Insurance 1.5% of livestock equipment and investment		2.38		1.61	1.35
6. Depreciation on livestock equipment		.45		.45	.45
7. Miscellaneous expenses		3.55		2.59	2.55
8. Enterprise Costs		$125.88		$102.90	$110.65
9. Returns for feed, capital and labor		110.79		69.58	59.35
10. Returns for feed, capital and labor (rounded)		111.00		70.00	59.00

*Adapted from, "Farm Business Planning Guide".

APPENDIX TABLE 5 (CONT.) -- COSTS AND RETURNS OF LIVESTOCK ENTERPRISES

Fed Yearling Steers Drylot – low roughage full grain		Fed Yearling Steers Drylot – high roughage & grain		Fed 2 Year Old Steers Drylot		Sow & 2 litters to Market (14 pigs raised, 7 per litter)
1100# @ 23¢ Less 1.5% death loss	$253.00 3.80	1150# @ 23¢ less 1.5% death loss	$264.50 3.97	1150# @ 23¢ less 1.5% death loss	$264.50 3.97	13 market hogs x 225# @ 15¢ $438.75 1 gilt saved for 52.00 replacement, 1 cull sow x 400# @ 13¢
	249.20		260.53		260.53	490.75 (1)
650# @ 21¢	136.50	650# @ 21¢	136.50	900# @ 20¢	180.00	(2)
	9.00		15.00		6.00	84.00 (3)
	1.00		1.00		1.00	16.00 (4)
	1.80		1.83		1.08	4.05 (5)
	.45		.45		.45	4.50 (6)
	3.74		3.91		3.91	14.36 (7)
	152.49		158.69		192.44	122.91 (8)
	96.11		101.84		68.09	367.84 (9)
	97.00		102.00		68.00	368.00 (10)

APPENDIX TABLE 6 -- LIVESTOCK LABOR REQUIREMENTS

	Steer Calf	Heifer Calf	Plain Steer	Yearling Steer (low roughage)	Yearling Steer (high roughage)	2 year old steer	Hogs (Sow & two litters)
Unit:	one head	one head	one head	one head	one head	one head	two litters
				(hours per unit)			
January	1.33	1.33	1.33	1.4	1.4	3	2.67
February	1.33	1.33	1.33	1.4	1.4	-	4.00
March	1.33	1.33	1.33	1.4	1.4	-	8.00
April	1.33	1.33	2.00	2.0	1.4	-	4.67
May	.33	2.00	2.00	2.0	2.0	-	4.67
June	.33	2.00	--	-	2.0	-	2.67
July	.33	--	--	-	-	-	2.67
August	1.33	--	--	-	-	-	3.33
September	2.00	--	--	-	-	-	8.00
October	2.00	--	--	-	-	2	5.33
November	1.33	1.33	1.0	1.4	1.4	2	4.67
December	1.33	1.33	1.0	1.4	1.4	2	2.67

SOURCE: Adapted from "Farm Business Planning Guide" and "Planning the Farm Business", Agricultural Extension Service and Department of Agricultural Economics, College of Agriculture, University of Nebraska.

APPENDIX TABLE 7 -- LIVESTOCK FEED REQUIREMENTS

Enterprise	Unit	Feed Required		
		Grain Equivalent (bu.)	Hay (T)	Pasture (day)
Steer calf	one head	45	1.25	75
Heifer calf	one head	30	1.20	--
Plain steer	one head	15	1.50	--
Yearling steer (low roughage)	one head	55	.75	--
Yearling steer (high roughage)	one head	45	1.25	--
2 year old steer	one head	40	.50	--
Hogs	Sow & 2 litters	210	--	50

SOURCE: "Farm Business Planning Guide".

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