EFFECTS OF LENDER DECISIONS
ON FARM FINANCIAL PLANNING

Some solutions to problems arising from credit limitations set by commercial lenders

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Effects of Lender Decisions on Farm Financial Planning

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LOAN LIMITS obtained in a survey of commercial banks and production credit associations for each of five loan purposes were reported in Bulletin 671, "Effects of Borrowing From Commercial Lenders on Farm Organization." They were for a farmer dependent on loans in the cash-grain area of east-central Illinois and for one in the livestock area of west-central Illinois (Fig. 1). The effects of these loan limits on profitable changes in farm organization are reported in the present bulletin. Specifically, starting from the present farm organization, the use of credit available to the farmer was allocated among fertilizer, general operating expenses, and feeder cattle purchases so as to use the credit most profitably considering lender limits on loans for these purposes.

The financial position of the farm in each area is summarized in Table 1. The similarity in aggregate financial position allows compar-

Location of cash-grain
and livestock areas.
(Fig. 1)

Table 1. — Financial Summaries Used in the Lender Survey

	Cash-grain area	Livestock area
Assets		
Cash..	$ 1,431	$ 250
Cash value of life insurance.....................	910	279
Farm feeds....................................	1,571	1,935
Market livestock..............................	6,784	8,688
Current assets............................	10,696	11,152
Other livestock...............................	398	1,040
Machinery and equipment......................	8,492	7,394
Working assets..........................	8,890	8,434
Real estate...................................	38,125	38,125
Total assets............................	57,711	57,711
Liabilities		
Open account (grain elevator)..................	620	1,152
Note on cattle................................	5,500	5,500
Fertilizer loan...............................	282	206
Current liabilities........................	6,402	6,858
Machinery purchase contract....................	3,125	2,669
Real estate mortgage..........................	19,684	19,684
Total liabilities..........................	29,211	29,211
Equity		
Net worth....................................	28,500	28,500
Current worth................................	4,294	4,294
Intermediate worth...........................	$10,059	$10,059

isons between areas. Thus, while financial positions differ slightly in detail, they yield the same current, intermediate, and net worth figures. To be consistent with farming dominant in each area, the farm organization and operation also differ in detail though they are similar in most respects related to additional financing.

THE PROBLEM

The cash-grain situation

A 31-year-old cash-grain farmer is assumed to have just bought 80 acres of land adjoining 160 acres he rents on a crop-share lease. Of the 225 acres of cropland, 145 or 64 percent are in corn and soybeans; 40 acres or 18 percent are in small grain; and 40 acres are in standover legume. He has been feeding 3,250 out of 6,150 bushels of feed grains, his share of crops, to 10 litters of hogs (5 sows farrowing twice a year) and 40 steers. This fixed organization, which serves as a starting point for this report, is summarized in Tables 1, 2, and 3.

A quarterly summary of receipts and expenses (Table 2) shows the amount of cash available each quarter to meet operating expenses and

Table 2. — Cash Balances Available to Cash-Grain Operator, by Quarter

Item	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.
Receipts		Cash position		
Cash balance, Oct. 1..........				$1,504
From hogs..................	$919			1,029
From soybeans..............				2,280
From steers................			$10,920	
Total....................	(919)	(0)	(10,920)	(4,813)
Obligations and living expense				
Fertilizer bill due...........				296
Machinery payment..........		$ 945		1,001
Real estate payment..........		1,717		
Cattle loan payment.........			5,775	
Family living expenses[a].......	915	915	915	915
Total....................	(915)	(3,577)	(6,690)	(2,212)
Cash balance available for operating expense, fertilizer and feeder cattle...............	4	−3,577	4,230	2,601
		Operating expenses		
Machinery repair..............	120	505	312	312
Machinery hire...............				583
Gasoline and oil..............	80	321	161	161
Taxes.......................	187	320	320	
Livestock feed and medicine.....	194	155	250	71
Cash rent and miscellaneous.....	170	160	172	160
Total operating expenses[b].......	(751)	(1,461)	(1,215)	(1,287)
		Net balances		
Cash surplus..................	−747	−5,038	3,015	1,314
Cumulative surplus.............	−$747	−$5,785	−$2,770	−$1,456

[a] Based on 1956 expenditure level for low-income farm families (Tompkins (5) p. 127, p. 40), adjusted to 1959 level with use of BLS consumer price index.
[b] Illinois Farm Bureau Farm Management Service records for farms with less than $5,000 returns to capital and management in 1957.

Table 3. — Labor Use on the Cash-Grain Farm

Item	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.
Total hours available[a]..........	780	780	780	780
Already committed				
Annual overhead[b]............	113	158	164	135
To fixed enterprises[c]				
Corn, 105 acres............	7	251	27	135
Soybeans, 40 acres.........	14	86	6	34
Oats, 26 acres.............	7	24	47	0
Wheat, 14 acres............	0	0	30	19
Hay, 15 acres..............	0	17	28	0
Hogs, 5 sows (2 litters).....	90	68	77	65
Steer calves, 40 on pasture..	121	93	83	103
Total committed.............	352	697	462	491
Available for allocation.........	428	83	318	289

[a] Assumes 26 ten-hour days per month for one man.
[b] Total taken from Hinton (2); seasonal distribution based on Von Lanken (6, Table 5, page 42).
[c] Based on Hinton (2), (3).

to buy fertilizer and additional feeder cattle. The cash surplus or deficit during the year for other income and expenses, including living expenses of $305 per month for the family, are shown below the quarterly operating expense figures in Table 2.

When account is taken of debt commitments and living expenses, the unchanged organization results in a cumulative deficit over the whole period of $1,456 (Table 2). The deficit can be met by selling the stored corn, and by reorganizing with the added land and borrowing to expand the use of fertilizer and the cattle-feeding enterprise. The labor situation and surplus labor available are shown in Table 3.

The livestock situation

Comparable with the cash-grain farmer, a 31-year-old livestock farmer is also assumed to have just bought 80 acres of land adjoining 160 acres he rents on a crop-share lease. Of 172 cropland acres, 120 or 70 percent are in corn and soybeans; 40 or 23 percent are in oats; and 12 or 7 percent are in standover legume. He has been feeding 5,560 bushels out of 6,150 bushels of feed grains, comprising his share of crops, to 32 litters of hogs and 40 steers. This fixed organization is summarized in Tables 1, 4, and 5.

A quarterly summary of receipts and expenses (Table 4) shows cash available to meet outlays for operating expenses (shown in the lower portion of the table) and to buy fertilizer and additional cattle. Cash surpluses and deficits are shown by quarters and cumulatively. After meeting labor requirements for the fixed part of the farm organization, the livestock farmer has labor available as shown at the bottom of Table 5.

Borrowing alternatives

The operator in each area can borrow to finance more steers, or fertilizer, or to manage the seasonal surpluses and deficits from enterprises already decided upon. Since he is heavily in debt, these decisions are especially dependent on the nature and amounts of financing available from lenders. These limits are summarized in Table 6 for three purposes.

It is assumed that funds borrowed for a purpose must be used for that purpose. For example, money can not be borrowed for feeder cattle and then actually spent for fertilizer. The reason is that the cattle proposed to be purchased are to serve as chattels for the loan. On the other hand, to borrow for cattle may release some of the operator's cash for fertilizer and for operating expenses. Even so, farm organization may be affected if the total amount of funds available and borrowed come to less than is required to reach an optimum farm organization. The loan limits in Table 6 presume that each purpose is considered separately. Therefore, when reading the limit attached

Table 4. — Cash Balances Available to Livestock Operator, by Quarter

Item	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.
Receipts		Cash position		
Cash balance, Oct. 1..........				$ 250
From hogs..................	3,150			3,528
From soybeans..............				703
From steers................			10,920	
Total....................	(3,150)	(0)	(10,920)	(4,481)
Obligations and living expense				
Fertilizer bill due............				216
Machinery payment..........		807		854
Real estate payment..........		1,717		
Cattle loan payment..........			5,775	
Family living expense[a]........	915	915	915	915
Total....................	(915)	(3,439)	(6,690)	(1,985)
Cash balance available for operating expense, fertilizer, and feeder cattle................	2,235	−3,439	4,230	2,496
		Operating expenses		
Machinery repair..............	100	406	252	252
Machinery hire................				583
Gasoline and oil................	147	295	147	147
Taxes.........................	170	320	320	
Livestock feed and medicine.....	308	241	389	257
Cash rent and miscellaneous.....	200	180	202	180
Total operating expense[b]........	925	1,442	1,310	1,418
		Net balances		
Cash surplus..................	1,310	−4,881	2,920	1,077
Cumulative surplus.............	$1,310	−$3,471	−$551	$ 426

[a] Based on 1956 expenditure level for low-income farm families (Tompkins (5) p. 40, 127), adjusted to 1959 level with use of BLS consumer price index.
[b] Illinois Farm Bureau Farm Management Service records for farms with less than $5,000 returns to capital and management in 1957.

Table 5. — Labor Use on the Livestock Farm

Item	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.
Total hours available[a]..........	780	780	780	780
Already committed.............				
Annual overhead[b]...........	113	158	164	135
To fixed enterprises[c]..........				
Corn, 105 acres............	7	251	27	135
Soybeans, 15 acres.........	5	32	2	13
Oats, 40 acres.............	11	37	72	0
Hay, 12 acres..............	0	14	22	0
Hogs, 16 sows (2 litters)....	172	132	147	125
Steer calves, 40 on pasture..	121	93	83	103
Total committed.............	429	717	517	511
Available for allocation.........	351	63	263	169

[a] Assumes 26 ten-hour days per month for one man.
[b] Total taken from Hinton (2); seasonal distribution based on Von Lanken (6, Table 5, page 42).
[c] Based on Hinton (2), (3).

**Table 6. — Maximum Borrowing Limits, by Type of Lender and
Proposed Use of Loan Proceeds: East-Central Cash-Grain
Area and West-Central Livestock Area, 1959[a]**

Area and agency	Purpose of loan		
	Operating expense	Fertilizer	Feeder cattle
Grain area			
Small banks.....................	$2,167	$ 934	$5,944
Large banks.....................	1,837	1,591	4,975
PCA............................	1,775	1,375	7,000
All agencies....................	1,966	1,268	5,776
Livestock area			
Small banks.....................	1,478	624	6,128
Large banks.....................	2,212	875	7,581
PCA............................	2,500	972	6,000
All agencies....................	$1,952	$ 786	$6,657

[a] *Source:* Baker and Irwin (1, p. 19).

to any single purpose, it must be assumed that no borrowing occurs for
either of the other two purposes. This means that the total amount the
farmer could borrow is something less than the total of maximum
loans reported for all purposes in Table 6.

To estimate capacity more realistically, two concepts were defined:
(1) borrowing reserve and (2) lender discounts. Borrowing reserve
of a farm equals the largest amount that can be borrowed for any
purpose. In this study, borrowing reserve is equal to the number of
dollars that can be borrowed for feeder cattle.

Borrowing reserve can be imagined as the number of "units" of the
business that the lender is willing to take in exchange for a cash loan.
For a cattle loan, he will provide $1 cash for every "unit" of borrow-
ing reserve turned over. For fertilizer or operating loans, he is willing
to loan fewer dollars, so more "units" of borrowing reserve are re-
quired for each dollar loaned.

The discount factor for a loan is the number of additional units
that must be provided to obtain $1 cash loan for the purpose. Dis-
counts for each type of lender are presented in Table 7. The method
of computing them is reported in footnote a. In the grain area, by
definition, one "unit" of borrowing reserve will exchange for $1 of
cattle loan. To get $1 for fertilizer from small banks, an additional
1.743 units are required, making a total of 2.743 units for each dollar
of operating loan.

Actually, four sets of discount factors were used in the present
study. One set is based on responses obtained on the average from
lenders in the cash-grain area; a second, from lenders in the livestock
area; a third, for the type of lender found to differentiate most between

Table 7. — Discount Factors by Purpose of Loan[a]

Area and agency	Purpose of loan	
	Operating expense	Fertilizer
Grain area		
Small banks[b]	1.7430	5.3640
Large banks[b]	1.7082	2.1270
PCA	2.9437	4.0909
All agencies	1.9379	3.5552
Livestock area		
Small banks[b]	3.1460	8.8205
Large banks[b]	2.4272	7.6640
PCA	1.4000	5.1728
All agencies	2.4103	7.4694

[a] *Source:* Baker and Irwin (1). Amounts shown are derived from arithmetic means for lenders of type and area indicated, as the maximum loan for cattle less the maximum loan for the purpose indicated, the difference divided by the latter maximum. So defined, there is, of course, no discount applicable for cattle.
[b] "Large banks" are defined as banks in towns with either another bank or with a production credit association. "Small banks" are those found in a town without another bank or production credit association.

feeder cattle and fertilizer loans (small banks in the livestock area); and a fourth, for the type of lender that differentiated least between feeder cattle and fertilizer loans (large banks in the cash-grain area).

Lenders of all types in each area discriminated more sharply (by requiring more units per dollar borrowed) against fertilizer than against operating expense loans and against both relative to feeder cattle. The maximum discrimination is noticed in small banks in the livestock area, where to finance fertilizer uses the farmer's borrowing reserve at 8.8 times the rate it is used when cattle are financed.

It is interesting to note that, on the average, lenders in the livestock area discriminate against fertilizer loans far more heavily than do lenders in the cash-grain area. Moreover, while large banks discriminate less than the average in the cash-grain area, they discriminate more than the average in the livestock area. Much less difference is observed in discrimination against loans for operating expenses than against fertilizer loans.

It is assumed the farmer in each area will select alternatives that contribute most to his net income. The situation and borrowing alternatives, however, differ between areas. Finally, variations may occur in ability of farmers to defer operating expenses incurred throughout the year. Some farmers may have and use open-account credit rather freely; others may not. Since no information was obtained on this point, most profitable solutions have been worked out on several assumptions in each area. The following discussions deal with variations in discounts and borrowing reserve and changes in seasonal debt commitments.

PLANS FOR THE GRAIN-AREA FARM

Profit-maximizing plans for seven variations of the grain-area situation are summarized in Table 8. The figures represent changes from the beginning situations (Tables 1, 2, and 3). For example, Plan 1 adds 5 feeder cattle to the 40 head in the base organization. No fertilizer is used in this Plan. Most of the corn is sold to meet real estate and machinery payments due in the second quarter. A small amount of corn is required to feed out the additional 5 head of cattle. Much of the operating expense in the first and second quarters must be met by borrowing, since the sale of corn and cash on hand are the only sources of funds for this purpose.

In fact, the enterprise and financial organization are highly inter-

Table 8. — Optimum Plans for Grain-Area Situations

Item	Quarterly payment of operating expenses						Annual payment of operating expenses
	Average loan discounts			Highly differentiated loan discounts	Low differentiated loan discounts	Live-stock-area discounts	
	Mean loan limit	High loan limit	Low loan limit				
Plan number..............	1	3	4	11	13	10	2
Enterprise organization							
Corn fertilized, acres.....	0	0			69	0	0
Feeder cattle added, head	5	14			2	2	36
Disposal of surplus corn, bushels							
Fed..................	275	770			110	110	1,980
Bought..............	0	0			0	0	33
Sold.................	2,625	2,130			2,790	2,790	935
Borrowed for—							
Cattle.................	$ 470	$1,457			$ 179	$ 229	$3,680
Fertilizer..............	0	0			$ 414	0	0
Operating, Quarter 4.....	0	$ 155			0	0	$ 262
Operating, Quarter 1.....	$ 317	$ 840			$ 116	$ 152	$ 225
Operating, Quarter 2.....	$1,490	$1,550			$1,473	$1,475	$ 226
Operating, Quarter 3.....	0	0			0	0	0
Source of operating funds[a]			No solution possible	No solution possible			
Quarter 4..............	C	C,B			C	C	C,B
Quarter 1..............	C,B	C,B			C,B	C,B	C,B
Quarter 2..............	B	C,B			B	B	C,B
Quarter 3..............	C	C			C	C	C
Cash transfers							
Quarter 4 to 1..........	$1,285	$1,380			$1,303	$1,300	$2,601
Quarter 1 to 2..........	$ 826	$1,384			$ 662	$ 690	$2,605
Quarter 2 to 3..........	0	0			0	0	0
Income after change........	$2,313	$3,986			$2,560	$2,904	$7,886
Less payment of cattle and fertilizer loans..........	$ 470	$1,457			$ 593	$ 229	$3,680
Net income after change....	$,1843	$2,529			$1,967	$2,675	$4,206
Net income from fixed organization.................	—$1,456	—$1,456			—$1,456	—$1,456	—$1,456
Increase from change.......	$3,299	$3,985			$3,423	$3,131	$5,662
Source of change:							
Cattle.................	$ 636	$1,973			$ 243	$ 310	$4,980
Corn..................	$2,750	$2,193			$2,915	$2,886	$ 935
Fertilizer..............	0	0			$ 338	0	0
Less interest............	—$ 87	—$ 181			—$ 73	—$ 65	—$ 253

[a] C is cash; B is borrowing.

related. The number of cattle added depends on both the grain that must be sold to pay debts and on the borrowing capacity that remains after necessary borrowing for operating expenses. Cattle, rather than fertilizer, use the remaining borrowing capacity because the lender discounts allow a cattle enterprise that produces a higher total return, even though the marginal return on a dollar spent for fertilizer is higher. One dollar spent on fertilizer uses 4.555 units of the scarce borrowing capacity (the discount factor plus 1), while a dollar spent on cattle uses only 1 unit of borrowing capacity.[1]

Total borrowing capacity is exhausted only in the second quarter, with borrowings for cattle, operating expenses in the first quarter, and operating expenses in the second quarter charged against it. Operating loans are repaid in the third quarter with receipts from the sale of cattle.

In interviews, lenders often mention the undesirability of seasonal peaks in debt commitments. The dominance of fixed commitments for real estate and machinery debts requires sizable transfers of cash into the second quarter from the preceding two quarters. In the first quarter, it is necessary to borrow for part of the operating requirements to meet this drain in cash, to conserve owned funds in a non-earning capacity, and to sell most of the corn before the seasonal price rise.

The procedure used to solve for the optimum plans also gives the amount of income left after all expenses are paid, including interest, and after repaying any operating loans. These are the amounts shown as "Income after change" in Tables 8 and 9. "Net income after change" is derived by subtracting the amounts required to repay any loans for cattle or fertilizer. In all grain-area plans, the original deficit of $1,456 is changed to a surplus, the increases shown as "Increase from change." The sources of the increases are given in the last section of the tables. In all grain-area plans except Plan 2, much of the increase comes from sale of corn, an alternative that actually is possible with no organizational change.

Effects of lender liberalism or conservatism

Plan 3 in Table 8 is the solution for a farmer served by a lender making "larger-than-average" loans, while Plan 4 is the solution for a farmer served by a lender more conservative than the average. In both cases, the differentiation between loan purposes is assumed to be average for the cash-grain area (Table 7).

With a conservative lender, it is not possible for the farmer to pay

[1] See Footnote a, Table 7.

all his third quarter operating expenses (Plan 4). Were it possible to delay payment of operating expenses or obligations or both for one quarter, however, the business again becomes solvent as funds from cattle sale are available. Thus, it appears that a tight financial situation can force insolvency if it makes the lender react conservatively.

Plan 3 represents the results if a lender is prepared to back the borrower's business liberally. The farmer could not only avoid insolvency in a part of the year, but also obtain a much larger return than when average loan limits are available, $3,986 instead of $1,843. The cattle enterprise is increased by 14 head instead of 5 (to 54 instead of 45) because borrowing for operating expense both relieves the pressure to sell corn in the second quarter and, in addition to the increase in operating loan, makes a larger cattle loan possible. The reduced corn sale is reflected in larger cash carry-overs between quarters, and a consequent necessity to borrow more for operating expenses in the first two quarters. Much more interest is paid, but the net return is also increased.

Effects of varying lender differentiation by purpose

The discount factors represent units of borrowing reserve (or "credit") that must be exchanged for $1 borrowed for a purpose. Thus the high discount situation of Plan 11 indicates that small operating and fertilizer loans are available in relation to cattle loans. The low discount plan represents a lender with least discrimination. Both plans assume the total borrowing reserve that was used in Plan 1.

When high discounts are used by lenders, it is impossible to borrow enough to meet both operating expenses and fixed debt payments. Unless added funds can be obtained from some outside source to meet expenses in the second quarter, the business becomes insolvent in this period.

Low discounts on the other hand offer a drastically different picture. They favor fertilizer relatively and the change is enough to enable the farmer to fertilize all 69 acres at an intermediate level of fertilization. In other respects, total borrowing, interest paid, and cash transfers do not differ greatly from Plan 1. The favorable borrowing terms for fertilizer and operating expense are reflected in a slightly higher return than was found in Plan 1.

Effects of lender experience

For conditions that result in Plan 10, it is assumed that a livestock-area lender is suddenly moved into a grain-area situation and in his new situation applies loan discounts that are average for the livestock

area. Since the livestock-area discounts are intermediate between the grain-area discounts that are average and those that are high, Plan 10 is similar to Plan 1. Unlike Plan 11, there is a solution in Plan 10, but barely so. Plans 1, 10, and 11, representing adjustment to lender attitudes favorable to cattle loans at the expense of operating and fertilizer loans, suggest that lender background may well have an important influence on farm planning. These highly differentiating discounts can also be considered as representative of collateral-conscious lenders generally. Clearly, a collateral-conscious attitude can affect decisions made by profit-maximizing farmers.

Effects of seasonal needs for funds

In Plan 2, it is assumed that operating bills, machinery repair and hire, fuel, and livestock expenses other than feed, can be carried on open account or otherwise postponed with promise to repay at the end of a year, or, perhaps, when the feeder cattle are sold.

Considering the limited number of alternatives assumed available in the model, the results are startling. Cattle numbers increase by 36 head and income increases to $4,206, a figure which could justify paying a substantial charge for financing operating expense items.

The surplus cash available is carried over to meet the fixed commitments in the second quarter, freeing corn for cattle feed. Borrowing capacity is no longer used for operating requirements, so the cattle can be purchased. Again, the marginal return per unit of borrowing capacity for cattle exceeds that for fertilizer, even though the marginal return for $1 used may be higher for fertilizer.

PLANS FOR THE LIVESTOCK-AREA FARM

Profit-maximizing plans for seven variations of the livestock-area situation are summarized in Table 9. The livestock-area farm situation differs from the grain-area situation only in the magnitude of cash balances from fixed activities, amount of operating expenses required, and in corn available for disposal. Therefore, plans would be expected to be similar between areas.

Reference to Plan 6 in Table 9 supports this expectation. As was the case for the grain area, the debt obligations in the second quarter require cash to be conserved, corn to be sold, and money to be borrowed for operating expenses. Consequently, borrowing capacity is not available for either cattle or fertilizer loans. The feed supply for cattle is also limited. As a result, only 1 head of cattle is added to the 40 head already in the fixed part of the farm organization.

Table 9. — Optimum Plans for Livestock-Area Situations

| Item | Quarterly payment of operating expenses | | | | | | Annual payment of operating expenses |
| | Average loan discounts | | | Highly differentiated loan discounts | Low differentiated loan discounts | Grain-area discounts | |
	Mean loan limit	High loan limit	Low loan limit				
Plan number................	6	8	9	12	14	5	7
Enterprise organization							
Corn fertilized, acres.....	0	0			69	0	0
Feeder cattle added, head	1	7			1	4	35
Disposal of surplus corn, bushels							
Fed...................	55	385			55	220	590
Bought...............	0	0			0	0	1,335
Sold.................	535	205			535	370	0
Borrowed for—							
Cattle...................	$ 69	$ 744			$ 89	$ 354	$3,542
Fertilizer...............	0	0			$ 414	0	0
Operating, Quarter 4.....	0	0			0	0	$ 457
Operating, Quarter 1.....	$ 486	$ 950			$ 500	$ 682	$ 216
Operating, Quarter 2.....	$1,446	$1,487			$1,447	$1,464	$ 239
Operating, Quarter 3.....	0	0			0	0	0
Source of operating funds[a]			No solution possible	No solution possible			
Quarter 4...............	C	C			C	C	C
Quarter 1...............	C,B	C,B			C,B	C,B	B
Quarter 2...............	B	B			B	C,B	B
Quarter 3...............	C	C			C	C	C
Cash transfers							
Quarter 4 to 1..........	$1,073	$1,032			$1,071	$1,055	$1,204
Quarter 1 to 2..........	$2,864	$3,246			$2,875	$3,025	$2,439
Quarter 2 to 3..........	0	0			0	0	0
Income after change.......	$1,203	$2,247			$1,868	$1,578	$6,977
Less payment of cattle and fertilizer loan..........	$ 179	$ 744			$ 503	$ 354	$3,542
Net income after change....	$1,024	$1,503			$1,365	$1,224	$3,435
Net income from fixed organization................	$ 426	$ 426			$ 426	$ 426	$ 426
Increase from change.......	$ 598	$1,007			$ 939	$ 798	$3,009
Source of change:							
Cattle.................	$ 93	$1,007			$ 121	$ 480	$4,799
Corn..................	$ 574	$ 193			$ 563	$ 414	−$1,533
Fertilizer..............	0	0			$ 338	0	0
Less interest...........	−$ 69	−$ 133			−$ 83	−$ 96	$ 257

[a] C is cash; B is borrowing.

The increase in net returns is smaller for the livestock-area farm than for the cash-grain-area farm. Cash transfers between quarters exceed those of the grain farm because more liquid assets are in cash and less in stored corn.

Effects of lender liberalism or conservatism

Extremes in size of loans that might be allowed a farmer in the livestock area are represented in Plans 8 and 9. As was found in the grain area, the low-loan limit (Plan 9) forces the business into insolvency in the third quarter. On the other hand, the high limit (Plan 8) allows expansion of the cattle enterprise; in this case, by 7 head. Cash is freed to pay the fixed commitments because it is possible to borrow for more of the operating requirements, so that more corn can be re-

tained for feed. The extra corn, together with higher borrowing capacity, makes the cattle expansion possible.

Effects of varying lender differentiation by purpose

Plans 12 and 14 are comparable with Plan 6 except that they represent different lender discounts applied to loan purposes. The high discounts (Plan 12) discriminate so heavily against operating loans that when the average loan limits are assumed the situation is insolvent in the second quarter. The same result occurred in the grain area in a similar situation.

On the other hand, low discounts encourage borrowing for an intermediate level use of fertilizer (Plan 14), just as was found in the comparable situation in the grain area. The remaining borrowing capacity and corn are more than adequate to cover operating expenses, so that enough of each is available to handle 1 additional steer.

Effects of lender experience

In Plan 5 it is assumed that a grain-area lender is suddenly transplanted to the livestock area bringing with him a discount rate for operating expenses smaller than that used in Plan 6. The surplus borrowing potential thus created for the farmer allows him to buy 4 head of cattle instead of the 1 and results in a slight increase in income generated by the changed organization. The livestock-area resources include more cash, higher operating expenses, and less corn, so the added returns are less than for Plan 1 in the grain area. Plan 1 in the grain area is comparable with Plan 5 in the livestock area.

Effects of seasonal needs for funds

In Plan 7, payment of operating expenses is allowed to be deferred until the end of the year. This Plan allows the largest adjustment in feed and livestock. As in the case of the grain-area farm, the feeder-cattle enterprise is expanded nearly to capacity. In addition, it is found profitable to buy corn at 11 cents per bushel above the selling price and hire additional labor (70 hours) in the spring rush season.

The higher income generated in Plan 7, compared with Plan 6, amply demonstrates the cost of maintaining necessary short-term financial liquidity. All borrowing capacity is available for cattle and for cattle expenses, with other operating requirements paid at the time of the cattle sale. It would be possible for the indebted farmer to pay a substantial "interest rate" to dealers or other lenders for financing operating expenses to avoid seasonally binding commitments.

PLANS ASSUMING DIFFERENT FIXED PAYMENTS

Careful study of plans shown in Tables 8 and 9 reveals that each solution is heavily affected by the need to meet cash deficits that occur in the second quarter (Tables 2 and 4). The cash transfers from the fourth quarter to the first and the first to the second show funds left idle to pay these debts. In each case, operating expenses must be financed by borrowing in the third quarter.

It seems likely, therefore, that the relationships among plans may be affected by the dominance of debt commitments that result from the fixed part of the farm organization, primarily real estate payment of $1,717 in the second quarter and payment on machinery contract for the farm in each area. But lender limits were established with full knowledge of these commitments and presumably in consideration of them. Though the limits may, therefore, not be strictly applicable to a different set of conditions, two plans have been computed for each area using the same lender limits but with changes in the fixed requirements in debt payments.[1]

One possibility is to change the payment on real estate debt from the second quarter to the more common situation — semiannual payments in the first and third quarters. Results from this change in the initial farm situation are reported in Plan 15 (Table 10) for the cash-grain-area farm and Plan 17 (Table 11) for the livestock-area farm.

The other possibility is to change the payments of machinery contract from the previously assumed twice-per-year payments to equal quarterly payments. Results from this change, combined with the redistributed payment of real estate amortization, are shown in Plan 16 (Table 10) for the cash-grain-area farm and in Plan 18 (Table 11) for the livestock-area farm. In all cases, it is assumed that operating expenses are paid in the quarters in which they are incurred.

The redistributed real estate payments result in increased surplus income of $2,424 for the grain farm and $1,805 for the livestock farm (Tables 10 and 11). For the livestock farm, this increase exceeds the increase reached with the high-loan limits (Plan 8, Table 9), or reduced differentials among loan purposes (Plan 14, Table 9). For the grain farm, such an increase nearly matches the increase allowed by high-loan limits (Plan 3, Table 8) and exceeds the increase reached with reduced loan differentials (Plan 13, Table 8). If, in addition,

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[1] It might be reasonable to suppose that these changes would "liberalize" lender behavior. Thus the following estimates are conservative.

machinery payments are redistributed to four equal quarterly payments, the increase in surplus income exceeds for both farms that yielded by any plan except where operating expenses are allowed to be deferred until the end of the year. (Compare the last columns of Tables 10 and 11 with the last columns of Tables 8 and 9, respectively.)

Table 10. — Optimum Plans for the Grain-Area Farm, Assuming Different Fixed Payments

Item	Basic solution	Real estate payments in Quarters 1 and 3	Real estate payments as in Plan 15; quarterly machinery payments
Plan number....................	1	15	16
Enterprise organization			
Corn fertilized, acres............	0	0	0
Feeder cattle added, head........	5	12	17
Corn, bushels			
Fed........................	275	660	935
Bought.....................	0	0	0
Sold........................	2,625	2,240	1,965
Borrowed for			
Cattle.......................	$ 470	$1,258	$1,703
Fertilizer....................	0	0	0
Operating			
Quarter 4....................	0	0	0
Quarter 1....................	$ 317	$ 446	$ 473
Quarter 2....................	$1,490	$1,092	$ 913
Quarter 3....................	0	0	0
Source of operating funds[a]			
Quarter 4.....................	C	C	C
Quarter 1.....................	C,B	C,B	C,B
Quarter 2.....................	B	C,B	B
Quarter 3.....................	C	C	C
Income after change..............	$2,313	$3,682	$4,454
Less payment of cattle loan........	$ 470	$1,258	$1,703
Net income after change...........	$1,843	$2,424	$2,751
Net income from fixed organization	−$1,456	−$1,456	−$1,456
Increase from change.............	$3,299	$3,880	$4,207
Source of change:			
Cattle........................	$ 636	$1,705	$2,305
Corn.........................	$2,750	$2,305	$2,052
Less interest..................	−$ 87	−$ 130	−$ 150

[a] C is cash; B is borrowing.

Table 11. — Optimum Plans for the Livestock-Area Farm,
Assuming Different Fixed Payments

Item	Basic solution	Real estate payments in Quarters 1 and 3	Real estate payments as in Plan 17; quarterly machinery payments
Plan number....................	6	17	18
Enterprise organization			
Corn fertilized, acres............	0	0	0
Feeder cattle added, head........	1	11	22
Corn, bushels			
Fed........................	55	605	1,210
Bought.....................	0	15	620
Sold........................	535	0	0
Borrowed for			
Cattle........................	$ 69	$1,140	$2,225
Fertilizer.....................	0	0	0
Operating			
Quarter 4....................	0	0	0
Quarter 1....................	$ 486	$ 366	0
Quarter 2....................	$1,446	$1,512	$1,509
Quarter 3....................	0	0	0
Source of operating fund[a]			
Quarter 4.....................	C	C	C
Quarter 1.....................	C,B	C,B	C
Quarter 2.....................	B	C,B	C,B
Quarter 3.....................	C	C	C
Income after change..............	$1,203	$2,945	$4,775
Less payment of cattle loan........	$ 179	$1,140	$2,225
Net income after change..........	$1,024	$1,805	$2,550
Net income from fixed organization	$ 426	$ 426	$ 426
Increase from change.............	$ 598	$1,379	$2,124
Source of change			
Cattle........................	$ 93	$1,543	$3,014
Corn.........................	$ 574	−$ 34	−$ 711
Less interest...................	−$ 69	−$ 130	−$ 179

[a] C is cash; B is borrowing.

SUMMARY AND CONCLUSIONS

For the credit dependent farmer, lender behavior may well limit farm planning. If the lender is concerned with the safety of loans made, differential loan limits should be expected with respect to proposed use of funds, depending on whether the input to be purchased can serve as collateral for the loan. *Consequently, the optimal planning by the farmer, as well as level of income he gets, will be affected by lender limits.* This study investigated such lending limits and the farm organizational effects of adjusting to them.

A hypothetical farm situation was developed from farm records for a cash-grain and a livestock farm in terms of financing statements, physical inventories, production plans, and personal characteristics of the farm operator and his family. The cash-grain farm and the livestock farm were made as similar as possible, except for the setting in different areas of the state.

The lender survey indicated that loans to create assets (feeder cattle, machinery, or buildings that furnish chattel security) were granted in significantly larger amounts than were loans for purposes that do not create pledgeable assets (fertilizer or operating expense). Livestock-area lenders made larger loans for feeder cattle and machinery. Grain-area lenders made larger loans for buildings and fertilizer. Loans to finance operating expenses were similar between areas.

A procedure incorporating both production and financial decisions and using results from the lender survey was then used to deduce the consequences of various types of lender limits. Nine plans were computed for each area with varying over-all lender optimism (as reflected in maximum size of loan obtainable) with differing degree of seasonal demands for cash. Comparisons were made to suggest the importance of lender influence and of seasonal considerations in the situations under study.

In the first seven plans for each area the optimum organizations were dominated by adjustments to meet heavy fixed commitments on real estate and machinery loans. These requirements forced a build-up of cash balances, thus subjecting the operator to lender limits that necessitated borrowing to meet a part of the operating requirements. Grain sale was necessary to help meet debt payments. Cattle numbers were limited because funds from corn were too valuable in other uses. Operating expenses were treated as seasonally fixed, and thus had first claim on borrowing capacity, cash on hand, and cash income in previous quarters. In situations that allow borrowing in excess of these needs, the choice between cattle and fertilizer depended on a relationship between corn supplies, loan terms available, and the amount of fixed commitments to be met in the following quarters.

Lender decisions influenced both the choice of enterprises and the handling of financial accounts. Where lender differentiations were high or loan limits were low, the situation became financially insolvent. Where lender differentiations were low, it was most profitable to fertilize at an intermediate level. In all other cases the combination of higher differentiation between purposes and heavy necessary borrowing for operating expenses so used up borrowing capacity that the remaining borrowing could be used more profitably for cattle.

Changing fixed debt payments allowed enlarging the enterprises, but did not change the ones chosen in the optimum plans. Reducing fixed commitments in critical periods decreased the need to borrow for operating expense, and also the need to sell corn. As a result, borrowing capacity was less critical as a restraint on the decision to buy more cattle. *Hence, timing of debt payments was found critically important for financial success.* An important final conclusion is that marginal productivities associated with the use of owned funds are not appropriate for fund allocation decisions with the use of borrowed money, if lender discounts are met such as those found in this study. If other terms, (interest rate, length of loan) vary with purpose, this also would affect optimum allocation of resources.

LIMITATIONS

A number of crucial issues were ignored in this exploratory study. Several are worth further research. For example, an assumption was made that the borrowing limit for one purpose is independent of the amount borrowed for another purpose. But it is likely that total borrowing capacity depends on combinations of loan purposes. It was likewise assumed that total borrowing capacity was independent of use of secondary lenders. Finally, it was assumed the amount borrowed in one part of the year was not related to that borrowed in another part. None of the three assumptions is likely to hold. The assumptions were made in the present study to simplify the analysis and because relevant quantitative information is not now available. Additional study of these problems is underway.

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APPENDIX

The complete programming tableau for Plan 1 is shown in Table 12. In the P_0 vector, the numbers shown in lines 1-4 are loan limits established, on the average, by grain-area lenders. Hence, these are amounts that can not be exceeded by uses made of credit in each of the respective periods.[1] No value is attached to unused credit. Hence, c_i is zero for each period.

Each of lines 5-8 is an equation, requiring that the amount borrowed for operating expense be equal to the amount repaid plus the amount carried forward to the next period. An arbitrarily large negative price is imposed on the slack of each of these variables to insure that it does not appear in the final solution.

In each of lines 9-12, the amount shown in P_0 is the cash available from the fixed farm organization. The negative number in line 11 necessitates multiplying each number in this line by -1 to permit solution by simplex procedures.[2] Equalities for lines 9-11 have the same meaning as in lines 5-8. The inequality in line 12 permits cash transferred into period 4 to be transferred to savings (via P_{17}).

Expenses required to be met for fertilizer, cattle, and operating in each period, for the fixed farm organization, are shown in P_0 in lines 13-18, respectively. Again, the relations are equalities. No expense is required to be met unless fertilizer or cattle enter the plan that revises the fixed farm organization. On the other hand, the amounts shown in P_j vectors of lines 15-18 indicate operating expenses that must be met, per activity unit, along with such additions thereto as are incident to the revised plan.

The amounts in P_0, lines 19-22, are man-hours of labor available after the needs of the fixed farm organization have been supplied. The inequality in each of these lines implies the possibility of idle labor in the final solution. The c_i values of zero reflect an assumption that idle labor is worth nothing to the operator.

Unused feedlot capacity for 40 head of cattle available for use in the revised plan is shown in line 23. The 69 acres, to fertilize, line 24, are in corn. Failure to use any part of the excess feedlot capacity or to fertilize the corn neither adds to nor subtracts from profit ($c_i = 0$). Finally, 2,900 bushels of corn, line 25, are available for feeding or for

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[1] Period 1 is October-December; 2, January-March; 3, April-June; and 4, July-September. Hence these differ from the calendar "quarters" used in the text to report results. Quarters 1, 2, 3, and 4 are the same as periods 4, 1, 2, and 3, respectively.

[2] The same procedure is required in line 11 for Plans 2–10, 17, and 18 and in lines 10 and 11 for Plans 15 and 16.

Table 12. — Program Tableau for Plan 1[a]

			c_j	$0	$10.90	$21.80	$0	$0	$0	$1.09
Line no.	c_i^b			Cattle	Fertilizer		Sell corn in Period			
					Le1	Le2	1	2	3	4
			P0	P1	P2	P3	P4	P5	P6	P7
				head	acres		bushel			
		Maximum loan								
1	0	Period 1.......	$5,776							
2	0	Period 2.......	$5,776							
3	0	Period 3.......	$5,776							
4	0	Period 4.......	$5,776							
		Operating loan balance								
5	−M	Period 1.......	0							
6	−M	Period 2.......	0							
7	−M	Period 3.......	0							
8	−M	Period 4.......	0							
		Cash available								
9	0	Period 1.......	$2,601				−$1.00			
10	0	Period 2.......	$ 4					−$1.04		
11	−M	Period 3.......	−$3,577						−$1.11	
12	$1.00	Period 4.......	$4,230	−$263.23						
		Fertilizer expense								
13	−M	pense........	0		−$6.00	−$12.27				
14	−M	Cattle expense...	0	−$101.30						
		Operating expenses								
15	−M	Period 1.......	$1,287	−$ 6.19						
16	−M	Period 2.......	$ 751	−$ 6.19						
17	−M	Period 3.......	$1,461	−$ 6.19						
18	−M	Period 4.......	$1,215	−$ 6.19						
		Labor, man-hours								
19	0	Period 1.......	289	2.58						
20	0	Period 2.......	428	3.02	.10	.10				
21	0	Period 3.......	83	2.32	.10	.10				
22	0	Period 4.......	318	2.75						
		Feedlot capacity, head........	40	1.00						
23	0									
24	0	Acres to fertilize..	69		1.00	1.00				
25	$1.09	Corn, bushels....	2,900	55.00			1.00	1.00	1.00	1.00

			c_j	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Line no.	c_i^b			Transfer cash to—						Transfer cash from Period			
				Fert.	Cat-tle	Operating expense, Period							
						1	2	3	4	1-2	2-3	3-4	4-svgs.
			P0	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17
				dollar						dollar			
		Maximum loan											
1	0	Period 1.......	$5,776										
2	0	Period 2.......	$5,776										
3	0	Period 3.......	$5,776										
4	0	Period 4.......	$5,776										
		Operating loan balance											
5	−M	Period 1.......	0										
6	−M	Period 2.......	0										
7	−M	Period 3.......	0										
8	−M	Period 4.......	0										
		Cash available											
9	0	Period 1.......	$2,601		$1	$1				$1		$1	
10	0	Period 2.......	4				$1			−$1	$1		
11	−M	Period 3.......	−$3,577	$1				−$1			−$1	$1	
12	$1.00	Period 4.......	$4,230						$1			−$1	−$1.0198
13	−M	Fertilizer expense	0	$1									
14	−M	Cattle expense...	0		$1								
		Operating expenses											
15	−M	Period 1.......	$1,287			$1							
16	−M	Period 2.......	$ 751				$1						
17	−M	Period 3.......	$1,461					$1					
18	−M	Period 4.......	$1,215						$1				
		Labor, man-hours											
19	0	Period 1.......	289										
20	0	Period 2.......	428										
21	0	Period 3.......	83										
22	0	Period 4.......	318										
		Feedlot capacity, head........	40										
23	0												
24	0	Acres to fertilize..	69										
25	$1.09	Corn, bushels....	2,900										

Table 12. — Concluded

	c_j			−$0.06	−$0.045	−$0.03	−$0.015	−$0.03	−$0.06
					Borrow for				
					Operating expense, Period			Fertilizer	Cattle
Line no.	c_i[b]		P_0	1 P_{18}	2 P_{19}	3 P_{20}	4 P_{21}	P_{22}	P_{23}
						dollar			
1	0	Maximum loan Period 1......	$5,776	$2.938					$1
2	0	Period 2......	$5,766	$2.938	$2.938				$1
3	0	Period 3......	$5,766	$2.938	$2.938	$2.938		$4.555	$1
4	0	Period 4......	$5,766	$2.938	$2.938	$2.938	$2.938	$4.555	$1
5	−M	Operating loan balance Period 1......	0	−$1					
6	−M	Period 2......	0		−$1				
7	−M	Period 3......	0			−$1			
8	−M	Period 4......	0				−$1		
9	0	Cash available Period 1......	$2,601						
10	0	Period 2......	$ 4						
11	−M	Period 3......	−$3,577						
12	$1.00	Period 4......	$4,230						
13	−M	Fertilizer expense	0					$1	
14	−M	Cattle expense...	0						$1
15	−M	Operating expenses Period 1......	$1,287	$1					
16	−M	Period 2......	$ 751		$1				
17	−M	Period 3......	$1,461			$1			
18	−M	Period 4......	$1,215				$1		
19	0	Labor, man-hours Period 1......	289						
20	0	Period 2......	428						
21	0	Period 3......	83						
22	0	Period 4......	318						
23	0	Feedlot capacity, head........	40						
24	0	Acres to fertilize..	69						
25	$1.09	Corn, bushels....	2,900						

	c_j			$0.045	$0.03	$0.015	$0	$0	$0	$0	$1.00	$0	$0
					Repay operating loan in Period				Carry loan from Period			Transfer cash to profit	Purchase of	
Line no.	c_i[b]		P_0	1 P_{24}	2 P_{25}	3 P_{26}	4 P_{27}	1-2 P_{28}	2-3 P_{29}	3-4 P_{30}	P_{31}	Corn P_{32}	Labor P_{33}
					dollar				*dollar*		*dollar*	*dollar*	
1	0	Maximum loan Period 1......	$5,776										
2	0	Period 2......	$5,776	−$2.938									
3	0	Period 3......	$5,776	−$2.938	−$2.938								
4	0	Period 4......	$5,766	−$2.938	−$2.938	−$2.938							
5	−M	Operating loan balance Period 1......	0	$1				$1					
6	−M	Period 2......	0		$1			−$1	$1				
7	−M	Period 3......	0			$1			−$1	$1			
8	−M	Period 4......	0				$1			−$1			
9	0	Cash available Period 1......	$2,601	$1									
10	0	Period 2......	$ 4		$1								
11	−M	Period 3......	−$3,577			$1							
12	$1.00	Period 4......	$4,230				$1				$1		
13	−M	Fertilizer expense.	0										
14	−M	Cattle expense...	0										
15	−M	Operating expenses Period 1......	$1,287									−$1.15	
16	−M	Period 2......	$ 751										
17	−M	Period 3......	$1,461										−$1.25
18	−M	Period 4......	$1,215										
19	0	Labor, man-hours Period 1......	289										
20	0	Period 2......	428										
21	0	Period 3......	83										
22	0	Period 4......	318										
23	0	Feedlot capacity, head........	40										
24	0	Acres to fertilize..	69										
25	$1.09	Corn, bushels....	2,900									$1	

[a] Values for a_{ij} are also used for Plans 2, 3, 4, 5, 15, and 16.
[b] M is an arbitrarily large number. [c] L is an abbreviation of level.

sale. If sold in period 1 (P_4), corn receipts add cash at the rate of
$1.00 per bushel to cash available in Period 2; if sold in Period 2
(P_5), the receipts add to cash available in Period 3 at $1.04 per bushel;
if sold in Period 3, receipts add to cash available in Period 4 at the rate
of $1.11 per bushel. Finally, if sold in Period 4 (P_7), "profit" in-
creases at $1.09 per bushel. These prices are designed to reflect sea-
sonal variation in the price of corn.

Production and marketing alternatives are given in P_{1-7}, P_{32}, P_{33}.
P_{1-4} are production alternatives that require resources as indicated
by coefficients shown in the columns and produce returns as shown by
$a_{12, 1}$, for cattle, and c_2 and c_3 (in the c_j row vector) for fertilizer.
P_{4-7} have already been explained.

A series of cash transfers are provided for in P_{8-17}. In P_{8-13}, the
transfers are from Period 3 to meet fertilizer expense, from 1 to meet
cattle expenses, and from Periods 1, 2, 3, and 4 to meet operating
expense in Periods 1, 2, 3, and 4, respectively. P_{14-16} permit cash to be
transferred from one period to the next. Finally, in P_{17} any cash sur-
plus remaining is transferred to savings (valued at $1 per dollar thus
transferred, as indicated by c_i in line 12). All transfers are assumed
possible without cost. Hence c_j is zero in P_{8-17}.

P_{18} allows the operator to borrow in Period 1 for operating expense
in Period 1. He is limited to $5,776, as shown in P_0, line 1, and uses
this capacity at the rate of $2.938 for every dollar borrowed. He also
adds $1 to his loan balance in Period 1 (line 5), meets $1 of operating
expense in Period 1 (line 15) and reduces "profit" by $0.06 ($c_j =$
$-$0.06 in P_{18}). P_{19-21} are similar, except they relate to Periods 2, 3,
and 4, respectively. Hence, the annual interest per dollar borrowed is
reduced to account for the shorter time over which the loan is out-
standing. P_{22} and P_{23} are also similar, except that borrowing capacity
is used up at a faster rate ($4.555 per dollar borrowed) for fertilizer
and a far slower rate for cattle. The values for c_j reflect the assump-
tion that borrowing for fertilizer or cattle would occur in Periods 3
and 1, respectively.

P_{24-27} permit operating loans to be repaid in Periods 1-4, respec-
tively. If a payment of $1 is made in Period 1 ($P_{24}$), it restores
$2.938 to borrowing capacity in Period 2 (line 2), reduces operating
loan balance in Period 1 (line 5) and cash available in Period 1 (line
9), and adds a credit of $0.045 to "profit" ($c_j$ in P_{24}) because of inter-
est saved for the balance of the year. P_{25-27} are similar, there being
no savings of interest in P_{27}.

P_{28-30} permit a loan balance to be carried from one period to the
next adjacent period at zero cost. In P_{31} cash is transferred from
Period 4 to "profit." Finally, corn and labor are allowed to be pur-
chased in P_{32} and P_{33}, respectively, at rates of $1.15 per bushel for

corn in Period 1 (line 15) and $1.25 per hour for labor in Period 3 (line 21).

In Table 13, changes in P_0 that were used to obtain solutions given in Plans 2-5, 15, and 16 are given. In Plan 2, the only change is to allow operating expenses for the grain-area farm to be met in Period 4 instead of the period in which they were actually incurred. Hence, zeros appear in lines 14-17, while all operating expenses from the fixed organization cumulate in Period 4. Plan 3 is the same as Plan 1 except that the maximum amount that can be borrowed is assumed equal to the mean maximum observed in the grain area *plus* one standard deviation of the mean. In Plan 4 the assumption is the mean *minus* one standard deviation.

Plan 5 describes the livestock-farm situation, but the solution assumes loan discounts as found, on the average, in the grain area. It is included with the grain-area plans because it is a P_0 vector for the tableau described in Table 12. In Plan 15 the real estate payment is changed from once per year (Period 3) to twice per year (Periods 2 and 4). The results are evident in lines 10, 11, and 12. The same lines are affected in Plan 16, wherein the machinery payments also are changed from twice per year to four equal payments per year. In this Plan, line 9 is also affected.

Table 14 shows the changes required in relevant a_{ij} given in Table 12 to reflect the borrowing possibilities in the livestock area. In other respects, the programming tableau for the livestock-area farm is iden-

Table 13. — P_0 Vectors for Plans 2-5, 15, and 16

	Plan number					
	2	3	4	5	15	16
Maximum loan, each period.....	$5,776	$8,933	$2,619	$6,657	$5,776	$5,776
Operating loan balance, each period.....................	0	0	0	0	0	0
Cash available						
Period 1....................	$2,601	$2,601	$2,601	$2,496	$2,601	$3,115
Period 2....................	$ 4	$ 4	$ 4	$2,235	−$ 855	−$1,342
Period 3....................	−$3,577	−$3,577	−$3,577	−$3,439	−$1,860	−$1,402
Period 4....................	$4,230	$4,230	$4,230	$4,230	$3,371	$2,884
Fertilizer expense.............	0	0	0	0	0	0
Cattle expense................	0	0	0	0	0	0
Operating expense						
Period 1....................	0	$1,287	$1,287	$1,419	$1,287	$1,287
Period 2....................	0	$ 751	$ 751	$ 925	$ 751	$ 751
Period 3....................	0	$1,461	$1,461	$1,442	$1,461	$1,461
Period 4....................	$4,714	$1,215	$1,251	$1,310	$1,215	$1,215
Labor, man-hours						
Period 1....................	289	289	289	169	289	289
Period 2....................	428	428	428	351	428	428
Period 3....................	83	83	83	63	83	83
Period 4....................	318	318	318	263	318	318
Feedlot capacity, head..........	40	40	40	40	40	40
Acres to fertilize..............	69	69	69	69	69	69
Corn, bushels.................	2,900	2,900	2,900	590	2,900	2,900

Table 14. — Changes in Program Tableau for Plan 1 to Reflect
Average Loan Discounts in the Livestock Area and
to Yield Plans 6, 7, 8, 9, 10, 17, and 18

Line no.	Borrow for					Repay operating loan in Period		
	Operating expense, Period				Fert-ilizer			
	1 P_{18}	2 P_{19}	3 P_{20}	4 P_{21}	P_{22}	1 P_{24}	2 P_{25}	3 P_{26}
1	$3.410							
2	$3.410	$3.410				−$3.410		
3	$3.410	$3.410	$3.410		$8.469	−$3.410	−$3.410	
4	$3.410	$3.410	$3.410	$3.410	$8.469	−$3.410	−$3.410	−$3.410

tical to that for the grain-area farm, with exceptions in the P_0 vector, to be noted with reference to Table 15.

Plan 6 (Table 15) represents the situation in the livestock area comparable with Plan 1 in the grain area. The P_0 vector reflects the mean of loan limits, with operating expenses required to be met in the period in which they are incurred. The deviation in Plan 7 allows operating expenses to be deferred until the end of the year. Plan 8 reflects high loan limits in the livestock area; Plan 9, low limits. Plan 10 is the grain-area farm in the livestock-area financing setting. In Plan 17 the real estate payment for the livestock farm is made twice per year, while in Plan 18, the machinery payment is also changed to quarterly payments.

Table 15. — P_0 Vectors for Plans 6-10, 17, and 18

	Plan number						
	6	7	8	9	10	17	18
Maximum loan, each period............	$6,657	$6,657	$9,055	$4,259	$5,776	$6,657	$6,657
Operating loan balance, each period	0	0	0	0	0	0	0
Cash available							
Period 1..........	$2,496	$2,496	$2,496	$2,496	$2,601	$2,496	$2,935
Period 2..........	$2,235	$2,235	$2,235	$2,235	$2,235	$2,235	$2,235
Period 3..........	−$3,439	−$3,439	−$3,439	−$3,439	−$3,577	−$1,722	−$ 500
Period 4..........	$4,230	$4,230	$4,230	$4,230	$4,230	$3,371	$2,956
Fertilizer expense....	0	0	0	0	0	0	0
Cattle expense.......	0	0	0	0	0	0	0
Operating expense							
Period 1..........	$1,419	0	$1,419	$1,419	$1,287	$1,419	$1,419
Period 2..........	$ 925	0	$ 925	$ 925	$ 751	$ 925	$ 925
Period 3..........	$1,442	0	$1,442	$1,442	$1,461	$1,442	$1,422
Period 4..........	$1,310	$5,096	$1,310	$1,310	$1,215	$1,310	$1,310
Labor, man-hours							
Period 1..........	169	169	169	169	289	169	169
Period 2..........	351	351	351	351	428	351	351
Period 3..........	63	63	63	63	83	63	63
Period 4..........	263	263	263	263	318	263	263
Feedlot capacity, head	40	40	40	40	40	40	40
Acres to fertilize.....	69	69	69	69	69	69	69
Corn, bushels........	590	590	590	590	2,900	590	590

Table 16 shows changes required in Table 12 to obtain Plans 11 (grain area) and 12 (livestock area). These are plans attainable with high discounts; that is, sharp discrimination against loans for fertilizer and operating expenses, relative to cattle.

Similarly, Table 17 gives changes required to reflect low discounts among loan purposes. These coefficients, substituted into the tableau shown in Table 12, were used, with appropriate P_0 vectors to obtain Plans 13 (grain area) and 14 (livestock area).

Table 16. — Changes in Program Tableau for Plan 1 to Reflect High Loan Discounts and to Yield Plans 11 and 12

| Line no. | Borrow for | | | | | Repay operating loan in Period | | |
| | Operating expense, Period | | | | Fertilizer P_{22} | | | |
	1 P_{18}	2 P_{19}	3 P_{20}	4 P_{21}		1 P_{24}	2 P_{25}	3 P_{26}
1	$4.146					−$4.146		
2	$4.146	$4.146				−$4.146	−$4.146	
3	$4.146	$4.146	$4.146		$9.821	−$4.146	−$4.146	−$4.146
4	$4.146	$4.146	$4.146	$4.146	$9.821	−$4.146	−$4.146	−$4.146

Table 17. — Changes in Program Tableau for Plan 1 to Reflect Low Loan Discounts and to Yield Plans 13 and 14

| Line no. | Borrow for | | | | | Repay operating loan in Period | | |
| | Operating expense, Period | | | | Fertilizer P_{22} | | | |
	1 P_{18}	2 P_{19}	3 P_{20}	4 P_{21}		1 P_{24}	2 P_{25}	3 P_{26}
1	$2.400					−$2.400		
2	$2.400	$2.400				−$2.400	−$2.400	
3	$2.400	$2.400	$2.400		$3.127	−$2.400	−$2.400	−$2.400
4	$2.400	$2.400	$2.400	$2.400	$3.127	−$2.400	−$2.400	−$2.400