

RESOURCE COMBINATIONS: THEIR  
EFFECT ON RESOURCE USE AND POTENTIAL  
PRODUCTIVITY ON THREE TYPES OF  
KENTUCKY FARMS

By

James Thompson  
and  
Stephen Allen

Progress Report 119  
(Filing Code: 7)

UNIVERSITY OF KENTUCKY  
AGRICULTURAL EXPERIMENT STATION  
Department of Agricultural Economics  
Lexington

RESOURCE COMBINATIONS:  
THEIR EFFECT ON RESOURCE USE AND POTENTIAL PRODUCTIVITY  
ON THREE TYPES OF KENTUCKY FARMS

By James Thompson and Stephen Allen <sup>1/</sup>

Two primary problems facing Kentucky farmers are the use of capital and the production and use of hay and pasture crops. These are often referred to as "the capital problem" and "the forage problem."

The first deals with the amount of capital a farm can profitably use for investments and expenses, and the manner in which a given amount of capital can be used more profitably. The second concerns the best program for producing and using the forage crops.

How much of particular forage crops will yield maximum profit on farms of different sizes and land classes? Is the answer to this question affected by the quality of the forage, seasonal production patterns, other enterprises on the farm, and risks and uncertainties encountered in cropping programs having different amounts and kinds of forage crops?

The problems of capital use and of forage production and use are really parts of a larger problem which confronts most commercial farmers. Having land of given kinds and a set of available markets through which he can sell his products, a farmer must decide on the best amounts of other resources to use with his land, the enterprises which will make best use of both the resources and the markets, and the manner in which these enterprises should be operated.

The specific objective of this study was to determine for two labor situations the most profitable amounts of pasture, hay and silage relative to grain when different amounts of capital are available for use with the other resources on the farm. The results of the study also shed light on the relative profitability of different kinds of livestock and different amounts of capital.

Three typical farms chosen for study represent three different size groups and three different sets of land classes. In order to make the results more widely applicable, some of the special characteristics of the three case farms, such as field arrangement, were ignored in the analysis. Therefore, the results, while applying to a larger number of farms, will have to be adapted to some extent to make them fit the case farms. The study will have been worthwhile, however, if it does no more than stimulate and perhaps help guide thinking about problems of this kind.

Throughout the study it was assumed that the three farms used as examples were operated by good managers and that improved crop and livestock production practices were used. The plans made and discussed here were based on the assumption that the primary objective of the farm operators was to attain maximum profit from land and

---

<sup>1/</sup> The large volume of computing work necessary in this study was accomplished through the use of the equipment of the University of Kentucky Computing Center and with the aid of the Computing Center staff.

associated resources. Thus, the potential and not the actual productivity was examined. Average weather was assumed, and no allowance was made that some plans, while providing more profit than others, may at the same time have involved more risk.

The profitability of various farm enterprises relative to each other depends to a large extent on the prices received for their products and the prices paid for their inputs. Thus, it was necessary to determine a list of prices for both input and output items. (The most important items are shown in Tables 1 and 2.) The prices were based mainly on past prices and price trends, and partially on the long-term outlook for each of the products involved.

The term capital as used in this report included operating expenses as well as investments in all productive assets except land. The term income meant the return to the land, the resident labor force, and management after all other costs were paid.

TABLE 1. - ASSUMED PRICES PAID FOR MAJOR PRODUCTIVE ITEMS

Item and Unit	Price per Unit (dollars)
<u>Fertilizer (cwt)</u>	
Nitrogen (N)	12.00
Phosphate ( $P_2O_5$ )	8.50
Potash ( $K_2O$ )	5.00
Lime (ton)	2.75
<u>Seed</u>	
Corn (bu)	13.50
Grain sorghum (cwt)	15.00
Wheat (bu)	3.00
Barley (bu)	2.25
Oats (bu)	1.70
Alfalfa (cwt)	50.00
Red clover (cwt)	42.00
Lespedeza (cwt)	12.50
Sudan grass (cwt)	15.00
Ladino clover (cwt)	90.00
Orchard grass (cwt)	30.00
Fescue (cwt)	22.00
Cottonseed meal (cwt)	4.00
<u>Feeder cattle (cwt)</u>	
Choice, 350-400 lb	20.90
Choice, 400-500 lb	20.90
Choice, 600 lb	18.80
Medium, 700 lb	15.80
Choice, 800 lb	19.20
Feeder pigs, 50 lb (cwt)	25.60

TABLE 2. - ASSUMED PRICES RECEIVED FOR MAJOR PRODUCTS SOLD

Item and Unit	Price Per Unit (dollars)
Milk (cwt)	4.00
Grade A	3.00
Grade C	20.00
Lambs (cwt)	0.63
Wool (lb)	21.84
Feeder calves, choice, 500 lb (cwt)	20.00
Feeder steers, choice, 850 lb (cwt)	21.40
Fed steers, choice, 1,000 lb (cwt)	21.20
Fed steers, choice, 950 lb (cwt)	21.20
Fed steers, standard to good, 1,000 lb (cwt)	16.00
Fat hogs, 220 lb (cwt)	25.60
Feeder pigs, 40 lb (cwt)	13.40
Cull cows (cwt)	60.00
Tobacco (cwt)	

## FARM A - A LARGE FARM WITH GOOD LAND

Resources

The first farm, which will be designated Farm A, is relatively large and will be considered as being located in Warren county. Its 450 acres make it about four times as large as the average Kentucky farm. The amount and kind of this land will support a large volume of business. The land, which varies from relatively level to heavy rolling, has none of the karst topography found in some parts of Warren county. For the purposes of this study, the farm was divided into three land-use classes.

The first land class includes the best land - about 100 acres which may be used continuously in row crops with only moderate erosion. With appropriate fertilization and management and average weather conditions this 100 acres can be expected to produce corn yields of 100 bushels per acre.

The second class of land consisting of 220 acres is more rolling and thus poses more serious erosion-control problems. To avoid large losses of topsoil by erosion, this acreage should be in hay or pasture crops at least half of the years of the rotation. However, with a high level of management and proper fertilization, it can be expected to produce crop yields as high as those from the best land.

The third class of land is also very good in its fertility and soil structure; however, the 130 acres is heavily rolling and must be restricted entirely to the hay and pasture crops to control erosion.

While the third class of land can be used only for hay and pasture production, the better grades of land were not restricted (in this study) to the more intensive row crop uses. Thus, if it appeared more profitable to produce some hay and pasture on

the best land or to devote the 220 acres of second-grade land entirely to hay and pasture crops, this was done. Thus, the most profitable use, as contrasted to the most intensive, could be determined for each kind of land, due allowance being made for the necessity of preserving the productive capacity of the land for future generations. On the one extreme, then, all 450 acres could be in hay and pasture crops, if this would provide more profit than any other use. On the other hand, a maximum of 210 acres (47 percent of the total) could be in row crops in any one year. Associated with this farm was a 6-acre burley tobacco allotment and a 45-acre wheat allotment.

Two sets of maximum income plans were prepared. One assumed that the permanent labor supply consisted of two men and that no additional labor could be hired. The other was based on the assumption that the permanent labor supply consisted of the operator alone and that any additional labor required could be hired at a wage rate of \$1 per hour. In both cases, labor was subdivided by quarters of the year and labor in each quarter treated as a separate resource.

### Enterprises

A large number of enterprises was considered for this 450-acre farm. The crop enterprises included all of the crops commonly found in Kentucky with the exception of the horticultural crops, which are better suited to other conditions with regard to both resources and markets. Grain could be produced from corn, grain sorghum, and the small grains. Sudan grass was considered a summer supplement to regular pastures and could be raised continuously or in rotation. Tobacco production on both of the two better classes of land was considered. The data for the crop enterprises are presented in Table 3.

The livestock enterprises considered included those commonly found in Kentucky. Several production methods for each of these were also considered and are described below. Data for the livestock enterprises are presented in Table 4. Included in the cost of operating each enterprise is a 5 percent interest charge on the capital which it required.

### Description of Livestock Enterprises Considered For Inclusion in Maximum Income Plans

#### Dairy

Grade A - Cows are housed and handled to meet Grade A requirements for the production of fluid milk for bottling. Average production per cow is assumed to be 10,000 pounds.

Grade C - Milk is sold for processing purposes to Grade C outlets. Average production per cow is 6,000 pounds.

#### Sheep

Spring lambs and wool are produced. Production per ewe is assumed to be 100 pounds of lamb and 8 pounds of wool.

TABLE 3. - CROP YIELDS AND COSTS PER ACRE, LARGE FARM WITH GOOD LAND

	Burley Tobacco	Corn	Grain Sorghum	Wheat	Barley	Oats	Alfalfa	Red Clover	Lespedeza	Sudan Grass	Pasture
Yield (unit) <sup>a</sup>	1,800	100	100	32	50	60	3.5	2.0	1.25	1.5	0.5
<u>Costs</u>											
Seed and plants (dollars)	3.55	2.00	1.00	4.25	4.25	4.25	7.58	3.50	4.38	4.50	2.15
Fertilizer and lime (dollars)	37.75	17.45	15.05	13.55	13.55	13.55	13.40	11.75	0	14.40	8.00
Machinery (dollars)	109.30	17.15	14.66	13.43	13.43	13.43	22.62	18.55	13.87	13.87	4.00
Miscellaneous (dollars)	62.75	0	0	0	0	0	0	0	0	0	0
Total Costs (dollars)	213.35	36.60	30.71	31.23	31.23	31.23	43.60	32.80	18.25	32.77	14.15
Labor required (hours)	336.0	9.4	8.0	7.1	7.1	7.1	10.0	6.0	6.0	4.5	2.4

<sup>a</sup> Tobacco yields are in pounds per acre, grain yields in bushels per acre, hay yields in tons per acre, and pasture and Sudan grass yields in animal units carried per acre.

TABLE 4. - COSTS AND RESOURCE REQUIREMENTS FOR LIVESTOCK ENTERPRISES

	Dairy Cows		Beef Cows				Sows (2 litters/year)		
	Grade A	Grade C	Produce 500 Pound Calves		Produce 850 Pound Feeders		Produce 1,000 Pound Steer		
			Sheep Spring Lambs	Drylot	Grain on Grass	Produce Feeder Pigs	Produce Market Hogs		
Costs (dollars)	145.00	89.00	10.10	41.95	55.00	72.94	62.48	95.80	180.65
<u>Feed required</u>									
Corn equivalent (bushels)	53.00	30.00	1.50	4.50	0	44.70	47.00	67.00	215.00
Hay (tons)	2.00	1.50	0.33	1.70	1.50	3.00	3.70	0	0
Silage (tons)	3.00	2.00	0	0	3.00	0	0	0	0
Pasture (acres)	2.00	2.00	0.40	2.00	2.50	2.00	2.50	0.50	0.50
Labor required (hours)	92.00	122.00	6.00	20.00	21.50	25.00	25.00	24.00	60.00
Capital required (dollars)	775.00	490.00	43.00	280.00	330.00	330.00	330.00	195.00	355.00

TABLE 4. - (Continued) COSTS AND RESOURCE REQUIREMENTS FOR LIVESTOCK ENTERPRISES

	Feed Pur- chased Pig	Purchased Cattle									
		1 2a	2 3a	3 4a	4 5a	5 7a	6 9a	7 10a			
Costs (dollars)	21.65	138.30	161.77	158.73	133.86	186.76	116.25	144.89			
<u>Feed required</u>											
Corn equivalent (bushels)	11.00	0	38.00	26.00	20.00	21.00	26.00	12.00			
Hay (tons)	0	1.10	0.40	1.30	1.40	0.40	1.00	0.25			
Silage (tons)	0	0	0	0	0	0	0	2.00			
Pasture (acres)	0	1.40	0	0.50	0.50	0	1.00	0.25			
Labor required (hours)	2.00	7.00	10.00	10.50	7.30	7.00	9.30	7.00			
Capital required (dollars)	27.00	164.05	182.80	182.80	161.00	223.60	148.38	180.60			



Beef Cows

- No. 1 - Calves are dropped in January and sold as choice feeders about October 1 weighing about 500 pounds.
- No. 2 - Calves are dropped in April, pastured, roughed through winter, pastured and sold as 850-pound choice feeders around October 1.
- No. 3 - Calves are dropped in January, pastured, put in drylot November 1 and sold weighing about 1,000 pounds in April, grading choice.
- No. 4 - Calves are dropped in January, pastured, roughed through winter, pastured with grain, and sold as 1,000-pound fed steers in September, grading choice.

Purchased cattle

- No. 1 - Choice calves, weighing 400-500 pounds, are bought around October. They are wintered, pastured, and sold around October 1 of the following year, weighing 850 pounds and grading choice.
- No. 2 - Choice 600-pound calves are bought around October 1. They are put in drylot and sold as 1,000-pound fed steers in April, grading choice.
- No. 3 - Choice calves, weighing about 600 pounds, are bought around October 1. They are wintered, fed grain or grass, and sold in September, grading choice and weighing about 1,000 pounds.
- No. 4 - Choice calves, weighing 500 pounds, are bought around October 1. They are wintered, pastured and put in drylot August 1 for not more than 60 days and sold when about 950 pounds.
- No. 5 - Choice 800-pound feeder steers are bought September 1. They are put on full feed immediately and sold as 1,000 pound choice steers in December.
- No. 6 - Choice calves weighing 350-400 pounds are bought in September. They are wintered, pastured with no grain through June, fed full grain on pasture July to November, and sold grading choice when about 950 pounds.
- No. 7 - Medium steers weighing around 700 pounds are bought about October, pastured for 45 days, put on heavy silage feeding, and sold by April 1 weighing 1,000 pounds and grading standard to good.

### Hogs

Brood sows with pigs fed to 220 pounds - The sows are divided into three groups, each group farrowing twice yearly with farrowing dates arranged as far as possible so as not to coincide with peak labor requirements and yet to take advantage of seasonal price peaks. An average of seven pigs per litter is raised.

Brood sows with pigs sold as feeders - the sows farrow in January and July. An average of seven pigs is sold from each litter at about 40 pounds.

Feeding purchased pigs - Feeder pigs are bought in March and October weighing 40-60 pounds. They are fed and sold in July and February when about 220 pounds.

### MAXIMUM PROFIT SYSTEMS OF FARMING FOR DIFFERENT AMOUNTS OF CAPITAL - A TWO-MAN FARM

The procedure used in working out the relationship between the amount of available capital and the maximum profit combination of enterprises was to start from an extremely low level of capital and increase capital by \$10,000 increments until the point was reached when the farm could use no more capital profitably. None of the other resources was changed as the capital was increased. A combination of enterprises yielding maximum profit was determined for each level of capital along with the amount of income which the capital and other resources could be expected to earn. Since only capital was varied, the extra income could be credited to the extra capital. This provides estimates of the profitability of using different amounts of capital.

The beginning level of assumed capital was \$20,000 and the maximum amount which the farm with a two-man labor force could use profitably was approximately \$75,000. The maximum profit enterprise combinations and the resulting incomes are summarized in tables 5 and 6.

When a relatively small amount of capital is available, the capital resource limits the size of business more than any of the other resources. The maximum profit program is one which allows the scarce capital to be used very intensively; thus, it produces a relatively high income per dollar of capital used.

The farming systems for the two lowest capital levels were very strongly influenced by the need to stretch the capital supply as far as possible. The main crops were grain sorghum and tobacco. The land resource was not fully used; and, consequently, it was not very productive. The small amount of pasture produced was used in the hog enterprise, which is the only livestock enterprise. Tobacco, an especially intensive user of capital, was produced to the full extent of the 6-acre allotment. The grain sorghum was also used in the hog enterprise.

When the capital supply was increased from \$20,000 to \$30,000, the limited capital still influenced the best choice of enterprises, but the scarcity of labor also had some effect. The two-man permanent labor force was almost fully used. The acreage in grain

TABLE 5. - MAXIMUM INCOME PROGRAMS FOR DIFFERENT AMOUNTS OF CAPITAL, 450-ACRE FARM WITH GOOD LAND, TWO-MAN LABOR FORCE

Enterprises	Amount of Capital Available (\$1,000)						
	20	30	40	50	60	70	80
<u>Crops (acres)</u>							
Grain sorghum	62	95	96	96	70	42	74
Tobacco	6	5.3	3.7	3.6	2.2	0.7	1.3
Permanent pasture	13	6	4	82	116	146	130
Grain sorghum-barley and pasture <sup>a</sup>		26	68				
Silage corn and pasture <sup>a</sup>			37	110	157	203	220
<u>Corn</u>					28	58	24
<u>Livestock</u>							
Sows with pigs fed out	26	43	46	29	22	17	14
Beef cows producing heavy feeder calves with no grain			10	21	24	26	24
Beef steers wintered and fed on pasture to 950 pounds			24	102	164	225	220
Medium steers wintered on full feed of silage and sold							36

<sup>a</sup> Three years of pasture

TABLE 6. - RELATION OF AVAILABLE CAPITAL TO INCOME, CAPITAL PRODUCTIVITY, CONCENTRATE-ROUGHAGE BALANCE AND LIVESTOCK PROGRAM ON A LARGE FARM WITH GOOD LAND AND A TWO-MAN LABOR FORCE

Capital Available (dollars)	Income <sup>a</sup> (dollars)	Capital Productivity <sup>b</sup> (percent)	Acres in Roughage Crops and Pasture as Percent of Land in all Crops (percent)	Number of Sows	Number of Beef Cattle
20,000	11,666	40.80	17.3	26	0
30,000	15,169	15.42	16.7	43	0
40,000	16,563	12.03	37.2	46	34
50,000	17,776	12.03	66.6	29	122
60,000	18,715	9.28	73.6	22	188
70,000	19,643	9.28	77.9	17	251
75,000	19,810	0.00	78.0	14	280

<sup>a</sup>Return to land, labor and management

<sup>b</sup>Percent return on an additional \$100 capital

sorghum was expanded sharply, and a 4-year rotation of grain sorghum, barley, and pasture was introduced into the cropping system. The only other significant change in crop acreages was the reduction in tobacco acreage to 5.3 acres, from the original 6.0-acre allotment. The hog enterprise was expanded in order to make use of the increased feed supply.

When capital was increased by another \$10,000, a total of \$40,000, the additional money allowed some expansion, but also made profitable some changes in the relative importance of the various enterprises. The two-man farm labor force was fully employed with \$30,000 of capital; thus, if the additional money was to be used profitably, the combination of enterprises had to be one which required more capital, but the same labor. This was accomplished by reducing the tobacco area to 3.7 acres, which was 2.3 acres less than the allotment. This reduction made considerable labor available for use on other enterprises and resulted in a sharp expansion in the total acres cropped. The acreage in the grain-sorghum-barley-pasture rotation was more than doubled and silage appeared in the program for the first time. Pasture was still relatively unimportant since the two pasture-using livestock enterprises were on a small scale. Hogs were still the major livestock enterprise. The increase in income resulting from the new capital was relatively small because it was necessary to reduce the acreage of tobacco in order to use the capital.

When the supply of capital was again increased, this time to \$50,000, no new enterprises were added to the program, but large changes were made in the relative importance of those already in use. Pasture and pasture-consuming livestock became much more important and grain production was reduced sharply by the elimination of the grain-sorghum-barley-pasture rotation. The pasture lost from this rotation was more than replaced by increasing the silage corn-pasture rotation from 37 to 110 acres, and by increasing the small amount of permanent pasture to 82 acres. The tobacco acreage remained about the same.

The outstanding change in the livestock program was a shift from hogs to beef. The hog enterprise was reduced about one third and both beef enterprises were increased substantially.

As further increases in available capital were made, to a maximum of about \$75,000, the same enterprises remained in the program except that a third beef enterprise was added at the maximum capital level. The tendency over the entire \$40,000 to \$75,000 range was to increase production of pasture and silage and the animals which used them, and to reduce gradually the tobacco and hog enterprises. Grain production remained roughly the same, especially after the capital available exceeded \$50,000. Income increased to a maximum of \$19,810 at the maximum capital level.

Grain crops ordinarily produce more feed per dollar of capital than do roughage crops. For this reason, maximum profit programs for small amounts of capital usually emphasize grain production relative to that of roughage crops, including pasture. In addition, because the hog enterprise uses relatively little capital per dollar of income produced, it is often profitable to produce as much grain as the land resource will allow and either sell the grain for cash or feed it to hogs when capital is scarce. As more capital becomes available, it is probably profitable to use it to expand roughage and pasture production while decreasing

grain production or, if the land resource permits, holding grain at about the same levels. The reason for this probably is that roughage-consuming livestock use relatively large amounts of capital per dollar of income produced and so cannot be used to best advantage until capital reaches relatively high levels. There is little reason to produce roughage feeds until livestock is available to consume them, since most of these feeds do not have a good cash market. Table 6 shows that the programs previously discussed for different amounts of capital reflected this tendency.

At the low capital levels, grain crops were much more important than roughage crops and pasture, and much of the land remained idle or unproductive. At the lowest capital level considered, about 83 percent of the land in crops was devoted to grain production. Acreage in grain crops increased rapidly up to the \$40,000 capital level reaching a maximum of 123 acres at that point. However, acreage in roughages and pasture increased even more rapidly so that only 63 percent of crop acres were in grain at the \$40,000 level. When capital was increased above \$40,000, acres in grain dropped back to about 100, but acreage of roughages and pasture continued to increase. At the maximum capital level all the land was in use, and 78 percent of the land in crops was in roughages and pasture. In this particular case, most of the land was in pasture; silage was the only stored roughage produced. Over the entire range of capital, hogs, which consume very little roughage and pasture, were largely replaced by beef cattle, which consume large amounts of these feeds.

#### Resource Productivity

When the capital was held to low levels, the other resources were not fully employed and so were not productive. Capital was very productive since additional amounts of it allowed the other resources to be used more fully (Table 6). When the available capital reached the \$30,000 level, however, the farm labor was fully employed and the best land was all in use. The productivity of additional amounts of capital decreased rapidly up to this level, but dropped very slowly above that level.

The tobacco allotment was very important to the farm at the lowest capital level considered, since it is one of the few enterprises requiring much labor and little capital. However, as capital was increased, it became necessary to use the labor force more intensively and tobacco could not be produced economically to the full extent of the acreage allotment. For this reason additional acreage allotment would be worth nothing to the farm at the higher levels of capital.

#### MAXIMUM PROFIT SYSTEMS OF FARMING FOR DIFFERENT AMOUNTS OF CAPITAL - ONE OPERATOR WITH HIRED LABOR

Considerable flexibility in adapting the farming system to the capital supply was obtained by reducing the permanent labor supply to one man and allowing any other labor needed to be hired. When the permanent labor supply was large, its productivity was relatively low when small amounts of capital were used. Unless the supply was quite large, labor could become a limiting factor as capital is increased, so that it limited

expansion in the size of business unless extra labor could be hired. The use of hired labor with all its problems has the advantage that the amount of labor can be varied to make best use of the other resources. If labor is cheap, relatively large amounts of it will be used in maximum profit programs; less of it will be used if it is expensive. The wage rate of \$1 per hour used here represented a situation in which labor was quite expensive. It was assumed that labor could be hired in any quarter of the year without the necessity of hiring on a year-round basis.

The maximum profit-enterprise combinations and the resulting incomes are summarized in tables 7 and 8. These may be compared with the programs for the same amounts of capital on the two-man farm to see the effect of the change in the labor situation.

At the two lowest levels of capital, the maximum profit program again consisted of the enterprises which yielded the highest return per dollar of capital used. Again, the main crops were grain sorghum and tobacco. Grain sorghum is about equal to corn in the amount of feed produced per dollar of capital used. Corn could be substituted in this program for the sorghum with only slightly more capital required. Sorghum is widely believed to withstand drought better than corn; at the same time, however, it is more difficult to store than corn. Tobacco is a very economical user of capital, since it is a high user of labor instead.

The livestock program consisted entirely of hogs, which probably require less capital per dollar of income than any of the other common livestock enterprises.

As the capital supply was increased, emphasis in the enterprise combination shifted from these low-capital users to enterprises which were more profitable in this situation but used more capital per dollar of output. A beef enterprise, which requires more pasture than do hogs and also some silage, was introduced into the program. This resulted in the introduction of a rotation into the cropping system which included some silage corn.

As the capital supply was increased from \$40,000-\$80,000, in \$10,000 increments, the most significant change was the expansion in size of business. The enterprises involved remained much the same except that the beef enterprise was greatly enlarged, partly at the expense of the hog enterprise. When \$80,000 of the capital was available, Grade A dairying was introduced into the program at very low levels. As beef cattle was substituted for hogs, dairying was substituted for beef cattle until, at the maximum capital level, the farm had no beef cattle but instead, had quite a large dairy herd. The hog enterprise remained much the same, while dairying was substituted for beef production.

Tobacco was profitable enough to remain in the program at the maximum level allowed by the allotment throughout the entire range of capital levels.

As available capital increased throughout the entire range, the amount of labor hired increased from less than a one-man equivalent to about a five-man equivalents.

Table 8 shows that the relative emphasis on roughage and concentrate feed crops again underwent a drastic shift as the amount of capital is increased. At the \$20,000 capital level only 17.7 percent of the land in crops was in pasture or roughage production. This was the small acreage of pasture needed for the sows which were the only livestock. As capital became relatively more available, however, the percentage of all crop acreage

TABLE 7. - MAXIMUM INCOME PROGRAMS FOR DIFFERENT AMOUNTS OF CAPITAL 450-A CRE FARM WITH GOOD LAND, OPERATOR WITH HIRED LABOR

Crops (acres)	Amount of Capital Available (\$1, 000)											
	20	30	40	50	60	70	80	90	100	120	140	160
Grain sorghum	60	93	94	94	94	94	6	6	6	6	6	6
Tobacco	6	6	6	6	6	47	130	130	114	51	130	130
Permanent pasture	12	19										
Grain sorghum, barley and pasture <sup>a</sup>			59	95	131	100						
Silage corn and pasture <sup>a</sup>			18	48	77	120	190	210	220	219	167	220
Corn						94	94	94	94	94	92	47
Corn-barley and pasture <sup>a</sup>							30	10				
Silage corn, wheat and red clover											53	
Corn, barley, and silage corn <sup>b</sup>												47
Livestock												
Sows with pigs fed out	24	39	43	42	42	34	13	10	10	18	13	11
Beef steers wintered and fed on pasture to 950 pounds			28	72	116	180	281	244	179			
Dairy cows (Grade A)							12	22	47	103	124	147

<sup>a</sup>Three years of pasture

<sup>b</sup>Silage and barley double cropped

TABLE 8. - RELATION OF AVAILABLE CAPITAL TO INCOME, CAPITAL PRODUCTIVITY, CONCENTRATE-ROUGHAGE BALANCE, AND LIVESTOCK PROGRAM ON A LARGE FARM WITH GOOD LAND, OPERATOR AND HIRED LABOR

Capital Available (dollars)	Income <sup>a</sup> (dollars)	Capital Productivity <sup>b</sup> (percent)	Acres in Roughage Crops and Pasture as Percent of Land in all Crops (percent)	Number of Sows	Number of Beef Cattle	Number of Dairy Cows
20,000	10,146	27.43	17.1	24	0	0
30,000	12,700	24.40	17.7	39	0	0
40,000	14,374	15.70	31.4	43	28	0
50,000	15,944	15.70	44.3	43	72	0
60,000	17,513	15.70	51.7	42	116	0
70,000	18,866	12.24	62.9	34	180	0
80,000	20,078	10.65	76.4	13	281	12
90,000	21,143	10.65	78.0	10	244	22
100,000	22,180	10.09	78.0	10	179	47
120,000	24,198	10.00	74.2	18	0	103
140,000	26,194	9.43	75.3	13	0	124
155,000	27,465	0.00	81.9	11	0	147

<sup>a</sup>Return to land and operator's labor and management

<sup>b</sup>Percent return on an additional \$100.00 capital



consisting of hay, pasture, and silage crops increased steadily, reaching a maximum of 81.9 percent at the maximum capital level.

Allowing labor to be hired seems to have made little difference in the relation of capital available to the best combination of roughage and concentrate feeds in the cropping system. The percentage of the land resource devoted to each of these at both the minimum and maximum capital levels was almost the same for both labor situations.

#### Resource Productivity

The small amount of land in crops indicates that the lowest levels of capital are still inadequate for a farm the size of this one, even with the increased flexibility in the labor supply. Unless more capital could be acquired and used, it would be better to sell some of the land and operate a smaller farm so that the investment in land and fences could be used more intensively. At the first two capital levels some of the land of all three classes was used. The \$40,000 level allowed the entire 100 acres of the best land to be used. Some of the second-grade land remained unused until \$70,000 of capital was available; when \$80,000 is available, all the land on the farm could be used.

The tobacco allotment appeared to be a very valuable resource on this farm when labor could be hired at \$1 per hour. At the lowest level of capital, an additional acre of allotment would have added \$290 to the income resulting from the best program. In addition, the allotment became still more valuable as the amount of capital was increased, reaching a maximum at the maximum capital level where an additional acre of allotment would have added about \$465 to income. Though the value of tobacco production per man hour was lower than for some other enterprises, it still was high enough to enable labor to be hired at \$1 per hour for tobacco production. Thus, as capital became more plentiful, relative to other resources, and land became relatively scarce, tobacco became more profitable, relative to the enterprises requiring more land per unit of output.

Even the low-capital levels were sufficient to use fully the farm's one-man permanent labor force. At the lowest level of capital, a small amount of labor was left unused in the first quarter of the year; however, it was fully used in the other three quarters and substantial amounts were hired. Since additional labor could be hired freely at the \$1 wage rate, the value of an additional hour of labor was always the same as the wage rate. If the value had been more than the wage rate, then more labor would have been hired; if, however, it had been less than the wage rate, it would not have paid to hire the last amounts that were used in the maximum profit program.

The capital supply itself was something of a bottleneck to production when it was held at the low levels. As a result of this, it was very productive at the low levels and became less productive as its amount was increased until finally, at about \$153,500, additional amounts would have added nothing to income, but would have been invested off the farm where they would earn some return (Table 8). When capital was held at the \$20,000 level, each additional dollar which could be acquired and invested in the business would have added about 27 cents to income. At this rate of return, the use of additional capital would be very profitable.

## FARM B - A LARGE FARM WITH ROLLING LAND

### Resources

Farm B will be considered as being located in Harrison county, in the inner Bluegrass region of Kentucky. It is slightly smaller than farm A; however, the nature of the 395 acres of crop and pasture land places more severe limitations on the uses which can be made of it. None of the land is suitable for use in continuous row crops, but none of it is restricted to use in permanent pasture alone.

The 395 acres fall into three use classes. The best land consists of 38 acres, about 10 percent of the total, which can be used for row crops as often as every third year. About half of the rest of the land can be in row crops in no more than one-fourth of the years. The remaining 153 acres can be in row crops in no more than one-fifth of the years. Thus, in any year slightly less than one-fourth of the entire land resource can be used for corn or other row crops.

Most of the land tests medium to high in phosphate and potash and has a pH value of about 6.0. Corn yields of 70-80 bushels per acre, corn silage yields of 12-14 tons per acre, and alfalfa yields of about 4.0 tons per acre can be expected from such land with proper fertilization and good management.

As in the case of farm A, the best land may be used in the same way as the poorer grades. The entire farm could be in permanent pasture should this be most profitable; however, none of it was restricted to this use alone.

This farm has a relatively large burley tobacco allotment of 12.9 acres and a wheat allotment of 15 acres.

### Enterprises

The enterprises considered for this farm were about the same as for farm A, although the costs and returns for the crop enterprises were somewhat different because of the variation in the land resource. The various crops combined into a number of rotations, and the cropping alternatives considered were rotations rather than individual crops. It was assumed that corn could be bought at \$1.30 per bushel and hay at \$30 per ton. The direct sale of feed crops for cash was not considered a possibility. The data for the livestock enterprises were the same as for farm A and are shown in Table 4. The data for the crop enterprises are shown in Table 9.

### MAXIMUM PROFIT SYSTEMS OF FARMING FOR DIFFERENT AMOUNTS OF CAPITAL - A THREE-MAN FARM

Maximum profit plans were also determined for farm B for two different labor supply situations. The first of these consisted of a three-man permanent labor force with no hired labor. The permanent labor was set at three men since 12.9 acres of tobacco would require more than 4,000 hours of labor, or the equivalent of 1.6 men. At some seasons of the year the farm would probably require the full time of all three men. The lowest level of capital considered was \$20,000 and the capital supply was increased by \$10,000 increments. The maximum income programs for this farm with a three-man labor force are summarized in tables 10 and 11.

TABLE 9. - CROP YIELDS AND COSTS PER ACRE, LARGE FARM WITH ROLLING LAND

	Burley Tobacco	Corn	Crain Sorghum	Wheat	Barley	Oats	Alfalfa	Red Clover	Lespedeza	Sudan Grass	Pasture
Yield (unit) <sup>a</sup>	1,800	80	70	35	50	60	4.0	2.5	1.5	1.5	0.5
<u>Costs</u>											
Seeds and plants (dollars)	30.55	2.00	1.00	4.00	4.00	4.00	7.50	2.60	2.40	4.50	0.90
Fertilizer and lime (dollars)	42.75	17.10	17.10	4.80	4.80	4.80	11.60	8.60	3.90	14.40	7.10
Machinery (dollars)	119.20	17.15	14.60	13.40	13.40	13.40	22.60	18.55	13.50	13.87	4.00
Miscellaneous (dollars)	62.75	4.50	4.20	1.50	3.00	3.60	0	0	0	0	0
Total costs (dollars)	228.25	40.75	36.90	23.70	25.20	25.80	40.60	29.75	19.90	32.77	12.00
Labor requirement (hours)	318	9.4	8.0	7.1	7.1	7.1	10.0	6.0	6.0	4.5	2.4
Investment required (dollars)	464	53.33	46.67	46.67	46.67	46.67	60.33	46.67	46.67	47.47	13.33

<sup>a</sup>Tobacco yields are in pounds per acre, grain yields in bushels per acre, hay yields in tons per acre, and pasture and Sudan grass yields in animal units carried per acre.

TABLE 10. - MAXIMUM INCOME PROGRAMS FOR DIFFERENT AMOUNTS OF CAPITAL, 395-ACRE FARM WITH ROLLING LAND, THREE-MAN LABOR FORCE

Enterprise	Amount of Capital Available (\$1,000)					
	20	30	40	50	60	62
<u>Crops (acres)</u>						
Barley and lespedeza <sup>a</sup>	14	30				
Silage corn and pasture <sup>b</sup>	10	22	14		69	90
Orchard grass seed and pasture	20	50				
Tobacco		12.9	12.9	12.9	12.9	12.9
Corn, wheat and red clover <sup>c</sup>			25			25
Corn, barley and pasture <sup>d</sup>			114	152	37	25
Red clover for seed			30			
Corn, wheat and red clover <sup>e</sup>				92	102	
Permanent pasture				40	174	191
Corn and alfalfa <sup>f</sup>						50
<u>Livestock</u>						
Dairy cows (Grade A)	10	22	13			
Beef steers wintered and fed on pasture to 950 pounds			70	145	82	55
Beef cows producing heavy feeder calves with no grain					69	90

<sup>a</sup>Double cropped

<sup>b</sup>Three years of pasture

<sup>c</sup>Two years of red clover

<sup>d</sup>Five years of pasture

<sup>e</sup>Three years of red clover

<sup>f</sup>Five years of alfalfa

TABLE 11. - RELATION OF AVAILABLE CAPITAL TO INCOME, CAPITAL PRODUCTIVITY, CONCENTRATE-ROUGHAGE BALANCE, AND LIVESTOCK PROGRAM ON A LARGE FARM WITH ROLLING LAND AND A THREE-MAN LABOR FORCE

Capital Available (dollars)	Income <sup>a</sup> (dollars)	Capital Productivity <sup>b</sup> (percent)	Acres in Roughage Crops and Pasture as Percent of Land in all Crops (percent)	Number of Beef Cattle	Number of Dairy Cows
20,000	13,650	26.29	71.2	0	10
30,000	16,283	26.29	72.0	0	22
40,000	18,017	12.66	73.5	69	13
50,000	19,132	7.85	73.1	147	0
60,000	19,917	7.85	88.0	152	0
62,500	20,032	0	92.7	144	0

<sup>a</sup>Return to land, labor and management

<sup>b</sup>Percent return on an additional \$100 capital

Again the program for the lowest level of capital is important mainly as a point from which to work toward more realistic levels. At this level, the main enterprise is tobacco since it makes heavy use of labor which, along with land, was in surplus supply on this form. Tobacco was produced to the extent of the 12.9 acre allotment. More could be produced profitably if the allotment were larger, but it would be necessary to reduce the levels of the other enterprises in order to free the capital necessary to produce more tobacco. Dairying was the only livestock enterprise; orchardgrass seed was produced as a cash crop.

As the capital was increased to \$30,000 the only change in the program was expansion of all the enterprises except tobacco which was limited by the allotment. The dairy herd reached a level of 22 cows, which was a larger number than many small dairies have, but far below the number necessary to utilize the 395 acres of land in farm B.

At levels of capital just above \$30,000 the labor supply became fully utilized, especially at some times of the year. In order to use additional amounts of capital profitably, it was necessary to adopt enterprises which produced more income per hour of labor. Since capital was becoming relatively more abundant, the new enterprises may be ones which would produce less income per dollar of capital.

These factors tended to favor the beef enterprise relative to dairying, so the beef enterprise began to enter the maximum profit program in small numbers. The systems of beef production which fitted this situation best were the same ones as used on farm A. The steers were bought in the fall at about 450 pounds, wintered, fed on pasture to about 950 pounds, and sold about one year after purchase.

The beef system was substituted for dairying in the maximum profit program until, at \$40,000 capital, the dairy herd was reduced to 13 cows and the program included 70 beef steers. At \$50,000 available capital, dairying disappeared from the program and the beef steers had been increased to 145.

At this point, capital was relatively abundant. The need was not to economize on capital, but to find profitable ways to use it. The lower grades of land were still not used intensively, but labor was in very short supply, especially late in the year. Thus, in order to expand the business so that it would use more capital profitably and produce more income, enterprises had to be found which would increase the income per hour of labor. These might yield a lower income per dollar of capital and per acre of land. As a result, when capital was further increased to \$60,000 the beef steer enterprise was reduced from 145 to 82 head, and a herd of beef cows was added to the program. The particular cow-calf system coming into the program was the production of 850-pound feeder steers at about 1.5 years of age on roughage alone. The program for \$60,000 included 69 beef cows on this system, as well as 82 head of purchased light feeders for wintering and feeding grain on pasture.

As long as the labor supply was fixed at three men, farm B could profitably use only \$62,500 of capital. Beyond this amount, additional capital would add nothing to income and would have no effect on the maximum profit program. At the maximum capital level, the program included 90 beef cows and 55 purchased feeder steers. The return to labor, management, and land reached a maximum of \$20,032 compared with \$11,644 at the \$20,000 level of capital (Table 11). The difference of \$8,388 represented a return of almost 20 percent on the additional \$42,500 of capital.

Table 11 also shows that pasture and harvested roughage crops increased in importance relative to grain crops as more capital became available. However, the rate of increase in the importance of these crops was considerably higher on farm A. On this farm, the importance of these crops increased by 1.1 percent for each \$1,000 of additional capital. The rate of increase on farm B was only 0.51 percent for each \$1,000 of additional capital. However, farm B had a substantially higher percentage of its crop acres in these crops at all levels of capital than did farm A. This is probably because of the difference in the kind of land available on the two farms.

#### Resource Productivity

As in the case of farm A, the additions to capital on farm B permitted the land and labor resources to be more fully employed and, thus, made them more productive. On farm B, capital remained the primary factor limiting expansion until about \$50,000 became available. With less than this amount, it paid well to add more capital, but did not pay to add more labor or land. When more capital was available, labor and land became the primary limitations. Thus, increases in capital became less profitable, and additions to labor and land became more profitable. This is especially true of labor in the last half of the year. Additional labor at this time would have returned about \$3.50 per hour to the business. Additional amounts of land would have returned about \$10 per acre. The value of additional feed was kept low because either labor or capital was in extremely short supply at all capital levels and this limited the opportunities for using additional feed.

#### MAXIMUM PROFIT SYSTEMS OF FARMING FOR DIFFERENT LEVELS OF CAPITAL - ONE OPERATOR WITH HIRED LABOR

When the labor supply for farm B was assumed to be fixed at three men, it was seriously under-utilized at the low-capital levels. The labor supply became fully used; however, when about \$62,500 capital was employed, and further expansion of the program for farm B was stopped, with the land being used at less than maximum intensity. Introducing labor hiring in each quarter of the year as a possible use of capital would allow the land resource to be used more intensively if it were profitable enough to justify hiring labor at the assumed wage rate of \$1 per hour. As capital continued to be added, under these assumptions, a point would eventually be reached at which the land was used at maximum intensity and so the additional capital would not earn enough to justify hiring labor for use with it. In either case, this would set the limit on the maximum amount of capital which could be used profitably on the farm. None of the other conditions was changed.

Because of the smaller supply of resident labor, the relatively large tobacco allotment, and the profitability of tobacco, considerable amounts of labor were hired on farm B, even at the lowest capital level of \$20,000. Production of 12.9 acres of tobacco required more than 4,000 hours of labor, or the equivalent of 1.6 men on the average. However, owing to the seasonal nature of the requirements, most of this labor was required in the last half of the year for harvesting and stripping.

The remainder of the program for the \$20,000 capital level was of little significance except that it set the pattern followed by the programs for higher levels of capital. The only livestock enterprise consisted of 24 beef steers which were handled in the same way as when the labor supply was fixed at three men. Most of the land was unused and would be better sold if only this amount of capital were available. The cropping program, aside from tobacco, consisted of the three rotations listed in Table 12 for the \$20,000 capital level.

As capital was increased from the minimum level of \$20,000 to \$70,000, the only change in this program was expansion. For each \$10,000 of additional capital, 40 steers were added, 67 acres of additional land was brought into production, and each of the three rotations was increased by the same percentage.

At levels of capital just above \$70,000, all of the land was in production; thus, if more capital were to be used profitably, ways must be found to increase the income per acre of land. This could be done by reducing the size of the beef enterprise and introducing dairying into the program. Between the \$70,000 and the \$130,000 level of capital, farm B was converted from a beef farm into a dairy farm. Within this range, for each additional \$10,000 of capital, the beef enterprise was reduced by 43 steers, and 20 dairy cows were added. In the cropping program, silage received increased emphasis due to the need to increase the feed production per acre of land. Acreage in the barley and lespedeza rotation was increased slightly. To obtain more silage, the rotation of silage corn and three years of pasture was increased at the expense of the rotation of corn and barley followed by five years of pasture. When \$130,000 in capital was available, the dairy herd had reached a level of 112 cows.

At this point, the feed-producing capacity of the land was being utilized to the fullest possible extent. If further expansion in the livestock program was to take place, feed would have to be purchased. The result was that the rotation of corn and barley followed by five years of pasture dropped out of the cropping system, the silage corn and pasture rotation was increased from 195-229 acres, 73 acres was placed in permanent pasture, and 3,150 bushels of corn was purchased. These changes made expansion of the dairy herd to 124 cows profitable, with a capital supply of \$150,000. Beyond this level additional capital could not be used profitably.

When the flexibility of hired labor was introduced into the situation, the relative importance of pasture and harvested roughage in the cropping system again increased slowly, as more capital was added to other resources. The only significant changes, other than expansion, occurred at the \$130,000 capital level and the maximum level of \$150,000 when the rotation of corn, barley, and pasture was dropped and permanent pasture was added to the program.

#### Resource Productivity

As in the case of farm A, the flexible labor force permitted more intensive use of the land resource. At the higher levels of capital, land was the primary factor limiting the size of the business. Consequently, land and land products became very valuable at these capital levels. When \$130,000 of capital was available, corn became valuable

TABLE 12. - MAXIMUM INCOME PROGRAMS FOR DIFFERENT AMOUNTS OF CAPITAL, 395-ACRE FARM WITH ROLLING LAND, OPERATOR WITH HIRED LABOR

	Amount of Capital Available (\$1,000)												
	20	30	40	50	60	70	80	90	100	110	120	130	150
<u>Crops (acres)</u>													
Barley and lespedeza <sup>a</sup>	8	19	30	41	52	63	69	74	79	83	88	82	80
Corn and barley <sup>b</sup>	18	54	90	126	162	198	192	176	159	143	127	105	
Silage corn <sup>c</sup>	10	30	49	69	88	108	121	133	144	156	167	195	229
Tobacco	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
Permanent pasture													73
<u>Livestock</u>													
Beef steers wintered and fed on pasture to 950 pounds	24	64	104	144	185	225	198	155	112	69	27		
Dairy cows (GradeA)							16	36	56	76	96	112	124
Corn purchased (bushels)												770	3,150

<sup>a</sup>Double cropped

<sup>b</sup>Followed by five years of pasture

<sup>c</sup>Followed by three years of pasture



TABLE 13. - RELATION OF AVAILABLE CAPITAL TO INCOME, CAPITAL PRODUCTIVITY, CONCENTRATE-ROUGHAGE BALANCE, AND LIVESTOCK PROGRAM ON A LARGE FARM WITH ROLLING LAND, OPERATOR AND HIRED LABOR

Capital Available (dollars)	Income <sup>a</sup> (dollars)	Capital Productivity <sup>b</sup> (percent)	Acres in Roughage Crops and Pasture as Percent of Land in all Crops (percent)	Number of Beef Cattle	Number of Dairy Cows
20,000	7,703	13.10	70.2	24	0
30,000	9,013	13.10	71.9	64	0
40,000	10,323	13.10	71.9	104	0
50,000	11,633	13.10	72.1	144	0
60,000	12,943	13.10	72.0	185	0
70,000	14,253	13.10	72.2	225	0
80,000	15,358	10.57	72.3	198	16
90,000	16,415	10.57	72.6	155	36
100,000	17,472	10.57	72.9	112	56
110,000	18,529	10.57	73.2	69	76
120,000	19,586	10.57	73.3	27	96
130,000	20,312	1.77	75.9	0	112
150,000	20,474	0.00	82.7	0	124

<sup>a</sup>Return to land, labor, and management

<sup>b</sup>Percent return on an additional \$100 capital

enough so the relatively high price of \$1.30 per bushel could be paid profitably for more than 3,000 bushels of it. The purchase price of \$30 per ton for hay was also relatively high, since even at the high capital levels, \$20 per ton was the maximum price which could be paid profitably for hay. Consequently, no hay was bought. Hay would have been sold in the maximum profit program, if the possibility of selling hay at \$20 per ton or more had been considered.

The value of additional tobacco acreage allotment also increased along with the increase in available capital. At the maximum capital level, an additional acre of tobacco allotment would have added about \$500 to the return to operator labor, management, and land. Small amounts of additional land would have added about \$30 per acre to this income.

### FARM C - A SMALL FARM WITH POOR LAND

#### Resources

Farm C, considered as being located in Edmonson county, is quite small compared with farms A and B. The land on this farm is also of poorer quality than that of the other two farms. The land resource consists of 163 acres divided into four land-use classes. None of this land is suitable for continuous row cropping.

The best land on the farm makes up about three-fourths of the total land. It is suitable for use in row crops in only one-third of the years and must be in close growing crops in the remaining years. Sixty-five acres, or about half, of this best land is still more restricted, for it is not suitable for the production of alfalfa. The remaining 61 acres of the best land will produce alfalfa yields of about three tons per acre with proper fertilization and good management. The entire 126 acres will produce corn yields of about 75 bushels per acre if fertilized properly and managed well.

Another 22 acres of land is more rolling and must be used for close-growing crops in at least three-fourths of the years, leaving only one year in four for row crops. This land can also be used for alfalfa production and yields of three tons of alfalfa hay per acre can be expected if proper fertilization is applied and good management practiced. The remaining 15 acres of open land is even more rolling and is suited for permanent pasture only. The other 25 acres of land are in woodland and are not suited for more intensive use. The maximum possible acreage of row crops in any year is 47.5 acres, or about 30 percent of the total crop and pasture land.

This farm has a 0.6-acre burley tobacco allotment and a 15-acre wheat allotment.

#### Enterprises

As in the case of farms A and B, the enterprises considered for farm C included all those which were known to be suited for use in the area. The crop enterprises were combined in a number of different rotations. A number of different systems of production for each livestock enterprise was also considered. The data for the livestock enterprises are the same as those used for farms A and B and are shown in Table 4. The data for the crop enterprises are shown in Table 14.

TABLE 14. - CROP YIELDS AND COSTS PER ACRE, SMALL FARM WITH POOR LAND

	Burley Tobacco	Corn	Grain Sorghum	Wheat	Barley	Oats	Alfalfa	Red Clover	Lespedeza	Sudan Grass	Pasture
Yield (unit) <sup>a</sup>	1,800	75	70	25	50	60	3.0	2.0	1.0	1.5	0.5
<u>Costs</u>											
Seed and plants (dollars)	3.55	2.00	1.00	4.00	4.00	4.00	7.50	2.60	2.40	4.50	1.00
Fertilizer and lime (dollars)	42.75	14.40	14.40	13.55	13.55	13.55	16.90	9.05	0.75	14.40	11.60
Machinery (dollars)	119.20	17.15	14.60	13.40	13.40	13.40	22.60	18.55	13.50	13.87	4.00
Miscellaneous (dollars)	62.75	4.50	4.20	1.50	3.00	3.60	0	0	0	0	0
Total costs (dollars)	228.25	38.05	34.20	32.45	33.95	34.55	47.00	30.20	16.65	32.77	16.60
Labor requirement (hours)	445.0	9.4	8.0	7.1	7.1	7.1	10.0	6.0	6.0	4.5	2.4
Investment required (dollars)	464.00	53.33	46.67	46.67	46.67	46.67	60.33	46.67	46.67	47.47	13.33

<sup>a</sup>Tobacco yields are in pounds per acre, grain yields in bushels per acre, hay yields in tons per acre, and pasture and Sudan grass yields in animal units carried per acre.

MAXIMUM PROFIT SYSTEMS OF FARMING FOR DIFFERENT  
AMOUNTS OF CAPITAL - A TWO-MAN FARM

The same procedure was followed with farm C as with farms A and B. The beginning level of capital considered was \$10,000, since this farm was considerably smaller than the other two. The capital available could be used for operating expenses and investments in livestock, equipment, and buildings. Costs for the enterprises included a five percent charge for the use of the necessary capital. The income from each program would be the return to the resident labor force and to the land. The maximum profit programs and the resulting incomes are summarized in Table 15 and 16.

As with farms A and B, the labor and land resources were seriously under-utilized at the lowest levels of available capital. In fact, the lowest level of capital, \$10,000, permitted economical use of only about three fourths of the labor and about one-fourth of the land, indicating that if no more capital could be obtained, it would be profitable to sell the unused land and find off-farm employment, if available, for most of the labor or to dispose of the farm entirely and find other employment for the two-man labor force. However, the enterprises in the program for \$10,000 capital remained in the program through several higher levels of capital. Through the \$30,000 level, the only change which occurred was expansion of the same program. Through this range, each additional \$10,000 of capital allowed an additional 48 acres of cropland to be brought into use and an additional 1,160 hours of labor to be utilized, as well as the addition of eight dairy cows and two sows.

When the capital level reached about \$33,000, all the land could be profitably used except the 15 acres suited only for pasture. At this point the dairy herd was increased to 30 cows and the hog enterprise, which had been as large as six sows, disappeared from the maximum profit program. About 100 tons of corn silage was produced in this program as well as 56 tons of clover-grass hay. About 60 acres of land would be in rotation pasture and 48 acres in grain crops. When only \$10,000 capital was available, 57 percent of the land in use was used in production of pasture and harvested roughage. When \$33,000 was available, 67 percent of the land in crops was in these uses.

The \$40,000 capital level was the lowest one which permitted all of the crop and pasture land to be used. At this point, the dairy herd had grown to 40 cows and was the only livestock enterprise in the program. Land became a limiting factor, as indicated by the purchase of a small amount of corn. Roughage production was increased by substituting a rotation of silage corn and three years of pasture for the rotation of corn, wheat and two years of red clover. Pasture and harvested roughage increased relative to grain to 75 percent of all crop acres. Labor was still in surplus supply.

Should the available capital have been increased further, from \$40,000 to \$50,000, the dairy herd would have been increased to 49 cows, 1,260 bushels of corn would be purchased, and the cropping system would have been changed to allow still more pasture and harvested roughage to be produced. In this program about 85 percent of the crop and pasture land would have been devoted to production of pasture and harvested roughage as compared with 57 percent when only \$10,000 capital was available.

The 0.6-acre burley allotment would be fully used at all capital levels.

TABLE 15. - MAXIMUM INCOME PROGRAMS FOR DIFFERENT AMOUNTS OF CAPITAL, 163-ACRE FARM WITH POOR LAND, TWO-MAN LABOR FORCE

Enterprise	Amount of Capital Available (\$1,000)				
	10	20	30	40	50
<u>Crops (acres)</u>					
Corn, wheat and red clover <sup>a</sup>	11	23	34		
Silage corn, barley and red clover <sup>b</sup>	7	15	22	47	
Grain sorghum, barley and pasture <sup>c</sup>	26	54	82	65	
Tobacco	0.6	0.6	0.6	0.6	0.6
Silage corn and pasture <sup>c</sup>				36	104
Permanent pasture				15	15
Barley and lespedeza (d. c.)					17
Corn, barley and alfalfa <sup>d</sup>					26
<u>Livestock</u>					
Dairy cows (Grade A)	8	16	25	40	49
Sows with pigs fed out	2	4	6		
Corn purchased (bushels)				85	1,260

<sup>a</sup>Two years of red clover  
<sup>b</sup>One year of red clover  
<sup>c</sup>Three years of pasture  
<sup>d</sup>Three years of alfalfa

TABLE 16. - RELATION OF AVAILABLE CAPITAL TO INCOME, CAPITAL PRODUCTIVITY, CONCENTRATE-ROUGHAGE BALANCE, AND LIVESTOCK PROGRAM ON A SMALL FARM WITH POOR LAND AND A TWO-MAN LABOR FORCE

Capital Available (dollars)	Income <sup>a</sup> (dollars)	Capital Productivity <sup>b</sup> (percent)	Acres in Roughage Crops and Pasture as Percent of Land in all Crops (percent)	Number of Sows	Number of Dairy Cows
10,000	2,638	22.19	56.6	2	8
20,000	4,858	22.19	58.2	4	16
30,000	7,077	22.19	53.7	6	25
40,000	9,140	13.52	74.7	0	40
50,000	10,224	00.00	84.4	0	49

<sup>a</sup>Return to land, labor, and management  
<sup>b</sup>Percent return on an additional \$100 capital

### Resource Productivity

At the lower levels of capital, land and labor were in surplus supply, so additional amounts of these resources without additional capital would have been worth nothing to the farm business. Additional capital and additional feed, however, would have been very productive. For capital levels below \$37,500, each additional dollar of capital would have added about 22 cents to the return to labor, management, and land. At this point, the productivity of additional capital dropped to 13.5 percent. At \$40,000, the farm business was saturated with capital, and the addition of more of it would not increase the returns to labor, management, and land.

The profitability of additional amounts of feed increased with increasing capital until the maximum level of \$50,000. At this point, the labor supply was fully employed. Additional feed would then have been less productive than when labor was available to use with it.

The same was true of the tobacco allotment. As long as labor was in surplus, additional tobacco allotment would have been very productive, since each additional acre would have increased the return to labor, management, and land by about \$700. When labor became scarce, the productivity of an additional acre of burley allotment dropped to about \$100.

#### MAXIMUM PROFIT SYSTEMS OF FARMING FOR DIFFERENT AMOUNTS OF CAPITAL - ONE OPERATOR WITH HIRED LABOR

When \$20,000 of capital was available for use on farm C, less than one-man equivalent of labor could be used profitably. Because of this, changing the labor supply to one full-time operator with hired labor had no effect on the best program until more than \$20,000 in capital was made available.

The equivalent of two full-time men is a rather large labor force for a farm with 163 acres of cropland, especially when the land resource limits the size of the livestock enterprises which the farm will support, as is the case with farm C. When the permanent labor force is assumed to be two men, the labor resource halts expansion of the program at a level of capital not far below that at which it would have been limited by the land resource. Consequently, the addition of a labor-hiring alternative would have made little difference in the kind and size of program which would maximize income. When the permanent labor force is reduced to one man, however, the possibility of hiring labor in each quarter of the year makes considerable difference. The maximum profit programs and resulting incomes for this situation are summarized in Tables 17 and 18.

Again, the maximum income program for the lowest level of capital is important mainly in that it sets the pattern which is followed by the programs for higher and more realistic levels of capital. Actually, if only this much capital were available, a more profitable alternative would be to sell the farm and devote the labor resource to other employment. In this program most of the land is idle and the livestock enterprises are so small that they would incur relatively high fixed costs per unit of output.

TABLE 17. - MAXIMUM INCOME PROGRAMS FOR DIFFERENT AMOUNTS OF CAPITAL, 163-ACRE FARM WITH POOR LAND, OPERATOR WITH HIRED LABOR

Enterprise	Amount of Capital Available (\$1,000)				
	10	20	30	40	50
<u>Crops (acres)</u>					
Corn-wheat and red clover <sup>a</sup>	11	23	38	29	
Silage corn-barley and red clover <sup>b</sup>	7	15	22		11
Grain sorghum-barley and pasture <sup>b</sup>	26	54	85	26	
Tobacco	0.6	0.6	0.6	0.6	0.6
Corn-barley and red clover <sup>a</sup>				31	
Silage corn and pasture <sup>b</sup>				61	137
Permanent pasture				15	15
<u>Livestock</u>					
Sows with pigs fed out	2	4			
Dairy cows (Grade A)	8	16	26	38	59
Corn sold (bushels)			1,186		
Corn purchased (bushels)					3,000
Hay purchased (tons)					30

<sup>a</sup>Two years of red clover

<sup>b</sup>Three years of pasture

TABLE 18. - RELATION OF AVAILABLE CAPITAL TO INCOME, CAPITAL PRODUCTIVITY, CONCENTRATE-ROUGHAGE BALANCE, AND LIVESTOCK PROGRAM ON A SMALL FARM WITH POOR LAND, ONE OPERATOR WITH HIRED LABOR

Capital Available (dollars)	Income <sup>a</sup> (dollars)	Capital Productivity <sup>b</sup> (percent)	Acres in Roughage Crops and Pasture as Percent of Land in all Crops (percent)	Number of Sows	Number of Dairy Cows
10,000	2,638	22.19	56.6	2	8
20,000	4,858	22.19	58.6	4	15
30,000	6,356	8.69	59.1	0	26
40,000	7,146	6.54	74.9	0	38
50,000	7,714	0.00	97.8	0	59

<sup>a</sup>Return to land, labor and management

<sup>b</sup>Percent return on an additional \$100 capital

With the exception of the hog enterprise, the combination of enterprises on Farm C remained much the same as capital was increased to about \$41,000. The hog enterprise remained in the program until available capital reached a level of about \$25,000, although it was never an important part of the farm program.

Dairying was the main livestock enterprise at all levels of capital, and the cropping programs were designed mainly to produce feed for the dairy cows and replacement stock, except for the tobacco enterprise which remained in the maximum income program at all levels of capital. Thus, the main effect of adding capital to the farm business was to allow expansion and more intensive use of the land and permanent labor resources.

When \$30,000 of capital was available, hogs were no longer a part of the program, but the dairy enterprise had not expanded rapidly enough to use all of the grain which was released by the hog enterprise. About 1,200 bushels of corn was sold for cash in the program for this level of capital. Between the \$30,000 and \$40,000 capital levels, dairying increased more rapidly than did feed production, and no feed was sold when \$40,000 was available.

The proportion of grain and forage crops in the cropping system remained about the same until about \$35,000 capital was available. At this point the land was fully used, and additional amounts of pasture and harvested roughage could be obtained only by decreasing grain production. Consequently, grain acreage was down by about one-third at the \$40,000 level, while acreage in pasture and harvested roughage was up about one-half compared with that at the \$30,000 level. The percentage of total crop acres devoted to pasture and harvested roughage increased from 59 percent to 75 percent. Additional corn was purchased until, at the \$50,000 capital level, 1,260 bushels of corn was purchased. At about this level, the productivity of additional capital fell to zero, and expansion of the program was stopped. The maximum level of the dairy herd was about 50 cows.

#### Resource Productivity

As in all the farm programs previously discussed, additional capital allowed the land resource of farm C to be used more intensively, and the productivity of additional amounts of land increased as the level of capital increased. In this case, additional land added very little to income until the supply of capital reached about \$40,000. At this point, the land was fully utilized and additional feed was needed to expand the livestock enterprises. Thus, the productivity of additional land rose rapidly until the \$50,000 capital level when the program reached its maximum size.

When \$10,000 capital was available and both labor and land were under-utilized, the additional tobacco allotment was worth about \$700 per acre. As the capital was increased, the value of additional allotment fell until, at the maximum capital level when both labor and land were used intensively, the additional allotment was worth only \$372 per acre.

The value of additional grain, hay, and pasture to the farm business rose as capital became more abundant, due to the added pressure of feed needs on the land and labor resources. At the maximum level of capital, the additional pasture was worth about \$37 per acre or about twice its value at the minimum capital level. Over the same range of



capital, corn increased in value from \$1.12 per bushel to \$1.25 per bushel, while red clover hay increased in value from \$18 per ton to \$25 per ton. It was assumed that corn could be purchased and delivered to the farm for \$1.25 per bushel; thus, no corn was purchased until its value to the business reached this level.

#### SUMMARY AND CONCLUSION

Maximum income farm plans were derived for three farms, designated "A", "B", and "C", which were believed to be fairly representative of a large number of other farms. This process was repeated for two labor situations and for a number of capital situations ranging from very small amounts to the maximum amount the farms could use profitably. Particular attention was paid to the effect of both labor and capital on the most profitable enterprise combination, and especially to the emphasis on production of grain relative to that of pasture and harvested roughage.

The three farms were (A) a 450-acre farm, a large part of which is suited for use in continuous row crops; (B) a 395-acre farm, with heavily rolling but generally fertile land; and (C) a 163-acre farm, with low fertility, which responded well to treatment. Part of the smallest farm is restricted in use to permanent pasture owing to erosion hazards.

In all three cases, a flexible labor supply allowed the farms to make profitable use of much larger amounts of capital than was the case when labor was fixed at a predetermined level. It also allowed them to make much more intensive use of the land resource.

In all cases increased capital resulted in increases in the relative importance of pasture and harvested roughage in the cropping system and accompanying increases in the importance of animals which consumed these feeds. This was probably because harvested roughage and, to a lesser extent, pasture require relatively large amounts of capital per unit of output as do the animals necessary to consume them.

The burley tobacco allotments probably were also factors affecting the best grain-roughage balance. Tobacco is a relatively economical user of capital. This, along with its profitability, makes it an especially desirable enterprise when capital is scarce relative to labor. Thus, it tends to crowd out the roughage-producing-and-consuming enterprises which use capital less economically.