An Analysis of the Effect of Selected Economic Variables on the Optimum Location of Burley Tobacco Production Within the Burley Belt

Verner N. Grise, James F. Thompson, and Fred E. Justus, Jr.

•

TABLE OF CONTENTS

LIST OF TABLES

iv

LIST OF ILLUSTRATIONS

AN ANALYSIS OF THE EFFECT OF SELECTED ECONOMIC VARIABLES ON THE OPTIMUM LOCATION OF BURLEY TOBACCO PRODUCTION WITHIN THE BURLEY BELT

By

Verner N. Grise, James F. Thompson and Fred E. Justus, Jr.*

INTRODUCTION

Burley tobacco provides a major source of income to many farmers in Kentucky, middle and eastern Tennessee, and southwestern Virginia. In some counties, up to 60 percent of the gross farm income is derived from burley tobacco. For such an important commodity, changes in demand or production have important consequences.

The demand for burley tobacco has increased almost constantly in the past four decades. But, the future demand is uncertain. The Surgeon General's report of 1964, indicating a relationship between smoking and diseases, is already affecting the demand for burley tobacco. If additional evidence is generated, this may have an even greater effect in the future. However, even if the demand for burley tobacco is not affected, future price support and acreage allotment legislation may not be as favorable as in the past. Moreover, if price remains high, synthetic products may be substituted for tobacco. Some substitution is already taking place in that tobacco stems formerly used as by-products are now being used in cigarettes. In addition, there has been a trend toward filter tip cigarettes and these, except for the 100 millimeter brands, contain a smaller tobacco column.

Since 1933, burley tobacco production has been controlled by Federal regulations administered by the U. S. Department of Agriculture. These regulations have restricted acreage; while, at the same time, they have guaranteed prices considerably higher than a free market would establish. The effect has been to raise the value productivity of resources used in burley production relative to the use of the same resources in other production activities.

The limited acreage and the price incentive created by Federal regulations have resulted in increasing burley tobacco yields, via such things as improved varieties of tobacco, increased fertilization, and closer spacing of tobacco plants. The continuing increase in yields, which has been of a greater magnitude than the increase in demand, has made it necessary to reduce burley acreages several times.

Burley tobacco allotments on individual farms are based largely on historical acreages of burley grown. However, such devices as minimum allotment sizes, new allotments, and acreages made available for the correction of inequities—not necessarily economic in nature—have allowed some changes in the regional distribution of burley acreage. The federally established distribution of acreages

*Agricultural Economist, Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture formerly stationed at the University of Kentucky; former associate professor of Agricultural Economics, University of Kentucky, now Professor of Economics, Murray State University, Murray, Kentucky and Professor of Agricultural Economics, University of Kentucky, Lexington, Kentucky.

is probably not the most efficient from the standpoint of resource use in the burley belt. The probable non-optimal distribution of tobacco acreages, the possibility of changes in the demand for burley tobacco, and the continuing changes that characterize agriculture create the need for research that has as its main objective the evaluation of optimum resource use patterns (maximum regional income).

Purpose and Objectives

The overall purpose of this publication is to provide economic information about enterprise competitiveness in the burley belt of Kentucky, Tennessee, and Virginia. The focus is on the optimum location of burley tobacco production under various burley tobacco prices and allotments, and with varying assumptions about other pertinent variables. The results are particularly relevant for use in evaluations of tobacco programs that allow the sale, lease and/or transfer of allotments.

The specific objectives of this study are:

a. To determine the optimum locational pattern of burley tobacco within the burley belt under alternative tobacco price-allotment combinations.

b. To determine the effects of varying assumptions regarding prices of products, levels of different enterprises, and amounts of labor and land on the distribution of tobacco acreage.

c. To determine changes that would occur in the optimum farm organization within various regions under different burley tobacco price and allotment schemes.

d. To determine the changes in net farm income in various regions that would result from alternative price and allotment combinations.

Methods and Procedures

The Study Area

Nine regions were delineated for study purposes (Figure 1). The nine regions, composed of 174 counties in three states, are modifications of Agricultural Census subregions. These regions include 88.7 percent of the total United States burley tobacco acreage. These regions are identified and described in the following paragraphs.

Region 1 (census subregion 44, Tennessee)

This region consists of what is generally termed the Central Basin of Tennessee. The landscape of the Inner Basin is undulating to gently rolling with large portions occupied by stony land. Many of the soils are shallow to bedrock, but on the better soils productivity is generally high.

The Outer Basin is characterized by a more hilly outer fringe and a less hilly inner fringe. The topography of the Outer Basin is undulating to rolling. Most soils are formed from phosphatic rocks and productivity is moderate.

Region 2 (twelve subregion 43 counties in Kentucky and Tennessee, and 4 Ohio Valley Counties of Kentucky)

Most of this region is gently sloping Karst country with soils derived from limestone rocks of varying degrees of purity. Most of the soils are physically well suited to farming. Hagerstown, Decatur, Baxter, and Dickson silt loams are the important soil types. The lower Ohio Valley counties contain considerable Memphis and other well-drained soils derived from loess. The soils of this region are not acid and are well supplied with phosphate.

FIGURE 1, THE AREA OF STUDY, NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA
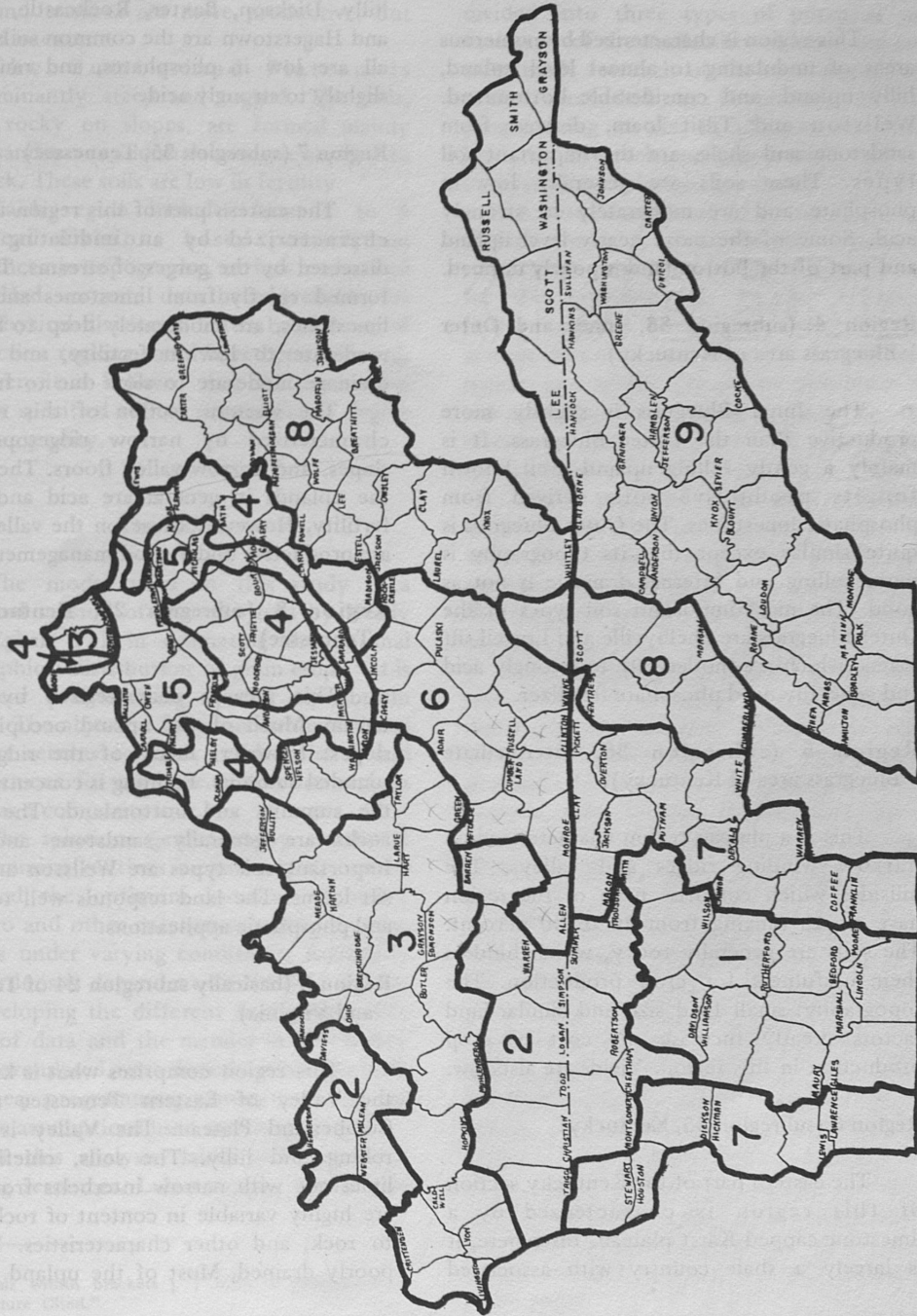
Region 3 (subregion 37, Kentucky)

This region is characterized by numerous areas of undulating to almost level upland, hilly upland, and considerable bottomland. Wellston and Tilsit loam, derived from sandstone and shale, are the important soil types. These soils are generally low in phosphate and are moderately to strongly acid. Some of the more nearly level upland and part of the bottomland is poorly drained.

Region 4 (subregion 36, Inner and Outer Bluegrass area of Kentucky)

The Inner Bluegrass is slightly more productive than the Outer Bluegrass. It is mainly a gently rolling upland, well known for its productive soils derived from phosphatic limestones. The Outer Bluegrass is quite similar except that its topography is more rolling and internal drainage is not as good. The most important soil types of the Outer Bluegrass are Shelbyville and Lowell silt loams, which are moderately to strongly acid and generally need phosphate fertilizer.

Region 5 (subregion 36, Intermediate Bluegrass area of Kentucky)

This is a plateau region characterized by narrow winding ridges and valleys. The hillsides which comprise most of the region have slopes ranging from 20 to 30 percent. The soils are generally rocky, which hinders their usefulness for crop production. The topography, small field size and similar land factors greatly increase the cost of crop production in this region. Yields are also low.

Region 6 (subregion 35, Kentucky)

The eastern part of the Kentucky section of this region is characterized by a limestone-capped Karst plateau. Elsewhere, it is largely a shale country with associated limestone. The topography is undulating to hilly. Dickson, Baxter, Rockcastle, Decatur, and Hagerstown are the common soils. Nearly all are low in phosphates, and range from slightly to strongly acid.

Region 7 (subregion 35, Tennessee)

The eastern part of this region is largely characterized by an undulating plateau dissected by the gorges of streams. The soils, formed chiefly from limestones and cherty limestones, are moderately deep to bedrock, moderate to low in fertility, and internal drainage moderate to slow due to fragipans.

The western section of this region is characterized by narrow ridgetops, steep slopes, and narrow valley floors. The soils of the uplands in general are acid and low in fertility. However, those on the valley floors are productive under good management.

Region 8 (subregion 23, Kentucky and Tennessee)

This area is characterized by rugged terrain. Much of the upland occupies steep slopes; however, many of the ridges have rounded summits. Farming is concentrated on the summits and bottomland. The surface rocks are generally sandstone and shale. Important soil types are Wellston and Tilsit silt loams. The land responds well to liming and phosphatic applications.

Region 9 (basically subregion 24 of Tennessee and Virginia)

This region comprises what is known as the Valley of Eastern Tennessee and the Cumberland Plateau. The Valley is mainly rolling and hilly. The soils, chiefly from limestone with narrow interbelts from shale, are highly variable in content of rock, depth to rock, and other characteristics. Few are poorly drained. Most of the upland soils are

moderate to low in productivity. Bottom land soils and terraces are more productive, but limited in extent.

The Cumberland Plateau is predominantly steep and rugged. The soils, often rocky on slopes, are formed mainly from sandstones and shales and are shallow to bedrock. These soils are low in fertility.

Each region includes from 1 to 4 physical divisions based primarily on differences in topography, surface rocks, and soils. Had accurate data been available for each physical division, a better breakdown of production regions could have been achieved. However, it is believed that the production regions specified reflect an acceptable degree of homogeneity.

The Model

The model used in this study is a modified version of the one used by Heady and Egbert [1] in estimating the optimal geographical distribution of grain crops.[1] It is a linear programming spatial equilibrium model. The objective function maximized was the net returns to land, resident labor and management for the nine production regions taken as a composite unit.

The solutions generated by the linear programming routines included in the model specified the optimum location of burley tobacco and other enterprises among the nine regions under varying conditions. Reliability of solutions is dependent on the data utilized in developing the different coefficients. The types of data and the manner in which they were formulated were directly related to both the linear programming assumptions and the specific assumptions used in this study [2].

In this analysis, labor and land were limiting resources. Labor supply was divided

into six periods of availability and land was divided into three types of potential use. Estimates of the availability of labor and land were made for each of the nine regions and were included as restraints in the programming matrix. In addition, maximum levels on livestock enterprises were included in most of the solutions generated.

A basic assumption of the model is that all farm resources within the nine regions are completely immobile among regions except for the hypothetically mobile "resource" burley tobacco acreage allotment. A total acreage allotment was specified for the nine regions as a whole. The model distributes the acreage allotment among regions so that returns to the resources of the nine regions taken as a whole are maximized.

It is assumed that the technology employed on all farms within a region is the same. Each region was treated as if it were one farm. The model, thus, produces directly the aggregate activity levels for each of the regions.

The programming matrix consisted of nine submatrices; one for each production region. Up to ten crop activities and eight livestock activities were included as production alternatives for each of the nine regions. The overall matrix consisted of approximately 200 rows, 300 columns, and 2,200 elements for most of the solutions generated.

The major variables examined, as indicated before, were burley tobacco prices and allotment levels. The effects of different prices and allotment levels on: (1) the distribution of burley tobacco production among regions, (2) enterprise mix, (3) the resources used, and (4) the returns to resident labor and management, and land were analyzed. The effects of these changes were also later estimated with different assumptions about hog prices, beef prices, labor and land availability, and variations in other resource restrictions and enterprise alternatives.

---

[1]Numerals within brackets [ ] refer to publications in "Literature Cited."

Components of the Model

The time context of this analysis is the intermediate length of run. An approximate target date, 1972, was selected in order to be more consistent in quantifying the variables. Prices and input-output coefficients are based on 1972 projections, whereas land and labor availability estimates are based on 1964 data except for two solutions presented in the latter part of the analyses.

Primary Variables Analyzed

Initially, solutions are generated for seven burley tobacco price and allotment combinations. The base price was assumed to be 74 cents per pound (approximately the average 1968 burley price) and the base allotment level is essentially the 1968 level. Consequently, the base price-allotment level is essentially an equilibrium of burley tobacco supply and demand under present conditions. Results obtained with this price-allotment combination are identified as solution 1 results. In addition, five other burley tobacco price-allotment levels were considered and one price level was considered without allotments (Table 1). As there is a lack of information about the demand for burley tobacco, the assumed price and allotment levels are largely judgments about the demand and supply for burley tobacco.

Other Variables Analyzed

Changes from those initially derived were made in some of the variables and are included as variations of solutions 1 and 2. Solution identifications are thus 1A, 1B, etc., and 2A, 2B, etc. These changes are grouped into the following three categories: (1) price changes, (2) resource availability and cost changes, and (3) enterprise alternative changes. Specific changes are discussed, along with their effects on the results, later.

Management and Technology

An improved level of technology and a relatively high level of managerial ability were assumed for this study. Only tested production practices were considered, and the more progressive farmers in each of the production regions have already used the production methods and attained the assumed crop yields, feed conversion ratios, and input-output ratios.[2]

Enterprises Considered

Each region was considered to have a maximum of 18 production alternatives. Crop alternatives were burley tobacco, corn, wheat, barley, alfalfa hay, red clover hay, lespedeza hay, improved permanent pasture, unimproved permanent pasture, and sudan grass. In regions 2 and 3 soybeans were also an alternative. Wheat, soybeans, and tobacco were considered cash crops; the other crops could be used only for livestock feed. Livestock enterprises included were: Grade A dairying, two beef cow-calf enterprises, two beef-feeder enterprises, market hogs from purchased or home-grown pigs, and feeder-pig production.

Pasture, hay, and grain needed for livestock, except for corn, had to be obtained from the region in which the livestock were produced. For the major part of the analysis it was assumed that corn could be imported from outside the study area at $1.40 per bushel.

_____

[2]See Appendix C for the annual crop production costs associated with the production methods assumed in each of the nine regions.

TABLE 1

PRICE AND ALLOTMENT COMBINATIONS

Solution Identification	Price	Allotment
	cents per pound	acres
Solution 1[a]	.74	187,876 (1966 base)[b]
Solution 2[a]	.82	150,301 (80 percent of base)
Solution 3	.90	112,726 (60 percent of base)
Solution 4	.98	75,150 (40 percent of base)
Solution 5	.66	225,451 (120 percent of base)
Solution 6	.58	263,026 (140 percent of base)
Solution 7	.42	No allotment restriction

[a]In addition, several changes are made in other variables and the results evaluated at these two tobacco price allotment combinations. See page 12 for a description of solution 1 and page 14 for a description of solution 2.

[b]The burley tobacco acreage allotment in the nine regions included in this study was 221,777 acres in 1966. However, 33,901 acres were located on farms with 0-9 acres or 1,000 acres or more of land and this acreage was excluded from the analysis.

Coefficient Assumptions and Derivations

Crop Assumptions

Crop yields were determined by both historical and projective methods. Average crop yields were determined for each production region for the period 1961-65, revised upward to reflect yields the better-than-average farmers of these areas are presently attaining, and then estimates made of what can be achieved in the intermediate length future (1972).

Fertilizer requirements, reflecting major soil types and the projected crop yields, were based primarily on recommendations of agronomists. Use of spray materials, inoculants, and other enterprise inputs were based on research reports and recommendations of production specialists.

Machinery Cost and Capital Estimates

Machinery cost and capital requirements were estimated for each crop enterprise.

These estimates reflect the relevant crop mechanization conditions in each region. Two row machinery complexes were assumed for all regions except region 2. Four row equipment was assumed for this region because of the more level topography and larger field sizes.

Soil Conservation Service data were used in estimating machinery requirements. For nine counties believed to be representative of the nine regions studied, information on frequency distributions relative to the types of crops, sizes of fields, and the number of fields was compiled. Using these data and data on the capabilities of different machines, obtained from the Tennessee Agricultural Experiment Station, the average time required per acre for each machine in that county (and thus for the region) was calculated.

New costs, salvage value, life expectancies, fixed ownership costs, and operating costs of machines were estimated on the basis of data obtained from machinery dealers and other sources. Based on an assumed level of use for each machine, the total cost and capital requirements for each

machine were calculated, and these allocated among the enterprises in accordance with unit requirements of enterprises for specific machines.

Livestock Assumptions

Input requirements and feeding efficiency for livestock were based on recommendation of animal scientists and previous research reports. Feed costs were not varied among the production regions.

Grade A Dairy

The dairy enterprise coefficients are based on a production level of 11,000 pounds of 4 percent fat corrected milk per cow. Artificial breeding is assumed, with one yearling heifer and one heifer calf kept as herd replacements for every six cows. Facilities for the herd include a four-stall milking parlor, bulk tank, and a loafing barn.[3]

Production of Market Hogs

The hogs are sold at 220 pounds. Sixteen pigs are raised per sow per year; 15 are sold, and 1 is saved for replacement. Costs are based on a 25-sow herd, multiple farrowing and an eight-stall farrowing quarters.

Buying of Feeder Pigs for Fattening

Pigs are bought at 40 pounds and sold at 220 pounds. They are castrated and vaccinated when purchased.

Beef Cow-Calf Enterprises

Two beef cow-calf enterprises were considered. In the first, cows drop calves in

January, calves are creep fed, and sold at 500 pounds (choice grade) in October. In the second beef cow enterprise the cows crop calves in January, calves are pastured, roughed through the next winter, pastured with grain, and sold at 1,000 pounds in September for slaughter as choice cattle.[4] An 80 percent calf crop was used in both systems.

Beef Feeding Enterprises

Two beef-feeding enterprises were considered. Under the first program choice calves were bought in October at 500 pounds, wintered, pastured, put in dry lot around June 15, and sold at 1,050 pounds as prime slaughter cattle. In the second program, choice calves were bought in October at 500 pounds, wintered, pastured, put in dry lot about August 1 for 60 days of feeding, and sold as 950 pounds choice cattle slaughter.[5]

Prices of Inputs and Outputs for Crops and Livestock

Input and output prices (except for burley tobacco) are based on prices that could reasonably be expected in 1972, the approximate target date of this study. An attempt was made to adjust for seasonal and cyclical price variations (Appendix B, Tables 1 and 2).

Resource and Livestock Production Restraints

Land

The amount of land in farms and average farm sizes for each region was obtained from the 1964 Agricultural Census reports. Farms

---

[3]Grade C dairying was excluded as an alternative, because under the improved technology and relatively high level of management assumed in this study, Grade A dairying is more profitable, except under extremely limited capital conditions. Unlimited capital is assumed in this analysis.

[4]This beef cow-calf enterprise did not enter any of the optimum solutions.

[5]This beef-feeding enterprise did not enter any of the optimum solutions.

containing from 0 to 9 acres and over 1,000 acres were believed to be less responsive to the economic factors analyzed and, for that reason, were not included. Land in farms available for given uses was estimate; for each region on the basis of Soil Conservation Service Conservation Needs Inventory data and combined with 1964 Agricultural Census data to arrive at present land use estimates.[6] Then, the amount of land was projected to 1972. The percentages of cropland, pastureland, and other land included in the 1972 projections were not changed from the 1964 estimates.

It was assumed that burley tobacco, corn, wheat, barley, soybeans, and sudan grass were restricted to land defined as cropland. Cropland consisted of all openland in class I (based on the Soil Conservation Service classification), one-half of the class II openland, and one-third of the class III openland. Alfalfa hay, red clover hay, lespedeza hay, and improved pasture could be grown on what is termed improved pastureland (one-half of class II openland, two-thirds of class III openland, and all of class IV openland). However, these crops could also be grown on cropland if it were profitable to do so. Class VI land could be used only for unimproved pasture.

Total land in farms and the quantity of land available for different uses in each production region are presented in Table 2.

Labor Availability and Use

Due to the lack of data on the quantity of labor available in the study regions, labor estimates were developed from 1964 Census of Agriculture data. The total number of operators residing on farms with from 10 to 999 acres was enumerated for each region. It was assumed that each operator was available for work 2,950 hours per year on some job. Hours these operators worked off the farm, according to Census reports, was subtracted from total hours available for work to obtain the quantity of operators' labor available for farm use in each region. Other family members were assumed to work one hour for every three worked by the operator.[7]

For most of the analysis, hired labor was made available at $1.50 per hour from November 1 to April 30, and at $1.75 per hour from May 1 to October 31. Specified percentages of the labor used in harvesting hay, as well as used for setting, harvesting, and stripping tobacco were hired. Labor could be hired as needed for other crop and livestock enterprises if profitable to do so. Custom operators were available for baling hay and combining grain.

The total resident labor supply was divided into six time periods, based primarily on the seasonality of farm operations. Due to the differences in daylight hours and the activities peculiar to particular times of the year the labor supply was not evenly distributed throughout the year. Based on previous research and judgments concerning seasonal factors it was assumed that each full-time resident man-equivalent (2,950 hours per year) the following seasonal labor distribution prevails:

November-January	675 hours
February-April	700 hours
May-June	525 hours
July	275 hours
August	275 hours
September-October	500 hours

[6]The Conservation Needs Inventory breaks the total land into eight different main categories with from one to three subcategories included in each main category, based on the characteristics of the land which affect its potential agricultural uses. Class I land has few limitations that restrict its use. Class II land has more limitations and requires moderate conservation practices. Class III land is characterized by more severe limitations in use than are Class I and Class II land. Class IV, Class V, and Class VI land have even more severe limitations in use, and Class II and Class III land are usually considered unsuited to any tillage crop.

[7]This estimate was largely based on a study by W. P. Ranney [3]. Due to the heterogeneity of farm families, it is very difficult to realistically estimate the labor contributed by family members without detailed knowledge of each member.

TABLE 2

LAND IN FARMS AND DIFFERENT POTENTIAL USES OF LAND FOR
NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA (1964)[a]

| Region | Total Land Available for | | | Total Land in Farms[d] | Average Farm Size[e] |
	Cropland	Improved Pastureland[b]	Unimproved Pastureland[c]		
	1,000 acres				(acres)
1	620.1	980.1	1,158.4	2,472.9	137.3
2	1,022.8	2,405.8	2,638.0	3,074.4	138.1
3	722.8	2,051.5	2,451.8	3,011.3	133.2
4	655.1	1,685.3	2,331.8	2,835.6	144.3
5	231.7	639.0	707.9	1,579.8	143.6
6	355.3	898.1	1,135.5	1,918.2	107.5
7	505.1	1,265.0	1,412.1	2,242.6	118.0
8	251.3	620.2	790.1	2,356.4	104.7
9	744.3	2,345.0	2,860.5	4.095.6	87.9

[a]Estimated from data in the 1964 Census of Agriculture and unpublished Conservation Needs Inventory Reports.

[b]Includes cropland.

[c]Includes cropland and improved pastureland.

[d]The land included in this category that is not included in cropland, improved pastureland, or unimproved pastureland is in forest or some other use such as roads, drainage ditches, etc.

[e]Farms with 0-9 acres and 1,000 acres and over were excluded from the analysis.

The estimated total hours of operator and family labor for each region is given in Table 3.

Capital

Capital was considered not to be a limited resource in this analysis. Both operating and investment capital, however, are included in the requirements of specific enterprises. Operating capital was charged at an annual rate of six percent for six months (the average production period), while capital for investment purposes was charged at 6 percent for the full year. Operating capital is the total annual operating expenses incurred in the production of all enterprises included in the optimum solution. Investment capital included the average investment in such items as buildings and machinery. As the program determines capital needs, the total capital estimates are the optimum levels of capital use under the conditions of this study.

Livestock Production Restraints

Maximum limits were placed on livestock numbers. The following total nine region (as a composite) restrictions were placed on the enterprise levels: 675,000 dairy cows, 2,000,000 beef cows producing calves, 2,500,000 beef-feeders, 625,000 sows producing market hogs or feeder pigs, and a maximum of purchased 12,500,000 feeder

TABLE 3

ESTIMATED HOURS OF OPERATOR AND FAMILY LABOR AVAILABLE FOR NINE REGIONS—KENTUCKY, TENNESSEE, AND VIRGINIA[a]

	Labor Periods						
Region	November-January	February-April	May-June	July	August	September-October	Total
	1,000 hours						
1	9,673	10,032	7,525	3,940	3,940	7,166	42,276
2	13,658	14,166	10,626	5,564	5,564	10,118	59,696
3	13,130	13,618	10,215	5,349	5,349	9,727	57,388
4	12,493	12,957	9,719	5,089	5,089	9,255	54,602
5	6,948	7,207	5,406	2,830	2,830	5,148	30,369
6	11,966	12,410	9,309	4,874	4,874	8,864	52,297
7	10,858	11,261	8,447	4,423	4,423	8,044	47,456
8	13,074	13,560	10,171	5,326	5,326	9,686	57,143
9	26,695	27,687	20,768	10,874	10,874	22,752	119,650

[a]Estimated from data in the 1964 Census of Agriculture.

pigs. Of this number of feeder pigs, 2,500,000 could be purchased from outside the study area. The maximum overall levels for beef and hogs were 2.0 and 2.5 times, respectively, the total number of these animals on farms in the regions in 1966. In addition, the maximum number of dairy cows permitted in any region was set at 20 percent more than the number of milk cows in that region in 1966 (Table 4).

It is possible to contend that livestock numbers should have been kept at their approximate historical levels, since these levels would indicate an equilibrium of price and quantity. But, in doing this, production adjustments would be highly circumscribed. Although unrealistic to assume that production of a commodity could expand indefinitely in an intermediate length of run, it is conceivable that substantial expansion can occur. It is believed to be realistic to assume that, since the expansion to the upper livestock levels indicated is such a small part

TABLE 4

MAXIMUM NUMBER OF DAIRY COWS ALLOWED FOR EACH OF THE NINE REGIONS—KENTUCKY, TENNESSEE, AND VIRGINIA

Region	Number of Cows
1	81,970
2	109,675
3	180,840
4	92,825
5	38,555
6	182,735
7	109,675
8	158,160
9	155,565

of the total national production, this expansion would have little effect on the price received.

Results—Seven Initial Solutions

The effects of the competition of the nine regions for given tobacco acreage allotments at specified tobacco prices are evaluated in this section. The results reveal the optimum production patterns of burley tobacco and other enterprises and the resource use associated therewith under the assumed conditions of this study, in an intermediate length of run (six years).

Solution 1—Tobacco Allotment 187,876 Acres—Price 74¢

In the optimum geographic distribution of burley tobacco under this assumed price-allotment (the 1966 base acreage) combination, tobacco acreage was located in region 2, (Western Pennyroyal of Kentucky and Tennessee and four lower Ohio Valley counties of Kentucky), region 4 (Inner and Outer Bluegrass of Kentucky) and region 6 (Eastern Pennyroyal of Kentucky). Compared with the 1966 governmentally determined regional acreages, region 6 gained approximately 46,000 acres of tobacco, region 2 gained approximately 39,000 acres of tobacco, and region 4 gained approximately 19,000 acres of tobacco (Table 5). The other six regions lost all their acreage. In reaching the tobacco acreage level attained in regions 2 and 6, the marginal value product of hired labor in the August labor period was equated to the wage rate of $1.75 per hour. The MVP of hired August labor in region 4 was $0.14 greater than the assumed wage rate of $1.75 per hour, but the quantity of resident labor was depleted.[8] It was assumed that each hour of hired labor required 0.075 hours of resident labor for work supervision. Although additional resident labor would have been available for tobacco production in

region 4 if the size of the other enterprises entering the porgram had been reduced, it was not profitable to do this.

Relatively small reductions in the tobacco yield, or an offsetting cost or price disadvantage, if any of the three regions producing tobacco would result in a reduction in tobacco acreage in the region, provided all else remained constant.[9] Tobacco yield decreases of 6, 30, and 20 pounds per acre in regions 2, 4, and 6, respectively, would cause additional corn and livestock to be produced and some tobacco to be shifted to other regions.

The regions that could most favorable compete with the three tobacco producing regions were region 3 (Western Coalfield region of Kentucky), and region 9 (28 eastern Tennessee and 6 southwestern Virginia counties). With yield increases of just under 30 pounds per acre, or an equivalent offsetting production advantage, these regions would produce some tobacco. Region 9 would have a slight advantage over region 3.

As indicated previously, up to 10 income producing activities in addition to burley tobacco and 8 supporting feed activities were included as production alternatives in each production region. The less labor intensive livestock feeding enterprises (feeder pig and feeder calf) were the major enterprises produced in conjunction with burley tobacco in regions 2 and 4 (see Appendix D). However, in the other tobacco producing region, region 6, because of a larger labor supply, market hog production (sow herd), fat steer, and feeder calf production were combined with the tobacco.

In regions 1, 7, 8, and 9 dairy and market hog production predominate in the optimum solutions, with region 9 also containing a large number of beef cows. Region 3 contains a more diversified set of

---

[8]MVP refers to marginal value product. It is defined as the contribution to net returns provided by an additional unit of a given resource, with other factors held constant.

[9]Hereafter, statements concerning yield, price, cost, and other variations and the changes which result from them are in terms of ceteris paribus conditions, i.e., all else constant.

TABLE 5

REGIONAL DISTRIBUTIONS OF BURLEY TOBACCO ACREAGES IN NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA—1966 AND SEVEN ALTERNATE SOLUTIONS

Region	1966 Actual	Solution 1	Solution 2	Solution 3	Solution 4	Solution 5	Solution 6	Solution 7
				Results				
				1,000 acres				
1	8.36	0	0	0	0	0	0	37.91
2	19.80	59.38	51.33	51.62	31.06	67.74	67.74	67.74
3	18.11	0	0	0	0	0	0	42.47
4	46.93	65.80	44.09	44.09	44.09	65.80	65.80	57.26
5	23.54	0	0	0	0	0	0	33.45
6	16.50	62.70	54.88	17.02	0	66.37	66.37	63.46
7	7.35	0	0	0	0	0	0	38.28
8	15.01	0	0	0	0	0	0	67.82
9	32.28	0	0	0	0	25.54	63.12	116.48

enterprises; more than half of the cropland was used for soybean production, with the remainder being used for corn production to feed the large number of dairy cows and beef feeders produced here. A small number of beef-cows producing feeder calves, and sows producing market hogs were also in the solution for region 3. Since the topography of region 5 (Intermediate Bluegrass of Kentucky) is very rough, the production centered around enterprises using small usage of farm machinery, dairying and production of 500 pound feeder calves. All corn used was purchased from the outside.

Resource Use

The quantities of labor, capital, and land used in conjunction with the optimum regional distributions of tobacco and other enterprises reported on above are discussed in this section. These resource use levels are the optimum levels based on previously stated conditions and assumptions.

The resident labor assumed available in August was fully utilized in regions 2, 4, and 6; the regions producing tobacco (see Appendix E). In addition, the entire supply of November, December, and January labor was fully utilized in regions 4 and 6. Some resident labor was left idle in the other labor periods in the regions mentioned above, and there was unused labor in all six labor periods in the other regions.

The quantity of labor used per acre of land in production varied widely among the nine regions (Table 6). Region 6 used substantially more labor per acre than did the other regions. The abundant supply of labor relative to land, the profitability of tobacco production, and the types of livestock entering the solution accounted for this. Even though the tobacco acreage in regions 2 and 4 were not substantially different from that in region 6, these regions used less labor per acre of land (less intensified livestock). The ratio

TABLE 6

LABOR–LAND AND CAPITAL–LAND RATIOS FOR SOLUTION 1, NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA

Region	Total Labor Used Per Acre of Land in Production (Resident and Hired)	Capital Used Per Acre of Land in Production[a]
	hours	dollars
1	15.77	$138.00
2	18.85	209.00
3	15.26	155.00
4	21.77	200.00
5	22.87	270.00
6	35.85	239.00
7	19.29	175.00
8	16.78	187.00
9	17.66	189.00

[a]Includes all operating and investment capital used for crops and livestock.

of labor to land use in the other six regions varied according to the total amount of land in production and the combination of crop and livestock enterprises produced in them, and not by the total labor available.

The use of both operating and investment capital varied among regions according to the quantities and types of enterprises entering the optimum solution. In general, regions producing tobacco used greater quantities of capital, although regions with a substantial number of dairy cows also required a large amount of capital.

The pattern of the ratio of capital use to land use among regions was similar to that of labor to land. Region 1 exhibited the lowest ratio of capital to land use, $1,381 per acre and region 5, the highest, $2,705 per acre. Regions producing tobacco and having larger numbers of dairy cows generally required larger amounts of capital per acre.

All cropland and land that could be used for improved pasture was utilized. However, the supply of land suited only to unimproved pasture was utilized only in regions 1, 4, and 6 (Appendix E).

Solution 2—Tobacco Allotment 150,301 Acres—Price 82¢

Compared with solution 1, the tobacco acreage allotment was reduced by 20 percent and the price increased by 8 cents per pound for this analysis. The 150,301 acres of tobacco included in this solution was located in regions 2, 4, and 6, as it was in the primary solution, and the tobacco acreage was reduced in all three regions (Table 5).

Approximately 58 percent of the tobacco acreage decrease came in region 4. To partially offset the income lost by this decrease in acreage, even though the tobacco

price was higher, an additional 189,000 feeder pigs were purchased and fattened in region 4 (Appendix D). The adjustments in region 2, as a result of the tobacco acreage reduction, were mainly the substitution of market hog and greater corn production for feeder pig production, fed beef calves, and soybean production. With the smaller tobacco acreage it became profitable to substitute the more labor-intensive market hog enterprise for some of the feeder livestock that were produced along with the larger tobacco acreage.

The reduced tobacco acreage in region 6 also had the effect of increasing the more labor-intensive enterprises and reducing the less labor-intensive enterprises. Here, dairying and market hog production replaced a large number of the beef cows kept for calf production and some beef feeders. However, the tobacco acreage was still large enough so that a greater proportion of the more labor-intensive dairy and market hog enterprises were in regions not producing tobacco, and the less labor-intensive feeder activities were in the regions producing tobacco.

Soybeans became a more important enterprise in region 3. With the tobacco acreage decrease, region 2 became a producer of market hogs. Since the level of hog production was limited for the entire area, this caused a reduction in market hogs produced in region 9. With the decrease in hog numbers, however, region 9 gained a competitive advantage over region 3 in the fattening of some calves, thus, soybeans increased in region 3.

The reduction in tobacco acreage made it profitable, from the standpoint of the nine regions as a whole, to relocate in region 6 the dairy cows that were located in region 8. Major factors involved in this relocation are the lower feed production costs in region 6, and the fact that dairying uses more grain and hay, than the beef cow herd. The enterprises and their levels did not change in region 1 or region 7.

Resource Use

Commensurate with the changes in crop and livestock production resulting from the 20-percent tobacco acreage decrease were changes in labor and capital use (Appendix E). Although region 4 used somewhat less resident labor as a result of the decreased tobacco acreage, regions 2 and 6 used slightly more resident labor due to the change to market hog production in region 2 and the change to dairying in region 6. On the other hand, resident labor use declined in regions 3, 5, 8, and 9 as a result of the reductions in market hog and/or dairying numbers.

The quantity of hired labor used declined in all the regions except region 9 as a result of the reduced level of tobacco production. The total land used did not change in any of the nine regions, although the uses to which it was put did change in 7 of the 9 regions.

Solution 3—Tobacco Allotment 112,726 Acres—Price 90¢

The tobacco acreage allotment in this solution was 40 percent below the 1966 base acreage (solution 1). The enterprise and resource use levels with the 112,726 acre allotment and tobacco price of 90 cents per pound were different from those at the base price and allotment level in seven of the nine regions. However, optimum solutions were different from those at the 150,301 acre allotment level in only four of the nine regions, regions 2, 3, 6, and 9 (see Appendix D, Table 5).

The allotment reduction (from 150,301) had the effect of decreasing tobacco acreage in region 6 by 37,871 acres and increasing the acreage in region 2 by 295 acres. Due to the large tobacco reduction in region 6 the number of sows producing market hogs and beef cows producing calves were substantially increased (Appendix D). The increase in market hog production in region 6 caused a reduced market hog production and expanded

soybean production in region 2. Region 3 substituted feeder-calf production and soybeans for beef feeding. This substitution had the effect of increasing beef feeding substantially in region 9 (and slightly in region 2).

Along with the above changes went changes in grain, hay, and pasture production commensurate with those in the types of and levels of the livestock enterprises. Soybeans became a more important enterprise with reduced levels of tobacco, particularly with the maximum limits set on livestock enterprises.

Resource Use

Each of the four regions making substantial adjustments used less resident labor than with the larger tobacco acreage. The reduction in resident labor used was extremely small in regions 2, 3, and 9, but amounted to a 34-percent reduction in region 6. While the amount of resident labor used in regions 2 and 9 decreased, the amount of hired labor used in these regions increased due to the larger acreages of hay. The quantity of hired labor used in regions 3 and 6 declined as a result of the smaller acreage of hay grown in region 3 and the smaller tobacco acreage in region 6.

Capital use declined slightly in regions 2 and 3, substantially in region 6, and increased slightly in region 9 (Appendix E). The primary reason for the increase in the quantity of capital used in region 9 was because of the increased production of hay there. The amount of land that was used did not change.

Solution 4—Tobacco Allotment 75,150 Acres—Price 98¢

At this tobacco allotment level, 60 percent below the 1966 base (solution 1), a greater regional concentration of tobacco acreage occurred. All burley tobacco was

produced in regions 2 and 4 (Table 5). The acreage of tobacco in region 4 did not change from the acreage produced there with a 37,576 acre larger allotment. However, the tobacco acreage in region 2 was reduced substantially and region 6 produced no tobacco.

The decrease in tobacco acreage from 60 percent of base to 40 percent of base affected the enterprise levels in only 3 regions, regions 2, 6, and 9; and, the change in region 9 was relatively small. The net effect of the lower allotment was to increase soybeans and beef feeding in region 2, increase market hog production in regions 6 and 9, and decrease market hog production in region 2 and beef feeding in region 9. With these changes, some additional land for grain and hay production became available in regions 6 and 9 and was used to increase the beef cow-calf operations.

Resource Use

With the tobacco acreage reduced from 112,725 to 75,150 acres, resident labor, hired labor, and capital use declined or remained the same in all regions, except for a small increase in resident labor use in region 9. Decreases of 6, 25, and 5 percent occurred in the amounts of total resident labor, hired labor, and capital used in the nine regions as a whole compared with those used at the higher allotment level.

Solution 5—Tobacco Allotment 225,451 Acres—Price 66¢

The tobacco acreage included in this solution was 20 percent above the base acreage (solution 1). The tobacco price of 66 cents per pound was 8 cents below the base price. The tobacco acreage was more widely dispersed as a result of the allotment increase, with region 9 producing some tobacco along with regions 2, 4, and 6 (Table 5).

Together with the wider dispersion of tobacco production among the nine regions

were changes in the crop and livestock levels in 4 of the 9 regions (see Appendix D). For region 2 and region 6 to concomitantly increase tobacco production, region 2 produced a substantially larger acreage of soybeans, and the feeder pigs that were produced in region 2 were now produced in region 6. Region 6 also substantially reduced the number of calves fattened, and slightly increased the number of beef cows producing feeder calves. Although the higher tobacco allotment made it profitable to expand soybean production in region 2, it had the opposite effect in region 3. A large number of the market hogs that were produced in region 6 in solution 1 were produced in region 3 as a result of the tobacco acreage increase, and land shifted from soybeans to corn for feed. Additionally, the production of tobacco in region 9 had the effect of shifting some of the market hogs from region 9 to region 3. Beef feeding increased in region 9.

Resource Use

The quantity of resident labor use increased in the four regions with changed programs. Although the increase was relatively small in regions 2 and 6, the production of tobacco in region 9, and the change to a higher level of market hog production in region 3 resulted in an appreciable increase in resident labor use in these regions. Hired labor use increased in regions 2, 6, and 9. As expected, a relatively large increase occurred in region 9. A reduction in hay acreage in region 3 resulted in less hired labor used there.

A more pronounced change in the use of capital occurred with this tobacco acreage change than with any of the changes investigated earlier. Regions 3, 6, and 9 experienced marked increases in capital use, while region 2 used substantially less capital (due to the change from corn and the buying of feeder pigs to soybean production). Quantity of land used did not change although the land use changed in four regions.

Solution 6—Tobacco Allotment 263,026 Acres—Price 58¢

Increasing the tobacco acreage from 120 percent to 140 percent of the base acreage only affected the enterprise levels in regions 3 and 9. Some of the market hogs in region 9 at the 225,451-acre level was shifted to region 3; however, the slightly fewer steers that were fed in region 3 were now fed in region 9. To feed the additional market hogs produced in region 3, it was necessary to substitute corn production for soybeans.

Resource Use

The quantity of resident labor and capital used in both region 3 and region 9 increased while the quantity of hired labor used more than doubled in region 9. Land use changed only in regions 3 and 9, but the total amount of land in use did not change.

Solution 7—No Tobacco Allotment Price 42¢

With no tobacco allotments, even at the relatively low price of 42 cents per pound, approximately 2.8 times as many acres of tobacco would be produced than was produced under allotment controls in 1966 (at an average price of 66 cents). However, if livestock numbers were allowed to increase and relatively favorable returns could be received for them, this acreage would probable decrease.

All nine regions produced tobacco in this solution although the level of production in region 4 was reduced from that in solution 1 (base acreage). At this price it became more profitable in region 4 to produce a relatively large number of market hogs and beef-feeders than to maintain the level of tobacco production at that of solution 1. Other regions producing a large number of market hogs were regions 1, 3, 6, 7, and 9. Region 2 would largely engage in the buying and selling of feeder livestock, while regions 1, 3, 5, 7, and 9 would have the large number of dairy cows.

With the restraint on tobacco acreage lifted, soybeans became a less important enterprise in regions 2 and 3 since the cropland could be more profitable utilized in grain and livestock production. Beef cow-herds decreased in importance.

Resource Use

All regions, except regions 4 and 6, used somewhat more resident labor than in any of the six previous solutions. Substantially more hired labor was used in all regions except in regions 2, 4, and 6. The quantity of capital used followed the same general pattern, i.e., increased quantities of capital were used in regions not producing tobacco under restricted tobacco acreages and decreased

capital use occurred in the regions that did produce tobacco when allotments were maintained. However, region 2 did use a larger amount of capital due to the changes in enterprises other than tobacco. Region 5 used a smaller quantity of capital since only a little over one-half of the land was used, hay and pasture production was reduced, and tobacco and dairying were relied on for income.

Less total land was used for crop production when tobacco allotments were removed. Unimproved pastureland was not used in regions 4 and 6, and reductions occurred in the amount of all three classes of land used in region 5. With the large increase in tobacco, less livestock was produced (mainly feeder calves).

SUMMARY OF ADJUSTMENTS IN THE NINE REGIONS AT DIFFERENT
TOBACCO PRICE AND ALLOTMENT LEVELS

Tobacco acreage was concentrated in fewer regions as the allotment levels were reduced (Table 5). Tobacco allotment reductions had the effect of increasing corn and soybean acreages, particularly the latter. Red clover hay acreages were increased slightly while lespedeza hay acreages decreased a little. The acreage devoted to improved pasture increased by a small amount while the acreage used for unimproved pasture and sudan grass did not change from the highest to the lowest allotment level. An allotment increase had essentially the opposite effect on enterprises, since less land was available and more labor was being devoted to tobacco production. With no restrictions on tobacco production, corn, soybeans, lespedeza, unimproved pasture, and sudan grass production decreased, whereas the tobacco, red clover hay, and improved pasture enterprises increased.

Although the geographic distribution of the livestock enterprises was not the same at

different tobacco allotment levels, the maximum limit set for sows, dairy cows, feeder pigs, and steers determined the production levels of these enterprises. The number of feeder-calves produced did not vary greatly at different tobacco allotment levels, although it tended to increase at the lower allotment levels. However, with no tobacco allotment, the number of beef cows was reduced to less than one-half the number produced when tobacco acreage was fixed at a given level.

Net Returns At Seven Alternative
Price-Allotment Combinations

Estimates of net returns to land and resident labor and management were generated for each of the seven solutions discussed above (Table 7). Net returns were the largest at the base allotment level and 74 cent tobacco price. Returns were greater with

TABLE 7

NET RETURNS TO RESIDENT LABOR AND MANAGEMENT
AND LAND FOR SEVEN SOLUTIONS

Identification	Net Returns to Nine Regions
	1,000,000 dollars
Solution 1 (74 cent price—187,876 acre allotment)	733.9
Solution 2 (82 cent price—150,301 acre allotment)	726.8
Solution 3 (90 cent price—112,726 acre allotment)	702.8
Solution 4 (98 cent price—75,150 acre allotment)	663.4
Solution 5 (66 cent price—225,451 acre allotment)	724.9
Solution 6 (58 cent price (263,026 acre allotment)	701.7
Solution 7 (42 cent price—no allotment)	641.2

a 20-percent allotment reduction and an 8-cent price increase than at 20 percent allotment increase accompanied by an 8-cent per pound price reduction. With unrestricted production of tobacco at 42 cents per pound, acreage increased approximately 2.8 times that of the base allotments, but returns were nearly $93 million lower than at the 74 cent price—base allotment level.[10]

Marginal Value Products of Limited Resources and Restricted Livestock Activities

The amount by which net returns to land and resident labor and management could be increased by an additional unit of a limited resource, or an additional unit of a productive process is termed the marginal value product.[11] For the nine regions as a

whole in each of the first six solutions, tobacco acreage was restricted. The amount by which returns could be increased with an additional acre of tobacco allotment is given in Table 8.

The MVP of an acre of tobacco becomes increasingly smaller as the tobacco acreage is expanded. The tobacco price reduction is a factor in this, but also as tobacco acreage is increased some of the tobacco acreage is moved to less productive regions.

The most limiting resource in the regions, individually, was cropland. The increase in annual net returns that would occur in each of the regions with an additional acre of cropland are given in Table 9.

Increasing the quantity of pastureland would also increase net returns. However, this increase was substantially less than for cropland (Table 10). As tobacco allotments were reduced, the MVP of pastureland generally increased in the most efficient tobacco producing regions and decreased in other regions. The reason for this was that as tobacco allotments were reduced, the more efficient tobacco production regions became

---

[10]In a later section, the prices of tobacco at given allotment levels are reduced and the effects of this reduction evaluated.

[11]As was the case in previous references to marginal value product, this term is shortened to MVP.

TABLE 8

MVP'S OF TOBACCO ALLOTMENT (NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA AS A WHOLE)

Solution Identification[a]	MVP of an Additional Acre of Tobacco
	dollars
Solution 1 (74 cent price—187,876 acre allotment)	$ 957.
Solution 2 (82 cent price—150,301 acre allotment)	1206.
Solution 3 (90 cent price—112,726 acre allotment)	1428.
Solution 4 (98 cent price—75,150 acre allotment)	1623.
Solution 5 (66 cent price—225,451 acre allotment)	748.
Solution 6 (58 cent price—263,026 acre allotment)	562.
Solution 7 (42 cent price—uncontrolled production)	0.

[a]See Table 5 for tobacco price and allotment combinations associated with each of these solutions.

TABLE 9

MVP'S FOR CROPLAND (NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA)

Solution Identification[a]	Region								
	1	2	3	4	5	6	7	8	9
	dollars								
Solution 1	41.10	53.16	42.76	64.18	2.85	31.87	27.00	17.84	38.40
Solution 2	41.18	52.75	42.76	63.92	2.85	33.12	27.08	17.83	38.39
Solution 3	40.72	52.60	42.76	63.81	2.85	33.28	26.64	17.37	37.83
Solution 4	40.22	52.45	42.76	63.61	2.85	32.73	26.16	16.88	37.23
Solution 5	40.31	53.20	42.76	63.88	2.85	31.54	27.00	17.85	38.40
Solution 6	40.31	53.17	42.76	64.07	2.85	31.71	27.00	17.84	38.40
Solution 7	42.56	53.73	42.76	64.74	0.00	32.06	27.41	18.35	38.55

[a]See Table 5 for tobacco price and allotment combinations associated with each of these solutions.

TABLE 10

MVP'S FOR IMPROVED PASTURELAND (NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA)

Solution Identification[a]	Region								
	1	2	3	4	5	6	7	8	9
	dollars								
Solution 1	9.58	12.15	7.77	7.53	1.95	6.50	8.08	4.64	5.19
Solution 2	8.90	13.38	7.77	8.30	1.95	7.24	7.32	4.64	5.19
Solution 3	8.91	13.82	7.77	8.64	1.95	7.62	7.33	4.65	5.20
Solution 4	8.92	14.29	7.77	9.24	1.95	7.64	7.34	4.66	5.21
Solution 5	8.78	12.03	7.77	7.57	1.95	6.30	8.08	4.64	5.19
Solution 6	8.78	12.12	7.77	7.66	1.95	6.30	8.08	4.64	5.19
Solution 7	9.64	10.45	5.37	6.29	0.00	4.21	6.46	2.58	2.87

[a]See Table 5 for the tobacco price and allotment levels associated with each of these solutions.

more competitive for the limited livestock production.

Restrictions were placed on the maximum size of the livestock enterprises. These restrictions are only estimates of realistic potentials under assumed conditions. To shed some light on the effects of increasing the maximum levels of livestock production, a short discussion is presented here about the MVP's of these enterprises. It is still assumed that these limits could be realized with no change in the product or factor prices.

The MVP of an additional dairy cow ranged from $209 to $214 for each of the six solutions in which tobacco acreages were restricted and $190 in the solution involving no tobacco allotment. However, if the capital requirements, managerial abilities, and farmer attitudes relative to dairying were more closely analyzed, this figure might well prove too high. Furthermore, the period involved is probably too short to expect a large increase in dairying.[12]

For each additional sow producing market hogs, approximately $110 would be added to net returns in each of these solutions. The price used for market hogs in this study, $17 per cwt is close to the average price actually received over the past 15 years; but the upper limit on the number of sows was approximately 2.5 the number on farms in the study area in 1966. As the present level of hog production in the entire area is about 3.0 to 3.5 percent of total U. S. production, some point would be reached at which hog prices would decline.[13]

[12]See the next section of this report relative to the effects of changing milk prices and excluding dairying from the analysis.

[13]See the next section relative to the effects of hog price decreases and of unlimited hog production.

For each additional steer fed approximately $18 would be added to net returns and for each additional feeder pig that could be bought, fed, and sold, $1.10 would be added to net returns. In the optimum solutions under these initial conditions, a large proportion of the cattle and all the purchased pigs that were fed out in the area had to be brought in from outside the study areas (feeder calves produced in the nine regions amounted to only just over one-fifth of the cattle fed). Moreover, all the sows in the optimum organizations were used in market hog production. Since the large number of feeder calves coming from the outside seems unrealistic, in the latter section of this report, it is assumed that four-fifths of the feeder cattle must be produced in the nine study regions.

RESULTS—SELECTED CHANGES IN VARIABLES INCLUDED IN INITIAL SOLUTIONS 1 AND 2

The major purpose of this section is to evaluate the distribution of tobacco acreages with specific changes in: (1) tobacco prices, (2) prices of other products, (3) wage rates, (4) production costs, and (5) the levels and types of resource restrictions. The solution identifications and the specific changes from the initial values are presented in Table 11. These variations are evaluated in terms of specific changes from solutions 1 and 2. Effects of these variations on other enterprises and resource use are discussed only in limited detail.

A multitude of possible price, cost, resource use, and enterprise alternatives may present themselves in the future. It is believed that those chosen for analysis here include some of the more important alternatives, changes, and/or directions of change which should be considered in production decision-making. The analysis also provides insights into possible directions which might be taken in decisions at a macro-economic level. Both the present allotment level (solution 1's) and a decreased tobacco allotment level (solution 2's) are considered under a broader range of conditions than was investigated earlier.

Solutions 1A and 2A—Reductions in Tobacco Price

Reducing the price of tobacco by 8 cents per pound from 74 cents to 66 cents per pound with 187,876 acres of tobacco and from 82 cents to 74 cents per pound at the 150,301 acre allotment level did not have any effect on the distribution of tobacco acreages. Proportional variations in tobacco prices, with all else constant, does not change the competitive position of the different regions in the production of tobacco. The price reductions did, of course, lower the net returns to land and resident labor and management.

Solutions 1B and 2B—Reductions in Beef Prices

Reducing the price of beef calves 2 cents per pound and the price of fed cattle from 24.2 to 22.9 cents per pound, had the effect of moving tobacco acreage from region 6 to regions 2 and 4 in solution 1B (Table 12). However, in solution 2B, tobacco production was increased in region 6, reduced in region 2, and remained the same in region 4 (Table 13).

TABLE 11

CHANGES IN VARIABLES

Solution 1A and 2A	Tobacco price reduced from 74 cents per pound to 66 cents per pound in Solution 1A. Tobacco price reduced from 82 cents per pound to 74 cents per pound in Solution 2A.
Solution 1B and 2B	The price received for beef calves was reduced from 21.6 cents per pound to 19.6 cents per pound. The price received for fed cattle was reduced from 24.2 cents per pound to 22.9 cents per pound.
Solution 1C and 2C	The price received for 220 pound market hogs was reduced from 17 cents per pound to 14.5 cents per pound. The price received for 40 pound feeder pigs was reduced from $13.00 per pig to $11.50 per pig.
Solution 1D and 2D	The milk price was first reduced from $4.75 to $4.25 per hundred pounds and then to $3.75 per hundred pounds.
Solution 1E and 2E	Dairying was excluded from the analyses.
Solution 1F and 2F	Four-fifths of the calves purchased for feeding must be produced within the nine regions.
Solution 1G and 2G	No restrictions were placed on livestock production except dairying. The dairy restriction was 120 percent of the milk cows on farms in 1966.
Solution 1H and 2H	Wage rates were increased from $1.50 per hour to $2.50 per hour during the period from November to April. Wage rates were increased from $1.75 to $2.75 per hour during the period from May to October.
Solution 1I and 2I	Wage rates were increased from $1.50 per hour to $2.00 per hour from November to April and $1.75 per hour to $2.25 per hour from May to October in Region 4. Wage rates were increased from $1.50 per hour to $1.75 per hour from November to April and from $1.75 to $2.00 per hour from May to October in Region 2 and Region 6.
Solution 1J and 2J	The maximum quantity of hired labor was 20 percent of the resident labor assumed available from November to April and 30 percent of that available from May 1 to October 31.
Solution 1K and 2K	Land and labor availability estimates were projected to 1972.
Solution 1L and 2L	An off-farm employment alternative, paying $1.75 per hour, was assumed available.
Solution 1M and 2M	Tobacco production costs were reduced in Region 5 to a level equivalent to those in Region 4.

24

TABLE 12

OPTIMUM TOBACCO ACREAGES WITH FOUR PRICE VARIATIONS
FROM THOSE ORIGINALLY ASSUMED[a]

Solution Identification[b]	Regions								
	1	2	3	4	5	6	7	8	9
				(thousand acres)					
Solution 1	0	59.38	0	65.80	0	62.70	0	0	0
Solution 1A	0	59.38	0	65.80	0	62.70	0	0	0
Solution 1B	0	63.78	0	67.40	0	56.69	0	0	0
Solution 1C	0	64.63	0	60.55	0	62.70	0	0	0
Solution 1D	0	59.38	0	65.80	0	62.70	0	0	0

[a]See Table 11 for the price changes associated with solutions 1A, 1B, 1C, and 1D.

[b]The tobacco price is 74 cents per pound and the allotment level is 187,876 acres for each of these solutions.

TABLE 13

OPTIMUM TOBACCO ACREAGES WITH FOUR PRICE VARIATIONS
FROM THOSE ORIGINALLY ASSUMED[a]

Solution Identification[b]	Regions								
	1	2	3	4	5	6	7	8	9
				(thousand acres)					
Solution 2	0	51.33	0	44.09	0	54.88	0	0	0
Solution 2A	0	51.33	0	44.09	0	54.88	0	0	0
Solution 2B	0	50.93	0	44.09	0	55.28	0	0	0
Solution 2C	0	55.16	0	40.39	0	54.75	0	0	0
Solution 2D	0	51.33	0	44.09	0	54.88	0	0	0

[a]See Table 11 for the price changes associated with solutions 2A, 2B, 2C, and 2D.

[b]The tobacco price is 82 cents per pound and the allotment level is 150,301 acres for each of these solutions.

The major factor involved in the changes in tobacco acreages centered around the 60 percent decline in feeder calf production that followed the beef price reduction. The decrease in feeder-calf production freed resources, particularly cropland and pastureland, for other uses. In solution 1B the increases in tobacco acreage in regions 2 and 4 were combined with a relocation of some of the pigs that were bought and fattened in region 2 to region 4, and a movement of some of the beef feeding that was in these two regions into other regions.[14] Accompanying the reduced tobacco acreage in region 6, some of the dairying located in regions with higher hay and grain production costs moved to region 6.

At the lower tobacco allotment level (solution 2B) relatively minor adjustments were made in regions 2 and 6 after the beef price reduction. In region 2, additional market hogs were produced and a slight decrease in tobacco acreage occurred. Beef feeder production decreased in region 6, and tobacco acreage increased slightly.

To the extent that livestock production could be moved among the regions to better utilize the total resources, the location of tobacco production was changed. Together with the availability of cropland and pastureland, and the uses to which this land could be put, the role of the livestock enterprises was important. Beef feeder production and the purchasing of pigs for fattening displayed more of a supplementary resource use pattern with tobacco, while dairying displayed a competitive resource use pattern, particularly in the use of labor in critical labor periods.

For the entire area the amount of resident labor, hired labor, and capital used declined with the beef price reduction (see

_____

[14]References to beef feeders indicate a practice in which calves were bought at 500 pounds, fattened, and sold at 1,050 pounds.

Appendix E, Table 2). The decreases were primarily due to the change in location in some beef feeder production, the reduction in feeder-calf production, and the change in the location of some of the tobacco acreage.

A more important factor in the quantity of capital used in the nine regions as a whole, following the beef price reduction, was the large decline in agricultural production of all types in region 5. A large part of the $180 million and $160 million decreases in capital use in solution 1B and solution 2B, respectively, resulted from this.

In the nine-region area as a whole, less land was utilized under the reduced beef price assumption. Most of this reduction was less utilization of unimproved pastureland. However, in region 5 large reductions occurred in the use of all land classes.

Solutions 1C and 2C—Reductions in Hog Prices

The price reduction of 2.5 cent per pound for fat hogs and $1.50 per feeder pig resulted in, at both tobacco allotment levels, a larger acreage of tobacco being produced in region 2, a smaller acreage in region 4, and virtually no change in region 6 (Tables 12 and 13). The major adjustments in other enterprises were: (1) elimination of buying of feeder pigs for fattening from outside the study area, (2) movement of some of the market hog production (sow herd on farms) to lower feed production cost regions, such as regions 4 and 6, (3) reduction in feeder-calf production, and (4) increase in soybean production in regions 2 and 3. Basically, with the lower hog price, it was more profitable from the standpoint of the entire area to place greater reliance on cash sales of soybeans and less reliance on livestock.

Resident labor use decreased by approximately 3 million hours in both solution 1C and 2C as a result of the hog price reduction. In each case, this was due to the greater soybean production and less corn,

hay, and livestock production. The quantity of hired labor used in the entire area did not change very much. The changes that did occur were in response to movements of tobacco production among regions and the changes in hay acreages.

Capital requirements for the entire area were reduced in both solutions 1C and 2C (Appendix E, Tables 2 and 3). A larger quantity of capital was used only in region 9, where a larger quantity of hay was produced to meet the needs of increased beef-feeder production. Rather large reductions in capital requirements were experienced in regions 2, 3, and 4.

Solutions 1D and 2D—Reduction in Milk Price

Two milk price reductions (Table 11) had no effect on the level and distribution of tobacco or any other enterprise. The 675,000 cows—the upper limit—were optimally located in the same regions and at the same levels at prices of $4.75 per hundred pounds of milk, $4.25 per hundred pounds of milk, and $3.75 per hundred pounds of milk.

Solutions 1E and 2E—Dairying Excluded from Analysis

Grade A dairying was excluded as an alternative in solution 1E and 2E and the resources that were used for dairying in earlier analyses were assumed available for other uses. Even though Grade A dairying was shown to be very profitable enterprise in earlier solutions, certain peculiarities of Grade A dairying provide a basis for excluding it as an alternative and assuming it does not respond to economic stimuli in a manner similar to other enterprises in an intermediate length of run.[15]

Excluding dairying did not change the tobacco acreage distribution among the three regions that produced tobacco at the higher allotment level, (solution 1E); but as shown in Table 15, it did shift approximately 4,600 acres from region 6 to region 2 at the lower allotment level (solution 2E). The major effect of the exclusion of dairying, other than the relatively small change in tobacco acreage, was to increase feeder-calf production by 300 percent. Consequently, more of the land suited to hay or pasture was used for pasture rather than hay. In region 3 a large increase in soybeans occurred, replacing corn on land suited for row crops.

Resident labor, hired labor, and capital use declined as a result of the exclusion of dairying; however, the quantity of hired labor decreased only slightly (Appendix E, Table 2). Total acreage of land used did not change.

Solutions 1F and 2F—Change in Source of Feeder Cattle

In solutions 1F and 2F it was assumed that four-fifths of the calves that were purchased for further feeding were produced within the nine-region study area. No restrictions were placed on the numbers produced. The feeder calves were bought at 500 pounds in October, wintered, pastured, and put in a dry lot June 15 and sold at 1050 pounds.

The tobacco acreage as well as the location of the cattle feeding was affected by linking feeder-calf production and cattle feeding together. As in earlier solutions, tobacco production and beef feeding displayed supplementarity in resource use. Most calves were fed out in regions 2 and 4, but were produced in the other seven regions.

---

[15]Factors bearing on the rate at which Grade A dairying may expand in an intermediate length of run, even at highly favorable milk prices, include: (1) the highly specialized equipment and high quality cows required, and resulting high fixed costs, (2) the smaller degree of divisibility in profitable herd sizes than for most livestock enterprises, (3) the larger amount of labor needed and its periodicity relative to other enterprises, (4) the specialized and confining managerial abilities required and (5) the investment of capital in relatively fixed uses over a period of years.

However, by explicitly limiting beef-feeder production to the production of feeder-calves in the nine regions, a larger proportion of the beef feeding was located in region 2.

The effects on the distribution of tobacco acreage were different at the higher (solution 1F) than at the lower (solution 2F) allotment levels. At the higher allotment level tobacco acreage increased in region 2 and declined in regions 4 and 6. A small acreage was produced in region 9 (Table 14). However, at the lower allotment level, tobacco acreage was increased substantially in region 4, decreased substantially in region 2, and decreased by a lesser amount in region 6 (Table 14).

The total quantities of resident labor, hired labor, and capital used in the entire area were increased as a result of the greater reliance on more resource intensive livestock production, such as dairying and market hog production (Appendix E, Tables 2 and 3). After the tying together of feeder-calf and beef-feeder production, it was also more profitable to use the resources needed for the production of calves sold within the study area. Soybeans were produced in regions 2 and 3. Land use increased since more unimproved pastureland was required to meet the pasture needs of the increased number of beef cows.

Solutions 1G and 2G—No Restrictions on Livestock

For these solutions, except for dairying, livestock production in the area was permitted to expand to the maximum that was profitable at the assumed prices. The number of dairy cows was limited to 120 percent of the number of cows on farms in each region in 1966.

Removing the restriction on hog and beef production caused a dispersion of the tobacco acreage. Instead of 3 or 4 regions producing tobacco as was the case in most of the previous solutions, 5 or 6 regions now

produced tobacco. Moreover, at both allotment levels, a large part of the tobacco was produced in region 9 and region 6 (Tables 14 and 15).

With sow numbers unrestricted, extremely large numbers of sows producing feeder pigs were located in all nine regions. Production of feeder pigs and the redistribution of tobacco acreages allowed the maximum use of resident labor.

Resident labor use increased considerably for the nine regions as a whole (Appendix E, Table 2). Some of the regions with less tobacco than before the restriction change used less resident labor and less capital; otherwise, resident labor and capital use increased. Hired labor use declined in both solutions 1G and 2G since considerable land was diverted from hay to pasture. Total land use decreased slightly.

Solutions 1H and 2H—Increased Wage Rates

In these analyses wage rates were increased by $1.00 per hour in all nine regions (Table 11). All other variables are the same as in the analyses for initial solutions 1 and 2.

Increasing wages had the effect of dispersing tobacco acreage in solution 1H, the higher of the two allotment levels. Tobacco was produced in region 9, as well as in regions 2, 4, and 6 (Table 16). It also had the effect of decreasing tobacco acreage in regions 2 and 4, and of increasing tobacco acreage slightly in region 6.

The wage increase had no effect on the levels and production location of enterprises in solution 2H, the lowest allotment level. However, higher wage rates than those assumed here would tend to move some of the tobacco acreage to region 9, even at the assumed lower tobacco allotment level.

Associated with the decrease in tobacco production in regions 2 and 4 at the higher allotment level was an increase in soybean production in region 2 and an increase in the

TABLE 14

OPTIMUM TOBACCO ACREAGES WITH THREE LEVELS AND TYPES
OF RESTRICTION VARIATIONS FROM THOSE ORIGINALLY ASSUMED[a]

Solution	Regions								
Identification[b]	1	2	3	4	5	6	7	8	9
	(thousand acres)								
Solution 1	0	59.38	0	65.80	0	62.70	0	0	0
Solution 1E	0	59.38	0	65.80	0	62.70	0	0	0
Solution 1F	0	61.91	0	62.09	0	59.43	0	0	4.45
Solution 1G	0	8.84	11.57	23.86	0	46.87	0	24.23	72.50

[a]See Table 11 for the level and type of restriction variations associated with solutions 1E, 1F, and 1G.

[b]The tobacco price is 74 cents per pound and the allotment level is 187,876 acres for each of these solutions.

TABLE 15

OPTIMUM TOBACCO ACREAGES WITH THREE LEVELS AND TYPES OF
RESTRICTION VARIATIONS FROM THOSE ORIGINALLY ASSUMED[a]

Solution	Regions								
Identification[b]	1	2	3	4	5	6	7	8	9
	(thousand acres)								
Solution 2	0	51.33	0	44.09	0	54.88	0	0	0
Solution 2E	0	55.96	0	44.09	0	50.25	0	0	0
Solution 2F	0	41.18	0	58.20	0	50.92	0	0	0
Solution 2G	0	8.84	0.08	23.86	0	46.87	0	0	70.64

[a]See Table 11 for the level and type of restriction variations associated with solutions 2E, 2F, and 2G.

[b]The tobacco price is 82 cents per pound and the allotment level is 150,301 acres for each of these solutions.

TABLE 16

OPTIMUM TOBACCO ACREAGES WITH FIVE RESOURCE AVAILABILITY AND WAGE CHANGES[a]

Solution Identification[b]	Regions								
	1	2	3	4	5	6	7	8	9
	(thousand acres)								
Solution 1	0	59.38	0	65.80	0	62.70	0	0	0
Solution 1H	0	55.96	0	51.94	0	63.46	0	0	16.51
Solution 1I	0	55.96	0	44.09	0	62.70	0	0	25.12
Solution 1J	0	36.23	26.01	24.19	0	33.25	0	0	68.21
Solution 1K	0	48.63	0	48.47	0	49.18	0	0	41.61
Solution 1L	0	68.33	0	64.50	0	55.05	0	0	0

[a]See Table 11 for the resource availability and wage changes associated with solutions 1H, 1I, 1J, 1K, and 1L.

[b]The tobacco price is 74 cents per pound and the allotment level is 187,876 acres for each of these solutions.

fattening of purchased pigs in region 4. Tobacco acreage did not decrease as much in region 2 as it did in region 4 because livestock enterprises compete more strongly with tobacco for labor (especially November—January and August labor) than do soybeans. Resident labor and capital use increased, while hired labor use decreased with the higher wage rates in solution 1H. Capital use increased in solution 2H (Appendix E, Table 2).

Solutions 1I and 2I—Differential in Wage Rates

For solutions 1I and 2I the wage rates are increased by differential amounts in regions 2, 4, and 6. Historically, the Bluegrass Region of Kentucky has had higher farm wage rates than the other regions.[16] The relatively

large tobacco acreage historically located here has created intense competition for labor during the tobacco setting, harvesting, and stripping seasons. This, coupled with the proximity to the urban centers of Lexington, Louisville, and Cincinnati has resulted in higher wage rates.[17] Wage rates were also increased in region 2 and in region 6 but by smaller amounts. These regions also have higher wages due to nearness to urban centers and larger tobacco acreages. Also, from the standpoint of prior optimum solutions, the tobacco acreage levels in these regions would tend to bid up the price of hired labor.

Wage rates in region 4 were assumed to be $2.00 per hour and $2.25 per hour for labor hired in the November—April and the May—October labor periods, respectively. For the same labor periods, wage rates of $1.75 per hour and $2.00 per hour were assumed in regions 2 and 6.

[16]The Bluegrass Region includes three clearly definable zones—Inner, Intermediate, and Outer zones. The Inner and Outer Bluegrass Regions are region 4 in this study and the Intermediate is region 5.

[17]The wage rate in the Intermediate Bluegrass was not increased since it is not a strong competitor for tobacco labor due to lower yields and rougher topography.

The wage changes at the higher allotment level (solution 1I) had the effect of substantially reducing the tobacco acreage in region 4, reducing the acreage in region 2 (but by much less than in region 4), and shifting all this acreage to region 9. The tobacco acreage in region 6 did not change as a result of the wage changes (Table 16). At the lower allotment level (solution 2I) the wage increases resulted in regions 4 and 6 losing tobacco acreage, though region 6 lost very little, and the tobacco acreage in region 2 was increased by the amount of these losses (Table 17).

Changes in other enterprises largely centered around an increase in soybean production in region 2, an increase in the buying of pigs and fattening them in region 4, and the relocation of a large number of sows kept for the production of market hogs from region 9 to region 3.

The quantity of resources used in the nine regions as a whole followed essentially the same pattern as in the case of the wage increase that was applicable to all regions. However, the increase in resident labor use and the decrease in hired labor use were less pronounced (Appendix E, Tables 2 and 3). The quantity of land use did not change from the level before the wage increase.

Solutions 1J and 2J—Restrictions on Availability of Hired Labor

For solutions 1J and 2J the total quantity of labor that could be hired in each region was restricted to that estimated available for hire in each labor period. The maximum quantity of hired labor assumed available was 20 percent of the quantity of resident labor available during the November-April period and 30 percent of the quantity of resident labor available during the May-October period (Appendix F, Table 1). Due to the lack of current data on available hired labor in each region, the historical quantities of hired labor used relative to

resident labor used in the study area provided the basis for deriving labor estimates.

As expected, the limited hired labor supply resulted in a wider dispersion of tobacco acreage. At the higher of the two allotment levels, regions 2, 3, 4, 6, and 9 produced tobacco. The largest acreage was located in region 9, since this region contained a larger estimated quantity of labor available for hire. Labor available for hire in the critical periods was depleted in regions 2, 4, and 6. At the lower allotment level, tobacco was located in regions 2, 4, 6, and 9. Region 2 had the same acreage as at the higher allotment level, and region 4 a slightly larger acreage (Tables 16 and 17).

In conjunction with the dispersion of tobacco acreage, the restriction on hiring labor had the effect of moving some of the more labor-intensive livestock enterprises, such as market hog production and dairying, to the regions producing less tobacco. The less labor-intensive livestock enterprises, such as beef feeding and the fattening of purchased pigs, tended to move to regions which gained tobacco acreage. Production of soybeans also increased in regions 2 and 3.

For the entire study area larger quantities of resident and hired labor were used (Appendix E, Tables 2 and 3). Generally, regions producing less tobacco as a result of the hired labor restriction required smaller amounts of each whereas those gaining tobacco acreage required larger quantities of these resources. Since tobacco acreage was dispersed to regions in which it was produced efficiently, the labor and the capital requirements in the regions that produced tobacco after the change increased proportionately more than did acreage. No change occurred in the total amount of land used.

Solutions 1K and 2K—Projecting Land and Labor

For solutions 1K and 2K estimates of

TABLE 17

OPTIMUM TOBACCO ACREAGES WITH FIVE RESOURCE
AVAILABILITY AND WAGE CHANGES[a]

Solution	Regions								
Identification[b]	1	2	3	4	5	6	7	8	9
					(thousand acres)				
Solution 2	0	51.33	0	44.09	0	54.88	0	0	0
Solution 2H	0	51.33	0	44.09	0	54.88	0	0	0
Solution 2I	0	55.16	0	40.39	0	54.75	0	0	0
Solution 2J	0	36.23	0	24.76	0	33.25	0	0	56.07
Solution 2K	0	48.63	0	48.47	0	49.18	0	0	4.03
Solution 2L	0	68.33	0	60.53	0	21.44	0	0	0

[a]See Table 11 for the resource availability and wage changes associated with solutions 2H, 2I, 2J, 2K, and 2L.

[b]The tobacco price is 82 cents per pound and the allotment level is 150,301 acres for each of these solutions.

labor and land availability are projected to 1972. The price, cost, and yield data used throughout this study was based on 1972 projections. A projection of historical trends indicates a reduction in the resident labor supply of 23 percent from 1964 and 1972.[18] Land available for agricultural purposes was projected to 1972 on the basis of changes in land in farms from 1954 to 1964. The projected decrease averaged 6.2 percent. Relative amounts of cropland and pastureland were unchanged (Appendix F, Tables 2 and 3).

The projected decline in the quantity of resident labor caused the tobacco acreage

located in each of the three tobacco producing regions (2, 4, and 6) to decline. This acreage was relocated in region 9 in both solutions (Tables 16 and 17). The reduced quantity of land, together with the decreased labor supply, caused more of a change in the levels of the crop and livestock production levels than a change in the regional distribution of the enterprises. The other major change was that region 3 gave more emphasis to livestock production and less to soybeans.

Although the projections reduced the quantity of resident labor available by 23 percent, the quantity that was actually used was not greatly different. However, in regions such as 2, 4, and 6, the tobacco producing regions, the decrease in resident labor used was substantial. The quantity of capital used decreased by a relatively small amount. Slightly more hired labor was used, and the decrease in the quantity of land used was proportional to the projected decrease in available land (Appendix E, Tables 2 and 3).

[18]Even with the projection to 1972, the effective labor force may have been over-estimated. It was assumed that each full time resident farm operator worked an average of 10 hours per day 295 days a year and other family members contributed the equivalent of 98.3 days per year. These labor estimates are based on potential labor supplies for the different regions and may not accurately reflect the amount of labor actually available to given farms. Labor is not a homogeneous input that can be transferred among farms, used at different tasks and a given output achieved as a result.

Solutions 1L and 2L—Off-Farm Employment Available

For solutions 1L and 2L, an off-farm employment alternative (paying $1.75 per hour) was introduced to determine its effect on the distribution of tobacco and other enterprises, and on resource use. It was assumed, however, that for each hour worked off the farm 1.33 hours of resident labor available on farms was depleted. In other words, even though 1 hour was actually spent in work, 0.33 of an hour was not employed due to such things as differences in the length of the work day when working off the farm, and the time required in commuting to and from work.

At the 1966 base allotment level (solution 1L). The additional alternative use for resident labor caused the tobacco acreage to increase by approximately 9,000 acres in region 2, to decrease by approximately 1,000 acres in region 4, and to decrease by almost 8,000 acres in region 6. At the lower allotment level (solution 2L) tobacco acreage in region 2 was the same as in solution 1L, but this was 17,000 acres larger than in original solution 2. Likewise in region 4, the tobacco acreage was substantially greater after off-farm employment was included (solution 2L vs Solution 2). But, the tobacco acreage was substantially decreased in region 6 (Table 17).

Overall, the off-farm employment alternative for labor enhanced the competitive positions of regions 2 and 4 for tobacco relative to the other regions. Livestock production levels were reduced, since a wage rate of $1.75 per hour made it unprofitable to purchase pigs for fattening and to produce feeder calves. Furthermore, the less labor intensive lespedeza hay crop was produced rather than alfalfa or red clover.

In region 5, the off-farm employment alternative completely eliminated agriculture of any type. In regions 1, 3, 5, 7, 8, and 9 a substantial quantity of labor could be profitably employed off the farm (in industry or other regions) even if all workers working off the farm did not work on the farm during the entire year (Appendix F, Table 4). These results point up a potential for some movement of labor (along with tobacco acreage) from regions 1, 3, 5, 7, 8, and 9 to regions 2, 4, and 6.

Solutions 1M and 2M—Reduction in Region 5 Costs

In solutions 1M and 2M the production costs for burley tobacco in region 5 (Intermediate Bluegrass) were reduced to the level of those in region 4 (Inner and Outer Bluegrass). Initially, machinery costs were developed for each region on the basis of the average topography of that region. This resulted in costs for region 5 being substantially higher than in other regions. However, land used in tobacco production is generally more level, and a quantity of land of this topography sufficient for at least the present tobacco acreage probably exists. For this reason solutions 1M and 2M were obtained.

The analysis revealed, however, that tobacco still would not be produced in region 5 at the 1966 allotment level, or at an allotment level 20 percent below this level under the conditions of this study. The reason for the lack of competitiveness in region 5 is the lower tobacco yields in the region.

THE EFFECTS OF THIRTEEN CHANGES IN VARIABLES
ON NET RETURNS

Variables analyzed in this phase of the research effort were quite diverse by nature. The impact of changes in these variables upon net returns to land and resident labor and management logically would also vary greatly.

The greatest gain in net returns was achieved in solutions 1L and 2L (resident labor can be employed outside of agriculture at $1.75 per hour). The $300 million increase indicated in Table 18 probably overestimates the increase in returns which could be obtained from off-farm employment. It was assumed that 3 of every 4 hours of resident farm labor was directly transferable between farm and nonfarm activities without regard to the indivisibilities of off-farm employment. However, even if all off-farm employment was full-time employment, a considerable increase in net returns would be forthcoming (Appendix F, Table 4).

Unrestricted production of livestock (solution 1G and 2G) also resulted in a large increase in net returns (nearly $200 million).

However, in the light of prevailing market conditions and forces of interregional competition, this is probably unrealistic.

Reductions of 8 cents per pound in the price of tobacco resulted in net returns reductions in the regions producing tobacco proportional to the acreage of tobacco located in them. Eliminating Grade A dairying from consideration (solutions 1E and 2E), reducing the price of milk (solutions 1D and 2D), and reducing the price of hogs (solutions 1C and 2C) lowered net returns substantially. Regions not producing tobacco depended heavily on these two enterprises, and suffered the greatest loss of net returns.

Wage increases (solutions 1H, 1I, 2H, and 2I) and more restrictive assumptions relative to labor availabilities caused net returns to be reduced by relatively smaller amounts than the changes cited above (Table 18). These changes did, however, have a substantial effect on the distribution of tobacco production.

SUMMARY

The research reported in this publication is a regional aggregative analysis of the burley belt of Kentucky, Tennessee, and Virginia. The major objectives of this study were: (1) to determine the optimum locational pattern of burley tobacco within the burley belt under alternative price and allotment levels, (2) to determine the effects of varying prices of tobacco and other products, levels of different products, and amounts of labor and land on the optimum distribution of tobacco acreages and resource use, and (3) to determine the changes in net farm income due

to different production control programs and/or other changes.

The study area includes 174 counties in Kentucky, Tennessee, and Virginia. In 1966, about 89 percent of the total U. S. burley production was within this area. For analysis the area was divided into nine regions based on topography, soils, and types of farming.

A linear programming spatial equilibrium model was used in the analysis. Total tobacco acreage allotments were specified for the entire study area. The model distributed a given acreage allotment among regions so that

TABLE 18

NET RETURNS TO RESIDENT LABOR AND MANAGEMENT, AND LAND
IN NINE REGIONS FOR TWO INITIAL SOLUTIONS AND THIRTEEN VARIABLE
CHANGES FROM THOSE INITIALLY ASSUMED

Solution Identification[a]	Net Returns	Solution Identification[a]	Net Returns
	($1,000,000)		($1,000,000)
Solution 1	733.9	Solution 2	726.8
Solution 1A	696.7	Solution 2A	702.8
Solution 1B	706.4	Solution 2B	699.2
Solution 1C	682.4	Solution 2C	675.4
Solution 1D	698.0 (662.0)[b]	Solution 2D	690.8 (654.8)[b]
Solution 1E	588.7	Solution 2E	581.0
Solution 1F	717.3	Solution 2F	711.1
Solution 1G	911.0	Solution 2G	908.0
Solution 1H	705.1	Solution 2H	703.7
Solution 1I	725.9	Solution 2I	720.3
Solution 1J	722.3	Solution 2J	716.9
Solution 1K	713.8	Solution 2K	708.4
Solution 1L	1,033.9	Solution 2L	1,026.6
Solution 1M	733.9	Solution 2M	726.8

[a]See Table 11 for the description of the changes associated with each of these solutions.

[b]Two 50-cent price reductions were considered. See Table 11.

the allotment was used most efficiently, in the sense that net returns to the resources in all nine regions were maximized.

Each of the nine regions was treated as a separate entity in the model. Separate structural variables were estimated for each region and the programmed results produced separate activity levels for each region. For the major part of the analysis, all structural variables except quantities of labor and land were projected to 1972.

Results

The results indicate that region 4 (Inner and Outer Bluegrass), region 2 (Western Pennyroyal region of Kentucky and

Tennessee and four lower Ohio Valley counties of Kentucky), region 6 (basically the Eastern Pennyroyal region of Kentucky), and region 9 (28 eastern Tennessee counties and 6 western Virginia counties), in the order presented were the most efficient producers of tobacco under most of the specified conditions of this study. With the initial conditions and at the lowest allotment level (75,150 acres), region 4 contained approximately 59 percent of the tobacco acreage, while region 2 contained approximately 41 percent. With increased tobacco acreages, region 6 and region 9 competed successfully for tobacco; however, region 6 competed at lower allotment levels than did region 9. Tobacco acreage increases, therefore, had the effect of distributing

tobacco acreage. For example, with a tobacco acreage equal to 140 percent of the 1966 base allotment, the acreage was rather evenly distributed among regions 2, 4, 6, and 9. In contrast, at the 80 to 100 percent allotment levels acreage was concentrated in regions 2, 4, and 6.

A major factor contributing to competitiveness of individual tobacco producing regions was the projected tobacco yields. Due to the relative shortness of the time period under consideration, projected yields were based primarily on the average yields and their trend in each region from 1961 to 1965.

Associated with tobacco acreage allotment reductions went increased soybean and feeder calf production. Throughout most of the analysis the general pattern of the enterprise combinations centered around: (1) tobacco and beef cattle fattening, (2) market hog production and dairying, and (3) feeder calf production and dairying. These production patterns tended to provide a high level of supplementarity in resource use.

Thirteen different changes involving: (1) the prices of products sold, (2) wage rates, and (3) the levels and types of resource restrictions and production costs were investigated. Changes which markedly dispersed tobacco acreages were: (1) increases in wage rates, (2) more restrictive availability of both resident and hired labor, and (3) unrestricted production of livestock. The changes which tended to concentrate tobacco acreage were: (1) beef cattle price reductions, and (2) availability of off-farm employment for resident labor. The other changes either had minor or no effects on the distribution of tobacco acreage among the nine regions.

The tobacco acreage distributions obtained in this study were more concentrated than historically has been the case. With an acreage allotment level the same as that prevailing in 1966 and under the initial conditions set forth in this study, all the tobacco production was concentrated in

regions 2, 4, and 6. In contrast, approximately 45 percent of the total 1966 burley tobacco acreage was actually produced in these regions.

Much of the estimated resident labor supply was not used in the results of this study. To the extent that labor not used in agriculture in at least 6 regions could find employment outside agriculture, the income in the nine regions would be increased substantially. For example, at the 74 cent tobacco price and base allotment level (solution 1 vs solution 1L), the average net income could be increased from $3,679 to $5,178 per farm if three-fourths of the estimated supply not used could find employment outside of agriculture at $1.75 per hour.

If livestock could be increased above the maximum levels of this study, income could be increased; however, the maximum limits except for dairying were 2 to 2.5 times the present levels in the study region. Consequently, it is doubtful that there is room for income improvement in this direction. It would appear that labor not used would need to be channeled into nonfarm activities or to the extent feasible, specialized farm activities not included as alternatives in this study.

Implications

The results reported in this study have implications relative to policy decisions affecting the burley belt. A lease and transfer provision or an allotment sale provision for burley tobacco has been proposed from time to time that would allow burley tobacco acreages to be moved to the more efficient burley producing regions. This study indicates that if such a provision were made in the burley program in an intermediate length of run, region 2, region 4, and region 6 would tend to become relatively larger producers of burley tobacco. Region 1, region 3, region 5,

region 7, region 8, and region 9 would decrease in tobacco production. Region 9, however, would tend to draw some tobacco acreage at higher tobacco allotment levels than presently exist, or at present allotment levels accompanied with the lower labor supplies than estimated for 1972.

With decreases in tobacco allotments and relative mobility of labor, regions 2 and 4 would tend to become the predominant producers of tobacco. Mechanization in tobacco harvesting would likely improve even more the competitiveness of these two regions. However, without harvest mechanization, and with wage rates increasing, regions 6 and 9 would tend to become important producers of tobacco.

The resident labor supplies in regions in which tobacco is produced less efficiently cannot be fully utilized in agriculture. Although the more labor-intensive livestock enterprises would locate in these regions, income could be increased substantially if a large number of the residents obtained off-farm jobs. Provided that livestock production could expand at a favorable price to the limits allowed by the most limiting resources, the relatively more labor-intensive—more land-extensive,

sow-producing feeder pig enterprise would become a major enterprise. Tobacco, assuming acreage allotments, would tend to locate in regions with greater amounts of labor relative to cropland, such as regions 6 and 9, providing yields would be reasonably comparable. Tobacco would be produced in all regions if its production were unrestricted by allotments even at a price as low as 42 cents per pound, and the relative distribution of tobacco acreages would be different, but not markedly so, from the present distribution.

A shift in tobacco acreages among regions would have a major impact on owners of tobacco warehouses, farm input suppliers, and the general economic conditions of the communities affected. Concurrent with changes in policies regarding the production of burley tobacco and the probable effects these changes have on the location of its production, come changes in the economic activities of the communities affected. Ways and means of implementing a smooth transition into some other type of livelihood would be needed both for the people engaged directly in farming and those who serve the agricultural communities as suppliers of inputs.

LITERATURE CITED

[1] Egbert, A. C., and Heady, E. O. *Regional Adjustments in Grain Production: A Linear Programming Analysis.* U. S. Department of Agriculture, Technical Bulletin No. 1241, June 1961.

[2] Heady, Earl O., and Candler, Wilfred.

Linear Programming Methods. Ames: The Iowa State College Press, 1958.

[3] Ranney, W. P. *The Labor Force on Tennessee Farms.* The University of Tennessee Agricultural Experiment Station, Bulletin 304, October 1959.

APPENDIX A

TABLE 1

POTENTIAL LAND USE FOR NINE REGIONS OF
KENTUCKY, TENNESSEE, AND VIRGINIA

Region	Cropland	Improved Pastureland[a,b]	Unimproved Pastureland[c]
		percent of total land in farms	
1	23.8	37.6	44.5
2	30.8	72.4	78.3
3	23.5	62.4	74.5
4	20.9	53.9	74.6
5	14.0	38.6	42.0
6	19.2	44.5	56.3
7	20.5	49.6	55.4
8	9.9	24.3	31.0
9	10.5	33.0	40.3

[a]In this study, it was assumed that hay crops could be grown on improved pastureland.

[b]Includes cropland.

[c]Includes cropland and improved pastureland.

APPENDIX B

TABLE 1

ASSUMED PRICES RECEIVED BY FARMERS (NINE REGIONS—KENTUCKY, TENNESSEE, AND VIRGINIA)

Product	Unit	Price
Crops		
Tobacco	lb.	$ 0.74[a]
Soybeans	bu.	1.35
Wheat	bu.	2.30
Livestock and Livestock Products[b]		
Cull Dairy Cows	cwt.	15.00
Dairy Calves	head	8.00
Surplus Dairy Heifers	head	140.00
Grade A Milk	cwt.	5.26
Grade C Milk	cwt.	3.80
Blend Price for Milk[c]	cwt.	4.75
Market Hogs	cwt.	17.00
Feeder Pigs (40 lbs.)	head	13.00
Boars	head	140.00
Cull sows	cwt.	13.00
Feeder Calves (500 lbs.)	cwt.	21.59
Choice Steers (950 lbs.)	cwt.	23.17
Prime Steers (1,050 lbs.)	cwt.	24.21
Cull Beef Cows	cwt.	15.00
Bulls (Beef)	head	425.00

[a]In addition to the 74 cent per pound tobacco price, prices of 42 cents per pound, 58 cents per pound, 66 cents per pound, 82 cents per pound, 90 cents per pound, and 98 cents per pound were considered.

[b]The prices given are the prices used throughout the analysis except when specifically stated otherwise.

[c]Based on 65 percent class I utilization, .65(5.26) + .35(3.80) = $4.75.

APPENDIX B—*Continued*

TABLE 2

ASSUMED PRICES PAID BY FARMERS (NINE REGIONS—KENTUCKY,
TENNESSEE, AND VIRGINIA)

Item	Unit	Price
Seed		
Tobacco	oz.	$ 2.50
Alfalfa	lb.	0.50
Red Clover	lb.	0.45
Ladino Clover	lb.	0.65
White Clover	lb.	0.65
Korean Lespedeza	lb.	0.19
Bluegrass	lb.	0.80
Orchard Grass	lb.	0.28
Sudan Grass	lb.	0.14
Wheat, Certified	bu.	3.00
Corn, Certified	bu.	13.00
Barley, Certified	bu.	2.10
Rye	bu.	2.50
Feed		
Wheat Bran	cwt	3.80
Soybean Meal	cwt	5.00
Salt	cwt	1.65
Bone Meal	cwt	8.00
Pig Starter	cwt	5.50
Mineral	cwt	4.00
Fertilizer		
Nitrogen	lb.	0.12
K$_2$O	lb.	0.085
P$_2$O$_5$	lb.	0.055
Limestone, spread	ton	3.00
Livestock		
Boars	head	140.00
Bulls (Beef)	head	425.00
Feeder Steers (500 lbs.)	head	21.59
Feeder Pigs (40 lbs.)	head	13.00

APPENDIX C

TABLE 1

ESTIMATED YIELDS PER ACRE FOR MAJOR CROPS (NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA)

Enterprise	Unit	Region								
		1	2	3	4	5	6	7	8	9
		yields (per acre)[a]								
Burley Tobacco	lb.	2,150	2,550	2,350	2,644	2,245	2,525	2,235	2,325	2,425
Corn	bu.	64	87	78	85	70	71	62	64	78
Wheat	bu.	35	51	40	45	40	43	36	40	38
Barley	bu.	31	40	36	35	35	34	32	34	34
Soybeans	bu.	--	34	32	--	--	--	--	--	--
Alfalfa	ton	3.3	3.7	3.7	3.9	3.3	3.6	3.3	3.2	3.3
Red Clover	ton	2.5	3.3	2.7	3.0	2.8	2.7	2.5	2.5	2.7
Lespedeza	ton	1.8	2.3	1.9	2.0	1.7	1.9	1.7	1.7	1.7

[a]The crop yields used in this study are projected 1972 yields. Yields were derived for each of the nine production regions based on data from 1961-1965 Kentucky, Tennessee, and Virginia Agricultural Statistics Reports. Then data were adjusted upward by relative amounts based on information obtained from the study entitled "Production Potentials for Kentucky Agriculture" and other information from specialists in Agronomy.

APPENDIX C—*Continued*

TABLE 2

ESTIMATED ANNUAL PRODUCTION COSTS PER ACRE FOR MAJOR CROPS (NINE PRODUCTION REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA)

Enterprise	Region								
	1	2	3	4	5	6	7	8	9
	Annual Production Cost (per acre) dollars								
Burley Tobacco	489.45	480.73	494.38	507.63	590.53ª	499.93	486.01	530.08	523.73
Corn	37.56	48.52	53.43	40.26	141.44	53.77	49.31	61.25	57.79
Wheat	21.62	24.44	33.32	22.50	59.18	31.99	26.74	34.84	29.54
Barley,	23.72	26.42	37.69	24.04	62.87	32.18	28.27	35.03	31.09
Soybeans	--	24.31	30.84	--	--	--	--	--	--
Alfalfa	58.85	63.73	67.84	59.62	85.89	67.51	58.44	67.54	67.20
Red Clover	39.72	41.15	43.76	41.02	55.38	44.04	41.21	47.75	46.16
Lespedeza	25.77	29.23	32.43	30.24	30.70	32.52	28.97	32.71	31.38

ªBecause of topography, small and irregular field size, rockiness and other land factors, costs of crop production are considerably higher in region 5 than in other regions.

APPENDIX D

TABLE 1

CROP ENTERPRISE LEVELS EXCLUDING TOBACCO FOR SEVEN SOLUTIONS NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA[a]

Solution Identification and Enterprise	Regions									Total of 9 Regions
	1	2	3	4	5	6	7	8	9	
	1,000 acres									
Solution 1										
Corn	588.5	682.2	321.6	526.8	0[b]	274.9	459.7	233.3	692.2	3,779.2
Soybeans	--	205.3	386.0	--	--	--	--	--	--	591.3
Red Clover Hay	0	557.5	398.9	0	0	156.8	192.3	84.5	358.8	1,748.8
Lespedeza Hay	123.8	0	0	552.8	336.9	0	0	0	0	1,013.5
Improved Pasture	217.4	721.3	772.5	383.0	51.7	359.2	460.3	254.9	1,127.9	4,348.2
Unimproved Pasture	170.6	181.4	0	587.0	0	226.3	0	0	0	1,165.3
Sudan Grass	0	0	0	0	221.2	0	0	0	0	221.2
Solution 2										
Corn	588.5	862.9	131.5	548.6	0[c]	282.7	459.7	233.3	692.2	3,799.4
Soybeans	--	32.6	576.2	--	--	--	--	--	--	608.8
Red Clover Hay	0	542.7	327.0	0	0	193.1	192.3	82.2	449.5	1,786.8
Lespedeza Hay	123.8	0	0	552.8	286.5	0	0	0	0	963.1
Improved Pasture	217.4	736.2	844.4	383.0	102.1	322.9	460.3	257.2	1,037.2	4,360.7
Unimproved Pasture	170.6	181.4	0	587.0	0	226.3	0	0	0	1,165.3
Sudan Grass	0	0	0	0	221.2	0	0	0	0	221.2
Solution 3										
Corn	588.5	850.0	111.1	548.6	0[d]	320.6	459.7	233.3	692.2	3,804.0
Soybeans	--	45.2	596.6	--	--	--	--	--	--	641.8
Red Clover Hay	0	543.6	312.9	0	0	142.9	192.3	82.2	512.8	1,786.7
Lespedeza Hay	123.8	0	0	552.8	286.5	0	0	0	0	963.1
Improved Pasture	217.4	735.2	858.6	383.0	102.1	373.1	460.3	257.2	973.9	4,360.8
Unimproved Pasture	170.6	181.4	0	587.0	0	226.3	0	0	0	1,165.3
Sudan Grass	0	0	0	0	221.2	0	0	0	0	221.2

(Continued)

APPENDIX D—*(Continued)*

TABLE 1 *(Continued)*

CROP ENTERPRISE LEVELS EXCLUDING TOBACCO FOR SEVEN SOLUTIONS NINE
REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA[a]

Solution Identification and Enterprise	Regions									Total of 9 Regions
	1	2	3	4	5	6	7	8	9	
	1,000 acres									
Solution 4										
Corn	588.5	835.8	111.1	548.6	0[e]	337.6	459.7	233.3	692.2	3,806.8
Soybeans	--	80.0	596.6	--	0	--	--	--	--	676.6
Red Clover Hay	0	544.7	312.9	0	0	142.5	192.3	82.2	512.0	1,786.6
Lespedeza Hay	123.8	0	0	552.8	286.5	0	0	0	0	963.1
Improved Pasture	217.4	734.2	858.6	383.0	102.1	373.5	460.3	257.2	974.7	4,361.0
Unimproved Pasture	170.6	181.4	0	587.0	0	226.3	0	0	0	1,165.3
Sudan Grass	0	0	0	0	221.2	0	0	0	0	221.2
Solution 5										
Corn	588.5	548.4	496.3	526.8	0[f]	271.3	459.7	233.3	666.6	3,790.9
Soybeans	--	330.7	211.4	--	0	--	--	--	--	542.1
Red Clover Hay	0	557.5	394.9	0	0	151.5	192.3	84.5	368.1	1,748.8
Lespedeza Hay	123.8	0	0	552.8	337.0	0	0	0	0	1,013.6
Improved Pasture	217.4	721.3	776.5	383.0	51.7	364.5	460.3	254.9	1,118.6	4,348.2
Unimproved Pasture	170.6	181.4	0	587.0	0	226.3	0	0	0	1,165.3
Sudan Grass	0	0	0	0	221.2	0	0	0	0	221.2
Solution 6										
Corn	588.5	548.4	533.9	526.8	0[g]	271.2	459.7	233.3	629.0	3,790.8
Soybeans	--	330.7	173.8	--	0	--	--	--	--	504.5
Red Clover Hay	0	557.5	392.1	0	0	151.5	192.3	84.5	370.9	1,748.8
Lespedeza Hay	123.8	0	0	552.8	336.9	0	0	0	0	1,013.5
Improved Pasture	217.4	721.3	779.2	383.0	51.7	364.5	460.3	254.9	1,115.8	4,348.1
Unimproved Pasture	170.6	181.4	0	587.0	0	226.3	0	0	0	1,165.3
Sudan Grass	0	0	0	0	221.2	0	0	0	0	221.2

(Continued)

TABLE 1 *(Continued)*

CROP ENTERPRISE LEVELS EXCLUDING TOBACCO FOR SEVEN SOLUTIONS NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA[a]

Solution Identification and Enterprise	Regions									Total of 9 Regions
	1	2	3	4	5	6	7	8	9	
					1,000 acres					
Solution 7										
Corn	550.6	842.5	380.0	535.4	0[h]	274.1	421.5	165.5	575.7	3,745.3
Soybeans	--	36.6	285.2	--	--	--	--	--	--	321.8
Red Clover Hay	0	557.5	354.6	0	--	147.2	194.0	86.2	480.2	1,819.7
Lespedeza Hay	125.7	0	0	438.2	113.6	0	0	0	0	677.5
Improved Pasture	215.6	721.3	816.8	487.5	167.7	368.8	458.8	253.1	1,006.5	4,506.1
Unimproved Pasture	170.6	181.4	0	0	0	0	0	0	0	352.0
Sudan Grass	0	0	0	0	0	0	0	0	0	0

[a]See Table 5 for the distributions of tobacco acreages in each of these solutions.

[b]No corn was produced in Region 5, but 4.29 million bushels were purchased from the outside.

[c]No corn was produced in Region 5, but 1.33 million bushels were purchased from the outside.

[d]No corn was produced in Region 5, but 1.33 million bushels were purchased from the outside.

[e]No corn was produced in Region 5, but 1.33 million bushels were purchased from the outside.

[f]No corn was produced in Region 5, but 4.29 million bushels were purchased from the outside.

[g]See Table 5 for the distributions of tobacco acreages in each of these solutions.

[h]No corn was produced in Region 5, but 2.41 million bushels were purchased from the outside.

TABLE 2

LIVESTOCK ENTERPRISE LEVELS FOR SEVEN SOLUTIONS NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA

Solution Identification and Enterprise	Regions									Total of 9 Regions
	1	2	3	4	5	6	7	8	9	
				1,000 acres						
Solution 1										
Dairy (cows)	61.9	0	180.8	0	77.4	0	133.6	38.6	182.7	675.0
Beef cow-calf (cows)	0	0	9.6	0	178.3	118.1	0	0	188.4	494.4
Beef-feeder (head)	0	1,226.6	273.5	847.6	0	152.3	0	0	0	2,500.0
Sows Producing Market Hogs (head)	161.5	0	30.2	0	0	61.1	104.0	60.2	208.0	625.00
Buying and Selling of Feeder Pigs (head)	0	1,137.2	0	1,362.8	0	0	0	0	0	2,500.00
Solution 2										
Dairy (cows)	61.9	0	180.8	0	0	82.0	133.6	34.0	182.7	675.0
Beef cow-calf (cows)	0	0	100.7	0	0	4.6	0	50.3	92.4	544.0
Beef-feeder (head)	0	1,193.9	43.8	847.6	296.0	145.7	0	0	269.0	2,500.0
Sows Producing Market Hogs (head)	161.5	85.6	0	0	0	50.1	104.0	61.0	162.6	624.8
Buying and Selling of Feeder Pigs (head)	0	948.4	0	1,551.6	0	0	0	0	0	2,500.0
Solution 3										
Dairy (cows)	61.9	0	180.8	0	0	82.0	133.6	34.0	182.7	675.0
Beef cow-calf (cows)	0	0	117.4	0	295.2	55.0	0	50.3	25.4	543.3
Beef feeder (head)	0	1,196.0	0	847.6	0	0	0	0	456.4	2,500.0
Sows Producing Market Hogs (head)	161.5	80.2	0	0	0	87.2	104.0	61.0	131.1	625.0
Buying and Selling of Feeder Pigs (head)	0	948.4	0	1,551.6	0	0	0	0	0	2,500.0

(Continued)

TABLE 2 *(Continued)*

LIVESTOCK ENTERPRISE LEVELS FOR SEVEN SOLUTIONS NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA

Solution Identification and Enterprise	Regions									Total of 9 Regions
	1	2	3	4	5	6	7	8	9	
				1,000 acres						
Solution 4										
Dairy (cows)	61.9	0	180.8	0	0	82.0	133.6	34.0	182.7	675.0
Beef cow-calf (cows)	0	0	117.4	0	295.2	54.3	0	50.3	26.2	543.4
Beef feeder (head)	0	1,198.2	0	847.6	0	0	0	0	454.2	2,500.0
Sows Producing Market Hogs (head)	161.5	74.3	0	0	0	92.8	104.0	61.0	131.4	625.0
Buying and Selling of Feeder Pigs (head)	0	948.4	0	1,551.6	0	0	0	0	0	2,500.0
Solution 5										
Dairy (cows)	61.9	0	180.8	0	77.4	0	133.6	38.6	182.7	675.0
Beef cow-calf (cows)	0	0	0	0	178.3	135.5	0	43.8	180.6	538.2
Beef-feeder (head)	0	1,226.6	276.9	847.6	0	123.7	0	0	25.2	2,500.0
Sows Producing Market Hogs (head)	161.5	0	92.8	0	0	11.9	104.0	60.2	194.6	625.0
Buying and Selling of Feeder Pigs (head)	0	0	0	1,362.8	0	1,137.2	0	0	0	2,500.0
Solution 6										
Dairy (cows)	61.9	0	180.8	0	77.4	0	133.6	38.6	182.7	675.0
Beef cow-calf (cows)	0	0	0	0	178.3	135.5	0	43.8	180.6	538.2
Beef-feeder (head)	0	1,226.6	271.8	847.6	0	123.7	0	0	30.3	2,500.0
Sows Producing Market Hogs (head)	161.5	0	107.3	0	0	11.9	104.0	60.3	180.0	625.0
Buying and Selling of Feeder Pigs (head)	0	0	0	1,362.8	0	1,137.2	0	0	0	2,500.0

(Continued)

TABLE 2 (Continued)

LIVESTOCK ENTERPRISE LEVELS FOR SEVEN SOLUTIONS NINE REGIONS
OF KENTUCKY, TENNESSEE, AND VIRGINIA

Solution Identification and Enterprise	Regions									Total of 9 Regions
	1	2	3	4	5	6	7	8	9	
					1,000 acres					
Solution 7										
Dairy (cows)	62.8	0	180.8	21.8	53.7	0	134.6	38.6	182.7	675.0
Beef cow-calf (cows)	0	0	51.9	0	0	98.3	0	46.5	69.1	265.8
Beef-feeder (head)	0	1,226.6	147.2	619.6	0	156.9	0	0	349.7	2,500.0
Sows Producing Market Hogs (head)	150.1	0	72.6	102.1	0	60.5	93.0	40.0	106.7	625.0
Buying and Selling of Feeder Pigs (head)	0	2,500.0	0	0	0	0	0	0	0	2,500.0

TABLE 1

RESOURCE USE FOR SEVEN SOLUTIONS (NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA)

Solution Identification and Enterprise	Unit	Regions									Total of 9 Regions
		1	2	3	4	5	6	7	8	9	
	1,000										
Solution 1											
Resident Labor	hours	17,250	37,287	27,811	36,108	13,521	30,467	21,045	9,427	37,692	230,608
Hired Labor	hours	108	8,085	842	9,925	428	8,246	427	187	797	29,045
Capital	1000 dollars	152	503	292	424	165	258	195	107	412	2,508
Total Land Used	acres	1,101	2,407	1,878	2,115	610	1,080	1,113	573	2,180	13,057
Solution 2											
Resident Labor	hours	17,250	38,605	25,745	30,619	8,930	32,546	21,045	9,179	36,803	220,722
Hired Labor	hours	108	6,881	690	6,078	364	7,343	427	182	998	23,071
Capital	1000 dollars	152	510	257	388	145	262	195	106	423	2,438
Total Land Used	acres	1,101	2,407	1,878	2,115	610	1,080	1,113	573	2,180	13,057
Solution 3											
Resident Labor	hours	17,250	38,449	25,589	30,619	8,930	21,333	21,045	9,179	36,183	208,577
Hired Labor	hours	108	6,918	660	6,078	364	2,460	427	182	1,139	18,336
Capital	1000 dollars	152	508	253	388	145	190	195	106	431	2,368
Total Land Used	acres	1,101	2,407	1,878	2,115	610	1,080	1,113	573	2,180	13,057
Solution 4											
Resident Labor	hours	17,250	31,772	25,589	30,619	8,930	16,085	21,045	9,179	36,190	196,659
Hired Labor	hours	108	4,432	660	6,078	364	316	427	182	1,137	13,704
Capital	1000 dollars	152	469	253	388	145	161	145	106	430	2,249
Total Land Used	acres	1,101	2,407	1,878	2,115	610	1,080	1,113	573	2,180	13,057

(Continued)

TABLE 1 (Continued)

RESOURCE USE FOR SEVEN SOLUTIONS (NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA)

Solution Identification and Enterprise	Unit	Regions									Total of 9 Regions
		1	2	3	4	5	6	7	8	9	
Solution 5											
Resident Labor	hours	17,250	37,795	30,397	36,108	13,521	30,834	21,045	9,427	45,718	242,095
Hired Labor	hours	108	9,615	833	10,285	428	8,697	427	187	4,137	34,717
Capital	1000 dollars	152	469	317	424	165	293	195	107	460	2,582
Total Land Used	acres	1,101	2,407	1,878	2,115	610	1,080	1,113	573	2,180	13,057
Solution 6											
Resident Labor	hours	17,250	37,795	30,973	36,108	13,521	30,834	21,045	9,427	57,629	254,582
Hired Labor	hours	108	9,615	827	10,285	428	8,697	427	187	9,026	39,600
Capital	1000 dollars	152	469	322	424	165	293	195	107	529	2,656
Total Land Used	acres	1,101	2,407	1,878	2,115	610	1,080	1,113	573	2,180	13,057
Solution 7											
Resident Labor	hours	29,143	41,343	42,747	35,853	17,863	30,084	31,140	32,975	73,508	334,656
Hired Labor	hours	4,924	9,615	6,136	8,505	5,609	8,321	5,253	9,005	16,204	73,572
Capital	1000 dollars	219	579	375	351	133	251	262	233	640	3,043
Total Land Used	acres	1,101	2,407	1,878	1,528	314	854	1,113	573	2,180	11,948

APPENDIX E—*(Continued)*

TABLE 2

**TOTAL RESIDENT LABOR, HIRED LABOR, CAPITAL AND LAND USED
IN NINE REGIONS IN THIRTEEN SOLUTIONS INVOLVING
CHANGES FROM THE ORIGINAL ASSUMPTIONS**

(74 cent price and 187,876 acre allotment level)[a]

Solution Identification	Resident Labor	Hired Labor	Capital	Land in Production
	1,000 hours		1,000,000 dollars	1,000 acres
Solution 1	230,608	29,045	2,508	13,001
Solution 1A	230,608	29,045	2,508	13,001
Solution 1B	219,183	28,907	2,328	11,431
Solution 1C	227,236	29,590	2,399	13,001
Solution 1D	230,608	29,045	2,508	13,001
Solution 1E	188,888	28,693	2,319	13,001
Solution 1F	247,822	30,214	2,781	13,974
Solution 1G	363,506	27,539	3,230	12,905
Solution 1H	233,160	27,815	2,522	12,775
Solution 1I	232,329	27,773	2,513	13,001
Solution 1J	233,058	29,826	2,499	13,001
Solution 1K	224,482	30,102	2,429	12,319
Solution 1L	208,397[b]	29,044	2,131	11,227
Solution 1M	230,608	29,045	2,508	13,001

[a]See Table 11 for changes associated with solution 1A through 1M.

[b]Includes resident labor used in farming only.

APPENDIX E–*(Continued)*

TABLE 3

TOTAL RESIDENT LABOR, HIRED LABOR, CAPITAL AND LAND USED IN NINE REGIONS IN THIRTEEN SOLUTIONS INVOLVING CHANGES FROM THE ORIGINAL ASSUMPTIONS

(82 cent price and 150,301 acre allotment level)[a]

Solution Identification	Resident Labor	Hired Labor	Capital	Land in Production
	1,000 hours		1,000,000 dollars	1,000 acres
Solution 2	220,722	23,071	2,438	13,001
Solution 2A	220,722	23,071	2,438	13,001
Solution 2B	210,747	22,600	2,278	11,397
Solution 2C	217,200	23,053	2,328	13,001
Solution 2D	220,722	23,071	2,438	13,001
Solution 2E	178,181	22,293	2,245	13,001
Solution 2F	237,453	24,130	2,713	13,974
Solution 2G	352,259	22,683	3,166	12,905
Solution 2H	220,270	22,990	2,543	12,775
Solution 2I	220,737	23,053	2,445	13,001
Solution 2J	221,461	25,006	2,437	13,001
Solution 2K	211,996	25,216	2,355	12,319
Solution 2L	197,070[b]	23,399	2,059	11,227
Solution 2M	220,722	23,071	2,438	13,001

[a]See Table 11 for changes associated with solutions 2A through 2M.

[b]Includes resident labor used in farming only.

APPENDIX F

TABLE 1

ESTIMATED QUANTITIES OF LABOR AVAILABLE FOR HIRE IN SIX LABOR PERIOD, NINE REGIONS–KENTUCKY, TENNESSEE AND VIRGINIA[a]

Region	Labor Periods						Total
	Nov.-Jan.	Feb.-April	May June	July	August	Sept.-Oct.	
	1,000 hours						
1	2,393	2,482	2,793	1,462	1,462	2,659	13,251
2	2,499	2,591	2,916	1,527	1,527	2,776	13,836
3	2,626	2,724	3,065	1,605	1,605	2,918	14,542
4	2,732	2,833	3,188	1,669	1,669	3,035	15,126
5	2,615	2,712	3,051	1,598	1,598	2,906	14,480
6	5,339	5,537	6,230	3,262	3,262	6,772	30,402
7	1,935	2,006	2,258	1,182	1,182	2,150	10,713
8	1,390	1,441	1,622	849	849	1,544	7,695
9	2,172	2,252	2,534	1,327	1,327	2,413	12,025

[a]These estimates were based on a combination of data with regard to historical labor use in the different labor periods, seasonal labor requirements and the availability of labor adjusted to take account of school terms. Also, guidelines for these estimates were partially developed from Tennessee Experiment Station Bulletin 304, *The Labor Force on Tennessee Farms*, W. P. Ranney.

TABLE 2

RESIDENT LABOR AVAILABLE ON FARMS IN SIX LABOR PERIODS NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA
(projected to 1972)

Region	Labor Period						Total Labor Available
	Nov.-Jan.	Feb.-April	May June	July	August	Sept.Oct.	
	1,000 hours						
1	7,448	7,725	5,795	3,034	3,034	5,518	32,554
2	10,517	10,907	8,182	4,284	4,284	7,791	45,965
3	10,110	10,486	7,866	4,118	4,118	7,490	44,189
4	9,619	9,977	7,484	3,918	3,918	7,126	42,042
5	5,350	5,549	4,162	2,179	2,179	3,964	23,384
6	9,213	9,556	7,168	3,753	3,753	6,826	40,269
7	8,361	8,671	6,504	3,406	3,406	6,194	36,541
8	10,067	10,441	7,832	4,101	4,101	7,458	44,000
9	20,555	21,319	15,992	8,373	8,373	17,519	92,131

APPENDIX F—*(Continued)*

TABLE 3

LAND IN FARMS AND DIFFERENT POTENTIAL USES OF LAND NINE REGIONS OF KENTUCKY, TENNESSEE, AND VIRGINIA[a]

(Projected to 1972)

Region	Cropland	Improved Pastureland[b]	Unimproved Pastureland[c]	Total Land in Farms[d]
		1,000 acres		
1	556	878	1,039	2,334
2	924	2,172	2,349	3,000
3	674	1,789	2,136	2,867
4	566	1,460	2,021	2,708
5	199	548	596	1,419
6	316	799	1,011	1,795
7	432	1,046	1,168	2,108
8	213	523	667	2,149
9	394	1,632	1,512	3,752

[a]Farms with 0-9 acres and 1,000 acres or more are excluded.

[b]Includes cropland.

[c]Includes cropland and improved pastureland.

[d]Includes all land in farms—tillable land, as well as forest land and wasteland.

APPENDIX F—*(Continued)*

TABLE 4

HOURS OF LABOR EMPLOYED OFF-THE-FARM AND FULL MAN EQUIVALENTS
THAT COULD BE EMPLOYED OFF-THE-FARM NINE REGIONS
OF KENTUCKY, TENNESSEE, AND VIRGINIA

Region	Solution 1L[a]		Solution 2L[b]	
	Hours	Full Man Equivalents[c]	Hours	Full Man Equivalents[c]
	1,000		1,000	
1	19,464	391	19,464	391
2	16,750	0	16,750	0
3	24,785	551	24,986	559
4	14,358	0	14,630	0
5	22,832	581	22,832	581
6	15,715	0	23,493	0
7	20,553	428	20,553	428
8	36,837	887	37,108	899
9	63,652	1,454	63,646	1,454

[a]The tobacco price for Solution 1L is 74 cents per pound and the allotment level is 187,876 acres.

[b]The tobacco price for Solution 2L is 82 cents per pound and the allotment level is 150,301 acres.

[c]The number of full man equivalents of labor that could be utilized profitably off-the-farm on a full-time basis under the conditions of this study.

1,000-2/71