ABSTRACT

POTENTIAL LIVESTOCK PRODUCTION ADJUSTMENTS
ON FAMILY FARMS IN CENTRAL MACEDONIA, GREECE

By

Loukas Ioannis Ananikas

The dominant problem of the livestock industry in Greece is the growing imbalance between demand for and supply of livestock products. Livestock production has increased during recent years but has failed to keep pace with rapidly increasing consumption. Consequently, Greece has been forced to turn to imports of livestock products to meet growing consumer demands. In addition, the relative consumption among different categories of meat has changed significantly over the past decade. There is a trend toward increasing beef consumption primarily due to an increase in per capita income, urbanization, and education of the people concerning the nutritive qualities of beef.

Various suggestions have been made for increasing livestock production. These suggestions call for introduction of new technology, for reallocation of the existing resources on family farms, for acquisition of more land and

capital, for large scale specialized operations, and for group farming.

In response to the national goals of increasing domestic livestock production, minimizing imports, and improving farmers income relative to other sectors, the main objective of this study were:

(1) To assess the capability of the small family farms to increase livestock production through increased efficiency in resource use.

(2) To evaluate the potential and conditions under which livestock production on small family farms can be expanded by acquiring additional land and capital.

(3) To evaluate the impacts of present and potential price policies on livestock output on individual farms.

Linear programming techniques were used to determine the organizations that would maximize farm income under existing resources, varying land and capital resources, and under varying milk and beef prices. The objective function to be maximized in the model was the farm gross margin. Data concerning the resources, enterprise organization and technology were accumulated from a survey of family farms in Central Macedonia, using stratified random sampling. Data related to input-output coefficients and prices had to be assembled and synthesized from the survey personal interviews with technical specialists, statistical bulletins, and research publications related to the studied area. An

average farm was selected for the purpose of estimating optimum plans, which was assumed to be representative of the small family farms in the area.

The main conclusions of the study were as follows:

(1) Allocative efficiency promises only small improvements given the existing level of resources, technology and farm prices.

(2) Land and capital were the most limiting resources. Returns to land and capital were high in comparison with land rent rates and the opportunity cost of capital.

(3) At the assumed low level of capital the expansion of livestock enterprises was limited by capital, while at the higher level of capital (unlimited credit) the expansion of livestock enterprises was restricted by fall, spring and summer labor.

(4) Since labor resources were not fully utilized, it would be profitable for the farmer and family members to work off the farm providing employment opportunities were available as assumed. The expansion of capital with no expansion in land generated more livestock production and less unemployed labor. On the other hand, expansion of land with no expansion in capital brought about less livestock production and more unemployed labor.

(5) Farm enterprises were sensitive to price relationships. Corn entered the optimal plan only when a milk price of 5.6 to 6.1 Dr/kg was applied. Beef production activity

entered the farm organization when the farm price of beef exceeded 69.0 Dr/kg.

(6) The current level of feed grain subsidy was insufficient to bring about the changes in livestock production desired by the government.

It should be emphasized that the above conclusions are dependent upon the assumptions made in the model. Therefore, farmers and policy makers should not rule out consideration of alternative plans.

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Dedicated

to my parents Ioannis and Maria Ananikas

for all the sacrifices and support they made

for my education in Greece and the United States

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CHAPTER I

INTRODUCTION

Greece is a Mediterranean country of approximately 8,950,000 people in 1972 and an average annual rate of population growth of 0.5 percent. It occupies an estimated area of 131,986 square kilometers (sq. km.) with a population density of 67.8 inhabitants per sq. km.[1]

Greece, a member of the Organization for Economic Co-operation and Development (OECD) and an associate member of the European Economic Community (EEC) since 1961, managed in the relatively short time since the post World War II period to achieve substantial general economic growth. National economic growth usually is defined as a significant, sustained increase in economic output per capita, or in total, as measured in national income accounts. Often it is accompanied by increases in population, and it always involves sweeping changes in technology, institutions, and structures of production and consumption.[2] By certain criteria, Greece's progress in economic growth since 1960 compares favorably with most other developing countries.

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[1]National Statistical Service of Greece, Statistical Yearbook of Greece, 1973 (Athens, Greece, February 1974).

[2]OECD, Food Marketing and Economic Growth (Paris, 1970), p. 14.

This chapter aims at fulfilling three functions: (1) to offer a general view of the Greek economy, (2) to link Agriculture and Livestock sectors to the rest of the economy and, (3) to formulate the problem and specify the objectives of the study.

A Profile of the Economy

Measured in terms of Gross Domestic Product (GDP) in constant prices (1958) and factor cost, the average annual growth rate of the economy was 7.0 percent from 1955 to 1965 and 7.9 percent from 1966 to 1972 (Appendix A, Table A-1). The per capita GDP more than doubled from 1960 to 1971. Using indexes, the per capita GDP index number for 1960 and 1971 was 82 and 177, respectively,with base year 1963 = 100.[3]

In terms of total Gross National Product (GNP) and total Gross National Income (GNI) at constant prices (1958) both more than doubled for the decade 1963 to 1972. The per capita GNP at constant prices increased from $412 in 1960 to $976 in 1972. Respectively the per capita GNI for the same years and prices increased from $369 to $839 (Appendix A, Table A-2).

The average annual rate of population growth for the 1961-1971 period was 0.5 percent. This rate is considered very low and Greece, in terms of population growth, faces

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[3]United Nations, Yearbook of National Accounts and Statistics. Vol. III: International Tables, (New York, 1974).

a reverse of the world problem, with consequences on rural and urban manpower. The 15 to 64 years age group is decreasing in favor of under 15 and over 65 years age groups. The labor force (economically active population)[4] decreased from 43.3 percent in 1961 to 38.6 percent in 1971, almost the same as 20 years ago (Appendix A, Table A-3).

External migration, mainly of the children bearing age, later age at marriage, inadequate income and day-care facilities, economic and political uncertainty, are the main reasons for the low rate of population growth. Also there is a continuous population movement from the rural and semi-urban areas to urban areas. From 1961 to 1971 urban population increased from 43.3 percent to 53.2 percent and during the same time the rural population decreased from 43.8 to 35.1 percent. The urbanization movement has brought important policy questions related to the demand and supply of agricultural products, rural-urban manpower, urban-rural income differences, consumption patterns and tenure problems.

Unemployment rate, 3.4 for 1971, has decreased since 1960, mainly due to development of industry and to external migration.

Total value of imports is more than three times the total value of exports (1973). The importation rate has

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[4]Economically active were considered those usually working and those who are looking for a job.

been increasing more rapidly than growth in exports. The balance of payment deficit increased from 14,722 million drachmas (mil. drs.)[5] in 1961 to 43,068 in 1971 and to 84,009 in 1973. The 1973 balance of payment deficit was almost double that of 1971, primarily due to increased prices of imported goods and to the devaluation of the dollar to which the Greek currency is tied (Appendix A, Table A-4). The present trade deficit is partly compensated by workers' remittances, tourism, shipping and partly by capital inflows. Income from abroad increased by 325 percent from 1962 to 1972, and the total receipts from foreign tourism was 11,790 mil. drs. in 1972.[6]

With respect to monetary situation the international reserves of the country have increased from 273 million dollars in 1966 to 1,112 in 1973.[7]

The average increase in the consumer price index for 1970 through 1972, 3.6 percent, was among the lowest in the world. This was a result of government policies to

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[5]30 drachmas (drs.) = 1 U.S. dollar.

[6]Ministry of Planning and Governmental Policy, "Provisional National Accounts of Greece, Year 1972," (Athens, Greece, March, 1973).

[7]Analytically include.

Gold	148 mil. dol.
Reserve Position in IME	42 mil. dol.
Foreign Exchange	892 mil. dol.
Special Drawing Rights	30 mil. dol.
	1112 mil. dol.

Source: United Nations: Monthly Bulletin of Statistics, Vol. XXVIII, No. 3, (March 1974).

keep down inflation at the expense of the producers, e.g. by maintaining low cereal, milk, meat, and other agricultural product prices. The situation changed rapidly during 1973, when the consumer price index increased by 30 percent, among the highest in the world.[8] This was the result of increasing demands far greater than growth in supplies, the dollar devaluation, and the energy crisis.

Agriculture in the Economy

At the present level of economic development, though industry and services have expanded, agriculture remains a large sector within the total economy; but the rapid growth of the industry and services during the last decade was not following by the agricultural sector. The average annual growth rate of Gross Agricultural Product (GAP) at constant 1958 prices for the periods 1955-65 and 1966-72 was 3.5 and 1.9 percent, respectively. For the same periods and prices the GDP rates for all other sectors were 8.7 and 9.4 percent. Due to the lower growth rate of agriculture as compared to industry and services, its constribution to the GDP decreased from 34.4 percent in 1955 to 15.8 percent in 1972 (Appendix A, Table A-1).

Agricultural labor force was increasing in absolute numbers until 1961. Due to the development of the industry

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[8] Facts on File: World News Digest, Published Weekly, Vol. 34, No. 1742 (March 30, 1974), p. 159 and 254.

and services, also to external migration, particularly of young farmers, the agricultural active population started declining for the first time in 1962 (Appendix A, Table A-3). The decreased active agricultural population and the increased agricultural production indicate a productivity improvement per active unit in agriculture, and also a better per capita income. Indeed the GAP per active person at constant prices was twice in 1971 than in 1961.

The average labor productivity for the whole economy in terms of GDP per active person has improved since 1961, but in the nonagricultural sectors in 1971 was still three times as high as in agriculture. According to OECD conclusions "the transfer of agricultural workers to other sectors of activity remains a powerful means of increasing average productivity in the Greek economy."[9] The exodus of the farm people will influence the structure[10] of the Greek agriculture correcting some of the weaknesses. With further industry development, more labor from rural areas will be absorbed and, the remaining farmers will benefit in terms of increased farm size, consolidation of the already fragmented farms, the employment of more capital intensive methods with better planning, and changes to new

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[9]OECD, "Capital and Finance in Agriculture," Agricultural Policy Reports, Vol. II, (Paris, 1970), p. 4.

[10]Structure in this context includes farm size, tenure system, and land consolidation.

crops and/or more livestock production. The overall result will be increased agricultural production.[11]

Agricultural exports[12] constituted 21.7 and 23.8 percent of total exports for the years 1970 and 1971, respectively. Almost 94 percent of agricultural exports consisted of fruits and vegetables. Agricultural products accounted for 7.8 and 8.4 percent of total imports for 1970 and 1971, respectively. The bulk of agricultural imports is livestock and livestock feed (87 percent for 1970 and 77 percent for 1971). This is one of the reasons why the national agricultural policy is oriented towards increasing livestock production. In general crop production (including fruits and vegetables) continues to predominate in exports. Livestock imports have risen as a result of the demand for livestock products as a consequence of rising income associated with the economic growth.

Structure of the Agricultural Sector

Three structural characteristics of the Greek agriculture are responsible for the growth of agriculture in general and livestock industry in particular. These characteristics are: the farm size, the degree of fragmentation, and tenure arrangements.

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[11]There is a possibility that an increase in the proportion of elderly and part-time farmers, may slow down the rate of increase in productivity.

[12]Included here are: (a) live animals and animal products; (b) food-stuff (cereals-fruits-vegetables) and (c) feed-stuff.

The average farm size is 34.59 stremmas (str)[13] (1971) and although many farm people are moving to urban areas, the size of farms has not changed noticeably since 1961 (Table 1.1).

Table 1.1. Number of Agricultural Holdings, Farm Size and Irrigated Land

	1961	1971
Number of Holdings	1,140,163[1]	1,036,600[1]
Total Area ('000 Str)	36,733	35,863
Average Size (Str)	32.21	34.59
Irrigated Land ('000 Str)	4,890	7,337

[1]Excluding 16,009 for 1961 and 10,660 for 1971 holdings with animals only.

Source: National Statistical Service of Greece, Statistical Yearbook of Greece (Athens, 1973).

Given the small farm size, the policy has been an attempt to increase overall productivity by encouraging new enterprises or enterprise combinations, and increase use of capital for new technology and farm mechanization. This policy appears to have been effective at least for crop production. Shaw's work[14] indicates that "small size units

[13]One stremma (str) = 0.24709 acres.

[14]Lawrence H. Shaw, "Postwar Growth in Greek Agricultural Production." Center of Planning and Economic Research, Special Studies Series No. 2, (Athens, 1969), p. 374. In his work the size variable in terms of crop and livestock was included in regression analysis of factors responsible for regional and product differences in productivity in 1962 in Greece. The obtained coefficients were highly significant.

in Greek agriculture have not served as a deterrent for growth in production." The small farms are also fragmentated with an average of 7 plots per farm. The majority of the farms are owner-operated family farms and the prevailing characteristic is mixed farming. Large farm ownership is practically nonexistent and only a few specialized livestock and crop farms exist. Twenty percent of agricultural land was irrigated in 1971; about 1 percent of total arable land is currently being added each year toward a maximum irrigation potential of about one-third of arable land. With this expansion, more high-income crops and livestock enterprises will be possible.

During the last decade, crop production (including fruits and vegetables) showed a certain improvement in the direction of exportable and import-substitution products. Main exportable products include fruits, vegetables, cotton, tobacco, olive oil, and olives.

Relative Place of Livestock Industry

Gross agricultural output is defined as the sum of crop production (including trees and vegetables) and livestock production. Crop production during the last decade showed an increase in the direction of exportable and import-substitution products.

In spite of the fact that livestock production accounts for only about one-fourth of gross agricultural production (as compared to one-half for the United States)

it has made an increasing contribution to agricultural output.

The material in this section describes the general pattern of changes in the livestock-meat sector in terms of production, consumption and imports. Such material can help provide a basis for defining the problem and specifying the subsequent analysis for dealing with the problems.

Total meat production increased from 190 thousand metric tons in 1962 to 387 thousand metric tons in 1972, e.g. by 103.6 percent. Poultry production has increased by 283 percent from 1962 to 1972, followed by beef-veal at 176 percent. Pork production has also been of considerable importance particularly during the last years accounting for 52.5 percent increase from 1962 to 1972. Sheep and goat production importance has been declining in relation to other kinds. The change was an increase of 43 percent over the period 1962 to 1972. Milk production has increased by 35.5 percent over the same period (Appendix A, Table A-5).

The dominant problem in the livestock industry is the growing imbalance between demand for and production of livestock products. Total meat consumption has more than doubled since 1962 to a total of 481 thousand tons in 1972 (Appendix A, Table A-6). The relative consumption of different categories of meat has changed significantly over the past decade 1962-1972 (Table 1-2). There is a

Table 1-2. Per Capita Meat and Milk Consumption in Kgs Per Year

Year	Beef and Veal	Veal	Beef	Pork	Mutton Lamb Goat	Poultry	Meat Total	Milk[1]
1962	6.5	2.5	4.0	4.9	9.9	3.0	26.0	44.9
1963	8.8	3.2	5.7	4.7	10.5	3.5	29.5	46.1
1964	8.8	3.9	4.9	4.7	11.4	3.8	30.7	49.4
1965	10.9	4.8	6.1	5.7	13.0	4.4	36.3	55.4
1966	12.1	6.3	5.8	5.9	13.5	5.5	39.4	60.7
1967	13.0	6.8	6.7	5.4	13.7	6.7	41.1	65.7
1968	14.8	7.9	6.9	5.0	13.4	6.1	41.6	65.7
1969	16.1	8.1	8.0	5.2	14.2	7.3	45.4	66.1
1970	18.0	8.3	9.7	5.9	14.9	8.4	49.8	66.5
1971	16.3	8.5	7.8	6.1	17.5	9.2	51.6	67.2
1972	16.9	9.6	7.3	6.9	17.1	10.2	54.0	66.9

[1]Whole milk for liquid consumption or processing into cream and other fresh products.

Sources: OECD, "Meat Balances in OECD Member Countries," (Paris, January 1974).

OECD, "Milk and Milk Products Balances in OECD Member Countries," (Paris, July 1974).

National Statistical Service of Greece, "Statistical Yearbook of Greece," (Athens, February 1974).

trend toward increased beef and veal consumption primarily due to an increase in per capita income (per capita income in current prices has risen from 454 dollars in 1962 to 1,224 in 1972), changes in relative prices and education of the people concerning the nutritive qualities of beef. Per capita beef and veal consumption increased from 6.5 kilograms in 1962 to 16.9 kilograms in 1972. Per capita lamb-mutton and goat meat consumption also increased but at a slower rate than beef consumption (from 9.9 kilograms

in 1962 to 17.1 in 1972). The overall per capita meat consumption (beef, lamb, etc.) has reached 54.0 kilograms in 1972 (26.0 kilograms for 1962). Milk consumption has also increased from 44.9 kgs. per capita in 1962 to 66.9 kgs. in 1972.

Consequently, Greece has been forced to turn to imports of livestock products to meet growing consumer demands. Total meat imports have increased from 30 thousand tons in 1962 to 114 thousand tons in 1971. Under current world market conditions, there is national concern about dependence on foreign supplies for livestock products. During 1970-71, imports of meat, dairy products, and live animals amounted annually to nearly $130 million. By meat categories, poultry imports have been declining, beef and veal have increased by 50 percent since 1965, pig meat imports reached zero for the last three years, mutton, lamb, and goat meat imports have increased by 40 percent since 1965, and dairy product imports have more than doubled since 1965 (Table 1-3).

In 1972, 18.2 million dollars were paid to import live animals, mainly cattle. The main countries exporting to Greece are: Yugoslavia for live animals, E.E.C. and South America for meat, and E.E.C. for the bulk of dairy products (Appendix A, Table A-7).

One of the main objectives of the government's policy in relation to the livestock-meat sector is to stimulate

Table 1-3. Meat Imports in Thousand Metric Tons

Year	Beef and Veal	Pork	Mutton Lamb Goat	Poultry	Total Meat
1962	17	1	10	2	30
1963	28	1	15	6	50
1964	22	1	20	6	49
1965	31	2	32	11	76
1966	31	-	34	11	76
1967	37	1	35	12	85
1968	45	4	33	8	90
1969	55	1	36	6	98
1970	68	-	40	3	111
1971	51	-	60	3	114
1972	45	-	46	3	94

Sources: OECD "Meat Balances in OECD Member Countries," (Paris, January 1974).

production in order to minimize imports which have increased considerably the last five years. The FAO/IBRD Livestock Identification Mission[15] to Greece in May 1971 concluded that "even with maximum development, continuing imports of beef and sheep meat will be required, whereas poultry, pork, and dairy production could meet market requirements." This is so far true except that maximum development has not yet taken place.

The Structure of the Livestock Industry

The livestock enterprises may be considered supplementary enterprises to the extent that they contribute to

[15]FAO/IBRD Cooperative Programme, "Greece: Livestock and Dryland Agriculture Identification Mission" (May 13, 1971), p. 5.

farm income without curtailing other productive activities and complementary enterprises to the extent that they utilize the by-products coming from the production or some of the crops. There are only a few specialized meat and dairy product farms. The increased production has come primarily from mixed family farms. Of the 243,300 holdings with cattle, only 240 holdings during 1971 reported more than 50 head of cattle. Almost 79 percent of the holdings are in the category of between 1 and 4 cattle (Table 1-4).

Table 1-4. Distribution of Cattle Holdings 1971[1]

	Number of Cattle per Holdings[2]						
	Total	1-4	5-9	10-19	20-29	30-49	50 & Over
Number of Holdings	243,300	192,720	39,400	9,100	1,220	620	240
Number of Cattle	836,280	413,500	244,920	113,240	22,000	28,120	14,500

[1]A Sample of a 5 percent of total farms.

[2]Include dairy, beef cattle and the dual purpose cattle.

Source: National Statistical Service of Greece, "Statistical Yearbook of Greece," (Athens, 1973).

The existing livestock breeds may be classified in three general categories: (a) domestic breeds; (b) improved domestic breeds; and (c) foreign (exotic) breeds. The policy has been to move from the domestic breeds of low productivity to improved domestic and foreign breeds. From 1961 to 1971 the unimproved domestic cattle decreased by an

average of 11.7 percent. The improved and foreign breeds increased by 10.6 and 7.1 percent, respectively.[16] Nearly all of the cattle industry is dual-purpose in nature (milk and beef), and milk is still the main product of the small farm. Production decisions are primarily taken in relation to the milk market. Only on a few farms is beef production the major enterprise. These types of farms buy calves to fatten rather than produce their own.

According to the Agricultural Bank of Greece, the government in an attempt to increase production provided 2.23 million dollars in 1971 for large-scale operation subsidies. This amount was increased to 3.6 million dollars in 1972. The results of direct subsidies to these operators are only partially known. It is known that pork production increased in 1973 due to the large specialized operations. Little is known about the results of direct subsidies to specialized producers in veal-beef production because beef production takes such a larger period of time from initiation to marketing than is the case for hogs.

Problem Setting

As discussed in previous sections livestock production has increased during recent years but has failed to keep pace with rapidly increasing consumption. A substantial increase in meat production was achieved by further fattening

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[16]National Statistical Service of Greece, op. cit.

calves, by taking at least one calf from a heifer before slaughter, by decreased mortality rates, increased calving rates, better breeding practices, disease control, improved breeds, and better nutrition and housing. Part of the production increase has been achieved by the reduction of the breeding herd.

At the farm level low prices of livestock products, price uncertainty, instability in terms of future government programs, management problems, profitability of crop enterprises and, import-export policies complicate decision making and planning processes for livestock producers. Under these conditions they hesitate to expand and/or adjust their operations despite the increasing demand. Other important factors retarding livestock adjustments are: the small and fragmented farm size in terms of land area, the focus of government programs during the 1960's which has favored crop expansion rather than livestock and, the lack of livestock feed and feeder calves during recent years.

The overall consequence of the above mentioned factors has been the unwillingness of farmers to undertake livestock enterprises, continuing low productivity in the livestock industry, and finally insufficient supplies of meat and dairy products to meet the growing consumption at given prices.

The gap between domestic supply and demand is covered by imports of live animals, meat (fresh and frozen) and dairy products. The year by year increasing loss of

foreign exchange due to insufficient domestic supplies led the government recently to change its general policy emphasis from crops to livestock production. In view of the goals of achieving self-sufficiency and simultaneously reducing livestock imports and, improving livestock producer's income, the last two five-year economic development plans (1968-1973 and 1973-1978)[17] provide the necessary preconditions to accelerate the development of the livestock industry. This will be achieved through higher prices to the producers, credit availability, farm improvements, breeding improvements, technical assistance, duty-free imports of breeding animals and feed price concessions.

From the demand side increased income per capita, urbanization, and better education allowed the standard of living of the average consumer to be improved as reflected in the increase in the per capita consumption of meat and dairy products. The food requirements of the Greek consumer have altered in recent years as diets have improved, e.g. from cereals to meat and dairy products. In this situation, the agricultural sector is under pressure to adjust its structure to the new conditions by making changes in farm organization and farm practices.

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[17]Ministry of Coordination, "Economic Development Plan for Greece, 1968-1972." (Athens, February 1968), p. 61.; and James Frink, "Greece Unveils 5-Year Plan to Revitalize Past Farm Goals," Foreign Agriculture (U.S.D.A., October, 22, 1973), pp. 6-8.

From the farmer's point of view the livestock production adjustments problem is one of maintaining and/or increasing income while better utilizing the family labor. From the government's point of view the adjustments will result in an increase in meat and dairy supplies, a reduction in the use of foreign exchange for livestock products, so improving the balance of payment situation and an overall increase of agricultural sector income. Hence, the per capita income gap between agriculture and nonagriculture sectors would be narrowed. The total adjustments and expansion over the country will affect the demand for land and capital, the number of farms and farmers and, the average size of operation. Also the reorganization will call for transferring part of the resources from crop to livestock production as well as possible reallocation of resources from one region to another.

The study will not attempt to examine the efficacy of or the social cost associated with increased livestock production through large scale specialized operations. The consideration will be centered on the small family farms.[18]

The Objectives

In response to the national goals of increasing domestic livestock production, minimizing imports, and improving

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[18]Small in terms of cropland size and number of livestock units; family farms in terms of labor which is provided only from the operator and his family.

farmers income relative to other sectors, the specific objectives of the study are:

(1) To assess the capability of the small family farms to increase livestock production through increased efficiency in resource use.

(2) To evaluate the potential and conditions under which livestock production on small family farms can be expanded by acquiring additional land and capital.

(3) To evaluate the impacts of present and potential price policies on livestock output on individual farms.

The study will be restricted to the examination of the potential adjustments on the average farm. This will be accomplished by reallocating the existing resources and by adding more resources to the limited land and capital. No attempt will be made to empirically discover the potential contribution of introducing new technology. The analysis will be concentrated on crop and cattle enterprises and will not consider poultry, swine, sheep and goat enterprises. It will also focus on the individual farm adjustment and will not emphasize the interregional or international aspects of the problem.

Plan of Study

In Chapter II, the national and regional setting of the cattle production industry in Greece will be more fully developed with a discussion of the relevant policy issues. Chapter III will describe the research methodology

and analytical procedures used, from data collection to final analysis. It will include the description of a linear programming model with parametric objective function which will be used in the analysis. The Linear Programming model is presented in Chapter IV. This chapter discusses the model activities, coefficients and resource restrictions used in the study area (Central Macedonia). Chapter V is devoted to Linear Programming optimal solutions where present average conditions are compared with several potential changes. Chapter VI provides an interpretation of the results, some policy implicatons of the study and suggests areas for future research.

CHAPTER II

THE NATIONAL AND REGIONAL SETTING OF THE CATTLE PRODUCTION INDUSTRY: DESCRIPTIVE ANALYSIS

Recent changes in the Greek agricultural economy in terms of technology, consumption patterns, inputs availability, the institutional setting, prices and other economic forces have shifted concern among farmers and extension personnel from crops to livestock production. The Greek Government through the Ministry of Agriculture and the Agricultural Bank of Greece has been instrumental in influencing this concern. The position has been taken that adjustments in resource use are possible which will make for more efficient farm operations. Before moving into the adjustment problems, knowledge on the organization of production at the national and regional level will be provided. The general objectives of this chapter are: (1) to provide some degree of familiarity to the readers who are not familiar with the Greek livestock industry, and (2) to provide the basis and linkages for constructing the model. Also the structure of the industry is prerequisite knowledge for policy makers.

Natural Characteristics

In general, the Greek climate is of the Mediterrenean type, with hot, dry summers and mild winters. Rainfall averages only around 16 to 25 inches a year although considerably more falls on the west coast and mountains. In Thessaloniki (subregion of the study area) rainfall averages from .7 inches in July and August to 2.5 inches in October and November with an annual average total of 17.9 inches. Temperature ranges from 49°F in January to 90°F in July and August with an annual average of 19 frost days.[1] Most of the mainland consists of mountainous or hilly-semimountainous areas with two important plains for future development of Macedonia and Thessaly.

In the study area of the 14,319 thousand stremmas, 31.7 percent is cultivated area, 14.1 percent communal pasture and 14.8 percent, private pasture.[2] Each community member has the right to graze the common pasture with a year average grazing fee of 60 Dr. per animal unit. Most of the area is considered as natural pasture with a limited number of facilities. Domestic cattle breeds mainly use the communal pasture which is supplemented by fallow land and crop residues after harvesting.

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[1]Data compiled from reports of "Statistical Yearbook of Greece," and "An Outline of the Climate of Greece," by E. G. Mariolopoulos (Athens).

[2]National Statistical Service of Greece, "Agricultural Statistics of Greece, 1961," (Athens, Greece).

Size and Location of Cattle Industry

Due to the lack of reliable statistical data to allow a distinction between dairy, beef and dual purpose cattle, it has been necessary to examine the changes and trends for all together.

From 1935 to 1972 three times (1935, 1956 and 1971) cattle population numbers remain almost the same (Table 2.1). The shocks of the industry due to World War II and Civil War and the continued change from domestic (indigenous) to improved and foreign breeds may partly explain the delayed development. If 1947 is considered as base year for comparison, the cattle population increased from 693 thousand to 1,069 thousand in 1961 and remained almost stable or slightly decreased thereafter. The average rate of change has been a 2.34 percent increase from 1955 to 1960, a 0.51 percent decrease from 1960 to 1965 and a 0.21 percent decrease from 1965 to 1972 (Table 2.1).

No attempt was made to explain the above changes as cyclical fluctuations. Papaioannou[3] using simultaneous equations to explain the cyclical fluctuations of cattle in Greece, found that "the cycle moves in a regular oscillatory but, nonetheless, damped pattern, with an eight year duration."

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[3]M. C.Papaioannou, "Quantitative Analysis and Agricultural Policy with Special Reference to Animal Breeding in Greece," Options Mediterraneennes, No. 8 (August, 1971), p. 70.

Table 2.1. Cattle Numbers in the National Herd ('000 Head)

Year	Total	Domestic	Improved[1]	Foreign[2]	Milked Cows
1935	975	---	---	---	---
1947	693	---	---	---	---
1956	981	---	---	---	---
1961	1,069	767	261	40	383
1962	1,060	705	309	46	394
1963	1,034	646	339	49	407
1964	1,017	561	406	50	402
1965	1,046	499	489	58	416
1966	1,082	439	573	70	437
1967	1,094	394	624	76	452
1968	1,038	328	641	69	453
1969	1,097	290	639	68	445
1970	952	251	629	72	438
1971	986	223	672	91	---
1972	1,056	---	---	---	---

[1]Cross breedings with domestic cattle and dairy-beef cross-breedings.

[2]Exotic or pure breeds mainly for milk production.

Source: Statistical Yearbooks of Greece, op. cit.

A simple price quantity cobweb-theorem will not offer any complete explanation of the cyclical movements. This is due to the "exogenous variables. . .of the system which must be regarded as the determina factor on both quantities and prices. . . "[4] Even with the existence of an eight-year

[4]Ibid.

cycle, we do not know its causes well enough to design viable policy mechanisms. This is one of the main reasons for continuously changing policies and control devices in the livestock industry.

Part of the beef and veal production increase during recent years has been achieved by the reduction of the breeding herd. This leads to the conclusion that one of the goals of the 5-year plan (1973-1978) to increase all types of meat production to 555,000 tons, or 70 percent more than in 1971, without decreasing the stocks, will not be realized.

Most cattle are maintained in the level zones (plain areas) and the numbers have increased since 1961. Of 1,069 thousand cattle in 1961, 56 percent were concentrated in level areas, 23 percent in semimountainous and 21 percent in mountainous areas. The coresponding numbers for 1970 are 64, 20 and 16 percent, respectively for level, semi-mountainous and mountainous areas.[5] This means that no emphasis has been given to the expansion of beef and dual purpose breeds to pasture areas, and the continuous increase of the cattle population in the level areas will require an increase in the production of feed-grains and forages.

While the national herd decreased by 4,000 cattle in 1972 as compared to 1962, cattle population in the study

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[5] Statistical Yearbook of Greece, 1962, 1972, op. cit.

Table 2.2. Cattle Population in Central Macedonia

Subregions	1962	1967	1968	1969	1970	1971	1972
1. Chalkidiki	12,772	11,394	10,672	10,776	10,053	11,115	13,008
2. Imathia	23,345	32,720	31,089	28,827	28,912	31,053	32,703
3. Kilkis	46,955	48,467	45,392	43,105	42,102	43,023	47,205
4. Pella	50,626	57,839	60,284	61,907	60,524	59,957	61,101
5. Pieria	18,151	15,235	13,389	12,036	11,557	11,935	15,815
6. Thessaloniki	59,854	63,323	65,640	64,667	63,916	70,220	75,846
Total	211,703	228,978	226,466	221,318	217,064	226,943	245,708
Total Greece	1,060,000	1,094,000	1,038,000	1,097,000	952,000	986,000	1,056,000
Percent of Total Greece	19.97	20,92	21.82	21.81	22.79	23.0	23.26

Sources: (1) National Statistical Service of Greece, "Agricultural Statistics of Greece," Years 1966, 1967, 1968, 1969, and 1971 (Athens, Greece).

(2) Ministry of Agriculture; Local Agricultural Offices.

area increased by more than 34,000 cattle indicating a trend and willingness by the farmers in this area to produce more cattle (Table 2.2). Chalkidiki subregion has the lowest concentration (number of cattle per 100 stremmas cultivated land) followed by Pieria, Kilkis, Imathia, Thessaloniki, and Pella with the highest (Table 2.3). The average concentration of 3.79 for the region is higher than the average for the whole country (2.45). The average carrying capacity for both private and communal pasture is approximately .51 cattle per 10 stremmas.[6]

Table 2.3. Cattle Concentration in Central Macedonia, 1969

Subregion	Cattle Number	Cultivated Area (Th. Str.)	Concentration
Chalkidiki	10,776	940	1.14
Pieria	12,036	558	2.15
Kilkis	43,105	1,132	3.80
Imathia	28,827	715	4.03
Thessaloniki	64,667	1,545	4.18
Pella	61,907	939	6.59
Total	221,318	5,829	3.79

Source: Agricultural Statistics of Greece, 1969, op. cit.

[6] 10 Stremmas = 1 hectare.

Few specialized dairy or beef operations exist. The average size of cattle enterprises in 1961 was 2.9 cattle, increased to 3.4 in 1971. Almost 79 percent of holdings belong in the category of 1-4 cattle in 1971 as compared with 85 percent during 1961.[7]

Cattle Breeds[8]

About 72 percent of all Greek cattle in 1961 belonged to the two indigenous breeds of Greek Shorthorn and Greek Steppe cattle, while 24 percent belong to the various crossbreeds (domestic improved) and 4 percent were foreign (pure) breeds. The situation had changed by 1971, with 23 percent indigenous breeds, 68 percent crossbreeds, and 9 percent foreign breeds. Improvements have been stimulated through artificial insemination campaigns by experienced technicians.

The Greek Shorthorn is found mostly in South Greece while the Greek Steppe is to be found in Macedonia, Thrace and the eastern area of Thessaly. Due to the long time for adaptation, both are in harmony with a wide range of soil conditions, topography and altitudes. Both are small in size with an average liveweight for the Shorthorn of 180-200

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[7] Agricultural Statistics of Greece, 1961, op. cit.; and Statistical Yearbook of Greece, 1972, op. cit.

[8] This part draws from the study of FAO, "European Breeds of Cattle," FAO, Vol. II, (Rome, 1966).

kg. and for the Steppe of 285-300 kg. Milk production range is 500-1,200 kg. depending upon feed provided, grazing situation and housing facilities.[9] For meat production purposes both breeds are not efficient because of their poor muscular development.

Because of the low productivity of the indigenous breeds, Brown Swiss[10] from Switzerland, Germany and United States, Friesians from the United States and Denmark, Simentals from Yugoslavia, Angelin, Hereford, Holstein, Jerseys and Aberdeen Angus from United States and Europe, have been imported for grading up the indigenous stock and for pure breeding purposes. Brown Swiss has been used the greatest extent, due to its dual-purpose characteristics. It exhibits a good rate of gain, e.g., 1.05 kg. a day average for bulls and .85 kg. for heifers. Meat is of good quality with comparatively little fat. Friesians have been used successfully for dairy operations. The results for the beef breeds "have not been really satifactory owing to the lack of opportunities to express their hereditary characters economically because of dietary restrictions."[11]

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[9] If the animals are kept in barns with good quality feed, the average annual milk yield will be around 1,200 kg.

[10] The common name for Brown Swiss by the Greek farmers and extension personnel is Schwyz, due to the origin from the canton of Schwyz (Switzerland).

[11] European Breeds of Cattle, op. cit., p. 308.

Simentals from Yugoslavia have been used after weaning to finished weight.

Production Systems

Cattle operations range from specialized production systems to small enterprises in mixed family farm situations. The following types of operations predominate in cattle production:

(1) Specialized dairy production: There is a small number of specialized dairy cattle farms, based on foreign (pure) breeds (Friesians, Holstein) mainly located close to the big cities (peri-urban herds). The cows are confined throughout the year and receive purchased feeding stuff. The only land available is for the buildings (stable, and feed storage) and other livestock facilities. Out of 1,047,260 total holdings in 1971 only 10,660 belong in this category.[12] In Thessaloniki subregion 10 percent of the total cattle population during 1972 belonged in the category of foreign breeds. (Thessaloniki is the second largest city of Greece.) The corresponding number for Pella-subregion is 3.9 percent.[13]

The size of operation depends mainly upon feed supply, capital and space availability, and milk prices. The main

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[12]Including all the livestock confined operations (beef, pork and poultry). Statistical Yearbook of Greece, 1972, op. cit., p. 142.

[13]Ministry of Agriculture, Provincial Offices.

products are milk and replacement heifers. With calving rate approximately 85-90 percent and a replacement rate of 16.6 percent, the surplus heifers either remain in the same operation (if the operator has the desire and ability to expand his herd size) or are sold to other specialized dairy operations. Bull calves are a by-product of the milking herd and are marketed as deacon calves to specialized beef production farms. Recently, some of the operators attempted to take advantage of current trends in the Greek meat market by keeping the bull calves to be marketed as feeders or finished cattle and thereby develop a dairy-beef operation. The operation depends upon beef-milk prices, feed situation, housing and other facilities. The bull calves from the dairy herd could also be a source for veal production, highly preferred by the Greek consumers. Another source of beef production from the dairy herd is from the cows culled after the final lactation period.

The average milk production is approximately 4,000 kg. per year. Milk yield for individual herds depends upon the breeds, feed rations, sanitation and management factors. Dairy specialists from the United States believe that "the tendency by Greek farmers to keep dairy cows tethered in a stable probably prevents these cows from being most productive; and most certainly results in the use of an excessive amount of labor."[14]

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[14]F. A. Kutish and H. G. Sitler, "A Study of the Economics of Land Use and Livestock Production in Greece." United States Department of Agriculture (June 1967), p. 31.

(2) Specialized beef production: Beef production can be separated into four phases: (a) producing the calf, (b) growing the calf (veal, baby beef), (c) fattening the calf, and (d) producing from animals culled from the producing herd. All the phases or combinations can be carried out in the same farm or on various farms as in the United States. The specialized beef operations in Greece can be classified in two categories. First, a cow-calf operation based on beef imported breeds mostly Aberdeen Angus and Hereford from the United States carrying out both breeding and fattening processes on their own or rented land. The calves are retained until finished, pastured most of the time and provided additional feed grains and forage during winter months. Management of production including disease control and marketing are the most serious problems in this type of operation.

The other type of specialized beef production is that of large scale calf operations based on improved breeds imported from Yugoslavia and the United States which carry out only the fattening process. Depending upon the location of the operation, the availability of good pasture and feed grain, space availability and capital to meet requirements, the calves can be either confined or pastured. United States calves are purchased with initial weight of 50-60 kg. and sold at 450-500 kg. Yugoslavia calves are purchased at weaning weight and sold at 450-500 kg. The calves are fed from 5-6 kg. of concentrates and 2-3 kg. of

alfalfa daily. A daily weight gain of about 1-1.2 kg. is the target. In Greece, where "it is the policy of the Government not to permit meat comparable to that of United States choice grade to be sold at a higher price than other cattle, the initial cost of American calves is too high to result in a profit."[15] Another problem faced by the calf fattening operations is the world-wide shortage of calves explained by the traditionally exporting countries meeting their own needs for beef before selling to other countries. Yugoslavia, the main exporter of live animals to Greece, "counts baby beef as a top export and has recently concluded a 5-year agreement (1973-1978) with the European Community to assure a stable market there."[16] Also the lack of good quality grazing land constrains the keeping of herds for beef production.

Due to the above problems Greece will need to develop her long range production base for beef either on improved-native cattle through crossbreeds or on well adapted foreign breeds.

(3) Beef and milk production from dual purpose cattle: This is the largest category in the Greek herd in terms of cattle units and production of milk and beef. The herd is either crossbreds between domestic and foreign, as many of

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[15] F. A. Kutish and H. G. Sitler, op. cit., p. 26.

[16] Foreign Agriculture, USDA, Foreign Agricultural Service, (November 26, 1973), p. 7.

the smaller local breeds are being bred to more productive breeds such as the Brown Swiss, or crosses between dairy-beef breeds. During 1971, crossbreeds in Central Macedonia represented 75.6 percent with 16.3 domestic and 8.1 foreign.[17]

The average annual production of milk per cow is in the range of 1,500 kg. to 3,000 kg. according to breed used for crosses and management practices. The operation is small in terms of animal units and farm size. A range of 3-15 animal units per farm were found in the study area. Feed is partly provided by the farm and partly purchased from the free market or provided by the Agricultural Bank at lower prices. Bull calves are raised on the same farm to slaughter weight. Heifer replacements are also produced and the surplus heifers are kept, fattened, or sold as live animals according to the Government's policy and the desire of the operator to expand. Replacement heifers for the dairy-beef crossbreed herd must be purchased to satisfy the genetic characteristics and the desire for more milk or beef. In any case, milk-beef production does not take place in isolation from the rest of the farm, but forms a part of the farming system of the family farm. The farmer depends partly on the market for additional feed and replacements, but produces and raises his own calves, therefore partially solving the problem of calf shortages.

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[17]National Statistical Service of Greece, Agricultural Statistics of Greece, Yearbook, 1971 (Athens, Greece), pp. 80-81.

The concernof this analysis is on the above discussed type of operation, mainly on the dairy-beef crossbreed herds which are confined all year or which may be allowed out for exercise and some grazing. The analysis does not consider beef as a by-product from the dairy herd, but considers both milk and beef as products from a dual purpose cow. It is the belief of the author that this type of operation will provide the bridge to move from small-mixed operations to specialized ones in a step-by-step movement.

One of the big problems faced by the Greek specialized large-scale operations is lack of skill in dairy and beef management and marketing. Also large-scale beef operations require higher pasture quality than typically found in Greece. Good forages must be available also for the small (5-20 animal units) dual purpose cattle, in order to reach their inherent milk and beef production capacity. Forages are grown on the farm and moved to the stall and fed to the cow with the required balanced grain ration. The farmer, by finishing his own calves in response to the current shortage of calves, increases the output of meat per animal and increases profits by using surplus wheat, barley and roughages.

Research in the United States (North Carolina) has demonstrated that crossbred calves:[18] (1) show greater

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[18]C. R. Shumway, E. Bentley and E. R. Barrick, "Economic Analysis of a Beef Production Innovation: Dairy-Beef Crossbreeding," North Carolina State University, Department of

viability than purebred calves; (2) are larger than traditional beef calves; (3) are weaned earlier; (4) have higher pregnancy rate; and (4) yield a higher return to land, labor and management than beef cattle.

In general, Greece is characterized by climatic and physical conditions rather unfavorable to animal production, and a controlled environment with confinement facilities and good quality crossbreds cows may be part of the solution until pastures are improved, and better dairy and beef management skills are developed.

(4) Beef and milk production from the indigenous cattle: This is a low productivity cattle operation, producing both milk and beef from the well adapted domestic herd. Some years ago the same animals were used also for work, but increased use of mechanized equipment for farm operations has almost eliminated this practice. These small enterprises with 1 to 3 animal units provide balance in the small farm operation by utilizing slack labor and crop by-products and by providing milk and beef to the family. The main policy is to upgrade the domestic herd by crosses with foreign breeds. This has been done successfully during the last decade by using mostly artificial insemination. Milk production ranges between 500 and 1,200 kg. per

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Economics, ERP-26 (March 1974). This economic study compares one crossbreeding system, Angus-Holstein cows bred to a Charolais bull, with purebred Angus cattle.

year and the calves raised reach a maximum of 350 kg. live weight. Cows and calves pasture together mainly on the low quality communal pasture and receive a small amount of additional feed grains during winter.

Productivity Measures and Slaughterings

Cattle productivity is usually expressed in terms of extraction rate, calving rate, mortality rate, and in general, growth rate. Growth rate was examined in previous sections and show that the development of the industry during the last decade was very low.

Extraction Rate

The extraction rate is the proportion of the cattle population marketed each year. To calculate the extraction rate the number of cattle slaughtered was assumed equal to the number of cattle marketed. It was calculated for various age groups according to available data. The extraction rate for all cattle was found for 1971 equal to 54 percent as compared to 31 percent for 1961 (Table 2.4). This extraction rate may be compared with 40 percent in United States, 29 percent in Australia, 24 percent in Argentina.[19] It is considered very high and thus offers some explanation for the low development of cattle herds in terms of total

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[19]A. Posada. "A Simulation Analysis of Policies for the Northern Colombia Beef Cattle Industry." (Ph.D. dissertation, Michigan State University, 1974).

Table 2.4. Cattle Slaughterings, Extraction Rate, and Productivity Index for Selected Years

Year	Cattle '000	Slaughterings '000	Extraction Rate (Percent)	Productivity Index
1961	1,069	329	31	29
1966	1,082	490	45	67
1967	1,094	507	46	69
1968	1,038	536	52	81
1969	1,097	592	54	86
1970	952	559	59	94
1971	986	535	54	87

Source: The Extraction Rate and Productivity Index have been calculated by the author using as basic data those provided by the Statistical Yearbooks of Greece (1962-1972).

population. Among the factors that keep high extraction rate, the unfavorable cow milk prices, favorable seasonal beef prices and feed shortages played the most significant role. The extraction rate for calves with age less than a year is more than 50 percent (57 percent for 1966) and shows an irregular trend, depending upon veal prices, milk prices, inputs availability, mortality rates and various government policies. The proportion of calves slaughtered for veal is extremely high and reflects traditional preferences of the Greek consumer for veal. Logically, feeding of these animals to heavier weights would increase beef supply.

Calving Rate

The number of calves born as a percent of females at breeding age depends upon genetic characteristics (breed), climate, adaptability of particular breed, nutrition, sanitary and medical care. A low calving rate suggests a potential for improvement in the production of calves. The model calving rate was found in the study area to be approximately 80 percent, with a range from 65 to 100.[20]

Mortality Rate

Mortality rate averages 6 percent a year for all cattle. Death losses are greater among calves during the first months where the rate reaches 8-12 percent.

Average Slaughter Weight

Average slaughter weight (carcass weight) is indicated in Table 2.5 for calves less than 2 years old, cattle more than 2 years and all cattle together. It shows an increasing trend and space for improvement. The trend to increase average carcass weight has been attributed mainly to government policy, and diseases control, and is the result of more intensive fattening and of the fewer calves slaughtering for veal. Failing to increase the slaughter weight, more calves will be needed for a given amount of beef output.

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[20]The FAO Study "Marketing of Livestock and Meat" for Greece, TF-77 (Rome, 1967) accepts a calving rate equal to 40 percent (p. 5). This rate is very conservative though their definition is the number of calves born per 100 head of cattle.

Table 2.5. Average Slaughter Weight in Kg/Head, 1967-1972

Year	Calves (0-2 Years)	Cattle More Than 2 Years	All Cattle
1967	146	168	151
1968	149	174	154
1969	150	173	155
1970	160	176	163
1971	168	182	163
1972	173	187	---

Source: The data were compiled from the following sources: (a) Agricultural Statistics of Greece, 1968-1971, op. cit.; (b) KEPE, Development in the Livestock Industry," (Athens, 1972); (c) Statistical Yearbooks of Greece, 1967-1972, op. cit.

Seasonal fluctuations in slaughtering exists as a result of demand for veal, beef and milk, feed and housing availability, and such local factors as religious mores (Appendix B, Table B-1).

Productivity Index

Productivity index (Table 2.4) is obtained by dividing the production of the year (in kg. carcas weight) by the cattle population during the same year.[21] It is a combination of extraction rate and average carcass weight, and shows whether veal-beef production grows faster than cattle numbers. The productivity index increased from 26 in 1960 to the high 80s or low 90s ten years later.

[21] OECD. "The Market for Beef and Veal and Its Factors," (Paris, 1967), pp. 16-17.

Feed Production

Feeding stuff is the major input for cattle enterprises as it represents more than 55 percent of the total cost and increases as output of milk increases (Table 2.6). Economic and technical interdependence exists among feed and cattle production as "any change that affects either feed or meat must inevitably influence the supply and/or demand conditions of the other."[22]

Table 2.6. Contribution of Various Expenses to the Total Costs Per Cow According to Milk Production

Expenses	Milk Production in Kg		
	1501-2000	2001-2500	2501-3000
1. Labor (Percent)	20.8	20.2	19.2
2. Feed (Percent)	57.3	59.3	60.0
3. Depr., interest, mort. per cow	14.2	13.3	13.5
4. Depr., interest, repairs of bldgs.	4.1	3.8	3.9
5. Vetr., taxes	3.6	3.4	3.4
Total	100.0	100.0	100.0

Source: The table was adopted from G. J. Kitsopanidis, "The Economics of Milk Production in Central Macedonia, Greece," Agricultural Economic Review, Vol. VI, No. 1, (Thessaloniki, 1970), p. 18.

[22] D. Colyer and G. Irwin, "Beef, Pork, and Feed Grains in the Cornbelt: Supply Response and Resource Adjustments." (Columbia, Missouri, August 1967), p. 9.

Depending upon the feeding system (confined or not), size and location of cattle operations, the cattle feed is composed of feedgrains, fodder crops and supplements. The majority of the small, cattle enterprises on mixed farms feed their animals with crop by-products or crop residues otherwise wasted. Domestic breeds use the communal land for grazing and small quantities of grains.

Dairy operations, dual purpose cattle production and calf fattening enterprises on specialized farms have controlled environment confinement facilities in which cows and calves receive only harvested feed grains and forages. "The grain component of feeds has soared in recent years, reacting to high protein meal prices."[23] Therefore, feed grains prices is another major factor determining to the profitability level for milk and beef production.

Greece has increased rapidly its grain and forage production, but even with the existing livestock population the total supply is inadequate. Appendix B, Tables B-2 and B-3 present the feed grains and fodder crops production situation from 1963 to 1972. As Table B-2 indicates area under wheat has been decreased by 17.7 percent, but total production increased by 25 percent from 1963 to 1972. This

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[23] J. Lopes, "Greece to Triple '73-74 Grain Imports," Foreign Agriculture, USDA, (October 22, 1973), p. 8.

has been largely a function of new varieties, fertilizers and mechanization, which have resulted in yields increasing from 1,314 kg. per hectare in 1963 to 1,998 kg. per hectare in 1972. Area under barley and total barley production have been increased by 135 and 319 percent, respectively from 1963 to 1972. This was the result of a substantial transfer of area under wheat to barley production and increased average yield by 78 percent. Corn area has decreased slightly but the production has increased by 129 percent, due to an increase in average yields per hectare by 158 percent, resulting from new hybrid varieties on irrigated land.

The production of fodder crops in Greece has also increased, but still is in a deficit stage. Alfalfa makes up the largest percentage of fodder crops increasing from a total of 614 thousand tons in 1963 to 1,700 thousand tons in 1972 (Appendix B, Table B-3). Green corn production increased by 125 percent but still its contribution to livestock feed is very small. The feeding of corn silage is not practiced on the small farms.

Feed grain requirements have exceeded production especially in recent years as a direct result of the livestock industry's adjustments which have been accelerated by various incentives of the government. The situation has caused Greece to import substantial amounts of feed grains (mainly corn) and high protein meals (fish meal,

meat meal and soybean meal) and build up its feed mixing industry to improve feeding efficiency. Feeding stuff imports (not including unmilled cereals) reached $19.3 million in 1972, an increase of 421 percent from 1963 (Appendix B, Table B-3).

Greece's dependence on foreign supplies for feed and in view of the short world supply of grain and high protein meals, has shifted government's concern in the direction of self-sufficiency at least in feed grains.

With this background with regard to the livestock and feed situation in Greece, we turn to the research methodology which would analyze the small farm's role in this situation.

CHAPTER III

RESEARCH METHODOLOGY AND ANALYTICAL PROCEDURES

Given the nature of the problem and the objectives of the study, the techniques that were employed involve the use of linear programming analysis and budgeting to build on the descriptive analysis thus far presented.

Linear programming analysis is the main analytical approach used in this study to examine the impact of enterprise reorganization on farmer's income, livestock supplies, and government policies. Budgeting and further descriptive analysis supplements this main analytical approach. Parametric linear programming methods were used to investigate the impact of a variation in milk, beef prices and resource levels on enterprise organization and farm income.

The objective function to be maximized in the programming model is "gross margins" which is defined as total receipts less variable production costs. This measure of farm income was considered as the goal to be maximized because if it cannot be shown that more livestock on family farms will increase farm income, then we cannot expect farmers to respond in ways favorable to present national goals.

The steps by which the study was proceeded from data collection to final optimal solutions are as follows:[1]

(1) defining the study area,

(2) choosing the sample size,

(3) designing the questionnaire,

(4) surveying the area,

(5) using the survey data to define average farm resource situations,

(6) constructing the model,

(7) programming the average farm, and

(8) applying price mapping and resource mapping to the optimal plan.

The first five steps will be presented in this chapter.

Sources of Data and Area Studied

Several sources of data, both primary and secondary were used. The major data source for determining the resource base, production and organization information was the survey undertaken in the study area. Data concerning the input-output coefficients had to be assembled and synthesized from the survey, secondary sources, personal interviews from technical agricultural extension specialists and economists or were drawn from research publications

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[1]The first four steps were accomplished by the Department of Agricultural Extension and Sociology, (Head, Professor Anthony Adamopoulos), University of Thessaloniki, in collaboration with the author, and were financed by the National Research Institute.

related to the study area. The coefficients reflect an assumed level of technology, size of farm, number of cattle and institutional structure. Price data for both inputs and products to be marketed were obtained from the National Statistical Service of Greece.

The area chosen for the empirical analysis is the Central Macedonia, which is a region of the Macedonia division.[2] The primary reasons for choosing Central Macedonia are: (1) Central Macedonia is the largest producing region in Greece in terms of cattle production and population. In 1972, 23.26 percent of Greece's cattle population was concentrated in Central Macedonia producing 23.6 percent of the total beef production in Greece.[3] (2) Livestock production has improved markedly because of improved technology, better quality of feed and feeding practices. Low productivity domestic breeds have decreased from 48.31 percent in 1964 to 13.15 percent in 1972 to give space to improved domestic and foreign breeds (Table 3.1).

Secondary reasons for choosing Central Macedonia include: (1) the area is more familiar to the author in

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[2]Greece is divided in ten divisions as follows: (1) Greater Athens, (2) Central Greece-Euboea, (3) Peloponnesos, (4) Ionian Islands, (5) Epirus, (6) Thessaly, (7) Macedonia, (8) Thrace, (9) Aegean Islands, (10) Crete. Macedonia has three regions namely Central Macedonia (the study area), Eastern Macedonia, and Western Macedonia.

[3]National Statistical Service of Greece, Agricultural Statistics of Greece, 1971. (Athens, Greece, 1973), pp. 80-92.

Table 3.1. Cattle Breeds in Central Macedonia

Year	Domestic Breeds	Improved Breeds	Foreign Breeds
	----------Percent----------		
1964	48.31	51.56	.04
1970	21.08	71.97	6.95
1972	13.15	76.18	10.67

Source: National Statistical Service of Greece, op. cit.

terms of farm organization and practices resulting from his participation in a number of research projects there. Where judgment was required, this previous experience helped to properly specify the objective function, constraints and activities, and therefore minimize the specification error. (2) There are several publications related to the agricultural industry of the area, which the author used for reference. (3) Technically it was easier to collect the survey data by using well trained senior Agricultural College students at the author's alma mater, and (4) the thesis project was a part of a research project undertaken by the Department of Agricultural Extension and Sociology, University of Thessaloniki, and was financially supported by the National Research Institute.

The studied area consists of six subregions (Nomos): Chalkidiki, Imathia, Kilkis, Pella, Pieria, and Thessaloniki,

with an area of 14,855 square kilometers (total Greece covers an area of 131,986 square kilometers), and a population of 1,890 thousand which represents 21.5 percent of the total Greek population.[4]

Sampling Procedures

The population of the "Central Macedonia Livestock Project," of which this thesis is a part, was defined to include all the types of farms from specialized crop and tree farms, specialized livestock farms to mixed family farms which constitute the majority of farms. First a random sample of 630 farms to be interviewed was drawn from the entire population and a subsample of 190 farms was drawn from the initial sample for the purpose of this thesis. This subsample includes mixed family farms with cattle enterprises. Excluded are specialized large scale livestock farms and farms with mainly crop, vegetables or fruit production.

The heterogeneity of the population in terms of livestock practices, soils and vegetation conditions, topography, type of farming and metropolitan influence led to the use of stratified random sampling method for the purpose of taking into account those differences. The basic idea was that, "it may be possible to divide a heterogeneous population

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[4]National Statistical Service of Greece. Statistical Yearbook of Greece, 1973 (Athens, Greece, February 1974), pp. 18-19.

into subpopulations, each of which is internally homogeneous."[5]

The overall sampling procedure was carried out in two phases.

Phase 1: Recognizing topography as a major determinent of the land use, and rural-urban differences in terms of production, consumption and marketing, the total number of communities and municipalities (population) was stratified in a three way classification according to geographic subregion, elevation above sea level, and population size (number of inhabitants). The "population" N was divided into subpopulations of N_1, N_2,. . .,N_R, so that $N_1 + N_2 + ,. . ., + N_R = N$. The final sample size is denoted by n and it is equal to the sum of sample sizes within the strata ($n_1 + n_2 + ,. . ., + n_R = n$). Each stratum weight ($W_R$) is equal to $W_R = \frac{N_R}{N}$. The sample variance s_R^2 is used here as an unbiased estimate of the population variance S_R^2. According to "optimum allocation" method[6] the sample size is given by the formula:

$$n = \frac{(W_R s_R)^2}{\frac{d^2}{t^2} + \frac{1}{N} W_R s_R^2}$$

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[5]William G. Cochrane, Sampling Techniques, Second Edition (New York: John Wiley and Sons, Inc., 1963), p. 88.

[6]Anthony L. Adamopoulos, "Farm Land as a Basic Criterion of Sampling in Agricultural Economic and Social Regional Surveys." (Thessaloniki, Greece, 1960), pp. 23-24; and W. G. Cochrane, op. cit., p. 104.

where t = 1.96 for P = 0.95

d = the desired half-width of confidence interval where $\frac{d^2}{t^2} = V$ is the desired variance in the sample estimate.

s_R = the standard deviation of the average animal units for each community and municipality in Central Macedonia.

Applying the above formula the sample size was estimated equal to 90 communities and municipalities. For better distribution in the whole region, iso-distances and replacement purposes 15 percent extra communities were selected for a total of 103 to be surveyed. The distribution of the total sample size (n) within the strata was obtained by using the formula

$$n_R = \frac{W_R s_R}{\Sigma W_R s_R} n$$

Phase 2: After selecting the number of communities the number of holdings to be interviewed was selected with almost the same method as Phase 1. The difference is that N_R in Phase 2 denotes the number of holdings for each sea-level stratum and geographic subregion, and the used standard deviation was from the average farm size. The final sample to be interviewed was found equal to 610 holdings. Extra holdings were selected for replacement purposes (Table 3.2).

Table 3.2. Sample Size (Selection of Communities and Holdings)

Subregion	Communities (Number)	Sample Size (Phase 1) (Number)	Holdings[1] (Number)	Sample Size (Phase 2) (Number)
1. Thessaloniki	121	33	10,709	175
2. Pieria	44	11	3,296	54
3. Pella	85	15	3,256	95
4. Imathia	65	14	2,542	87
5. Kilkis	76	15	3,267	119
6. Chalkidiki	76	15	3,332	80
Total	467	103	26,402	610

[1]The number of holdings correspond to the number of communities included in the sample.

Questionnaire Design and Interviewing

A questionnaire[7] was designed to be used in collecting farm resources data, production and marketing practices, farm receipts and expenses, labor requirements, and input-output coefficients. These data were collected by personal interview. Senior agriculture college students of the University of Thessaloniki, in training at the Department of Agricultural Extension and Sociology were used as enumerators. The interviews were conducted in the summer of 1974 to cover the 1973-74 crop season.

[7]Part of the questionnaire used is included in Appendix C.

Construction of an Average Farm

For programming purposes an average farm was chosen from the stratum 0-249 meters from sea level and representative of the six subregions. The same stratification used for the sampling procedure was utilized to classify the farms. The average farm concept was more appropriate for the specific purpose of estimating optimal plans for the region.[8] Thus, the arithmetic mean was used for the most of the analysis, except for special cases, such as tractor availability where the "mode average" was used. Farms with more than ten cows were dropped from the average farm in order to reduce the upward bias of the herd size. Also farms with domestic breeds were not considered in the analysis. This was done to reflect the trend of changing to improved domestic and foreign breeds.

The decision to use only one average farm was made in order to offer the opportunity for more detailed analysis using parametric techniques. A large number of average farms can be avoided by using some parametric resource and price programming on fewer farms.[9] Therefore, an optimal organization for the average farm was computed at various combinations of milk and beef prices (price mapping), and at various resource levels (resource mapping)..

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[8]Jerry A. Sharples, E. O. Heady and M. M. Sherif. "Potential Agricultural Production and Resource Use in Iowa," R. B. 563, (Iowa State University, June 1969), p. 425.

[9]Jerry A. Sharples, "The Representative Farm Approach to Estimation of Supply Response." USDA (December 1968), p. 10.

Theoretical Considerations

The linear programming technique was used to find optimum combination of activities which maximizes farm income expressed as gross margins for given prices, input-output coefficients and resource constraints.

The mathematical formulation of the model in matrix notation is as follows:[10]

$$\text{Max } Z = C'X$$

$$\text{Subject to: } AX \leq B$$

$$\text{and } X \geq 0$$

Where Z = objective function to be maximized

C = n by 1 vector of prices

X = n by 1 vector of activity levels

A = m by n matrix of input-output coefficients

B = m by 1 vector of available resources.

The above model assumes that the supply of resources, input-output coefficients, prices of resources and activities are known with certainty. In reality when "uncertainty exits as to the proper resource restrictions, input coefficients or prices to be used, modified simplex methods can be used to advantage."[11] A conceptualization of such a linear programming problem with parametric objective function is given

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[10] E. O. Heady and W. Candler, Linear Programming Methods. (Ames, Iowa: Iowa State University Press, 1973), p. 416; and Olabisi Ogunfowora, "Derived Resource Demand, Product Supply and Farm Policy in the North Central State of Nigeria." (Ph.D. dissertation, Iowa State University, 1972), p. 12

[11] E. O. Heady and W. Candler, op. cit., p. 232.

by Ogunfowora[12] as follows:

$$\text{Max} \qquad Z_\alpha = \sum_{j=1}^{n} C_j X_j$$

$$\text{Subject to} \qquad \sum_{i=1}^{m} a_{ij} X_j \leq b_i$$

$$\text{and} \qquad X_j \geq 0$$

Where $Z = Z(X_1, X_2, \ldots, X_j, \ldots, X_n)$

$$C_j' \leq C_j \leq C_j''$$

$$\frac{C_j'' - C_j'}{\lambda} = k \text{ or } C_j'' - C_j' = \lambda k$$

Z_α = the α^{th} objective function to be maximized for a given price level within the acceptable price range.

b_i = the level of the i^{th} resource available

C_j' and C_j'' = the lower and upper limits of the price of the j^{th} activity

λ = constant increment in the price of the j^{th} activity

k = the number of optimum solutions within the price range

In the above modification it is assumed that farms have achieved an optimum organization before price changes occur.

The details on the construction of the model and the solutions will be presented in Chapters IV and V, respectively. The problem was solved on the CDC 6500 computer at Michigan State University using the CDC APEX-I program.

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[12] O. Ogunfowora, op. cit., p. 13.

CHAPTER IV

THE STRUCTURE OF THE LINEAR PROGRAMMING MODEL

The mathematical formulation of the model was presented in Chapter III following a discussion in Chapter II of the structure and policy issues of the livestock industry. This chapter will provide the structural components of the model in terms of activities included, resource levels, and input-output prices.

Model Activities

Seven general types of activities were included, classified in 44 columns (A_1 - A_{44}) as follows:

(1) Crop production activities (A_1 - A_4)

(2) Land rent activities (A_5 - A_6)

(3) Crop selling activities (A_7 - A_{11})

(4) Feed buying activities (A_{12} - A_{18})

(5) Livestock production and selling activities (A_{19} - A_{33})

(6) Labor selling and hiring activities (A_{34} - A_{41})

(7) Capital borrowing activities (A_{42} - A_{44})

Growing and selling tobacco activity was also added to the initial solutions. In subsequent solutions tobacco was eliminated and the resources used for tobacco were transferred to other activities in the model.

The activities to be included were identified by the

researcher in the survey area and/or were suggested by the farmers or agricultural extension specialists as new feasible activities. Activities or enterprises which made no significant contribution to the average farm output have been excluded, e.g., poultry, vegetables for home consumption, 1-2 pigs, and small number of trees. The budgets for crop and livestock production activities (variable costs and returns) were synthesized using the survey data, previous studies, unpublished data and personal interviews with crop and livestock specialists. All the sources will be identified during the discussion of particular budgets. The existing semi-advanced level of technology was assumed for crop production which allow for the use of more fertilizers, new higher yielding crop varieties, mechanization and disease control. For livestock production activities, lower than average technology was assumed in terms of mechanization and feeding facilities and semi-advanced technology in terms of housing facilities and genetic improvement of cattle.

Crop Production Activities

Crop enterprises considered were wheat, barley, corn for grain, and alfalfa, which could be sold, fed to livestock or both. At the present, corn silage is not a common practice for the small family farms. Wheat and barley are allowed only on nonirrigated land while corn and alfalfa are permitted on irrigated land. The crop activities, their

variable costs, and their requirements for land, labor and capital are presented in Tableau I. Obviously, different labor, land, capital and price assumptions would result in different costs. Annual budgets are presented in Appendix D, Table D-1. A summary of estimated annual costs and returns in terms of gross margins per stremma is presented in Table 4.1. For all Tableaus negative signs in front of the objective function coefficients (C_j values) indicate costs and no signs (implying positive) indicate income, while negative signs in front of coefficients indicate additions to resources and no signs indicate use of the resources.

Table 4.1. Annual Costs and Returns Per Stremma for Crop Production Activities

Activities	Total Revenue	Total Variable Costs	Gross Margin
	----------Drachmas----------		
Wheat	1,047	301.1	745.9
Barley	1,059	281.8	777.2
Corn	1,598	355.4	1,242.6
Alfalfa	2,880	464.6	2,415.4

Source: Appendix D, Table D-1.

Tableau I. Crop Production, Rent Land and Crop Selling Activities[1]

Row No.	Resources		Crop Production Activities				Rent Land Activities		Crop Selling Activities				
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
		Units	PRWH Str	PRB Str	PRC Str	PRA Str	RLNI Str	RLI Str	SSTR Kg	SWH Kg	SBAR Kg	SCORN Kg	SALF Kg
		C_j	-301.2	-281.8	-355.4	- 464.6	-240	-400	.75	3.60	3.40	3.40	2.4
1	NIL	Str	1	1			- 1						
2	IL	Str			1	1		- 1					
3	RNIL	Str					1						
4	RIL	Str						1					
5	WH	Kg	-245							1			
6	STR	Kg	-220	-234					1				
7	BAR	Kg		-260							1		
8	COR	Kg			-470							1	
9	ALF	Kg				-1200							1
24	AFL	Hours	4.08	3.7	33.8	25.9							
25	FL	Hours	1.31	1.0	11.8	4.6							
26	WL	Hours	.51	.7	.5	1.6							
27	SL	Hours	.62	.5	7.0	6.2							
28	SUL	Hours	1.64	1.5	14.5	13.5							
30	OPC	Dr	301.2	281.8	355.4	464.6	240	400					

[1]The explanation of abbreviations used in the above and followed tableaus are given in Appendix D, Table D-2.

Land Rent Activities

Renting land was included as a means to increase the farm size and to permit examination of the influence of this activity on farmer's income and enterprise organization. Because of the difference in rental rates among irrigated and nonirrigated land, the separate treatment of these land categories is justified.

The objective function coefficients (C_j value) include the actual rent paid by the farmers and reflects an average rent for the study area. Rent activities were based on the assumption that out-migrating farmers will rent their land to continuing farmers and will not turn to extensive cultivation, e.g. wheat production. The initial amount of rented land was estimated from data received from the farmers interviewed; however later, average size was permitted to increase. No land was allowed to be sold for cash.

Crop Selling Activities

All crop products and by-products were permitted to be sold or fed to livestock or both. Because of the concession subsidies provided for feed grains by the Agricultural Bank of Greece, farmers may sell part of their own crops for cash and buy back from the Bank at a price lower than the market. This amount of cash was also used to finance the business during the year. The objective function coefficients (C_j value) for crop selling activities indicates prices received by the farmers during 1973-74

period and reflects an average for the whole country. A country average was used instead of study area average due to the wide variation of prices and marketing practices found in the area.

Feed Buying Activities

In addition to wheat, barley, corn, alfalfa and straw grown on the farm, bran and cotton cake were allowed in order to reflect what farmers are actually feeding. The prices for purchased feed stuffs were higher than the corresponding selling prices and correspond to the free market price. This was done, first to take into consideration transportation cost, and second, as a solution devise to provide the opportunity for the farmers to use their home-grown feed. In reality, part of the feeding stuff is provided through the Agricultural Bank of Greece with prices at least .50 Dr lower than in the free market.

Other feed in the ration included high protein meals such as fish meal, sugar beet pie, soya meal or ready concentrates from the new mixture feed factories. Vitamins and minerals are also provided in the concentrates and were included in computing variable costs.

Livestock Activities

One way to increase the size of business for small family farms with limited resources, mainly land, is through intensive livestock production enterprises. This can be

Tableau II. Feed Buying Activities

Row No.	Resources	Units	Feed Buying Activities						
			A12	A13	A14	A15	A16	A17	A18
			BCORN Kg	BBAR Kg	BALF Kg	BBR Kg	BSTR Kg	BWH Kg	BCC Kg
		C_j	-3.5	-3.5	-2.5	-3.1	-1.0	-3.7	-4.0
5	WH	Kg						-1	
6	STR	Kg					-1		
7	BAR	Kg		-1					
8	COR	Kg	-1						
9	ALF	Kg			-1				
10	BR	Kg				-1			
11	CC	Kg							-1
30	OPC	Dr	3.5	3.5	2.5	3.1	1.0	3.7	4.0

achieved through better utilization of existing resources with the same or different feasible activites. Therefore, in the initial analysis, expansion will take the form of a more intensive use of presently controlled resources. Later in the analysis expansion will be examined by gaining control over additional land and capital resources.

The enterprises considered for this analysis are in the category of cow-calf operation and the calves are finished on the same farm with home-grown and/or additional purchased feed. All the calves are produced on the farm, except for improved breed replacements which can be purchased if the farmer wants to improve his herd and providing price relationships warrant it. Because the assumed breeds are dual purpose (milk and beef), coming from dairy-beef crossbreedings, the system is flexible in terms of more beef production and less milk or vice versa.

By considering these enterprises it was hypothesized that the farmer will be able to make effective use of his available labor during the winter months when it otherwise has few economic alternatives. Also these enterprises would have the advantage of requiring less capital when the calves are raised on the farm than if purchased. This organization is also expected to increase veal-beef production by eliminating one of the main obstacles, e.g. the shortage of calves supplied for fattening enterprises.

The profitability of a particular enterprise, feed availability, diseases, and government policies for

livestock production and marketing, are the most important factors for the producer to make the decision as to which age and weight he will market his calves. The following flow diagram (Figure 4.1) provides the basis for building the livestock production and marketing activities.

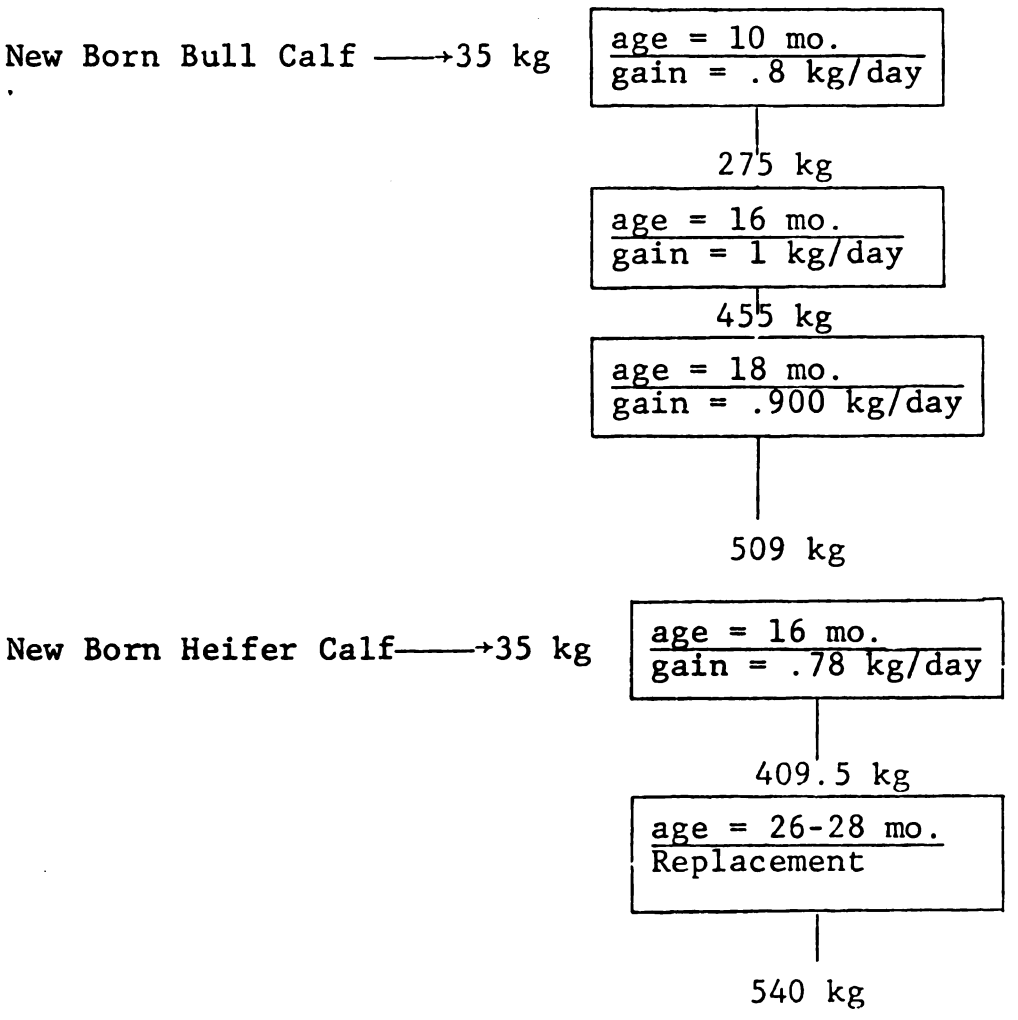

Figure 4.1. Bull calves and heifers flow diagram.

Only in special cases like diseases or feed shortage will the farmer slaughter heifers instead of keeping them for replacement or sale as live animals to specialized

fattening enterprises. No bulls are kept and their services are provided by artificial insemination showing up as a variable cost.

Livestock activites are presented in Tableau III (A_{19} through A_{33}). For each activity (enterprise) a unit was assigned together with the corresponding amount of concentrates, forages, labor and capital used to produce the unit. The objective function coefficients (C_j values) indicate variable costs when raising activities and gross returns when selling activities are considered. The selling activity objective function coefficients were calculated by using the formula:

$$G_t = W_t * C_t * P_t$$

Where:

G_t = gross returns

W_t = live weight

C_t = carcass weight coefficient

P_t = average received farm price

t = time period

Live weight can be controlled by the producer while prices are controlled by supply and demand or through government interventions.

All of the returns and costs are obtained by the budgeting process and are shown in Appendix D, Tables D-3 and D-4.

Two cow activities (Cow I and Cow II) have been included

Tableau III. Livestock Activities

Row No.	Resources	Units	Livestock Activities													
			A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	A30	A31	A32	A33
			DPCS Head	DPC Head	RSTE Head	RSSI Head	RSE Head	SST Head	SSS Head	SSE Head	RHAS Head	RHATE Head	SHSL Head	SHSS Head	BREP Head	SCCO Head	SMILK Kg
		C_j	-558	-558	-270	-410	-465	10703	15799	15876	-410	-752	15500	14218	-2667	9963	4.50
5	WH	Kg			72	144	174				144	130					
6	STR	Kg	1460	365	300	480	540				480	840					
7	BAR	Kg	469	469	288	576	666				576	851					
8	COR	Kg	782	782	216	432	552				432	772					
9	ALF	Kg	2190	2555	810	1890	2250				1890	2997					
10	BR	Kg	365	365	144	216	246				216	402					
11	CC	Kg	157	157		72	102				72	87					
12	COW	Head	1	1													
13	SC	Head	- .4	- .4	1	1	1										
14	HC	Head	- .4	- .4							1	1					
15	S10[1]	Head			-.94			1									
16	S16	Head				-.94			1								
17	S18	Head					-.94			1							
18	H16	Head									-.94		1	1			
19	HREP	Head	.166	.166								-.94			-1		
20	CULL	Head	-.159	-.159												1	
21	MILK	Kg	-2500	-2500	300	300	300				300	300					1
22	HFC	Head	1	1											1	-1	
23	HFSH	Head			1	1	1	-1	-1	-1	1	1	-1	-1			
24	AFL	Hours	305	305	75	120	135				120	224.5					
25	FL	Hours	76	76	22.5	22.5	30				22.5	52.5					
26	WL	Hours	75	75	15	22.5	22.5				22.5	45					
27	SL	Hours	77	77	15	37.5	37.5				37.5	60					
28	SUL	Hours	77	77	22.5	37.5	45				37.5	67					
30	OPC	Dr	558	558	270	410	465				410	752					
33	MLLC	Dr													16000		

[1]Since the proportion of male calves which is castrated is unknown, the terms steer and bull calf have been used interchangeably in the text.

to reflect the two feeding systems with and without straw. Both activities assume 80 percent calving rate with 50 percent bull calves and 50 percent heifers, and 15.9 percent of the cows are culled each year. The alternative of replacing cows by purchasing or by raising replacements is permitted in the model. No purchase of calves (except replacement heifers) were permitted, but they were transferred from the cow-calf activities to be raised to slaughter weight by any of the calf-raising activities. Raising bull calves and heifers activities are examined with specific start weight, gain per day, and selling weight. The model was designed to reflect government's policy by keeping a bull calf until it reaches 450 kgs liveweight and a heifer until it produces the first calf. Also the enterprises were designed to represent the situation where difficulty exists in terms of feeding stuff availability and prices, variation of slaughter prices and environmental considerations such as diseases and hazard weather. The alternative of feeding calves on pasture was not considered owing to the shortage of good quality pasture land and the lack of consistent and complete data.

Since cattle can be raised and sold at various ages, and weights, the following activities were considered.

Raising activities: A_{21} = raise bull calves for 10 months

A_{22} = raise bull calves for 16 months

A_{23} = raise bull calves for 18 months

A_{27} = raise heifers for 16 months

A_{28} = raise heifers replacements for 28 months.

Selling activities: A_{24} = sell 10 month old bull calves

A_{25} = sell 16 month old bull calves

A_{26} = sell 18 month old bull calves

A_{29} = sell 16 month old live heifers

A_{30} = sell 16 month old slaughter heifers

Additional activities:

A_{31} = Buy replacements

A_{32} = Sell cull cow

A_{33} = Sell milk

The demand for baby beef and veal was assumed to be satisfied mainly through domestic calves not otherwise fattening to heavy weights and from specialized dairy bull calves.

Labor Selling and Hiring Activities

Labor selling and hiring activities are also included for any season during the year. The wage rates are those averages at the study area during the survey period. Labor can be sold out from the available stock of family labor hours. Exchange of labor among farmers during peak periods

was assumed to cancel out. Of course, when additional labor was required, payments were made. In kind payments were transferred to money value by multiplying the product with its average price. Labor selling and hiring activities are presented in Tableau IV.

Capital Borrowing Activities

Borrowing short term capital for crop enterprises with 5 percent interest rate, and for livestock enterprises with 4 percent interest rate activities were included in the model to evaluate the potential contribution of credit facilities to farm income and enterprise reorganization. Also medium/long term capital activity was allowed with 4 percent interest rate to be used for buying replacements and expanding livestock housing facilities. Capital borrowing activities are presented in Tableau IV.

Resource Availability and Restrictions

Farm production, farm income and enterprise reogranization are limited by the availability of resources. Therefore, it becomes necessary to establish resource restrictions representative of the average farm. Restrictions were placed within the model to simulate the conditions normally experienced on mixed family farms and thus produce applicable results for the assumed conditions. Restrictions on land, capital, labor and livestock housing facilities comprise the resource or input restrictions and

Tableau IV. Sell, Hire Labor Activities and Capital Borrowing Activities

Row No.	Resources		Sell Labor Activities				Hire Labor Activities				Capital Borrowing Activities		
			A34	A35	A36	A37	A38	A39	A40	A41	A42	A43	A44
		Units	SFLA Hour	SWLA Hour	SSLA Hour	SSUL Hour	HFLA Hour	HWLA Hour	HSLA Hour	HSUL Hour	BMC Dr.	BML Dr.	MBBL Dr.
		C_j	25	20	25	26	-26	-21	-26	-27	-.05	-.04	-.04
24	AFL	Hours	1	1	1	1							
25	FL	Hours	1				- 1						
26	WL	Hours		1				- 1					
27	SL	Hours			1				- 1				
28	SUL	Hours				1				- 1			
29	SLL	Hours	1	1	1	1							
30	OPC	Dr.									-.95	-.96	
31	CSTCL	Dr.									1		
32	LSTCL	Dr.										1	
33	MLLC	Dr.											-1

are imposed by the farmer, his advisors and creditors, and by social and economical conditions around him. Subjective restrictions, which are imposed by the operator himself, are also significant to the planning process.[1] Subjective restrictions were used in this model for the borrowing capital from the Agricultural Bank of Greece. "Transfer rows are also included to 'provide a vehicle whereby the services or output of one activity may be transferred in the model to another activity.'"[2]

The initial resources and the imposed restrictions are presented in Table 4.2 and discussed below.

Land

Two types of land are considered: the nonirrigated land with a maximum of 27 stremmas and the irrigated land with a maximum of 12 stremmas. This was done to permit various cropping activities in each land category, due to the productivity difference among irrigated and nonirrigated land. Rented land-irrigated and nonirrigated was also restricted as it was found in the survey data. In the initial solution it is not possible to rent more land if the need arises, but this was permitted in the subsequent solutions. Orchards and vegetables land was omitted

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[1] R. R. Beneke and R. Winterboer, Linear Programming Applications to Agriculture. (Ames, Iowa: Iowa State University Press, 1973), p. 38.

[2] Ibid.

Table 4.2. Resource Supplies and Alternatives

Row No.	Resources	Units	Base Plan	Alternatives			
				I	II	III	IV
1	Nonirrigated land	Str[1]	21	21	21	21	21
2	Irrigated land	Str	9	9	9	9	9
3	Rent nonirrigated	Str	6	20	6	20	u
4	Rent irrigated	Str	3	9	3	9	10
12	Cow control	Head	u[3]	u	u	u	u
22	Housing for cows	Head	u	u	u	u	u
23	Housing for steers-heifers	Head	u	u	u	u	u
24	Annual family labor	Hours	3719	3719	3719	3719	3719
25	Fall family labor	Hours	865	865	865	865	865
26	Winter family labor	Hours	797	797	797	797	797
27	Spring family labor	Hours	1024	1024	1024	1024	1024
28	Summer family labor	Hours	1033	1033	1033	1033	1033
29	Sell labor	Hours	450	450	450	450	450
30	Operating capital	Dr[2]	23189	23189	34784	34784	23189
31	Crops short-term credit	Dr	7746	7746	11619	11619	7746
32	Livestock short-term crd.	Dr	10696	10696	16044	16044	10696
33	Medium/long livestock credit	Dr.	u	u	u	u	u

[1]One Stremma (Str) = 0.24709 acres

[2]30 Drachmas (Dr) = U.S. $1.00

[3]u = Unrestricted

Source: Survey data.

because it represents a small percentage (8 percent) of the total cropland. An allowance was made, however, for the hay or forage produced in the orchards which could be fed to the livestock. Cotton and tobacco land, 12 percent of the land on the survey farms was transferred to production grain activities, as it was assumed that the cropland would be fully utilized for feed grains and forage

production. Grazing land owned by the community was not included in the model due to the fact that the animals are almost entirely confined throughout the year, and cross-breeding with domestic animals grazing on this category of land was not desirable.

Labor

An estimate of the available family farm labor available was also derived from the survey data. Each farmer was asked to provide information on the composition of his family, age, occupation for each member, children in school, retired members, off farm work days, and hired-in workers. The supply of labor was derived for each family unit in the sample. This was done to take account of the social norms that prevail in the area, such as retirement age, women's work, children's work, and days of leisure.[3]

The total annually available work hours were assumed equla to 2,480. The figure takes into account Sundays, local and national holidays and work hours per day according to seasons.[4] Family labor not engaged in farming is excluded. Since physical labor productivity for farm work

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[3]P. A. Yotopoulos, "Allocative Efficiency in Economic Development." Center of Planning and Economic Research, (Athens, Greece, 1967), p. 88.

[4]A. L. Adamopoulos, "Economic and Social Characteristics of Farms in the Region of Kozani (Greece)." (University of Thessaloniki, School of Agriculture and Forestry. Thessaloniki, Greece, 1963), p. 120.

varies according to age, sex and specific task, various weights were used to convert the family labor in each cohort into equivalent man units (Table 4.3).

Table 4.3. Weights for Conversion into Equivalent Man Units

Sex	Age				
	0-9.9	10-14.9	15-64.9	65-69.9[1]	Over 70
Male	0	.3	1.0	.8	.5
Female	0	.3	.8	.6	.5

[1]Pensions are paid to farmers by the National Crop and Social Insurance Agency over 65 years of age.

Source: Adamopoulos, A. L, ibid.

Yotopoulos, P. A., op. cit.

For high school and college students only the actual work offered during summer season vacations were used. When two women were in the family one was used as full time in farm work. Twenty hours per month were subtracted from the total farm labor availability in order to cover over-head labor, e.g. labor related to farming operation but not a linear function of any of the enterprises considered. Also 95 hours per stremma and per year were devoted to orchard and vegetable operations and were subtracted from the available family labor. Finally the operator's and his family labor supply were found equal to 3,719 hours or 1.5 adult male equivalent.

For the purpose of programming restrictions, labor

availability was specified on a season basis. Limit on selling labor was placed on an annual basis. Labor can be hired on an hourly basis according to the needs and no restrictions were placed.

Capital

Capital requirements were classified according to the source acquired and the use for various enterprises as follows: (a) operating capital, (b) short term credit for crops, (c) short term credit for livestock and (d) medium/long term credit for livestock.

The demand for operating capital by enterprises was assumed to be their variable costs per unit of production and the prices paid per unit of feed purchasing. The demand for medium/long term credit was assumed to be for buying cattle replacements and for expanding storage and livestock housing facilities. The internally generated capital during the year by selling crop and livestock products was not used to finance the business but will appear in the income statement at the end of the year. The model was solved with and without capital restrictions. One alternative assumed that the quantity of cash was limited. The cash restriction was calculated from the gross output (using survey's data) by subtracting the annual farm and house operating expenses and adding the out-of-farm income and subsidies. Another solution was obtained by considering a 50 percent cash increase.

Short term credit was also examined with and without restrictions. This appears to be in harmony with the current policies, since the Agricultural Bank of Greece indicated that sufficient capital was available for most livestock enterprises. In practice the farmers considered capital rationing and borrow limited amounts of capital. Usually the amount of credit farmers get from the bank is approximately 25.2 percent of the gross output.[5] This percentage was used to determine the limit of short term credit and distribute to crop and livestock enterprises. Medium/long term credit was assumed without any restriction, and was secured by the farmer's ability to raise livestock and also his experience.

The short term loan payments were due at the end of the year or after the harvesting season. Short term interest rate for crops was assumed to be 5 percent and for livestock 4 percent to reflect a special treatment to livestock enterprises. Medium/long term interest rate was assumed 4 percent and the payment between 6 and 20 years according to the purpose of the loan.

Prices

The 1973-74 average prices received by the farmers were used as a basis for establishing price levels (Table 4.4).

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[5]F. Vakakis, "Meaning and Content of Agricultural Sector Investment Planning." Agricultural Bank of Greece, Bulletin 191, (March-April, 1973, Athens, Greece). The 1973 percentage was projected by the author using the provided by the above source time series data.

Table 4.4. Output Prices

Product	Average For	
	1968-1972 Dr/Kg	1973-1974 Dr/Kg
Wheat	2.68	3.60
Barley	2.48	3.40
Corn	2.70	3.40
Alfalfa	1.54	2.40
Milk	3.20	4.50
Veal	46.70	69.50
10-17 mo. calf	42.70	64.30
18-26 mo. calf	37.28	58.80
Cull cow	30.89	41.00

Source: (1) Ministry of Finance, Agricultural Section, "Weight Average Prices of Agricultural Products" (Athens, Greece, 1972).

(2) Survey data.

Upward and downward shifts in prices were considered in order to provide guidelines for adjustments. Prices for fertilizers and pesticides were those of 1972 adjusted to 1974 levels.

The solutions of the above presented model are the subject of the next chapter.

CHAPTER V

OPTIMUM ORGANIZATIONS FOR THE AVERAGE FARM WITH EXISTING AND CHANGING RESOURCES

The previous chapters have provided the framework for analysing whether the existing farm organization could be reorganized in order to increase the level of farm income and livestock production.

Livestock production can be increased through large scale specialized dairy or beef farms or through the small family farms. Specialized operations have the advantage of the economies of size, permitting the adoption of new technology and can influence a small, like the Greek, market in terms of output supply and input demand and therefore the prices. The lack of livestock management skills, and the lack of good quality pasture, and modern technology restrict the specialized operations. In contrast, it is believed by some that a small unit in terms of land size and animal units is an obstacle to expansion. This analysis attempts to offer some insights as to whether the reorganization of small farms with more efficient use of resources is a viable alternative to the expansion before the Greek livestock industry moves to large specialized operations, and to new technology.

Due to changes in economic, technological and government policy conditions, farmers have a continuing need for adjustments, seeking alternative ways to increase or at least maintain their income. In their plans, farmers include changes in farm size, change in enterprises, more efficient utilization of resources, as well as acquisition of new resources. One general type of adjustment involves investment and expansion in livestock and feed production enterprises on existing land area (intensive adjustment). The other type of adjustment is made by expanding farm size (extensive) given the existing capital and labor.[1] A combination of the above adjustments is also possible, e.g. an expansion of farm size and acquisition of more capital and labor inputs together with reorganization of enterprises.

This chapter presents the resulting optimal organizations of the average farm under (1) existing resources; (2) varying land and capital; and (3) varying selected output prices.

Before we present and analyze the optimum organizations, certain assumptions, explanations and the order of presentation will follow.

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[1]Curtis F. Lard, "Profitable Reorganizations of Representative Farms in Lower Michigan and Northeastern Indiana with Special Emphasis on Feed Grains and Livestock." (Ph.D. dissertation, Michigan State University, 1963), p. 34.

Assumptions and Presentation Scheme

Assumptions

The usefulness of the obtained results depends on the assumptions made with respect to technology, prices, resources and institutions influencing the adjustments. The main assumptions are as follows:

(1) Technology: The study is not an attempt to examine the economic assessments of existing versus advanced technology. The existing technology is assumed represented here by the technological coefficients (Chapter IV) which were found in the area during 1973-74 cropping year. So, throughout the analysis the input-output technical coefficients will remain constant. The difficulty of estimating the coefficients with certainty led to the range analysis in order to examine the stability of the plan.

(2) Prices: The optimum solutions presented in this chapter are based on 1973-74 average product and input prices (see Chapter IV, Table 4.4). The sensitivity of the plan to those prices is also examined using stability analysis.

(3) Farm Resources: The farm resources used are those taken from the survey in Central Macedonia during the 1973-74 cropping year.

(4) Credit: We assume that the Agricultural Bank of Greece will continue to provide short and long term credit for the necessary adjustments to qualified farmers.

(5) Management: The assumed level of management was that considered necessary for farmers to be able to operate a multi-enterprise operation.

(6) Finally, it was assumed that part-time farmers will continue moving to the new jobs developed in the industrial sector and the remaining idle land will be rented or sold to farmers remaining in the area giving at least some farmers the opportunity to increase their farm size.

Explanations and Presentation Scheme

The first optimum plan, referred to as a base plan, was determined by using linear programming techniques assuming existing resource levels. The linear programming solutions were obtained by using the CDC-6500 computer at Michigan State University with the APEX-I computing routine.[2] Additional plans were computed with capital limited above existing levels as well as with unlimited credit for comparison with the actual (existing) organization. After the base plan had been established, the effects of changing farm size, operating capital and the effects of alternative beef and milk prices upon the base plan were analyzed.

The output of the linear programming provides information on the optimum combination of activities included,

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[2]Control Data Corporation, "APEX-I Reference Manual." (Minneapolis, Minnesota, 1974). Initial solutions were computed by the Linear Programming developed by J. R. Black, and S. Harsh of Michigan State University.

the objective value of the model, the resources used with their respective Marginal Value Products (MVPs), and the activities which are not in the solution with their cost of entering the solution.[3] Also information was provided on the stability limits on prices, costs and basic resources for the optimum solution. The linear programming solution does not take into account costs considered fixed to the farm, such as depreciation on buildings and machinery, land investment cost, taxes, etc. The fixed costs must be subtracted from the total gross margin of the farm to provide an estimate of net income.

Actual and Optimal Organization with Existing Resources and Limited Credit

Comparisons of actual (present) and optimum organizations resulting from both the assumptions of limited credit and unlimited credit are presented in Table 5.1.

Considering first the comparion between actual and optimal with operating capital and short term credit constrained to 23,189 Dr. and 18,442 Dr., respectively, we found that, although the cropping program was reorganized and the cattle-units were increased by 1.3 units,[4] there was

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[3]The term "shadow price" in use by many authors, will not be used in this study due to different interpretations depending on whether we are referring to the real or disposal activities. Instead "cost of forcing nonbasis activities into the solution" or "unit cost" or "marginal cost" will be used interchangeably.

[4]For purposes of comparions, a cattle-unit was defined for which a dual purpose cow was one unit and a calf exceeding 10 months of age was 0.8 units.

Table 5.1. A Comparison of Actual and Optimal Organizations Under Limited and Unlimited Credit

Item	Unit	Limited Credit			Unlimited Credit		
		Actual	Optimal	Change Percent	Actual	Optimal	Change Percent
1. Gross Margin	Dr.	64,673	65,931	+ 1.9	65,153	69,589	+ 6.8
2. Family Labor Used	Hrs	2,630	2,268	- 13.8	2,651	3,719	+ 40.3
3. Operating Capital	Dr.	23,189	23,189	---	23,189	23,189	---
4. Short Term Credit	Dr.	18,442	18,442	---	20,112	77,240	+284
5. Long Term Credit	Dr.	7,968	9,759	+ 22.5	7,968	19,814	+149
Plan							
6. Wheat	Str	19.0	1.3	- 93.1	19.0	2.6	- 86.3
7. Barley	Str	8.0	25.7	221.2	8.0	24.4	+205.0
8. Corn	Str	5.0	---	-100.0	5.0	---	-100.0
9. Alfalfa	Str	4.5	12	+166.6	4.5	12	+166.6
10 Tobacco	Str	2.5	---	-100.0	2.5	---	-100.0
11 Cows	Head	3	3.7	+ 23.3	3.0	7.46	+149.0
12 Bull calves (10 Mo)	Head	1.2	1.5	+ 25.0	1.2	3.0	+150.0
13 Heifers (16 mo)	Head	1.0	1.5	+ 50.0	1.2	3.0	+150.0
14 Milk	Kg	6,832.0	8,304.0	+ 21.5	6,780.0	16,860.0	+149.0

Source: Computed.

slight change in total gross margins (from 64,673 Dr. to 65,931 Dr. or 1.9 percent). More long term credit, by 22.5 percent, was utilized in the optimum plan than in the actual plan owing to the need to buy additional livestock replacements.

Less family labor by 13.8 percent was used by the optimum plan, mainly due to the exclusion of the tobacco activity which is very labor intensive under Greek conditions. Sixty-one percent of the available family labor was utilized under the optimum plan compared to seventy-one for the present. Summer labor was a restrictive factor for the actual plan but the MVP was remarkably below the opportunity cost of labor. In the optimum plan the labor was in surplus for all the seasons. In both plans surplus labor was sold up to the limit (450 hours per year) but still some labor remained unutilized.

All the available land (39 str) was utilized by both plans, but the actual plan was more diversified including tobacco and corn whereas the programmed plan did not. The new plan calls for more barley and alfalfa production at the expense of wheat and corn, respectively, which compete for the same land.

More cattle are fed in the optimum plan than in the present, and milk production increased by 21.5 percent. Both plans call for purchasing of replacements. This conclusion is in accordance with the government's policy

to improve the national herd by substituting domestic heifers with crossbreedings or foreign.

In the optimum solution, barley and alfalfa are produced in excess of needs and are sold for 3.4 and 2.4 dr. per kg., respectively, while corn is purchased at the price of 3.5 dr. per kg. Only wheat is an excess in the actual plan and needed barley, corn, and alfalfa are purchased (Table 5.2).

Table 5.2. Feed Production and Utilization Under Actual and Optimal Plans

Feed	Produced (Kg)		Sold (Kg)		Purchased (Kg)		Unlimited Credit
	Actual	Optimum	Actual	Optimum	Actual	Optimum	Purchased (Kg) Optimum
Wheat	4655	368	4421	---	---	---	---
Barley	2080	6630	---	3690	263	---	---
Corn	2350	---	---	---	698	3826	7768
Alfalfa	5400	14400	---	2315	4080	---	12308

Source: Computed

Research on the feeding quality of wheat is underway to substitute barley and corn for the surplus wheat. The surplus quantity of barley produced under the optimum plan can be used at the present time to substitute in the ration for corn until new hybrid corn varieties will be introduced and the yield of corn per stremma will increase. With a production of corn per stremma equal to 600 kg and by

reducing the variable cost to 337 dr. (initial variable cost 355 dr.) corn enters the optimum solution.

Actual and Optimal Organizations with Existing Resources and Unlimited Credit

The unlimited credit category was added to the model to reflect the Agricultural Bank's policy that credit is always available to qualified farmers, especially for livestock expansion. This is an intensive adjustment and involves investment and expansion in livestock enterprises on existing land.

As Table 5.1 indicates, the total gross margin for the optimum plan with the unlimited credit assumption was increased by 6.8 percent as compared to the actual plan with the same assumption. Again, as in the limited credit case, the cropping system in the optimum plan was less diversified than in the actual plan. Barley is produced in excess of needs, but total corn and additional alfalfa have to be purchased (Table 5.2). The number of dual purpose cows increased by 149 percent, e.g. from 3 cows in the actual plan to 7.46 in the optimum plan. As Table 5.3 indicates the unlimited credit provision has increased veal production from 174 kg. in the actual plan to 431 kg. in the optimum, beef from 250 kg. to 619 kg., cull cow meat from 117 kg to 289 kg., and milk production from 6,780 kg. to 16,860 kg.

Meat and milk production has increased more than 100 percent in the unlimited credit optimum plan compared with

the limited credit optimum plan, indicating the contribution of capital throughout intensive adjustments, to increase livestock production.

Table 5.3. Meat and Milk Production in Kg. Carcass Weight Per Farm with Limited and Unlimited Credit

Item	Unlimited Credit		Limited Credit
	Actual	Optimum	Optimum
Veal	174	431	213
Beef	250	619	305
Cull cow meat	117	289	143
Milk	6,780	16,860	8,304

Source: Computed

More short term credit, by 284 percent, was utilized in the optimum plan than in the actual plan owing to the need to buy additional livestock feed. Family labor was fully utilized in the optimum plan because of the increased size of the livestock enterprises.

It is interesting to note that the gross margin in the unlimited credit optimum solution is slightly improved from the limited credit optimum solution, e.g. from 65,931 Dr. to 69,589 Dr. (Table 5.1), indicating that unlimited credit slightly contributes to farm income improvement under the assumed conditions.

Resource Use and MVP's for the Optimum Base Plan[5]

The resource requirements for the base plan with their respective MVP's are shown in Table 5.4.

Labor is not a limited factor as reflected by a zero MVP for all seasons. Seasonal labor was sold during summer up to the limit, with an hourly wage rate equal to its objective value. Land, operating capital and short-term credit were limiting factors in the optimum organization. The high MVP for both irrigated (IL) and nonirrigated land (NIL) indicates that expansion of the land beyond the available will be profitable under the given resources, prices and technology. As shown in Table 5.4, nonirrigated land has an MVP of 706 Dr. almost three times higher than its assumed factor cost. Irrigated's land MVP is more than five times higher than its factor cost. This was expected as policy makers in Greece realized that one of the restricted factors for expansion is the small farm size. Alternative I of the model examines the effects on gross margin and enterprise combination by expanding irrigated and nonirrigated land through renting activities. The other most limiting resources were operating capital and short term credit for both crops and livestock. The relatively high MVP for operating capital and short-term credit--as shown in Table 5.4--shows the scarcity of these resources which

[5]The Marginal Value Product (MVP) indicates the amount by which the gross margin of the farm would be increased by utilizing an additional unit of the resource.

Table 5.4. Resource Use and Marginal Value Products (MVPs) for the Base Plan

Resources	Unit	Limited Credit	
		Resource Level	MVP
NIL	Str	21	706
IL	Str	9	2,278
RNIL	Str	6	395
RIL	Str	3	1,760
SLL	Hrs	450	26.0
OPC	Dr	23,189	.29
CSTCL	Dr	7,746	.23
LSTCL	Dr	10,696	.24
AFL	Hrs	2,268	0.0
FL	Hrs	427	0.0
WL	Hrs	368	0.0
SL	Hrs	448	0.0
SUL	Hrs	1,024	0.0

Source: Computed

impose limitations on expanding livestock production activities.

Stability Limits for the Base Plan Resources

It is important to the decision maker to know the limits under which the optimum plan remains stable. Without those limits, which are called stability limits, the interpretation of the level of resources used, as well as the conclusions that arose from the MVP's analysis will not

be complete. Also the stability or range analysis provides information regarding the effects of resource variation upon the optimum farm plans.[6] "If the optimum plan appears to be relatively sensitive to small changes of certain values, care must be taken in selecting a plan which is stable over a wide range of values or more frequent adjustments should be made in farm operations."[7]

Stability limits of the base plan (limited credit), with respect to resources used, are given in Table 5.5 and discussed below. These limits provide an estimate of the range over which the MVP's are relevant, and the optimum farm organization remains the same even though the levels of the enterprises may change. For example, the initial level of irrigated land is 9 stremmas with lower and upper limits equal to 7 and 10, respectively. This means that the optimum organization determined in this analysis remains the same, if other resources remain at current levels, for farms with 7 to 10 stremmas of irrigated land and the MVP is relevant under this range. Beyond the lower level, less than 7 stremmas, the activity "sell alfalfa (SALF)" will be removed. Since less irrigated

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[6]A. K. Nisar and J. G. Elterich, "Changing Input-Output Relationships and Optimum Organizations of Large-Scale Dairy Farms on the Delmarva Peninsula." Bulletin 397 (University of Delaware, April, 1973), p. 14.

[7]A. K. Nisar and J. G. Elterich, "Optimum Organizations of Medium-Sized Dairy Farms on the Delmarva Peninsula." Bulletin 390, (University of Delaware, March 1972), p. 40.

Table 5.5. Stability Limits for the Base Plan Resources (Limited Credit)

Resource	Unit	Initial Level	Lower Level	Changing Variable[1]	Upper Level	Changing Variable[1]
NIL	Str	21	17	SUL	22	DPC
IL	Str	9	7	SALF	10	SUL
RNIL	Str	6	4	SUL	7	DPC
RIL	Str	3	1	SALF	4	DPC
AFL	Hours	2,268	2,223	CSTCL	2,305	PRC
FL	Hours	428	417	CSTCL	878	SFLA
WL	Hours	369	358	CSTCL	819	SWLA
SL	Hours	448	Inf	HSLA	898	SSLA
SUL	Hours	1,024	574	SSLA	1,052	PRC
OPC	Dr	23,189	22,382	DPC	23,810	SUL
CSTCL	Dr	7,746	6,897	DPC	8,400	SUL
LSTCL	Dr	10,696	9,856	DPC	11,343	SUL

[1]This column specifies the names of the activities and/or resources that would change as the result of applying resources beyond the stability limits.

Source: Computed

stremmas will be available for alfalfa, the produced alfalfa will be fully utilized by the livestock activities, so the activity "sell alfalfa" was removed. However, if the irrigated land increased beyond the upper limit, the summer labor availability (SUL) will be decreased and apparently will become a limiting factor and change the optimal organization and the MVP for the irrigated land. The interpretation of the stability limits for the remaining resources in Table 5.5 is similar. The main conclusion obtained by the stability analysis for the base plan resources is that the optimal solution appears to be relatively stable for the seasonal labor, e.g. Fall labor

(FL), Winter Labor (WL), Spring Labor (SL), Summer Labor (SUL), and relatively unstable for the land and capital resources, e.g. Non-Irrigated Land (NIL), Operating Capital (OPC), Short Term Credit for Crops (CSTCL) and Livestock Short Term Credit (LSTCL).

Enterprises Included in the Optimal Solution

Under the assumed conditions, the enterprise combination of the model farm in Central Macedonia turned out to be crops, mainly for feeding purposes, and dual purpose cattle and calves. The resulting crop plan includes production of wheat (PRWH), production of barley (PRB) and production of alfalfa (PRA) at the levels of 1.3, 2.57, and 12.0 stremmas, respectively (Table 5.6). Corn production (PRC) was not a sufficiently profitable alternative under the assumed prices and yields to enter the optimum solution. The results further demonstrate that corn and alfalfa compete for irrigated land and the adoption of corn production would bring about a reduction of alfalfa production. The surplus of barley and alfalfa were sold for cash, and the necessary corn for the balanced ration was purchased. The levels of the livestock activities are slightly higher than in the actual plan. The dual purpose cow activity with straw feeding (DPCS) was included in the optimum plan at a higher level than the same activity without straw feeding (DPC). The production of relatively large quantities of straw, may be given as explanation for the entry of the DPCS activity into the solution.

Table 5.6. Activities Included in the Optimal Solution and Their Stability Limits with Respect to Prices, or Variable Costs

Activity	Unit	Level	Unit	Stability Limits				
				Initial Cost or Price	Lower[1] Limit	Entering Variable	Upper[1] Limit	Entering Variable
PRWH	Str	1.3	Dr/Str	-301.2	- 544	BWH	- 263	SWH
PRB	Str	25.7	Dr/Str	-281.8	- 320	SWH	- 38	BWH
PRA	Str	12.0	Dr/Str	-464.6	- 1,071	PRC	+ Inf	NONE
SBAR	Kg	3,690	Dr/Kg	3.4	3.25	SWH	4.07	BWH
SALF	Kg	2,315	Dr/Kg	2.4	2.25	SSTR	2.74	BALF
BCORN	Kg	3,826	Dr/Kg	- 3.5	- 5.08	CSTCL	- 1.05	SCORN
DPCS	Head	3.5	Dr/Head	- 588	- 612	SSTR	- 64	BSTR
DPC	Head	.2	Dr/Head	- 588	- 988	BSTR	- 503	SSTR
RSTE	Head	1.5	Dr/Head	- 270	- 1,210	RSSI	5,617	PRC
SST	Head	1.4	Dr/Head	10,703	9,703	RSSI	16,966	PRC
SHSL	Head	1.4	Dr/Head	15,500	14,218	SHSS	21,763	PRC
SMILK	Kg	8,304	Dr/Kg	4.5	3.76	CSTCL	5.54	PRC

[1]Entries with negative signs indicate variable cost per unit of activity or purchasing price, and entries with no signs indicate gross margin per activity or selling price.

Source: Computed

The raising heifer for replacement activity (RHTE) was not sufficiently profitable under current conditions to enter the solution. Heifers were sold live after feeding to 16 months. Accordingly, all the replacements were purchased by use of long term credit.This is also consistent with the government's policy of encouraging the conversion of the existing herd to higher productivity breeds. Bull calves were raised to 10 months and an average liveweight of 275 kgs. and through the activity "sell steers at ten months" (SST) were slaughtered and sold as veal.[8] With the existing prices of feeding stuff and beef prices the "raise steers to sixteen months," (RSS) activity was not sufficiently profitable. As it was discussed in Chapter II, one way to increase beef production with the existing stock, is to feed the calves to heavier weights. A bull calf at sixteen months of age with an average liveweight of 455 Kgs. will produce 60 percent more beef than the 10 months calf. By forcing the 16 months bull calf into the solution the total gross margin will be reduced by 1,083 Dr/calf, ceteris paribus (Table 5.8). In reality this is what has been happening in Greece as the government provides 2 Dr. per Kg. liveweight to the farmers willing to keep the bull calves to 450 kg. On the basis of this analysis the above subsidy has to be increased to 2.5 Dr. per Kg. liveweight.

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[8]The term bull calves and steers are used with the same meaning. The distinction among veal and beef is according to age and liveweight.

The costs incurred by decreasing or increasing a unit of the included activities in the optimum plan, with their respective stability limits are presented in Table 5.7. These costs may serve as a useful guide to the farmers about whether to expand in certain enterprises. The columns "lower level" and "upper level" indicate the range beyond which the costs will be changed. As the Table 5.7 indicates the optimal solution appears to be relatively stable except for the production of alfalfa (PRA) activity. On the basis of these costs the government could encourage production of certain crop or livestock products by changing its subsidy policies. As an example, wheat compared to barley, is in the most competitive position for expansion, as reflected by the lower cost incurred if one additional stremma wheat has to be cultivated. On the other hand, barley is in the weakest competitive position for expansion and in the most competitive position for contraction.

Stability Limits of the Activities Included in the Optimal Solution With Respect to Prices and Variable Costs

The enterprises included in the optimum plan could be reorganized by changing the prices and/or variable costs per unit of activity. Table 5.6 presents the lower and upper limits of variable costs and prices beyond which the optimum plan will change. The significance of the analysis is "to know how much prices, costs, or yields would have to

Table 5.7. Cost Incurred by Decreasing or Increasing a Unit of Activity in the Optimal Solution and Their Stability Limits

Activity	Unit	Level	Cost of Decreasing (Dr)	Lower Level	Cost of Increasing (Dr)	Upper Limit
PRWH	Str	1.3	243	.4	38	16
PRB	Str	25.7	38	11	243	27
PRA	Str	12.0	607	11	+Inf	12
SBAR	Kg	3,690	.15	0	.67	4,014
SALF	Kg	2,315	.15	1,044	.35	3,096
DPCS	Head	3.5	55	0	493	3.7
DPC	Head	.2	430	0	55	3.7
BREP	Head	.61	9,956	.60	2,667	31.0
SMILK	Kg	8,304	.73	8,035	1.04	8,502

Source: Computed

Table 5.8. Cost of Forcing the Non-Basis Activities into the Optimum Plan and the Stability Limits with Respect to Prices or Variable Costs

Activity	Unit Cost (Dr)	Unit	Initial Cost or Price	Lower Limit	Entering Variable	Upper Limit	Entering Variable
PRC	607	Dr/Str	-355.4	0	DPC	251.8	SUL
BALF	.83	Dr/Kg	- 2.5	0	SUL	- 1.66	DPC
BBAR	1.13	Dr/Kg	- 3.5	0	SUL	- 2.36	DPC
BWH	1.03	Dr/Kg	- 3.7	0	SUL	- 2.66	DPC
SSS	1,083	Dr/Head	15,799	---	---	16,882	RSSI
RSE	3,168	Dr/Head	- 465	0	SSE	2,703	DPC
RHATE	18,699	Dr/Head	- 752	0	SUL	17,947	BREP
SHSS	1,282	Dr/Head	14,218	0	NONE	15,500	SHSL
SFLA	1.0	Dr/Head	25.0	0	SUL	26	FL

Source: Computed

change before the optimum farm organization should be change."[9] Also, the net effects of the changes are listed under the columns "Entering Variable" in Table 5.6. For example, the level of the activity "produce barley" (PRB) in the optimum plan is 25.7 stremmas with initial variable cost equal to 281.8 Dr/Stremma. The stability limits for barley production range between 38 to 320 Dr. This means that the optimum level of barley production remains stable unless the variable cost per stremma exceeds the limits. If the variable cost for barley exceeds 320 Dr. per stremma, wheat will substitute for barley, so the activity "sell wheat" (SWH) is the entering variable. If the variable cost falls less than 38 Dr. per stremma, more barley will be produced and the activity "buy wheat" (BWH) is the entering variable. Since input-output prices have significant effects upon farm organization, especially when prices are oriented, their respective stability limits offer a guide to policy makers on the appropriate direction and size of the change.

The variable cost of the activity "produce alfalfa" (PRA) has to be increased by 130 percent before the competing activity "produce corn" (PRC) enters the solution. If the variable cost of the enterprise "dual purpose cow feeding straw" (DPCS) increases by 10 percent the activity exits the

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[9]Nisar, A. K. and J. G. Elterich, op. cit.

solution, and the "dual purpose cow without feeding straw" (DPC) enters the solution. On the other hand, the variable cost of the activity DPC has to increase by 77 percent for the activity DPCS to enter the solution. These results demonstrate the significance of the stability analysis to give answers to policy questions and the competitive positions among the enterprises included in the solution.

Due to the production response to price changes, the farm organization is affected by changing the prices. Accordingly, the Greek government may discourage the production of veal and encourage the beef production through changes in the price ratio of beef to veal.[10] According to stability limits analysis the price of veal (carcass) has to go down from 69.5 Dr/Kg to 63 Dr/Kg[11] for the activity "raise steers to sixteen months" (RSSI) to enter the solution. If the existing price of veal increases by 58 percent the solution calls for production of corn (PRC). If the price of veal remains constant, beef price has to be increased from 64.3 Dr/Kg (current price) to 68.7 Dr/Kg before the activity "raise steers to sixteen months" (RSSI)

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[10]The distinction between veal and beef is according to age and liveweight. Meat production from a calf less than 10 months and 300 kg. liveweight is defined as veal, above these limits as beef.

[11]The prices were calculated from Table 5.6 by dividing the total receipts by the assumed carcass weight, e.g. $\frac{10703 \text{ Dr}}{154 \text{ Kg}} = 69.5$ Dr/Kg (Initial price, and $\frac{9703 \text{ Dr}}{154 \text{ Kg}} = 63$ Dr/Kg (lower limit).

enters the farm organization. The main conclusion from this analysis is that the price ratio of beef to veal has to be close to one, for the farmers to slaughter their calves to heavier weights.

The need for heifers not to be slaughtered at least until the first delivery in order to increase the cattle herd was emphasized in Chapter II. Various policies have been directed to this target, such as subsidies, grants, feed price concessions, etc. The activity "sell heifers sixteen months live" (SHSL) enters the optimum plan. For the activity "sell heifers sixteen months slaughter" (SHSS) to be found in the solution, the live heifer price has to go down by 8.5 percent according to the stability analysis (Table 5.6). When the demand for live heifers decreases and the prices fall, the government must provide subsidies to the farmers to prevent slaughter of the heifers. This conclusion is consistent with what is and has been taking place in Greece.

The profitability of employing more capital was also shown by the stability limits of the activities, "borrow money for crops" (BMC) and "borrow money for livestock" (BML). In both cases the maximum interest rate above which borrowed money is not profitable, is 28 percent, given the assumed conditions. Short term credit for livestock enterprises is borrowed from the Agricultural Bank of Greece with an interest rate of 4 percent, and yields an MVP equal to 24 (28-4) indicating the profitability of capital.

Enterprises Excluded from the Optimal Solution

Those enterprises or any combination of enterprises which were least profitable were excluded from the optimum plan or were at their lower level of zero. The net marginal cost, e.g. the excess of marginal cost over marginal return, of an excluded enterprise indicates by how much the total gross margin would be penalized when they forced into the farm organization. The cost of forcing the excluded enterprises into the optimum plan indicates the competitive position of these enterprises. The higher the net marginal cost of an excluded enterprise, the lower is its competitive position in the optimum plan. Table 5.8 (page 97) presents the excluded enterprises, their net marginal cost and their stability limits with respect to prices and variable costs.

Production of corn activity (PRC) was not included and the cost of forcing one stremma corn in the farm plan is 607 Dr. Due to the large quantities of corn imported (Appendix B, Table B-3), the government subsidized the production of corn by providing 200 Dr. per stremma. This analysis shows that the given subsidy is too small as compared with the net marginal cost of producing corn (607 Dr/Stremma). The stability analysis provides another way for the corn activity to enter the plan, by providing subsidy of 252 Dr/Stremma (higher than the upper limit) and the Agricultural Bank to cover the variable costs by providing fertilizers, pesticides and seeds to the farmers.

If the yield of corn increases to 600 Kg per stremma and the variable costs decrease by 18 Dr. per stremma the corn production activity enters the plan.[12]

Alfalfa is profitably produced, therefore the "buy alfalfa" (BALF) is excluded. If the price of alfalfa is reduced by 34 percent, the BALF activity enters the plan. The same interpretation applies to "buy barley" (BBAR) and "buy wheat" (BWH) activities. The prices for barley, wheat and corn are the 1973-74 prices. During the same period the Agricultural Bank supplied barley, wheat and corn to livestock producers with .50 Dr/Kg lower prices, e.g., 3.0 Dr/Kg for barley, 3.20 Dr/Kg for wheat and 3.0 Dr/Kg for corn. The stability analysis shows that either with these prices the farm optimal organization remains the same. Accordingly, the lower prices feeding stuff supplied by the Agricultural Bank do not lead to the reorganization of the average farm in the direction to increase livestock production, as it was expected. The prices have to be decreased to the levels provided by the upper limit before the "dual purpose cow" (DPC) activity enters the plan. An improvement to farm gross margin is expected, so the "subsidies" can be classified to income improvement (social subsidy) rather than to production response.

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[12]This result was achieved by increasing corn yield per stremma to 600 Kg. keeping all prices, input-output coefficients and resources, constant at the initial level.

Effects of Increasing Land and Capital on the Optimum Organization

The optimum base plan was a reorganized plan, using the existing resources of the average farm. As shown in previous sections the two most limiting resources were land and capital. This was demonstrated by the high MVPs of irrigated (IL) and non-irrigated land (NIL) and the high MVP for capital. The profitability of land and capital, as it was indicated by the magnitudes of their MVPs, calls for expansion of farm size and the use of more capital. In this section, the effects on farm gross margin and farm organization of land and capital expansion will be examined.

Four alternatives were considered as shown in Chapter IV, Table 4.2. Alternative I, the opportunity was given to the farmer to increase his initial farm size by 50 percent by renting additional irrigated and non-irrigated land. All other resources and input-output coefficients remain unchanged. Alternative II, a 50 percent increase in operating capital and short term credit was assumed, with other resources and coefficients as in the base plan. Alternative III, a simultaneous increase by 50 percent of land, operating capital and short term credit was assumed, with no change in labor availability and input-output coefficients. Alternative IV, no restriction was assumed on the non-irrigated rented land, and the total irrigated land was

increased by 58 percent. All other resources and coefficients were at the same level as in the base plan. The results of the analysis are shown in Tables 5.9, 5.10 and 5.11 and discussed below.

Table 5.9. Efficiency Measures for the Base Plan and Alternatives I-IV

Item	Unit	Base Plan[1]	Alternatives			
			I	II	III	IV
Gross Margin	Dr	65,931	81,706	68,189	87,387	91,852
Cultivated Land	Str	39	59	39	59	82
Returns per Stremma	Dr	1,691	1,385	1,748	1,481	1,120
Returns per Capital	Dr	1.58	1.96	1.09	1.39	2.20
Credit per Stremma[2]	Dr	473	313	709	469	225
Unemployed Labor	Hours	1,450	1,947	841	798	2,543

[1]Base Plan is included to facilitate the comparison.

[2]Short term credit

Source: Computed

Discussion on Efficiency Measures, MVPs, and Farm Organizations Under Various Levels of Land and Capital Resources

The increase in the amount of land and capital resulted in a larger gross margin for all alternatives when compared to the base plan gross margin. The largest increase, 33 percent, occurred in Alternative IV, and the smallest, 3 percent, in Alternative II. As land increases, ceteris

Table 5.10. Resource Marginal Value Products Under Various Levels of Land and Capital

Resource	Unit	Base Plan[1]	Alternatives			
			I	II	III	IV
Non-Irrigated Land	Dr/Str	706	691	788	693	487
Irrigated Land	Dr/Str	2,278	2,272	2,757	2,265	1,936
Rent Non-Irrigated Land	Dr/Str	395	376	525	383	0.0
Rent Irrigated Land	Dr/Str	1,760	1,748	2,319	1,748	1,124
Annual Family Labor	Dr/Hr	0.0	0.0	0.0	0.0	0.0
Summer Labor	Dr/Hr	0.0	0.0	1.0	1.0	0.0
Operating Capital	Dr	.29	.30	.09	.29	1.03
Crop Short-Term Credit	Dr	.23	.24	.04	.23	.92
Livestock Short Term Credit	Dr	.24	.26	.05	.24	---

[1]Base Plan is included to facilitate the comparison.

Source: Computed

paribus, gross returns per stremma decrease, and the MVPs for all land categories decrease, indicating diminishing returns to land. Gross returns per unit of capital decline, as the capital increases, ceteris paribus, and the MVPs for operating capital, and short term credit decrease, again, illustrating diminishing returns to capital. As the level of land increases, annual unemployed family labor increases, e.g. from 1,450 hours in the base plan to 2,543 hours in Alternative IV. This is explained by the fact that, when farms are permitted to acquire more land, the levels of livestock enterprises decrease or move out of the optimal solution. Accordingly, an expansion of cropping activity

Table 5.11. Level of Enterprises Included Under Various Levels of Land and Capital

Enterprise	Unit	Base Plan[1]	Alternatives			
			I	II	III	IV
Wheat Production	Str	1.3	.7	1.9	1.7	0.0
Barley Production	Str	25.7	40.3	25.1	39.3	63.0
Corn Production	Str	0.0	0.0	0.0	0.0	0.0
Alfalfa Production	Str	12.0	18.0	12.0	18.0	19.0
Buy Corn	Kg	3,826	1,913	5,483	5,037	0.0
Dual Purpose Cow Feeding Straw	Head	3.5	1.8	2.5	4.8	0.0
Dual Purpose Cow Without Straw	Head	.2	0.0	2.8	0.0	0.0
Ten Months Steers	Head	1.5	.7	2.1	1.9	0.0
Sixteen Months Steers	Head	0.0	0.0	0.0	0.0	0.0
Sixteen Months Heifers	Head	1.5	.7	2.1	1.9	0.0
Replacements	Head	.6	.3	.9	.8	0.0
Cull Cow	Head	.6	.3	.9	.8	0.0
Milk Production	Kg	8,304	4,153	11,901	10,934	0.0

[1]Base Plan was included to facilitate the comparison.

Source: Computed

levels occur which are labor extensive as compared to cattle activities. This is an important policy issue, related to out-migration and urbanization of farmworkers. Also, it is related to the overall livestock problem, and will be further examined in the policy implications section. When capital increases, less family labor is unemployed than in all other alternatives, mainly due to the increasing level of livestock enterprises. Summer labor becomes a restricting variable with an increase in capital availability.

The increase of the levels of land and capital also changed the optimum farm organizations (Table 5.11). The most significant adjustment was that of removing all the livestock enterprises when no restriction was assumed on non-irrigated land. The levels of livestock enterprises were increased with the increase of capital and eliminated with land expansion (Alternative IV). This points out the need for capital by the family farms in order to expand in the direction of livestock production. The combination of crop enterprises remains almost the same as in the base plan, except for higher levels which were expected with larger levels of resources.

The main effects of increasing land and capital can be summarized as follows:

(1) As land increases the size of livestock enterprises decreases,

(2) As capital increases, the size of livestock enterprises increases,

(3) With an increase by 110 percent of land, the result is only crops in the farm organization.

(4) Less labor was employed with a land expansion.

Effects of Varying Milk and Beef Prices on the Optimum Plan

This section discusses the effects of varying milk and beef prices on the use of resources and enterprise organizations. For this analysis, the initial resources, all other prices, and input-output relationships remain the same as

those used for the base plan. Parametric linear programming was used to measure the changes and provide the new enterprise organizations. The model uses the information obtained from the stability analysis, therefore the changing prices are those outside the stability limits. Specifically milk price was increased by 25 percent and beef price by 7 percent from the initial 1973-74 assumed average prices. When milk price was increased, beef price was held at the base solution level and vice versa.

Table 5.12 presents a summary of the resulting optimal solutions (Plan I and Plan II) with the parametrically changing prices. By changing milk price (Plan I), the gross margin increased by 14 percent compared to the base solution. Slightly more annual family labor (AFL) was utilized, but the summer labor (SUL) was fully exhausted, providing restriction to livestock expansion. The levels of wheat production (PRWH) and barley production (PRB) remain almost the same as in the base plan. Production of corn (PRC) was for the first time included in the plan. The size of cattle enterprises were slightly increased with production higher by 7 percent. The main conclusion of the above analysis, is that corn can be expected to enter the farm organization with milk prices assumed to be higher than in the base plan.

The change of beef price (Plan II) from 64.3 Dr/Kg to 69.0 Dr/Kg, yielded almost the same gross margin as the base plan, but lower by 14 percent compared to Plan I. The

Table 5.12. Optimum Organization with Variable Milk Prices, and Variable Beef Prices

Gross Margin or Resource or Activity	Unit	Base Plan[1]	Plan I Milk Price 5.6-6.1	Plan II Beef Price 69-95.3
Gross Margin	Dr	65,931	75,081	66,019
Cropland	Str	39	39	39
AFL	Hours	2,268	2,381	2,222
SUL	Hours	1,024	1,033	1,016
PRWH	Str	1.3	1.4	1.6
PRB	Str	25.7	25.5	25.4
PRC	Str	0.0	1.0	0.0
PRA	Str	12.0	11.0	12.0
DPCS	Head	3.5	3.3	3.4
DPC	Head	.2	.6	0.0
SST	Head	1.4	1.5	0.0
SSS	Head	0.0	0.0	1.3
SHSL	Head	1.4	1.5	1.3
SHSS	Head	0.0	0.0	0.0
SMILK	Kg	8,304	8,913	7,667

[1]The Base Plan remains stable for milk price 3.7-5.5 Dr/Kg and beef price 64.3-68.7 Dr/Kg.

Source: Computed

most significant adjustment in Plan II in relation to base plan and Plan I is that bull calves are raised to sixteen months and sold with an average liveweight of 455 Kgs. This implies that, for the farmers to keep the bull calves for beef and not slaughter them as veal, the price of beef has to be increased at least 7 percent more than the assumed prices. The overall effect will be an increase in the production of beef.

The main objective of this chapter was to determine optimum farm organizations with existing and varying

resources and prices, which would help farmers to make adjustments in order to increase their income and livestock production. The empirical analysis brought about important policy issues which will be further discussed in Chapter VI. Also, Chapter VI will present the summary of the study, the conclusions, the interpretation of the conclusions and suggestions for further research.

CHAPTER VI

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

Summary

Various suggestions have been made as to the type of operations to increase livestock and feed production in Greece. They range from support for large scale specialized operations to the encouragement for group farming to massive aid of small family farms. Suggestions have also been discussed for the way of achieving the increase, such as (a) by introducing new technology for the creation of a new production possibility curve, (b) by reallocating the existing resources on family farms to increase output from a given production function, and (c) by adding more resources to the already limited land and capital, hence, moving the production possibilities curve outward. In the overall scheme for achieving higher levels of livestock production and farm income, and to minimize imports, government's policies play an active role. Livestock production increase has become a national goal and an essential part of the overall planning. It is very important for policy makers to know how farmers respond to production incentives in order to evaluate production patterns and to know which policies will bring about desirable change.

With this information, the government will be in a better position to recommend stable policies which in turn will reduce uncertainty to farmers resulting in improved long range farm plans.

This study was designed to assess the potential and the conditions under which livestock production can be expanded on small family farms through (1) improved allocative efficiency and (2) by acquiring additional land and capital resources. In addition, through price mapping, it was possible to evaluate present and potential price policy impacts on livestock production output on individual farms.

Linear programming techniques were used to determine the organizations that would maximize farm income under existing resources, varying land and capital resources, and under varying milk and beef prices. The objective function to be maximized in the model was the farm gross margin. Data concerning the resources, enterprise organization and technology were accumulated from a survey of family farms in Central Macedonia, using stratified random sampling. Data related to input-output coefficients and prices had to be assembled and synthesized from the survey, personal interviews with technical specialists, statistical bulletins, and research publications related to the studied area. An average farm was selected for the purpose of estimating optimum plans, which was assumed to be representative of the small family farms in the area.

Information and data concerning the growth of the national and regional cattle herd, government programs and policies, regional production systems, and productivity measures were analyzed to provide the linkages from national and regional levels down to individual farm level. The model was constructed to include, crop production and selling activities, livestock production and selling activities, land rent and capital borrowing activities, feed buying activities, and labor selling and hiring activities. The problem was solved on the CDC-6500 Computer here at Michigan State University, using the CDC Apex-I routine. The optimum organizations for the assumed average farm were obtained under; (1) existing resources, (2) varying land and capital resources, and (3) varying milk and beef prices.

A summary of the main conclusions drawn from this study is presented in the next section.

Conclusions

The main conclusions from this study are summarized below. Interpretation of these conclusions will take place in the next section.

1. The average farm studied for Central Macedonia was organized to maximize farm income.

2. Allocative efficiency promises only small improvements given the existing level of resources, technology, and farm prices.

3. The optimum cropping system by including wheat, barley, and alfalfa was less diversified than the actual plan which included corn and tobacco as additional enterprises.

4. Alfalfa for hay is more profitable on irrigated land than corn for grain. Corn enters the optimum plan only when a milk price of 5.6 to 6.1 Dr/kg is applied. Barley and alfalfa were produced in excess of needs in the optimum plan and corn was totally purchased.

5. The size of livestock enterprises was slightly increased through the reorganization of existing resources, and appears to be less dependent on purchased feed than was the case in the actual plan.

6. Beef production and replacements raised on the farm activities did not enter the optimum solution under the assumed product prices. Beef production activity would enter, however, if the beef price exceed 69.0 Dr/kg.

7. The programmed results indicated that land and capital were the most limiting resources. Returns to land were high in comparison to the assumed rental value of 400 Dr. per stremma. The results also show that further use of credit on farms similar to the average farm would be profitable.

8. At the assumed low level of capital the expansion of livestock enterprises is limited by capital, while at the higher level of capital (unlimited credit) the expansion of livestock enterprises is restricted by fall, spring and sum

9. Since labor resources were not fully utilized, it would be profitable for the farmer and family members to work off the farm providing employment opportunities were available as assumed. The expansion of capital with no expansion in land generated more livestock production and less unemployed labor. On the other hand, expansion of land with no expansion in capital brought about less livestock production and more unemployed labor.

10. Farm enterprises are sensitive to price relationships. As milk prices increase, corn will more likely be grown. As the price of beef increases, farmers feed their calves to heavier weights.

11. The current level of feed grain subsidies is insufficient to bring about the changes in livestock production desired by the government.

Interpreting the Conclusions

Before attempting to draw implications from these conclusions either for farm management recommendations or national agricultural policy, some discussion of how these results are to be interpreted should take place. To start with, it should be emphasized that the conclusions are obtained by making particular assumptions in the model and changes in the set of assumptions may, of course, lead to different conclusions. Therefore, farmers and policy makers should not rule out consideration of alternative

plans including the actual plan. The stability limit analysis was used in this study to partially relax the single value expectation of prices and variable costs and therefore provide a wider range of applicability of the conclusions.

The slight difference in total gross margins between actual and optimum plans indicates that the average farm had been organized to maximize farm income. Conceivably, with the inclusion of risk and uncertainty considerations in the model, even the slight improvement would not be evident. The optimum farm plan as derived from linear programming assumed that prices, costs, and yields were known with certainty. Operating farmers, due to climatic and institutional conditions and instability of price policies, do not know these variables with certainty and therefore must be guided by their expectations.

Another warning to be considered is that the model does not evaluate the aggregate effects of regional or national adoption of the conclusions on input-output prices and resource supplies. Some discussion on the aggregate effects is attempted in relation to policy issues.

The optimal farm organization is less diversified than the actual organization. However, the more diversified program may be more suitable to some farmers. The operator will choose whether he prefers a slightly higher, but less stable farm income or whether

he prefers a lower, but more stable farm income. As the optimum plan includes fewer enterprises the income variance increases and the operator has to consider whether he prefers this situation or wants to minimize his income variance over some period with greater diversification. To this extent the variability of prices and yields over a period of years could be a guide to the farmer. The Central Macedonia farmer in order to follow the suggested optimum plan, must consider the higher variation of alfalfa prices as compared to lower variation of corn prices. To what extent the Central Macedonia farmers are risk takers or risk averters as a means of reducing income variability is unknown. Suggestions of crop and livestock planning based on optimum plans depend upon the relative prices of crops and livestock. If there is a great fluctuation in relative prices, it will make the farm organization uncertain.

It should also be recalled that because of the current government interest in increasing cattle production, the decision was made in this research to not consider other livestock enterprises such as sheep, goats, swine or poultry production. To have done so could have changed the conclusions from both a farm management and a national policy point of view. As the problem was defined, however, such analysis was considered outside the scope of the study.

The focus has been on analyzing the kinds of adjustments

at the farm level which would encourage individual farmers to respond to the market and to national policies in such a way as to coincide with national goals. In doing so, it is recognized that some adjustments at the farm level may have regional or national implications which have not been handled adequately in the methodology. For example, a suggestion that farmers substitute alfalfa production at the expense of corn production would have widespread reverberations if all farmers followed this advice. Some of the above conclusions should be discounted with this in mind.

Policy Implications

Given the above mentioned conclusions of the study and their interpretation, this section will concentrate on implications in the areas of farm units, and national agricultural policy.

One conclusion of this study is that the average farm is allocatively efficient and thus within the context of existing resources and technology reorganization would result in an insignificant increase of product and/or income. It follows that an acceptable way to increase income and livestock production is to widen resource base and introduce advanced technology of production. The rationality of the farmer implies that he is willing to adopt new technology and respond also to price incentives. As already noted the kind of resource made available to the farmer is a major determinant of the type of enterprise

commonly undertaken. For example, with more land the farmers would substitute more cropping enterprises for livestock enterprises, and when more capital becomes available livestock production increases until labor becomes restricted. Thus policy makers must be aware that some compromise between land and capital resource availability may be necessary. This approach has some implications for employment policy. Livestock enterprises in the study area were identified to be labor intensive, whereas crop enterprises tended to be less so. If the government is considering to support feed grain enterprises, it must find some means to reallocate the displaced labor. On the other hand, if the policy is to increase livestock production, a program that will, through appropriate incentives, attract more seasonal labor will be desirable.

The cropping system in the optimum plan was less diversified than the actual plan. The changes in relative prices among the competing crops during recent years had been given as an explanation for the particular crop activities to be included in the plan. With the elimination of corn and tobacco from the optimum plan, the available resources were reallocated to produce some wheat and surplus of barley and alfalfa. Again farmer's response to price incentives implies that most likely he will respond to the initiation of new programs and technology. In order to reduce the surplus of barley it would be recommended to the

farmers to substitute barley for corn in balancing their feed ration. This also results in reduction of corn shortages which, in the aggregate implies, savings of foreign exchange for corn imports. Due to the substitution of barley for corn in the ration a small loss of digestible energy and gains in crude protein, crude fiber, phosphorus and salt will follow. In Greece where the sugar beet industry developed during the last years, it is recommended that the loss of digestible energy can be obtained by including sugar beet molasses in the ration. In the case of alfalfa, the country is still in a deficit stage. The surplus alfalfa obtained in the optimum plan can be transferred in deficit regions, but the model does not examine interregional flows to trace the consequences of this policy. It is also expected, at least for the studied region, that alfalfa surpluses will bring a reduction in price, and less alfalfa will be produced. As alfalfa competes with corn for the irrigated land, a stable price ratio among those two products is advisable. During last years alfalfa price increased by 56 percent as compared to corn, by 26 percent. The 1973-74 price ratio of alfalfa to corn was .71 and the model solution provides a ratio of .53 for corn to enter the farm organization and partly eliminate alfalfa surpluses.

In terms of beef price, it is also recommended that the price ratio of veal to beef has to be close to one for beef to be produced. With higher than present beef prices,

beef production activity enters the farm organization. This implies that by slaughtering the bull calves in higher weights and age, more feed is needed during the critical six months period. It is suggested that a program, related to on time distribution of feed (special corn) from the Agricultural Bank to farmers is necessary. Failure to do so, the target for higher slaughter weights and therefore more output from a given stock of calves will not be achieved. A policy to increase the price of beef calls also for a stabilization price policy with regard to lamb and imported frozen meat. Due to the substitution possibilities among beef, lamb, and high quality imported frozen beef, Greek consumers change their buying habits easily and as the price of beef increases they would be expected to shift to lamb or frozen beef consumption resulting in a higher retail price for all close substitutes for beef.

Another important policy issue is related to heifer replacements. The results of the analysis call for purchased replacements instead of those being raised on the farm, and are according to the government's policy intended to achieve high quality breeding animals. This implies that large amounts of capital is needed by the farmers to purchase replacements and also by the government to import replacements. The present program to produce the necessary replacements in government operated units and to distribute them to the farmers is to be encouraged.

Suggestions for Further Research

This study was designed to assess the potential for an increased livestock production and farm income on small family farms in Central Macedonia by reallocating the existing resources and by acquiring additional land and capital resources. Also, the impacts of price policies on livestock and feed grain production on individual farms were examined. The contribution which new technology could make to family farm livestock production and income was not considered. An extended study using new input-output coefficients will give a more comprehensive idea of the potential for increasing livestock production and farm income on the small family farms in Central Macedonia. An important aspect in this regard is the risk associated with the adoption of new technology. In addition, the effects of new labor saving technology on family labor should be evaluated.

The results of this study reflect the average farm on the plains in Central Macedonia. To have a complete picture of the livestock-feed problem, similar studies are required to cover the semi-mountainous and mountainous areas. The results of such studies will lead to the formulation of livestock and feed grain supply functions at the regional level. Other regions outside of Central Macedonia might also be included to provide the basis for formulating the national supply function through micro data. By

including more regions, the regional flows of feed and livestock products will indicate the comparative advantage of some regions with respect to calf fattening, the raising of replacements and feed production activities.

Further research, regional and interregional, covering sheep, poultry, swine and goat production is needed to give a comprehensive idea of the potential for increasing farm income and livestock production on small family farms in Greece.

Furthermore, not all problems can be fully resolved by individual disciplinary research. It is therefore suggested that interdisciplinary research among animal husbandry scientists, crop scientists, and economists needs to be undertaken to improve decisions by individual farmers and national agricultural policy decisions.

APPENDICES

APPENDIX A

Table A-1. Gross Domestic Product at Factor Cost and Share of Agriculture.

1958 Prices — Million Drachmas

Year	Total GDP	Annual Variation %	Agriculture	Annual Variation %	All other sectors	Annual Variation %	Share of Agriculture[1] as % of GDP
1955	64,198		21,991		42,207		34.4
1956	67,691	+ 5.4	22,195	+ 0.9	45,596	+ 8.0	32.8
1957	73,459	+ 8.5	25,631	+15.5	47,828	+ 4.9	34.9
1958	82,955	+12.9	22,946	-10.5	60,009	+25.5	27.7
1959	86,502	+ 4.3	24,095	+ 5.0	62,407	+ 4.0	27.9
1960	88,859	+ 2.7	22,185	- 7.9	66,674	+ 6.8	25.0
1961	98,446	+10.8	27,151	+22.4	71,295	+ 6.9	27.6
1962	100,980	+ 2.6	25,184	- 7.3	75,796	+ 6.3	24.9
1963	108,805	+ 7.8	27,138	+ 7.8	81,667	+ 7.7	24.9
1964	118,092	+ 8.5	28,859	+ 6.3	82,233	+ 9.3	24.4
1965	126,853	+ 7.3	29,612	+ 2.6	97,241	+ 9.0	23.3
1966	136,800	+ 7.8	29,800	+ 0.6	107,000	+10.0	21.8
1967	144,100	+ 5.3	31,500	+ 5.7	112,600	+ 5.2	21.8
1968	153,000	+ 6.2	29,100	- 7.6	123,900	+10.0	19.0
1969	167,400	+ 9.4	30,500	+ 4.8	136,900	+10.5	18.2
1970	182,000	+ 8.7	33,200	+ 8.8	148,800	+ 8.7	18.2
1971	196,900	+ 8.2	33,300	+ 0.3	163,600	+ 9.9	16.9
1972	217,261	+10.3	34,450	+ 0.4	182,811	+11.7	15.8

Sources: OECD "Agricultural Development in Southern Europe", Paris 1969, p. 66-67.
United Nations Yearbook of National Accounts and Statistics, Vol. III, New York, 1974 [1966 to 1971].
Ministry of Planning and Government Policy" Provisional National Accounts of Greece, Year 1972, Athens, March 1973.

[1] Including Forestry and fishing.

Table A-2. Gross National Product (GNP) and Gross National Income (GNI). (Total in Million Drachmas, Per Capita in Dollars.)

1958 Prices

Year	Gross National Product		Gross National Income	
	Total	Per Capita	Total	Per Capita
1960	102,913	412	92,167	369
1961	114,379	454	102,026	405
1962	118,588	468	104,659	417
1963	128,042	503	112,587	443
1964	139,852	548	122,529	480
1965	152,113	593	132,913	518
1966	162,278	628	140,728	545
1967	172,349	659	148,521	568
1968	185,609	708	158,080	603
1969	202,649	770	172,432	655
1970	219,499	832	187,082	709
1971[1/]	237,741	895	203,915	768
1972[1/]	262,055	976	225,425	839

Source: Ministry of Planning and Government Policy, National Accounts Service, "Provisional National Accounts of Greece." Athens, March 1973.

[1/] Provisional Data

Table A-3. Population, Labor Force, Employment and Unemployment
Mid-Year Estimates

Year	Total Population (,000)	Labor Force		Employment			Unemployment %
		Total (,000)	% of Population	Total (,000)	In Agriculture		
					Total (,000)	%	
1958	8173	3527	43.2	3312	1897	57.3	6.1
1959	8258	3564	43.2	3349	1907	56.9	6.1
1960	8327	3601	43.2	3386	1917	56.6	6.0
1961	8398	3639	43.3	3424	1927	56.3	6.0
1962	8448	3614	42.8	3409	1841	54.0	5.7
1963	8480	3589	42.3	3394	1759	51.8	5.4
1964	8510	3564	41.9	3379	1681	49.7	5.2
1965	8551	3539	41.4	3364	1606	47.7	5.0
1966	8614	3514	40.8	3349	1534	45.8	4.7
1967	8716	3489	40.0	3337	1466	43.9	4.4
1968	8741	3464	39.6	3325	1401	42.1	4.0
1969	8773	3440	39.2	3314	1339	40.4	3.7
1970	8793	3416	38.8	3303	1279	38.7	3.4
1971	8852	3388	38.6	3275	1220	37.3	3.4

Sources:

OECD: "Labor Force Statistics 1960-1971." Basic Statistics, Paris, 1973.

OECD: "Main Economic Indicators," March 1974.

National Statistical Service of Greece: Statistical Yearbook of Greece 1973, February 1974.

Table A-4. Imports c.i.f. and exports f.o.b.; Greece, 1957-1973

Million Drachmas

Year	Imports	Exports	Balance of trade	Exports as % of imports
1957	15,734	6,588	- 9,146	41.9
1958	16,946	6,953	- 9,993	41.0
1959	17,009	6,127	-10,882	36.0
1960	21,060	6,096	-14,964	28.9
1961	21,422	6,700	-14,722	31.3
1962	21,037	7,503	-13,534	35.7
1963	24,129	8,703	-15,426	36.1
1964	26,552	9,256	-17,296	34.9
1965	34,012	9,833	-24,179	28.9
1966	36,685	12,179	-24,506	33.2
1967	35,588	14,856	-20,732	41.7
1968	41,830	14,047	-27,783	33.6
1969	47,824	16,608	-31,216	34.7
1970	58,750	19,276	-39,474	32.8
1971	62,942	19,874	-43,068	31.6
1972[1/]	72,212	26,065	-46,151	36.1
1973	120,924	36,915	-84,009	30.5

Source: Statistical Yearbook of Greece 1972, National Statistical Service of Greece, Athens, Greece, 1973, p. 245.

[1/] The data for 1972 and 1973 have been taken from Economicos Tachydromos, (Weekly Economic Bulletin), April 25, 1974.

Table A-5. Total Meat and Milk Production in Thousand Metric Tons.

Year	Veal	Beef	Pork	Mutton Lamb Goat	Poultry	Total Meat	Milk[1/] (cow)	Milk[1/] Total
1962	21	17	40	74	23	190	383	1035
1963	27	20	39	74	24	200	396	1054
1964	33	20	39	77	26	212	409	1070
1965	41	21	47	79	27	234	445	1119
1966	54	19	51	82	36	263	488	1190
1967	59	17	46	84	46	273	529	1265
1968	69	15	40	84	45	274	517	1253
1969	71	15	45	89	58	300	534	1299
1970	73	17	52	91	71	327	553	1358
1971	75	18	54	95	78	343	556	1401
1972	85	20	61	106	88	387	n.a.[2/]	1404

Sources: OECD, "Meat Balances in OECD Member Countries," Paris, January 1974.

OECD, "Milk and Milk Products Balances in OECD Member Countries," Paris July 1974.

National Statistical Service of Greece, "Statistical Yearbook of Greece," Athens, February 1974.

[1/] Excludes milk sucked by young animals and the quantities used for animal feed.

[2/] Not available.

Table A-6. Total Meat and Milk Consumption in Thousand Metric Tons.

Category / Year	Veal	Beef	Pork	Mutton Lamb Goat	Poultry	Total Meat	Milk[2/]
1962	21	34	41	84	25	220	379
1963	27	48	40	89	30	250	391
1964	33	42	40	97	32	261	420
1965	41	52	49	111	38	310	474
1966	54	50	51	116	47	339	523
1967	59	54	47	119	58	358	573
1968	69	60	44	117	53	364	574
1969	71	70	46	125	64	398	580
1970	73	85	52	131	74	438	585
1971	75	69	54	155	81	457	595
1972[1/]	85	65	61	152	91	481	595

Sources: OECD, "Milk and Milk Products Balances in OECD Member Countries," Paris, July 1974.

OECD, "Meat Balances in OECD Member Countries," Paris, January 1974.

[1/] Per capita consumption figures for beef and veal for selected countries in 1972 are: United States 53.6 kgs, France 28.5 kgs, Italy 25.4 kgs, and W. Germany 23.4 kgs.

[2/] Whole milk for liquid consumption or processing into cream and other fresh products (yogurt).

Table A-7. Livestock Imports c.i.f. (Trade by S.I.T.C. divisions)

Year	Live Animals		M E A T[1]			Milk and Cream	
	Total	From Yugoslavia	Total	From S. America	From Yugoslavia	Total	From EEC.
	Million U. S. Dollars						
1963	6.4	3.3[2]	24.8	18.0	3.0[2]	9.2	8.2
1964	5.2	4.3	30.3	11.3	2.7	12.2	10.3
1965	9.9	7.9	53.7	15.5	5.7	12.9	11.8
1966	12.0	7.0	51.6	22.3	3.6	15.2	13.3
1967	10.2	4.5	57.7	27.7	2.8	18.6	16.5
1968	16.2	9.0	57.8	26.5	14.7	19.6	17.9
1969	8.7	2.5	62.5	38.4	9.6	20.7	18.4
1970	9.5	3.6	82.5	54.1	9.4	22.4	19.7
1971	17.1[3]	9.5	85.9[4]	29.8	11.2	25.6	22.6
1972	18.2	8.9	82.5	23.3	13.7	29.8	25.4

Source: OECD, "Trade by Commodities, Analytical Abstracts," Series B, Annual, 1961-1972, Paris.

[1] Included is fresh, and chilled for frozen meat.

[2] For 1963 to 1967 the import value includes also other Eastern European countries.

[3] Includes 11.1 million U.S. dollars only for cattle.

[4] Other imported countries are: Australia 15.5 mil. dol. and N. Zealand, 13.9 mil. dol.

APPENDIX B

Table B-1.Monthly Cattle Slaughterings in Imathia, Pieria, Kilkis, 1973.

Month	Imathia	Pieria	Kilkis
1. January	1123	244	301
2. February	1772	188	792
3. March	977	166	465
4. April	1011	146	348
5. May	1520	202	628
6. June	1384	223	521
7. July	1295	391	666
8. August	551	395	679
9. September	361	322	921
10. October	916	306	812
11. November	1414	252	719
12. December	1504	313	494

Source: Provincial Veterinary Offices of the Ministry of Agriculture.

Table B-2. Area (th. hectares), Production (th. tons) and Average Yield (Kg/hectare) of: Wheat, Barley, Corn. Greece 1963-1972.

Year	WHEAT			BARLEY			CORN		
	Area	Production	Average Yield	Area	Production	Average Yield	Area	Production	Average Yield
1963	1078	1417	1314	175	207	1183	185	253	1367
1964	1263	2088	1652	167	242	1449	150	249	1660
1965	1258	2072	1647	203	338	1665	144	249	1729
1966	1132	2020	1784	284	563	1982	139	275	1978
1967	1051	1936	1746	351	774	2205	133	313	2353
1968	1098	1568	1428	332	471	1418	148	344	2324
1969	1078	1723	1598	282	447	1585	149	413	2771
1970	975	1931	1980	343	737	2148	170	511	3005
1971	977	1946	1991	380	781	2055	168	571	3398
1972	887	1773	1998	411	867	2109	164	579	3530

Source: Statistical Yearbook of Greece 1973, op. cit. p. 174.

Table B-3. Production of Fodder Crops in Th. tons, and Feeding Stuff Imports (c.i.f.) in mi. U.S. Dollars, Greece: 1963-1972.

Year	PRODUCTION			IMPORTS		
	Alfalfa (Hay)	Vetch (Hay)	Green Corn	Corn[2] Unmilled	Feeding Stuff[3] Total	Feeding Stuff[3] From EEC
1963	614	225	24	8.3	3.7	1.0
1964	701	208	29	8.11	4.7	1.4
1965	796	250	34	10.7	6.3	1.6
1966	1081	226	38	17.9	8.8	2.6
1967	1211	219	50	17.8	8.6	3.5
1968	1223	171	39	8.8	7.1	4.0
1969	1361	180	40	15.4	10.0	5.1
1970	1554	171	48	5.9	14.3	6.5
1971	1600	179[1]	54	28.9	17.9	7.9
1972	1700	n.a.[1]	n.a.	4.1	19.3	6.6

Source: For Production: Statistical Yearbooks of Greece 1965-1973, op. cit.
For Imports: OECD, "Trade by Commodities, Analytical Abstracts." Series B, Annual, 1962-1972. Paris

[1] not available

[2] Almost all the corn is imported from United States

[3] not including unmilled cereals.

APPENDIX C

QUESTIONNAIRE

I. LAND AND CROP PRODUCTION

Table C-1. Farm Size and Land Value

Land Classification	Total		Non-irrigated		Irrigat	
	Str.	Value Dr	Str.	Value Dr	Str	Val Dr
1. Owned Land						
a. Field crops						
b. Vineyards						
c. Gardens						
d. Orchards						
e. Alfalfa, clover						
f. Hay-field						
A. Total Owned Farm Land						
g. Forest Land						
h. Meadows						
i. Pasture						
j. Other land						
B. Total Owned Non-Farm Land						
C. Total Owned Land (A+B)						
2. Rented Land						
a. Rented						
(-) b. Rent out						
D. Rented Land + or -						
3. Suitable for cultivation Land						
a. Owned (1A)						
b. Rented (2D)						
E. Total (1A+2D)						
4. Cultivated Land						
a. Owned and Rented(3E)						
(-) b. Fallow						
F. Cultivated Land plus Rotated and Strip Land						
G. Total Cultivated Land						

Table C-2. Crop Production

Crops	Area Str	Quantity Produced Kg	Your Yield in relation to other years was			Reasons for Yield Differences
			Same	Lower	Greater	
Wheat Barley Oats Corn (dom) >> Hybrids Tobacco Cotton Orchard Alfalfa Meadows						

Table C-3. Crop Production Disposition.

Product	Sold out Kg	For Sale Kg	Inventory for		Home Consumption Kg
			Crops Kg	Livestock Kg	
1. Main products a. Wheat b. Barley c. d. 2. By-products a. Straw b. Hay c. d.					

II. LIVESTOCK: INVENTORY AND PRODUCTION

Table C-4. Cattle Population

Cattle	No.	This Year		Age	Last Year		Changes due to:				
		Value			No.	Total Value Dr	Born	Buy	Sale	Home Consumption	Died
		Per unit Dr	Total Dr								
a) Domestic Cows											
b) " Heifers											
c) " Steers											
d) " Bulls											
e) Improved Cows											
f) " Heifers											
g) " Steers											
h) " Bulls											
i) Foreign Cows											
j) " Heifers											
k) " Steers											
l) " Bulls											
m) Buffaloes											
Cattle, TOTAL											

III. FARM BUILDINGS, LAND IMPROVEMENTS, FARM MACHINERY AND EQUIPMENT

Table C-5. Farm Buildings

Type (Items)	No.	Year Made	Value Dr	Total Value		Remarks and Made From:
				Year Made	Today (1974)	
House Barn Stable Storage						
Total						

Table C-6. Land Improvements

Type (Items)	No.	Year Made	Value Dr	Total Value		Used For: (Crop production, Livestock prod garden, etc.)
				Year Made	Today (1974)	
Wells Fences						
Total						

Table C-7. Farm Machinery and Equipment

Type	No.	Initial Unit Value Dr	Total Value		Description	New(N) or Used(U)	Purchasing Year
			Initial Dr	Today 1974 Dr			
MACHINERY 1. Tractor 2. Combine 3. . . . 4. . . .							
EQUIPMENT 1. . . . 2. . . . 3. . . .							

IV. FARM FAMILY AND EMPLOYMENT

Table C-8. Farm Family Composition

Family Members	Year Born	School Years	Married or Single	Live in the same House	Employment	Years Employment
Farmer Spouse Son A Son B :						

APPENDIX D

Table D-1- Estimated Annual Budget for One Stremma of Crop Production Enterprises[1/]

A1 - Wheat Budget			
Item	Quantity (kg)	Price[2/] (Dr/kg)	Value or Cost (Dr)
Gross Income			
Wheat	245	3.60	882
Straw[3/]	220	.75	165
Total			1047
Variable Costs			
Seed, Fertilizers, Pesticides			154.2
Machinery Cost[5/]			146.9
Total			301.1
Labor (Hours/Str)			
Fall	1.31		
Winter	.51		
Spring	.62		
Summer	1.64		
Total	4.08		

Footnotes appear at the end of Table.

Table D-1- Continued

A2 - BARLEY BUDGET

ITEM	Quantity (kg)	Price[2/] (Dr/kg)	Value or Cost (Dr)
Gross Income			
Barley	260	3.40	884
Straw[2/]	234	.75	175
Total			1059
Variable Costs[4/]			
Seed, Fertilizers, Pesticides			136.9
Machinery Cost[5/]			144.9
Total			281.8

Labor (Hours/Str)	
Fall	1.0
Winter	.7
Spring	.5
Summer	1.5
Total	3.7

Footnotes appear at the end of Table.

Table D-1 Continued

A3 - CORN BUDGET

Item	Quantity (kg)	Price[2/] (Dr/kg)	Value or Cost (Dr)
Gross Income			
Corn-grain	470	3.40	1598
Variable Costs[4/]			
Seed, Fertilizers, Pesticides			96.6
Machinery Cost[5/]			258.8
Total			355.4

Labor (Hours/Str)

Fall	11.8
Winter	.5
Spring	7.0
Summer	14.5
Total	33.8

Footnotes appear at the end of Table.

Table D-1 Continued

A4 - ALFALFA BUDGET

Item	Quantity (kg)	Price[2/] (Dr/kg)	Value or Cost (Dr)
Gross Income			
Alfalfa (hay)	1200	2.4	2880
Variable Costs[4/]			
Seed, Fertilizers, Pesticides			98.6
Machinery Costs[5/]			366.0
Total			464.6
	Labor(Hours/Str)		
	Fall	4.6	
	Winter	1.6	
	Spring	6.2	
	Summer	13.5	
	Total	25.9	

Footnotes appear at the end of Table.

Footnotes for Table D-1.

1/ Estimates are developed from the following sources: a) Kitsopanidis, G. J., et al., "The Economics of Wheat, Barley, Maize, Lucerne Production." Four Bulletins. Department of Agricultural Economics Research, Thessaloniki, Greece, 1972; b) Tselepis, N., "Production Cost of Crop and Livestock Products." Athens, Greece 1968 (in Greek); c) Personal Communication with Mr. S. Lazaridis, Agricultural Specialist, Agricultural Bank of Greece; d) Survey data.

2/ The 1973-74 price levels.

3/ Actual selected straw

4/ Variable cost prices were adjusted for the 1973-74 period. When both home grown and purchased seed were used, the price of seed was assumed lower than the market.

5/ Includes costs of oil, lubrication, fuel and repairs for small machinery power. It was assumed that cultivating, harvesting, and baling were done on a custom basis.

Table D-2
EXPLANATION OF ABBREVIATIONS USED IN THE MATRIX

1. Resources (Rows)

Row No.	Abbreviation	Complete Heading
1	NIL	Non Irrigated Land
2	IL	Irrigated Land
3	RNIL	Rent Non Irrigated Land
4	RIL	Rent Irrigated Land
5	WH	Wheat account
6	STR	Straw account
7	BAR	Barley account
8	COR	Corn account
9	ALF	Alfalfa account
10	BR	Bran account
11	CC	Cotton cake account
12	COW	Cow Control account
13	SC	Steer Calves[1/]
14	HC	Heifer Calves
15	S10	Steers 10 months[1/]
16	S16	Steers 16 months[1/]
17	S18	Steers 18 months[1/]
18	H16	Heifers 16 months
19	HREP	Heifers Replacements
20	CULL	Cull Cow
21	MILC	Milk account
22	HFC	Housing For Cows
23	HFSH	Housing For Steers-Heifers
24	AFL	Annual Family Labor
25	FL	Fall Family Labor
26	WL	Winter Family Labor
27	SL	Spring Family Labor
28	SUL	Summer Family Labor

Footnotes appear at the end of Table.

Table D-2 continued

Row No.	Abbreviation	Complete Heading
29	SLL	Sell Labor Limit
30	OPC	Operating Capital
31	CSTCL	Crops Short Term Credit Limit
32	LSTCL	Livestock Short Term Credit Limit
33	MLLC	Medium-Long Livestock Credit

2. Activities (columns)

Column No.	Abbreviation	Complete Heading
1	PRWH	Produce Wheat
2	PRB	Produce Barley
3	PRC	Produce Corn for Grain
4	PRA	Produce Alfalfa
5	RLNI	Rent Land Non Irrigated
6	RLI	Rent Land Irrigated
7	SSTR	Sell Straw
8	SWH	Sell Wheat
9	SBAR	Sell Barley
10	SCORN	Sell Corn
11	SALF	Sell Alfalfa
12	BCORN	Buy Corn
13	BBAR	Buy Barley
14	BALF	Buy Alfalfa
15	BBR	Buy Bran
16	BSTR	Buy Straw
17	BWH	Buy Wheat
18	BCC	Buy Cotton Cake
19	DPCS	Dual Purpose Cow Feeding Straw
20	DPC	Dual Purpose Cow Without Straw
21	RSTE	Raise Steers Ten Months[1/]
22	RSSI	Raise Steers Sixteen Months[1/]
23	RSE	Raise Steers Eighteen Months[1/]

Footnotes appear at the end of Table.

Table D-2 continued

2. Activities

Column No.	Abbreviation	Complete Headings
24	SST	Sell Steers Ten Months[1/]
25	SSE	Sell Steers Eighteen Months[1/]
27	RHAS	Raise Heifers at Sixteen Months
28	RHATE	Raise Heifers at Twenty-Eight Months
29	SHSL	Sell Heivers Sixteen Months Live
30	SHSS	Sell Heifers Sixteen Months Slaught.
31	BREP	Buy Replacements
32	SCCO	Sell Cull Cow
33	SMILK	Sell Milk
34	SFLA	Sell Fall Labor
35	SWLA	Sell Winter Labor
36	SSLA	Sell Spring Labor
37	SSUL	Sell Summer Labor
38	HFLA	Hire Fall Labor
39	HWLA	Hire Winter Labor
40	HSLA	Hire Spring Labor
41	HSUL	Hire Summer Labor
42	BMC	Borrow Money for Crops
43	BML	Borrow Money for Livestock
44	BMBL	Borrow Money for Livestock Build. and Replacements

[1/] Since the proportion of male calves, which is castrated is unknown, the terms steer and bull calf have been used interchangeably.

Table D-3. Estimated Gross Income and Variable Costs For Livestock Production Activities[1]/

(1). Ten (10) Months Calf

Item	Value or Cost (Dr)	
Gross Income		
Sale of calf[2]/	10703	
Variable Costs		
Veterinary and medicine	90	
Electricity, water	20	
Buildings and equipment repairs (1%)[3]/	35	
Vitamins, Minerals	50	
Feed grinding[4]/	52	
Miscellaneous[5]/	23	
Death loss[6]/	--	
Total Variable Costs	270	
Feed		
Whole milk and milk substitute[7]/	60/days x 5 kg/day	300 kg
Alfalfa[8]/	270 days x 3 kg/day	810 kg
Concentrates[9]/	240 days x 3 kg/day	720 kg
Bedding		
Straw	300 kg	

Labor (Hours)

Fall	Winter	Spring	Summer	Total
22.5	15	15	22.5	75

Footnotes appear at the end of Table.

Table D-3 Continued

(2). Sixteen (16) Months Calf

Item			Value or Cost (Dr)
Gross Income			
Sale of calf[2]			15799
Variable Costs			
Veterinary and medicine			110
Electricity, water			32
Buildings and equipment repairs (1%)[3]			47
Vitamins, Minerals			70
Feed grinding[4]			104
Miscellaneous[5]			47
Death loss[6]			--
Total Variable Costs			410
Feed			
Whole milk and milk substitute[7]	60 days x 5 kg/day		300 kg
Alfalfa[8]	450 days x 4.2 kg/day		1890 kg
Concentrates[9]	420 days x 3.43 kg/day		1440 kg
Bedding			
Straw	480 kg		
Labor (Hours)			
Fall	Winter	Spring	Summer	Total
22.5	22.5	37.5	37.5	120

Footnotes appear at the end of Table.

Table D-3- Continued

(3) Eighteen (18) Months Calf

Item		Value or Cost (Dr)	
Gross Income			
Sale of calf[2/]		15876	
Variable Costs			
Veterinary and medicine		115	
Electricity, water		36	
Buildings and equipment repairs (1%)[3/]		52	
Vitamins, minerals		80	
Feed grinding[4/]		125	
Miscellaneous[5/]		57	
Death loss[6/]		--	
Total Variable Costs		465	
Feed			
Whole milk and milk substitute[7/]	60 days x 5 kg/day	300 kg	
Alfalfa[8/]	510 days x 4.41 kg/day	2250 kg	
Concentrates[9/]	480 days x 3.62 kg/day	1740 kg	
Bedding			
Straw	540 kg		

Labor(Hours)

Fall	Winter	Spring	Summer	Total
30	22.5	37.5	45	135

Footnotes appear at the end of Table.

Table D-3- Continued

(4) Heifer Raising for Replacement

Item		Value or Cost (Dr)
Gross Income		
Sale after first calf[2]		18000
Variable Costs		
Veterinary, medicine		196
Breeding fee		60
Electricity, water		56
Buildings and equipment repairs (1%)[3]		82
Vitamins, minerals		140
Feed grinding[4]		158
Miscellaneous[5]		60
Death loss[6]		--
Total Variable Costs		752
Feed		
Whole milk and milk substitute[7]	300 kg	
Alfalfa[8]	2997 kg	
Concentrates[9]	2112 kg	
Bedding		
Straw	840 kg	

Labor (Hours)

Fall	Winter	Spring	Summer	Total
52.5	45	60	67	224.5

Footnotes appear at the end of Table.

Footnotes for Table D-3

1/ Estimates are developed upon the following sources:

(a) Dailey, R. T., et al. "Agricultural Planning Data for the Northeastern United States." The Pennsylvania State University Press, University Park, A.E. and R.S., 51, July 1965.

(b) Tselepis, N. op. cit.

(c) Koutoglidis, H., "Economic Results of Cattle Fattening in a Small Farm." Hellenic Economic Review, Vol. 10, Thessaloniki, July 1974.

(d) Unpublished farm records kept by Farm Management personnel at the University of Thessaloniki, Department of Agricultural Economics.

(e) Emmanouilidis, P., Livestock Specialist. Personal communication.

(f) Survey data.

2/ Based on .56, .54, .53 carcass weight for calves 10 months, 16 months, 18 months respectively. For heifers ten (10) percent lower gain than bull calves was assumed. The sale value for replacement heifer, after the delivery of first calf, includes also Dr. 2000 as subsidy.

3/ Based on Dr 3490 necessary buildings and equipment per calf per year.

4/ Based on 3 percent grinding fee.

5/ Includes livestock insurance, travel expenses, etc.

6/ Internally generated in the model.

7/ Colostrum is provided during the first days.

8/ Dry alfalfa or other forages, and small quantities of green alfalfa or green chops.

9/ Various rations are provided. The most common includes: Barley 40%, Corn 30%, Wheat 10%, Bran 20%, or Corn 30%, Barley 30%, Wheat 10%, Bran 10%, Cotton Cake 10%, and high protein meals.

Table D-4. Estimated Gross Income and Variable Costs for a Cow -- Cow Weighs 540 kgs and Produces 2500 kgs milk.[1/]

Item	Unit	Amount (kg)	Price Dr	Value or Cost (Dr)
Gross Income				
Milk	Kg	2500	4.5	11250
Calf[2/]	Head	.75	4000	3000
Cull cow[3/]	Kg	40.33	41.0	1654
Total				15904
Variable Costs				
Veterinary and medicine				160
Breeding fee				60
Electricity and water				25
Vitamins, Minerals				60
Death loss (4 percent)[4/]				
Buildings and equipment repairs[5/]				74
Feed grinding[6/]				113
Miscellaneous				66
Total Variable Costs				558
Feed				
Concentrates[7/]	1565 kg			
Forage[8/]	2190 kg			
Straw	1095 kg			
Bedding				
Straw	365 kg			
Labor (Hours)				

Fall	Winter	Spring	Summer	Total
76	75	77	77	305

Footnotes appear at the end of Table.

Footnotes for Table D-4

1/ Estimates are developed upon the following sources:

(a) Kitsopanidis, G. "The Economics of Milk Production in Central Macedonia, Greece." Reprint from The Agricultural Economics Review, Vol. VI, No. 1, Thessaloniki, 1970.

(b) Recommendations of the Central Union of Livestock Cooperatives of Greece during the 2nd Panhellenic Livestock Seminar, April 1972.

(c) Tselepis, N. op. cit.

(d) Lazaridis, S., Extension Specialist, Agricultural Bank of Greece. Personal Interview.

(e) Emmanouilidis, P. op. cit.

(f) Survey data.

2/ Based on 80 percent calving rate and 6 percent mortality rate.

3/ Based on 16.6 percent culling rate.

4/ Internally included in the model.

5/ Based on Dr. 7385 per cow investment for buildings and equipment.

6/ Based on 3 percent grinding fee.

7/ 365 kg. for maintenance and 1200 kg for production, based on grain, milk ratio 1:2.5.

8/ Mainly dry alfalfa or vetch. During late Spring or Summer, cattle are fed cut alfalfa or are permitted to graze.

BIBLIOGRAPHY

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Adamopoulos, A. "Farm Land as a Basic Criterion of Sampling in Agricultural Economics and Social Regional Surveys." Thessaloniki, 1960.

_____. "Application of Linear Programming in Organizing New Farms: A Special Case in the Department of Pieria (Greece)," Agricultural Economic Review, Vol. 1, No. 2, Thessaloniki, (July, 1965).

Adamopoulos, A. L. "Economic and Social Characteristics of Farms in the Region of Kozani (Greece)." University of Thessaloniki, School of Agriculture and Forestry, Thessaloniki (1963).

_____ and Papageorgiou, E. "Farm Management Research and Planning in Northern Greece." Thessaloniki, 1963.

Andersen, J. C. and Heady, E. O. "Normative Supply Functions and Optimum Farm Plans for Northeastern Iowa," Research Bulletin 537, Ames, Iowa: Iowa State University, 1965.

Atta-Konadu, Y. K. "Economic Optima in Resource Allocation for Smallholder Subsistence Farming in Ghana." Ph.D. dissertation, Michigan State University, 1974.

Beneke, R. R. and Winterboer, R. Linear Programming Applications to Agriculture. Ames, Iowa: Iowa State University Press, 1973.

Bockenhoff, E. and Wernberg, N. "Marketing of Livestock and Meat: Report to the Government of Greece," FAO Publication, (Rome 1967).

_____, et al. "Short-Term Forecasting of Livestock Numbers and Livestock Production in the Federal Republic of Germany, Denmark, the Netherlands and the United Kingdom." Institut fur Landwirtschaftliche Marktlehre, Stuttgart, 1970.

Bradford, L. A. and Johnson, G. L. Farm Management Analysis. New York: John Wiley and Sons, 1960.

Cochrane, W. G. Sampling Techniques. 2nd Edition, New York: John Wiley and Sons, Inc., 1963.

Colyer, D. and Irwin, G. "Beef, Pork and Feed Grains in The Corn-Belt: Supply Response and Resource Adjustments." North Central Regional Research Publication Columbia, Missouri, 1967.

Connor, L. J. and Vincent, W. H. "A Framework for Developing Computerized Farm Management Information," Canadian Journal of Agricultural Economics, Vol. 18, No. 1, 1970.

Control Data Corporation. APEX-I Reference Manual. Minneapolis, Minnesota, 1974.

Dailey, R. T., et al. Agricultural Planning Data for the Northeastern United States. University Park: Pennsylvania State University Press, July 1965.

Desai, D. K. "Increasing Income and Production in Indian Farming," The Indian Society of Agricultural Economics, Bombay, 1963.

Dodson, J. D., Pasour, E. C. and Wells, R. C. "An Economic Adjustment Study of Dairy Farms in Western North Carolina," EIR-22, North Carolina State University, 1971.

Economicos Tachydromos (Weekly Economic Bulletin) (September, 1972 to April 1974).

FAO/IBRD, "Livestock Identification Mission in Greece," August 1971.

FAO. "European Breeds of Cattle," Vol II (Rome, 1966).

Ferguson, D. S. "The Nigerian Beef Industry," Cornell International Agricultural Development Bulletin, No. 9, Cornell University, Ithaca, New York, 1967.

Ferris, J., Sorenson, V., et al. "The Impact on U.S. Agricultural Trade of the Accession of the United Kingdom, Ireland, Denmark and Norway to the European Economic Community," Michigan State University, 1971.

Fielder, L. L and Londhe, S. R. "Farm Planning Guides for Small Farms," Louisiana State University, D.A.E. Research Report No. 350, January, 1966.

Heady, E. O., et. al., Agricultural Supply Functions Estimating Techniques and Interpretations. Ames, Iowa: Iowa State University Press, 1961.

_____ and Gibbons, J. R. "Cost Economies in Cattle Feeding and Combinations for Maximization of Profit and Stability," Research Bulletin 562, Iowa State University, (July 1968).

_____. Economics of Agricultural Production and Resource Use. Englewood Cliffs, N.J.: Prentice-Hall, 1957.

_____ and Candler, W. Linear Programming Methods. Ames, Iowa: Iowa State University Press, 1973.

Hildreth, C. and Jarrett, F. G. A Statistical Study of Livestock Production and Marketing. New York: John Wiley and Sons, Inc., 1955.

Huang, D. S. Introduction to the Use of Mathematics in Economic Analysis. New York: John Wiley and Sons, Inc., 1966.

Hutchison, J. E. Urban, F. S. and Dunmore, J. C. "Argentina: Growth Potential of the Grain and Livestock Sectors." USDA, Foreign Agricultural Economic Report, No. 78, Washington, D.C., 1972.

Johnson, G. L. "Supply Function--Some Facts and Notions," In Agricultural Adjustment Problems in a Growing Economy. Edited by E. O. Heady, et al. Ames, Iowa: Iowa State University Press, 1958.

_____. "Agricultural Economics, Production Economics and the Field of Farm Management," Journal of Farm Economics, Vol. XXXIX, No. 2, (May 1957).

_____, et al. Korean Agricultural Sector Analysis and Recommended Development Strategies, 1971-1985. Department of Agricultural Economics, Michigan State University, 1972.

Kerr, T. C. "Determinants of Regional Livestock Supply in Canada," Agricultural Economics Research Council of Canada, July 1968.

Kitsopanidis, G. J. "The Economics of Milk Production in Central Macedonia, Greece," Reprint from the Agricultural Economic Review, Vol. VI, No. 1, Thessaloniki, 1970.

_____, et al. "The Economics of Wheat, Barley, Maize, Lucerne and Tobacco Production." Five Bulletins, Department of Agricultural Economics Research, Thessaloniki, 1972.

_____. "Types of Farming in Central Macedonia, Greece: A Comparative Economic Analysis," Agricultural Economic Review, Vol. VIII, No. 1, Thessaloniki, 1972.

Knight, F. H. Risk, Uncertainty and Profit. Chicago: University of Chicago Press, 1971.

Kottke, M. W. "A Short-Cut Approach to the Use of Linear Programming for Solving On-The-Farm Problems," Research Report 26, University of Connecticut, (December 1967).

Kohout, J. "A Price and Allocation Decision Model for the Beef Economy in Argentina." Ph.D. dissertation, University of Illinois, 1969.

Krenz, R. D. Heady, E. O. and Baumann, R. V. "Profit-Maximizing Plans and Static Supply Schedules for Fluid Milk in the Des Moines Milkshed," Research Bulletin 486, Iowa State University, (October 1960).

Koutoglidis, H. "Economic Results of Cattle Fattening in a Small Farm," Hellenic Economic Review, Vol. 10, Thessaloniki, (July, 1974).

Kutish, F. and Sitler, H. "A Study of the Economics of Land Use and Livestock Production in Greece," USDA, (June 1967).

Ladd, G. and Easley, E. An Application of Linear Programming to the Study of Supply Responses in Dairying. Ames, Iowa: Iowa State University Press, 1959.

Lard, C. F. "Profitable Organization of Representative Farms in Lower Michigan and Northeastern Indiana with Special Emphasis on Feed Grains and Livestock." Ph.D. dissertation, Michigan State Univeristy, 1963.

Lee, Y. C. "Adjustment in the Utilization of Agricultural Land in South Central Michigan with Special Emphasis on Cash-Grain Farms." Ph.D. dissertation, Michigan State University, 1975.

Llewellyn, R. W. Linear Programming. New York: Holt, Rinehart and Winston, Inc., 1964.

Lopes, J. "Greece to Triple'73-74 Grain Imports," USDA, Foreign Agriculture, (October 1973).

Menzie, E. L., Hanekamp, W. J. and Phillips, G. W. "The Economics of the Cattle Feeding Industry in Arizona," University of Arizona, Technical Bulletin 207, 1973.

Miller, T. and Heady, E. O. Analysis of Aggregation Error in Supply Functions Based on Farm-Programming Models. Ames, Iowa: Iowa State University Press, 1973.

Ministry of Coordination. "Economic Development Plan for Greece, 1968-1972," Athens, Greece, 1968.

Ministry of Planning and Government Policy. "Provisional National Accounts of Greece." Athens, March 1973.

Missiaen, E. and Coffing, A. L. "Canada: Growth Potential of the Grain and Livestock Sectors." USDA, Foreign Agricultural Economic Report No. 77, Washington, D.C., 1972.

Myrick, D. and Witucki, L. "How Greece Developed Its Agriculture, 1947-67," USDA, Foreign Agricultural Economic Report No. 67, February 1971.

National Statistical Service of Greece. Statistical Yearbook of Greece, Years 1962 to 1973. Athens.

_____. Agricultural Statistics of Greece, Years 1962 to 1971. Athens.

Nisar, A. K. and Elterich, J. G. "Optimum Organizations of Medium-Sized Dairy Farms on the Delmarva Peninsula." University of Delaware, Bulletin 390, Newark,(March 1972).

_____. "Changing Input-Output Relationships and Optimum Organizations of Large-Scale Dairy Farms on the Delmarva Peninsula," University of Delaware, Bulletin 397, Newark, (April 1973).

OECD. Labor Force Statistics, 1960-1971. Basic Statistics, Paris, 1973.

_____. "Capital and Finance in Agriculture," Agricultural Policy Reports, Vol. II, Paris, 1970.

_____. Trade by Commodities, Analytical Abstracts. Series B, 1961-1972, Paris.

_____. Meat Balances in OECD Member Countries. Paris, January 1974.

_____. Milk and Milk Products Balances in OECD Member Countries. Paris, July 1974.

_____. Agricultural Policy in Greece. Paris, 1973.

_____. The Market for Beef and Veal and Its Factors, Paris, 1967.

_____. Agricultural Development in Southern Europe. Paris, 1969.

_____. Main Economic Indicators. Paris, March 1974.

Ogunforowa, O. "Derived Resource Demand, Product Supply and Farm Policy in the North Central State of Nigeria." Ph.D. dissertation, Iowa State University, 1972.

Papageorgiou, E. "Agricultural Policy. Thessaloniki, Greece.

Papaioannou, M. and Jones, G. "Supply Responses for Cattle, Sheep and Goats in Greece, 1952-65," Oxford Agrarian Studies, University of Oxford, Vol. I, No. 2, Oxford, 1972.

_____. "Quantitative Analysis and Agricultural Policy with Special Reference to Animal Breeding in Greece," Options Mediterraneennes, No. 8, 1971.

Petit, M. J. "Econometric Analysis of the Feed-Grain Livestock Economy," Ph.D. dissertation, Michigan State University, 1964.

_____ and Viallon, J. B. "The Grain-Livestock Economy of France with Projections to 1970 and 1975," Institute of International Agriculture, Michigan State University, 1968.

Posada, A. "A Simulation Analysis of Policies for the Northern Colombia Beef Cattle Industry." Ph.D. dissertation, Michigan State University, 1974.

Rossmiller, G. E. "The Grain-Livestock Economy of West Germany with Projections to 1970 and 1975," Institute of International Agriculture, Michigan State University, Research Report No. 1.

Schickele, R. "Farm Management Research for Planning Agricultural Development," The Agricultural Development Council, New York, 1966.

Sharples, J. A. Heady, E. O. and Sherif, M. M. "Potential Agricultural Production and Resource Use in Iowa," Research Bulletin, 569, Iowa State University, (June, 1969).

_____. "The Representative Farm Approach to Estimation of Supply Response," USDA, 1968.

Schultz, T. W. Transforming Traditional Agriculture. New Haven: Yale University Press, 1964.

Shaw, L. "Post-War Growth in Greek Agricultural Production," Center of Planning and Economic Research, Athens, 1969.

Shumway, C. R., Bentley, E. and Barrick, E. R. "Economic Analysis of a Beef Production Innovation: Dairy-Beef Crossbreeding," Department of Economics, ERR-26, North Carolina State University, March 1974.

Smith, S. F. "Linear Programming A New York Dairy Farm," Agricultural Extension Report 555, Cornell University, (March 1970).

Tselepis, N. Production Cost of Crop and Livestock Products. Athens, 1968.

United Nations. Monthly Bulletin of Statistics, Vol. XXVIII, No. 3, (March 1974).

_____. Yearbook of National Accounts and Statistics, Vol. III. New York, 1974.

Vakakis, F. "Meaning and Content of Agricultural Sector Investment Planning," Agricultural Bank of Greece, Bulletin 191, Athens (1973).

Vincent, W., ed. Economics and Management in Agriculture. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1962.

_____ and Connor, L. J. "An Orientation for Future Farm Planning and Information Systems," Agricultural Economics Miscellaneous, Michigan State University, 1968.

Wragg, S. R. Godsell, T. E. and Williams, G. "Co-operative Research on Input-Output Relationships in Beef Production," OECD, Paris, 1968.

Yotopoulos, P. "Allocative Efficiency in Economic Development," Center of Planning and Economic Research, Athens, 1967.

_____ and L. J. Lau. "On Modelling the Agricultural Sector in Developing Economies: An Integrated Approach of Micro and Macro Economics," Food Research Institute, Memorandum, No. 148, (June 1973).