RESEARCH REPORT NO. 3

THE GRAIN-LIVESTOCK ECONOMY OF FRANCE

WITH PROJECTIONS TO 1970 AND 1975

Michel J. Petit and
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Foreword

This report is one of a series of five. The other reports are:

The Grain-Livestock Economy of West Germany with Projections to 1970 and 1975 by George E. Rossmiller

The Grain-Livestock Economy of Italy with Projections to 1970 and 1975 by Fred A. Mangum, Jr.

Changes in Regional Grain and Livestock Prices under the European Economic Community Policies by Donald J. Epp

The Grain-Livestock Economy and Trade Patterns of the European Economic Community with Projections to 1970 and 1975 by Vernon L. Sorenson and Dale E. Hathaway.

This research was carried out in cooperation with the Department of Agricultural Economics, Michigan State University as part of a study they developed through arrangements with the Economic Research Service and the Foreign Agriculture Service, U.S. Department of Agriculture.

The information on which this report is based stems from the authors' research at the Institut National de la Recherche Agronomique, Paris, France. However, the views expressed here are the authors' and do not necessarily reflect those of either the USDA or of the French Ministry of Agriculture.

The study of the grain livestock economy of West Germany and Italy and the study of regional grain and livestock prices were undertaken in cooperation with the following research institutes respectively:

Institut für Landwirtschaftliche Betriebslehre, Göttingen, Germany, under the direction of Professor E. Woermann

Istituto di Economia e Politica Agraria della Universita di Perugia, Italy, under the direction of Professor G. Guerrieri and Istituto Nazionale di Economia Agraria, Rome, Italy under the direction of Professor M. Bandini

Institut für Landwirtschaftliche Marktlehre, Göttingen, Germany, under the direction of Professor A. Hanau

Direct supervision of each subproject was with the listed author(s) and overall leadership of the project was in the hands of Dr. Dale E. Hathaway and Dr. Vernon L. Sorenson of Michigan State University.

It is important that the U.S. assess changes in both production and consumption of agricultural products in the EEC countries since five of the top ten cash market countries for U.S. agricultural exports in the 1965/66 marketing year are members of the EEC.

The interaction of the supply-demand relationships within the EEC will directly affect the future level and mix of U.S. agricultural products and production inputs exported to that area.

The objective of this study is to analyze the impact of the various economic forces, including among others the Common Agricultural Policy of the

EEC, which will shape future developments of grain and livestock production. Projections to 1970 and 1975 are provided here as most likely results of all forces at work.

The authors gratefully acknowledge the help of various individuals who assisted in various stages of this study:

Dr. R. Bergmann, Directeur de Recherches, INRA, who has been a stimulating and understanding boss.

Drs. D.E. Hathaway and V.L. Sorenson who assisted with funds to support this study which they viewed as necessary to fulfill the objective of research dealing with the grain-livestock economy of the total of the EEC.

Dr. G.A. Peterson of the University of Wisconsin spent 18 months with the authors in Paris and participated in the elaboration of the research program which made this study feasible.

P.J. Albert, the authors' colleague and friend, who was a full fledged participant in the INRA research program until he was called to military service.

G. Legendre who carried on many computations and also provided help in the interpretation of data.

Any error remains under the authors' responsibility.

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HIGHLIGHTS OF PROJECTION RESULTS

Projections to 1970 and 1975 of grain and livestock production in France gave the following results:

1. A substantial increase in total grain production is expected to occur due almost entirely to increased yields. Total grain surface is expected to remain stable but the surface in barley and corn will increase at the expense of other grains. Total grain production will increase faster than consumption. This will add to the existing surpluses and bring about increased grain exports. Some of them will go to other members of the EEC but it is likely that large quantities of French wheat will be exported outside of the EEC. Purchasing behavior of feed mixing firms, and particularly their response to changes in relative prices of grains will be crucial in this respect.
2. For pork and poultry, the main assumption has been that French producers will be on the defensive in the EEC markets. Farm programming results indicate a strong pressure to increase hog production but marketing difficulties presently limit its expansion. Thus, it is likely that unless a costly intervention mechanism is operated, prices will fall rather low and restrict the expansion of hog production. Similarly poultry production will be restricted to large and efficient producers within the common market.
3. For cattle products, the projections must rely on very uncertain statistical data. As a result the figures given in the study must be taken as orders of magnitude and interpreted cautiously. It has been projected that dairy production would increase faster than consumption because of increases in both the number of cows and the yield of milk per cow. The latter will be brought about by better sanitary and feeding practices and by a continued shift to more productive dairy breeds.

   Beef and veal production will increase because of the projected increase in the number of cows (2% per year) and because of the continued decline in the proportion of calves slaughtered for veal. However, even with optimistic assumptions concerning the increase in beef and veal production, it appears very unlikely that French surpluses will be such as to fulfill any major part of the import requirements of other EEC member countries. This conclusion would of course be strengthened if the number of cows did not increase as fast as projected here.

Chapter 1

Introduction

The implications of the European Economic Community Common Agricultural Policy are manifold. The integration of six developed economies will undoubtedly have far-reaching effects and already has had, both internally and on world trade. But the Common Agricultural Policy is only one of a number of economic forces which will shape European agriculture in the coming years. This report, part of a series designed to appraise changes in the grain-livestock economy of the EEC, deals with French agriculture.

Place of French Agriculture in the EEC

With 46.9 percent of the EEC farmland, France is potentially the largest farm producer in the Community. Structural conditions are relatively favorable. The crucial figure in describing the structure of European farms is the number of hectares per man which in France is 13.4. Corresponding figures for the other member countries in the EEC are: 5.6 for The Netherlands, 8.4 for Belgium, 8.8 for Germany, 5.0 for Italy. French farms are larger than those in the other member countries of the EEC and climatic and soil conditions are relatively favorable. These factors are advantages which lead us to expect France to be the major agricultural producer in the EEC. Actually it meets this expectation since the agricultural output of French agriculture makes up roughly one-third of the European output. However, the difference between the proportion of farmland in France and the proportion of the output shows that the productivity of land in France is lower than the average for the EEC. This could be the result of various factors. In particular, it is the consequence of the smaller density of population in France which leads to a more extensive use of land. But it also indicates a technical lag in French agriculture as compared with other northern European countries. Since technical progress is taking place in French agriculture, and since some regions are just as progressive as any other in the world, it is to be expected that French agricultural production could increase very much over the next few years. This potential of French agriculture is well known and it is such that various studies have been made to try to appraise it.

In 1964 the U.S. Department of Agriculture financed a research project done in collaboration with the Department of Agricultural Economics, College of Agriculture, University of Wisconsin and the Institut National de la Recherche Agronomique, Economics Department, Paris, to study current changes in the livestock and grain economy of France and their effect upon foreign trade patterns. The French research institute is of course concerned with the appraisal of changes in its own national agriculture. A research team has been set up and a long-run research program has been established to estimate sup-

ply response in French agriculture, particularly in the grain and livestock sector. The latter program has resulted in various publications in French, and the Wisconsin study has led to publication of a report in English. The present paper, which is the contribution of a cooperative effort between Michigan State University and INRA, depends on the results already published in the previous reports. Due reference will be made to them in specific cases. This report differs from them in that it presents projections of grain and livestock production in France to 1970 and 1975. In a way, the former reports can be considered as basic material substantiating the conclusions presented in the present report.

Objectives

This report, as a part of a more comprehensive study, focuses only on French agricultural supply. Its main purpose is to appraise expected change in French agriculture for expanding grain and livestock production. Projections are made as indicative figures of the likely results evolving from forces at hand. These forces are analyzed.

To be specific, wheat, barley and corn are the three grains to which most attention is given in this report. Wheat is the major grain grown in France, in terms of both surface and production. Barley is the second most important grain and the major feed grain. Corn cultivation has progressed very rapidly in the last decade and it is expected to continue to increase. Other feed grains are less important. The production of oats has declined with mechanization and the disappearance of horses as draft animals. However, oat production is projected to 1970 and 1975. To balance feed grain supply and demand projections, other grains had to be taken into account also; but little attention was given to them because of their very small importance in France. A projection has, however, been made.

The major livestock products in France are pork, milk, beef, veal, poultry and eggs. These are produced under varying conditions of farm structure, feeding techniques, and capital intensities. Generally speaking, technology in French livestock production lags behind that of northern European countries. An objective of this report is to summarize the effect of the economic forces which will determine the production of these commodities.

Procedure

The projections made are our best estimates of what future production will be. Since the future is not known, projections can only rely on an analysis of how the future situation will evolve from past developments. Observation of past trends plays a crucial role in the projections. Future projections from these trends are based on what is known about causal relationships between the relevant economic variables. Microeconomic studies have been heavily relied on to provide such insights into French agricultural

production. Of course, the use of microeconomic results to produce supply estimates at the national level immediately raises an aggregation problem. In order to reduce the aggregation difficulties, the analysis was carried out at a regional level. France was divided into six fairly homogeneous regions as shown in Figure 1, and inasmuch as data were available, the analysis of past trends was made at that level.

To summarize, the procedure used to derive projections consisted of the following steps: 1.) Analysis of past trends at the regional level, 2.) Appraisal of the interrelationships between economic variables at the microeconomic level, and 3.) Determination of the most likely future course of events derivation of regional projections and of national projections by addition.

The microeconomic analyses were essentially surveys and linear programming studies of representative farms in four small areas chosen to provide a wide range of "typical situations" in French agriculture. Detailed reporting of these studies is not attempted here.[1] Their results are used as basic material in this report.

Outline of Report

After this introductory chapter, the six regions are briefly described. Then projections for grain, pork and cattle are given in three successive chapters. The sixth chapter contains projections for poultry and egg production and for the total derived demand for feed grains by livestock. Finally, a summary and conclusion chapter gathers the essential results of the previous chapters. These results are compared with demand projections to provide an estimate of needed imports and exports.

[1] For a thorough report, see P.J. Albert, M. Petit and Jean B. Viallon *Decisions de Production et Offre de Viande*, Paris, INRA, 1967; and for a less detailed version in English, G. A. Peterson and M. Petit, *Current Changes in the Livestock and Grain Economy of France and their Effect Upon Foreign Trade Patterns*, Madison, University of Wisconsin, 1966.

Chapter 2

Description of Regions

The six regions into which France was divided for our research purposes have previously been described.[1] Only a brief summary will be given here for readers not familiar with French agriculture or who may not have easy access to the previous report.

The six regions are delineated on the map shown in Figure 1. The regions are:

I - The Paris Basin (or Northern Region)
II - The Northeastern Region
III - The Western Region
IV - The Southwest
V - The Central Mountains
VI - The Mediterranean Southeast[2]

The Paris Basin Region

This region has the most fertile soil in France, and it also is characterized by the sizable share of farmland in large farms, such as those above 100 hectares. However, the average size of all farms, is not very large -- 28.4 hectares per farm. The mechanization in these fairly large farms is quite advanced and the use of fertilizer is widespread. The density of farm population is fairly low, and the substitution of capital for labor has taken place. This development came for various historical reasons and particularly because of the proximity to an industrially and economically developed area around Paris. Grain production, particularly wheat, dominates the agriculture of the region, but livestock production should not be neglected in the northwest region along the Channel coast in Normandy and the north. Milk production there is fairly important whereas it has disappeared for lack of hired labor in the Paris region. Thus a strange phenomenon occurs: a large metropolis is surrounded by large farms, by European standards, with fairly extensive farming while the outskirts of the regions are occupied by smaller farms, many with dairy cows. Grains other than wheat, particularly barley, play an important role in the agriculture of that region; and corn has played an important role since about 1950. Previously, sugar beets and potatoes were row crops often planted in advance of wheat in the crop rotation. Now, the reduction in labor availability and in the acreage allotted to sugar beets because of government policy has resulted in a search for other crops

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[1] G.A. Peterson and M. Petit, *op. cit.*, Chapter III.

[2] The same regional breakdown has been used in other publications in this series but each has its own numbering system; I is the same as 10; II is the same as 11; III is the same as 12; IV is the same as 13; V is the same as 14; VI is the same as 15.

Figure 1. Division of France in Six Regions

to use in the rotation before wheat. Corn is one of those. This is probably an important reason why corn production developed in the southern part of the region. The technological level of farm production in the region is high as witnessed by the average yields of grain or by the average milk production per cow. They are the highest in France and compare favorably with yields in other similar regions of the world.

The Eastern Region

The Eastern Region resembles, to some extent, the Paris Basin area although farms are generally smaller there and the importance of permanent grassland is greater than in the Paris Basin. Soil and topography conditions are less favorable to agricultural production than they are in the first region. They have led to the extension of permanent grasslands to support the production of milk which is the most important agricultural product of the region. A special case must be made for Alsace in the far eastern part of France where farms are very small and are intensely cultivated by many part-time farmers. There are also, of course, many full-time farmers who grow fruits and vegetables as well as general farming products. Undoubtedly, the agriculture of that region is influenced by the economic development and particularly the industrial development of both Lorraine and Alsace.

The Western Region

The most important characteristic of the western region is its climate. Climate is oceanic and, thus, very favorable to general farm production since rain and moisture are plentiful during many months of the year. The temperature is mild, and thus the growing season is very long -- 9 to 10 months per year. Soil conditions are less favorable, however. In parts of the region, soils are very heavy, as in Basse Normandy, so that tillage is difficult if not impossible in many cases. In other parts of the region, soils are very light and lack essential elements. In addition, they lack proper water reserves, and thus, in spite of the continuous rainfall, soils can be very dry during the summer. Farms in the region are small -- the average size in 1963 was 15 hectares. Because of these conditions, forage production is rather important: it is used to feed cattle. The most prevalent forages include grass in Normandy and cultivated forages in other areas, especially Brittany. In Brittany, poultry production on an integrated basis has developed very quickly during the last ten years. It constitutes the bulk of industrial broiler and egg production in France. Because of the small size of farms, it can easily be understood that pork production is very important in this western region. Both piglets and fat hogs are produced there. Cattle production is also important. The milk output is rather significant, whereas beef is a by-product of milk production in most cases. On the other hand, little grain is produced for sale. But, grains constitute an important part of the

feed fed to cattle on farms. As a result, it is not surprising that total grain production in the region is fairly large. The technological level of farming in the western region is not very high. Grain yields are not as high as in the Paris Basin partly because of unfavorable soil conditions. But grass yields are not very high either, and it is likely that they could be increased substantially by the use of more balanced fertilizer application and by improved pasture management practices. The livestock yields are not very high, whether dairy or beef, and these also could be significantly increased.

The Southwestern Region

Topography is very important in this region and permits a rough distinction between valleys, hills and mountains. In the mountains, agriculture is very extensive, limited to grass production which is used in the summer by sheep and beef cattle to a limited degree. The valleys, on the other hand, are quite prosperous. Wine, fruits and vegetables can be found where soil conditions are suitable. Forage production can also be found in the valleys, but most of the grain and livestock production in the region comes from the hills. Soil conditions are highly varied and are not very favorable to agricultural production in general, but climatic conditions are the most important factor in limiting the natural potential of the area. The temperature is high compared to other regions in France -- high enough in any case for the proper maturation of American corn varieties. Moisture and rainfall decrease as one moves away from the sea. It is fairly high along the Atlantic coast but decreases inland and summer drought conditions may be a limiting factor in some areas. Thus, it is not surprising that irrigation projects are being developed in the region and should reach a very significant level by 1975. This will probably contribute to the increasing specialization of the valleys in fruit and vegetable production and should make the hills more and more the major area for livestock production. However, market conditions for fruits and vegetables may become such that forage production under irrigation would become the most profitable alternative in the valleys and the previous conclusions would have to be amended.

In general, farms are fairly small -- the average size is 15 hectares. Farm population is relatively low, but prospects for fast movement of farmers out of the area are not very bright because of the lagging industrialization of the region. In the hills, where most of the general farming can be found, corn and grass production are the essential crops. A large portion of the corn production is sold off the farms. Recently a new crop, grain sorghum, has appeared in this region. It is a good substitute for corn production in the drier parts of the region. Grain sorghum could very well develop in those areas at the expense of the often assumed potential increase of corn.

In general, technology is very low in the area as shown by the low average grain yields and the very low milk yield per cow. Until recently, most cows were triple purpose: dairy, beef, and draft. Mechanization has reduced the importance of cows as draft animals. But, when considering the cow population of the region, the importance of dual-purpose cows should be remembered. Another feature of livestock production in this region is the great importance of veal. Most calves are used as vealers; very few are raised to become steers.

The Mountain Region

The unity of this region is named by its topography, because as its name implies it is essentially mountainous. As a result, agricultural conditions are very diversified in the region. Farms are a little larger in the central mountain region than in the west and southwest of France. Besides, some land and some forests in the mountains are collective property, the owner being the *commune* (i.e. the village community) in most cases. The high altitude pastures are used by the villagers in the summer months. Agriculture is very diversified in the region, but it is based on grass production which is mainly used to produce milk. Historically, the milk was transformed into cheese. Milk was produced in the summer months when grass was available. The cows had calved in the spring just before going into the mountains. The milk was transformed in the mountains into cheese. A distinction between two classes of cheese must be made because it has a very important impact at the present time. In the Alps and in the Jura, Swiss cheese was made. The demand for that cheese has been so great that local processing coops pay the highest price for milk received by farmers in France. This is partly due to the lack of investment, but it also reflects the good demand conditions for this cheese. Thus, the agricultural and especially the livestock production of the region has not changed very much; milk is the major farm product. Milk yields per cow are often very high from the red dotted breed called "Pie-Rouge." In the Central Mountains, the cheeses which were traditionally produced were not in as great demand as Swiss cheese, and their importance has dwindled. Thus, livestock production is much more diversified. Milk, because of the small size of farms, remains an important product, however. In some cases, it is sold as fluid milk. In other cases where farms are more remote from collecting channels, it is transformed on the farm as veal. It is in the Central Mountains that an increase in the specialized beef cattle feeder production could take place if extensive conditions could be organized. The essential problem in this respect is one of land consolidation to obtain farm units which would be large enough. In the Charolais area, where farms are larger than the average for the whole region, the famous Charolais breed has been developed. But, at the present time, farms are still too

small, around 50 hectares, to permit extensive production; and farmers who specialize as livestock breeders to produce feeder cattle are not very prosperous. On the other hand, those who are breeders of animals for reproduction are very prosperous. Another famous breed of the region is the Limousine, but it is mainly used to raise older calves sold on the Lyon market to satisfy a very specialized demand. The animals are sold at an age of 10 to 12 months. They appear to play, in the economies of the farms, about the same role as the calves in the other parts of the region.

The Southeastern Region

This region borders the Mediterranean Sea. It is characterized by a climate favorable to wine, fruits and vegetables. The soil conditions are usually poor, except in the valleys where vegetable production is much more profitable than grain and forage. Thus, it shouldn't be expected that grain and livestock production will play any important role in this region before 1975.

Chapter 3

Projection of Grain Production

The major grains produced in France are wheat, barley and corn. Major emphasis will therefore be placed on projecting the production of these three crops. Afterwards, attention will be given to other grains such as oats, rye, and sorghum.

To improve the quality of the estimates involved in any projection work, France has been divided into six regions as described previously. The projection work will be done by region and then aggregated at the national level. Grain output is the product of area planted and yield per unit of surface. It is generally accepted that yield depends mainly on technology. Of course, economic theory tells us that the amount of fertilizer to use on an acre of wheat is such that the marginal productivity of fertilizer equals its marginal cost. Thus, the amount of fertilizer to use and therefore the yield of wheat depends on both the price of wheat and the price of fertilizer. However, most farmers fall far short of the most profitable use at present. It is felt that other factors are more important. They include the increased awareness by farmers of the profitability of using fertilizer, the range in wheat varieties with the newer ones responding more to fertilizer application than the older ones. These arguments could be used for other inputs and globally it can be said that yields of grains have increased with technical progress, the latter concept being the result of many changes. In the U.S., Z. Griliches has attributed the increase in demand for fertilizer between 1911 and 1956 to the decrease in the real price of fertilizer.[1] But his econometric model is very simple, with a lagged variable highly correlated with time. As a result, it is felt justified to consider the yield of the various grains as linked with technical advance and to project them on the basis of past trends and of judgments concerning available technologies not yet widely used, diffusion of technical progress, agronomy scientists' efforts, etc.

On the other hand, the surface planted to a particular crop results from farmers' yearly production decisions. Thus, they depend on economic variables. Generally it is considered that they depend on farm structure, price, and available technology. Changes take place under the influence of shift in relative profitability (yield and price changes) within limits allowed by farm structure (area, available labor and working capital). Farm programming studies[2] have shown the relative influence of these variables. In

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[1] Z. Griliches, "The Demand for Fertilizer: An Econometric Interpretation of a Technical Change," *Journal of Farm Economics*, 40, August 3, 1958.

[2] P.J. Albert, M. Petit and J.B. Viallon, *Decisions de Production et Offre de Viande*, Paris, INRA, 1967.

general, the results indicate that grain acreage is sensitive to variations in farm size, more precisely to variations in labor density. In the Pays de Caux, it was found that above a density of .09 man unit per hectare (27 acres per man) farms did not show any sale of grains. Both survey and programming results gave the same limit. By contrast, the surface planted to grains is not sensitive to the price of grains. On small farms, the grain supply elasticity is very low. On larger farms, the elasticity is significant for a decrease in the price of grains but not for an expansion because grain acreage is presently limited by rotation constraints.[3] Relative prices of grains, however, along with the grain yields in the various regions, have a fairly important impact on the mix of grains produced.

Projections of Surfaces

In a study made for the USDA, Rottier and Dumard[4] discuss the validity of available agricultural statistics in France. It is generally accepted that crop surfaces are fairly well known and that inferences can be drawn from their variations. Land use patterns are discussed below region by region and crop acreages are projected.

Region I (North)

As described above, Region I is Northern France. For various reasons, it is the richest agricultural area of France. Table 1 gives the farmland use by major groups of crops for the period 1956-1964. Generally speaking, very little has changed during the period. Total grain acreage has slightly increased at the expense of hoed crops and forages.

Table 2 gives grain acreages in the North region for the period 1950 to 1965. Over the 15-year period, total grain surface increased slightly from around 3.2 to 3.55 million hectares. There have been changes in the relative importance of various grains. Before describing them, it is worth noting the role of winter freezing in 1956. In January 1956, most of the winter wheat was destroyed by frost. In the spring, farmers seeded spring wheat, barley and oats to replace the winter wheat. To their surprise, the yields were better than they had expected, particularly for barley. As a result it appears that farmers became suddenly more aware of the profitability of barley. The data clearly show this phenomenon as the surface planted into barley increased from 563,000 hectares in 1955 to 748,000 hectares in 1957 (i.e., a 33 percent increase). The year 1956 appearing as a break in the time series,

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[3] The agronomists are not unanimous on the real need to respect rotation constraints. The fact is that farmers respect them now and, in doing so, give up opportunities to have a larger income in the short run, probably because they are afraid to jeopardize the productivity of their land in the long run.

[4] CREDOC, *Production and Uses of Selected Farm Products in France. A Projection: 1960 to 1975*, Paris, 1965.

Table 1. Distribution of Farmland Between Major Groups of Crops, Northern Region, 1956-1965. (1000 Hectares)

Years	Permanent Pasture	Arable Land				
		Total	Grains	Hoed Crops	Forage Crops	Others
1956	1728	6132	3290	873	1379	590
1957	1742	6154	3390	820	1426	518
1958	1721	6176	3399	827	1432	518
1959	1714	6184	3478	840	1412	454
1960	1703	6205	3544	876	1368	417
1961	1700	6226	3599	829	1299	499
1962	1695	6227	3650	835	1348	384
1963	1713	6201	3531	819	1334	517
1964	1722	6108	3597	802	1290	519

Table 2. Distribution of Grain Surfaces, Northern Region, 1950-1965. (1000 Hectares)

Year	Total	Wheat	Barley	Oats	Corn	Others
1950	3224.6	1620.9	377.5	1110.1	0.8	115.3
1951	3188.9	1607.3	408.9	1074.7	5.1	92.7
1952	3219.0	1626.6	434.5	1074.4	6.0	77.5
1953	3284.7	1641.4	502.1	1043.5	6.3	91.4
1954	3340.3	1734.8	516.6	1012.5	12.6	63.8
1955	3378.8	1758.9	563.0	963.8	22.1	83.0
1956	3290.0	1074.7	1058.2	1035.7	55.1	66.3
1957	3389.7	1850.8	748.2	680.7	48.0	62.0
1958	3399.2	1807.9	848.7	629.2	50.9	62.5
1959	3478.2	1709.7	980.7	636.5	94.1	57.2
1960	3543.7	1741.6	1053.9	587.0	114.0	47.2
1961	3598.6	1788.9	1043.3	584.9	140.9	40.6
1962	3573.1	1866.2	1051.5	565.8	138.3	37.6
1963	3531.5	1567.8	1219.2	579.6	181.5	52.4
1964	3581.9	1787.3	1132.7	420.0	165.0	76.9
1965[1]	------	1844.1	1161.0	-----	187.1	----

[1]Provisional data.

recent trends will be appraised on the 1957-1965 period which will give nine observations.[5]

[5]It is considered here that nine observations are sufficient because only trends are studied. Of course, in the case of a more complicated model using simultaneous equations, more observations would be needed. Actually, it then would be justified to take a longer period because changes in more economic variables would be taken into account than when only trends are taken into account.

Since 1957 the wheat surface has slightly decreased, whereas it had increased slightly from 1950 to 1955. Barley and corn surfaces have increased since 1957 while the surface in oats declined from 630,000 hectares to 420,000 in 1964. The high figure for barley surface in 1963 (1,219,000 hectares is due to frosts similar to 1956. However, it appears that the rapid increase in barley which occurred after 1956 slowed down in the 1960's. For the future, further increases in barley acreage can be expected, but it is not likely that they will be as large as during the late 1950's. Wheat remains the most profitable grain in that area and will continue to be so unless an unexpected large drop in the price of wheat relative to that of feed grains occurs. Wheat acreage is limited by rotation constraints in the Northern Region as shown by programming results in Pays de Caux. Barley is often grown after wheat but is not a good crop to grow before wheat. Crops such as sugar beets, potatoes, corn and alfalfa are considered to leave a good soil for wheat. The prospect for a limited but definite increase in surfaces planted into these crops is good. Sugar beets are presently limited by production quotas but according to EEC agreements, these quotas should increase slowly by up to 20 percent by 1975. If yields do not increase much, the surface planted to beets could increase a little. Also, large investments are being made in dehydration plants for alfalfa. The competition from U.S. alfalfa meals dehydrated with much cheaper fuel is very intense; however, there seems to be room for a limited increase in the alfalfa surface.

Table 3. Grain Surfaces Projected to 1970 and 1975, Linear Trends and Final Projections, Northern Region. (1000 Hectares)

		Wheat	Barley	Corn
1970	Linear Trend	1748	1448	250
	Final Projection	1760	1300	250
1975	Linear Trend	1732	1697	320
	Final Projection	1750	1400	320

The corn surface will probably continue to increase, and the growth will be favored by the development of "complementary irrigation" in the Northern Region. In this area farmers are pumping underground water to irrigate during dry summer months. Depending on the year, irrigation results are more or less spectacular but, on the whole, they are positive for beets, corn and potatoes.

The limited extension of beets, potatoes, corn and alfalfa will favor wheat at the expense of barley, whereas the oats acreage will continue to decrease. Thus, it appears reasonable to expect a slowdown in the wheat surface decrease and in the barley surface increase.

Table 4. Distribution of Farmland Between Major Groups of Crops, Northeastern Region, 1956-1964. (1000 Hectares)

Years	Permanent Pasture	Arable Land				
		Total	Grains	Hoed Crops	Forage Crops	Others
1956	1135	1229	609	176	291	153
1957	1133	1223	605	160	309	149
1958	1133	1223	619	158	319	127
1959	1110	1214	627	155	321	114
1960	1146	1209	625	153	326	105
1961	1165	1213	623	141	338	111
1962	1169	1207	610	138	334	125
1963	1173	1194	618	130	331	115
1964	1190	1179	614	121	328	116

The linear trend, projected to 1970 and 1975 would give surfaces given in Table 3. The projections incorporating our best judgment based on information just described above are given in the same table. As can be seen, the slight wheat decrease and the large barley increase are assumed to slow down. The corn surface appears likely to continue to increase at a fairly rapid rate.

Region II (Northeast)

Table 4 gives the distribution of arable land between major groups of crops for the period 1956-1964. Changes have been very slight during that period. Permanent pastures increased a little at the expense of arable land but grain surfaces remained roughly constant.

Table 5 gives grain surfaces in the Northeastern Region for the period 1950 to 1965. Here again, wheat acreage has remained roughly stable since 1957, barley has increased from around 150,000 hectares to around 210,000 hectares, corn has increased but its surface remains small because the climate is too cold and often too dry. Projecting the grain surface does not raise major difficulties in this case, besides the region is small and thus does not weigh very much in the national figures. Linear trend and final projections are summarized in Table 6.

As can be seen in this table, we assume that the wheat surface will remain stable (the 1962 and 1963 figures being considered climatic accidents), that barley surfaces will continue to increase at the expense of oats but that, due to climatic restraints, the corn surface will not increase much.

Region III (West)

Table 7 gives the distribution of farmland between major groups of crops in the Western Region. Here, as in the other regions, little change

Table 5. Distribution of Grain Surface, Northeastern Region, 1950-1965. (1000 Hectares)

Year	Total	Wheat	Barley	Oats	Corn	Others
1950	622.7	253.3	76.5	242.2	3.6	47.1
1951	615.9	258.2	82.2	229.1	4.4	58.0
1952	618.3	261.5	87.7	227.9	5.0	36.2
1953	623.8	249.8	103.3	230.9	5.4	34.4
1954	632.4	263.8	106.0	222.4	6.5	33.7
1955	632.2	260.2	113.8	217.1	8.2	37.4
1956	609.5	113.9	203.6	249.5	13.8	28.7
1957	604.7	245.0	149.1	177.1	10.4	23.1
1958	619.4	259.4	155.9	166.3	10.0	27.8
1959	627.0	260.3	170.2	159.9	10.0	26.6
1960	625.2	252.4	181.6	155.0	11.1	25.1
1961	623.1	247.9	183.8	156.0	10.9	24.5
1962	609.2	203.7	215.0	164.3	11.7	14.5
1963	617.6	225.5	208.9	151.5	13.6	18.1
1964	643.3	259.1	202.8	124.5	11.1	45.8
1965[1]	-----	258.0	213.2	-----	15.0	----

[1] Provisional data

Table 6. Grain Surfaces Projected to 1970 and 1975, Linear Trends and Final Projections, Northeastern Region. (1000 Hectares)

		Wheat	Barley	Corn
1970	Linear Trend	212	259	17
	Final Projection	250	259	15
1975	Linear Trend	193	301	20
	Final Projection	250	301	16

occurred in the distribution of land between permanent pasture and arable land. But within the arable land category there has been a slight increase in the total grain surface and a marked increase in the forage surface at the expense of hoed crops.

Table 8 gives the various grain surfaces in the Western Region for the period 1950 to 1965. The figures show that the 1956 frosts led to a breaking point in the time series, as in the other regions. Since 1957 the wheat surface has decreased slightly; while the feed grain surface increased, barley increased faster than oats decreased. The corn surface has increased but the

Table 7. Distribution of Farmland Between Major Groups of Crops, Western Region, 1956-1965. (1000 Hectares)

Years	Permanent Pasture	Arable Land				
		Total	Grains	Hoed Crops	Forage Crops	Others
1956	3075	4724	1839	1047	1581	257
1957	3049	4768	1981	997	1510	280
1958	3031	4809	1936	994	1561	197
1959	3014	4827	1962	946	1710	209
1960	2991	4850	1953	964	1738	195
1961	2992	4803	1867	980	1762	194
1962	2954	4845	1965	938	1765	177
1963	3031	4764	1863	926	1751	249
1964	3046	4755	1924	828	1788	215

Table 8. Distribution of Grain Surfaces, Western Region, 1950-1965. (1000 Hectares)

Year	Total	Wheat	Barley	Oats	Corn	Others
1950	1960.2	1073.0	260.9	439.1	8.9	178.3
1951	1922.9	1033.6	272.1	428.8	11.0	177.4
1952	1949.5	1038.9	288.0	434.6	12.5	175.5
1953	1939.8	1012.2	305.7	438.1	17.4	166.4
1954	1974.0	1078.2	301.7	415.9	24.1	154.1
1955	1989.5	1094.5	318.3	408.0	29.8	138.9
1956	1838.6	708.4	500.3	447.7	54.1	128.1
1957	1981.3	1128.0	351.1	356.8	43.1	102.3
1958	1955.9	1102.6	376.1	328.7	43.6	104.9
1959	1962.1	1071.0	405.3	337.1	55.7	93.0
1960	1952.6	1061.1	431.2	324.2	55.9	80.2
1961	1867.4	892.6	522.3	313.6	65.5	73.4
1962	1965.1	1089.6	453.6	294.7	59.5	67.7
1963	1875.4	914.1	557.6	217.6	76.5	109.6
1964	1916.3	1000.5	517.0	253.0	75.2	70.6
1965[1]	------	1008.3	530.9	-----	76.9	-----

[1]Provisional data

extension of that crop for grains is limited by problems of water control in many soils of the region and by harvesting difficulties. The humidity is usually high and the temperature above freezing in the region during the fall.

Table 9 gives the projected surfaces on the basis of linear trends and the final projections incorporating the author's best judgment. In particu-

lar, it does not appear reasonable to expect the wheat surface to decrease as fast as the linear trend would indicate. Results of the programming study in Choletais have shown that the wheat surface was not influenced much by wheat prices but that it was sensitive to variations in farm size. Projections on

Table 9. Grain Surfaces Projected to 1970 and 1975, Linear Trends and Final Projections, Western Region. (1000 Hectares)

		Wheat	Barley	Corn
1970	Linear Trend	878	667	103
	Final Projection	900	667	103
1975	Linear Trend	789	789	127
	Final Projection	825	789	127

Table 10. Distribution of Farmland Between Major Groups of Crops, Southwestern Region, 1956-1965. (1000 Hectares)

Years	Permanent Pasture	Total	Grains	Hoed Crops	Forage Crops	Others
1956	1678	2497	1223	187	785	302
1957	1664	2529	1305	177	795	252
1958	1684	2555	1329	165	819	242
1959	1658	2589	1363	163	833	230
1960	1650	2607	1346	164	853	244
1961	1634	2630	1355	164	855	255
1962	1616	2667	1454	147	843	221
1963	1619	2667	1383	149	880	256
1964	1631	2631	1384	139	856	222

numbers of farms given in the Appendix indicate that there will be a definite decrease in the number of farms taking place at a faster rate than in the last ten years. Thus, it is likely that the decrease in wheat surface will be slowed down. The increase in barley should continue at least at the same rate. Most of it is fed to livestock on farms where it is produced and it can be expected that the demand for concentrates will increase because of the increase in both livestock production and the proportion of concentrates in the feeding rations. Accordingly, the large increase in barley acreage implied by the linear trend appears probable, with perhaps a faster increase between 1966 and 1970 and a slower one between 1970 and 1975 as less land presently in other grains will be available for barley expansion. Similarly the corn surface may continue to increase in spite of unfavorable climatic conditions if the harvesting difficulties are reduced by the use of airtight silos for grains. Present prospects indicate that such an innovation is possible. It could even induce a much faster increase in corn acreage but this

would occur at the expense of barley and the total feed grain surface would probably not be affected very much.

Region IV (Southwest)

Table 10 gives the distribution of farmland between major groups of crops in the Southwestern Region. Tillable land increased at the expense of vines and vegetables which do not appear in the table and of permanent pasture. Within the arable land category, grains and forage crops have increased.

Table 11 gives the surface planted into the various grains in the Southwestern Region for the period 1950 to 1965. The wheat surface has slightly decreased since 1957, while the barley and the corn surfaces increased. At the same time, the oats surface decreased. Barley and oats are close substitutes in production. The total of their surfaces has very slightly declined so it appears that corn has increased at the expense of almost all other plants. This region is known for its corn production but, as can be seen in Table 11, corn still occupies less than 40 percent of the total grain surface.

Table 11. Distribution of Grain Surfaces, Southwestern Region, 1950-1965. (1000 Hectares)

Year	Total	Wheat	Barley	Oats	Corn	Others
1950	1237.0	620.6	78.5	184.8	276.0	77.1
1951	1223.1	607.0	78.5	172.2	288.2	78.2
1952	1227.9	621.2	78.7	173.1	281.8	73.1
1953	1226.3	601.8	88.2	167.1	299.1	70.1
1954	1268.0	630.3	101.4	151.9	314.5	69.9
1955	1294.9	630.9	107.7	153.9	333.6	68.8
1956	1223.6	424.9	135.9	149.0	428.6	85.2
1957	1305.5	632.2	115.7	125.4	365.3	66.9
1958	1329.2	635.4	104.5	117.3	404.9	67.1
1959	1363.6	614.9	110.8	118.1	457.1	62.7
1960	1346.5	514.1	109.4	118.3	545.5	59.2
1961	1355.4	394.8	136.1	125.0	642.9	56.6
1962	1441.8	612.6	121.2	113.1	555.4	52.8
1963	1383.1	514.5	139.9	106.9	560.5	61.3
1964	1384.2	564.0	154.1	97.3	522.1	46.7
1965[1]	------	623.2	136.3	-----	478.5	----

[1] Provisional data

In this region, the crucial question in projecting grain surfaces is whether the rapid rate of increase in corn area observed over the last 10 years will be maintained or slowed down by the lack of proper land to devote

to corn. Important irrigation projects will be undertaken before 1970 in most valleys of the region. Once irrigated, an area turns to fruit and vegetable production but since there will probably be a surplus of these products, one may expect corn and grass production to develop. However, the linear trend of the 1952-1965 period projected to 1975 gives a corn surface of 806,000 hectares which is probably too much because there are reasons to believe that the permanent pasture surface will not decrease. These are located in hilly and mountainous areas where the number of farmers is decreasing. There some land is left idle or only used as pasture. As a result our final projection for the corn surface is well below the linear trend as can be seen in Table 12. Similarly it is assumed that the increase in barley surface will slow down a little, while the reduction of the wheat surface will continue.

Region V (Mountains)

Table 13 gives the distribution of farmland between major groups of crops for the period 1956-1965. The surface in permanent pasture has remained roughly constant, while the arable land surface decreased. In a number of remote areas, the departure of farmers does not lead to farm consolidation. Therefore, total farm land has decreased in this region as some land went completely out of farming with farmers' departure. Among the arable land category, forage crops have increased at the expense of hoed crops.

Table 12. Grain Surfaces Projected to 1970 and 1975, Linear Trends and Final Projections, Southwestern Region

		Wheat	Barley	Corn
1970	Linear Trend	480	168	696
	Final Projection	480	160	670
1975	Linear Trend	434	193	806
	Final Projection	430	180	700

Table 14 gives the surfaces devoted to various grains in the Mountain Region for the period 1950 to 1965. As in most other regions, wheat and oats surfaces have declined while barley and corn surfaces increased. In this region, the corn surface is still small because of unfavorable climatic conditions. Since 1957 the regression of the wheat surface is not very large, but it is clearly shown by a simple reading of the figures. Similarly the increase in barley appears very clearly. Survey and programming results in Combrailles indicate that farmers will continue to grow grains, but the total grain surface should not change much between now and 1975. There will be a downward pressure because some land will be removed from farming by the departure or the death of farmers without children or whose children have left the farm for other employment. But, on the other hand, with the increase in the average size of farm from 17.4 to around 30 hectares, the proportion of

Table 13. Distribution of Farmland Between Major Groups of Crops, Mountain Region, 1956-1965. (1000 Hectares)

Years	Permanent Pasture	Total	Arable Land			
			Grains	Hoed Crops	Forage Crops	Others
1956	4010	3359	1368	447	1300	244
1957	3954	3375	1444	379	1229	323
1958	3909	3411	1445	412	1362	192
1959	3900	3426	1449	410	1393	174
1960	3951	3433	1445	409	1414	165
1961	3949	3434	1411	408	1445	170
1962	3940	3440	1423	379	1454	184
1963	3884	3375	1392	369	1448	175
1964	3960	3183	1423	305	1319	136

Table 14. Distribution of Grain Surfaces, Mountain Region, 1950-1965. (1000 Hectares)

Year	Total	Wheat	Barley	Oats	Corn	Others
1950	1412.5	654.6	121.8	302.8	24.0	309.3
1951	1408.9	653.2	128.7	295.8	27.1	306.1
1952	1407.9	653.2	136.7	296.9	29.7	291.4
1953	1394.7	612.9	156.5	295.5	31.8	298.0
1954	1444.2	673.5	154.3	294.2	35.1	287.1
1955	1443.4	695.7	162.3	282.9	38.5	254.3
1956	1368.1	334.0	338.6	356.9	66.1	272.5
1957	1443.4	677.3	231.1	212.8	50.6	271.6
1958	1444.8	684.8	246.2	208.7	55.3	249.8
1959	1448.7	653.4	271.5	219.1	59.1	245.6
1960	1445.1	668.0	267.0	213.9	64.1	232.1
1961	1411.1	558.5	325.5	234.6	79.9	212.6
1962	1422.8	666.3	291.8	194.7	75.7	194.3
1963	1391.2	514.3	367.1	212.9	92.4	205.2
1964	1418.7	658.5	308.7	182.5	93.0	176.0
1965[1]	------	651.1	311.9	-----	94.5	-----

[1] Provisional Data

Table 15. Grain Surfaces Projected to 1970 and 1975, Linear Trend and Final Projections, Mountain Region. (1000 Hectares)

		Wheat	Barley	Corn
1970	Linear Trend	510	394	121
	Final Projection	510	394	121
1975	Linear Trend	437	455	147
	Final Projection	437	455	147

farmland in grains may increase a little. Accordingly projections for grains surfaces are given in Table 15. The linear trends indicate a very slight increase in the total surface of wheat, barley and corn, which will take place at the expense of oats and rye. As a result the linear trend figures have been used as projections.

Region VI (Southeast)

This region has very minor importance in grain production as can be seen in Table 16 giving the distribution of farmland between major groups of crops. As a result, the linear trends between 1957 and 1965 are used to project grain surfaces appearing in Table 17 to 1970 and 1975; these projections are given in Table 18.

Summary

It appears from the previous description that price changes will have little impact on grain surfaces. As mentioned previously, this conclusion

Table 16. Distribution of Farmland Between Major Groups of Crops, Southeastern Region, 1956-1965. (1000 Hectares)

Years	Permanent Pasture	Arable Land				
		Total	Grains	Hoed Crops	Forage Crops	Others
1956	1703	672	251	43	231	147
1957	1701	687	283	42	233	129
1958	1699	688	287	40	233	128
1959	1695	696	293	40	238	125
1960	1684	702	282	39	246	135
1961	1692	716	279	38	249	150
1962	1692	713	274	36	252	151
1963	1691	707	251	34	254	168
1964	1730	687	256	76	243	162

stems from programming results in Choletais, Pays de Caux, Combrailles and Coteaux de Gascogne. Where farms are small and labor plentiful, grain production does not provide a sufficient gross income per hectare to compete with livestock production. Where farms are large (by French standards) grain acreage is already high and cannot increase much as a result of price increases. It is limited by current rotation constraints which will probably continue to be respected over the next few years.

As a result, changes in grain acreages will respond to other economic variables such as those discussed above. It is projected that the area planted to wheat will continue to decrease from 4.4 million hectares in 1964 to 4.05 in 1970 and 3.86 in 1975. The area planted to barley will increase from 2.4 million hectares in 1964 to 2.8 in 1970 and 3.2 in 1975 while the

Table 17. Distribution of Grain Surfaces, Southeastern Region, 1950-1965. (1000 Hectares)

Year	Total	Wheat	Barley	Oats	Corn	Others
1950	268.0	96.4	46.9	74.9	12.90	36.9
1951	269.0	93.8	48.8	71.4	13.50	41.5
1952	271.8	94.9	49.3	68.4	14.07	45.1
1953	271.4	101.3	47.7	64.5	15.10	42.8
1954	277.5	110.7	50.8	56.8	17.73	41.5
1955	277.5	113.5	48.3	51.0	21.20	43.5
1956	251.4	89.1	44.9	37.8	35.30	44.3
1957	282.6	121.0	43.0	38.8	33.10	46.7
1958	286.8	125.1	50.7	36.9	24.50	49.6
1959	293.1	130.0	50.2	32.8	28.20	51.9
1960	282.0	121.0	45.5	28.3	33.70	53.5
1961	278.9	114.6	48.1	27.6	35.20	53.4
1962	273.4	132.1	43.4	23.6	25.20	49.1
1963	250.8	113.3	45.8	18.7	28.50	44.5
1964	262.9	122.8	44.8	16.9	26.30	52.1
1965[1]	-----	119.7	44.2	----	20.90	----

[1] Provisional data

Table 18. Grain Surfaces Projected to 1970 and 1975, Southeastern Region. (1000 Hectares)

Year	Wheat	Barley	Corn
1970	148	43	32
1975	170	42	35

corn surface will increase from .9 million hectares to 1.19 in 1970 and 1.34 in 1975.

Projections of Yields

Data on average yields are available at the national and regional level since they can be computed by dividing total production by the total surface. Besides, sample surveys on wheat, barley and corn productions have been conducted by the Statistical Service of the Ministry of Agriculture since 1962. These surveys were begun in only a few *departements* (administrative districts) and progressively extended to include larger areas. The last results published in *Statistique Agricole--Supplement* "Serie Etudes" No. 11, April, 1966, and No. 17, June, 1966 give information on yields and cultural practices in the areas surveyed.

Table 19. Wheat Yields by Region, 1950-1966. (Quintals per Hectare)

Year	Region I	Region II	Region III	Region IV	Region V	Region VI
1950	22.74	17.62	16.22	11.47	15.15	12.87
1951	20.80	19.06	14.40	8.93	12.90	12.20
1952	25.70	18.32	17.99	12.26	15.44	12.83
1953	27.27	18.28	20.27	14.74	15.77	14.06
1954	29.39	23.30	22.26	16.09	18.65	16.32
1955	29.94	22.52	20.36	14.58	17.39	8.14
1956	27.82	19.55	19.19	13.15	13.01	13.10
1957	29.68	22.48	22.05	17.20	18.36	18.13
1958	25.92	20.15	17.82	16.46	17.04	17.05
1959	32.67	25.92	25.12	17.53	19.50	18.38
1960	32.34	23.52	22.97	16.17	19.83	16.04
1961	29.45	23.73	21.00	14.85	19.05	16.72
1962	37.75	24.88	29.33	24.13	23.48	19.79
1963	33.62	26.16	23.41	21.31	18.47	17.98
1964	40.21	25.44	27.24	24.96	24.82	19.95
1965[1]	38.14	27.37	29.34	28.26	25.00	21.81
1966[1]	37.19	27.74	(19.81)	21.58	24.98	19.19

[1]Provisional data (from estimations on Nov. 1, 1965 and Aug. 1, 1966).

Table 20. Average Barley Yields by Region, 1950-1965. (Quintals per Hectare)

Year	Region I	Region II	Region III	Region IV	Region V	Region VI
1950	20.70	15.49	14.39	10.37	12.98	12.08
1951	20.28	16.45	14.78	10.11	12.37	12.24
1952	20.39	16.34	13.40	10.80	12.32	12.23
1953	22.87	18.47	15.86	13.85	14.66	13.25
1954	27.77	20.38	17.29	13.38	16.27	13.63
1955	25.62	20.59	16.68	12.99	16.30	12.12
1956	35.15	24.96	23.72	15.95	21.16	14.57
1957	26.51	20.44	18.71	14.97	18.95	16.28
1958	25.66	19.74	18.42	16.47	18.47	17.06
1959	29.21	23.34	22.00	17.14	18.49	17.05
1960	33.08	25.38	22.43	16.59	20.66	14.99
1961	28.04	23.64	21.29	15.85	20.03	15.40
1962	33.77	23.63	23.20	20.08	19.72	17.22
1963	34.61	28.44	24.57	20.19	22.95	16.28
1964	34.77	22.35	26.76	20.43	20.22	17.13
1965	35.99	26.20	27.19	24.46	22.54	15.84

Tables 19, 20, and 21 give the yield of wheat, barley and corn respectively by region and by year for the period 1950 to 1965. It appears that all yields have increased during that period. They are the highest and they increase the fastest in the Northern Region. Survey sample results show that

Table 21. Average Corn Yields by Region, 1950-1965. (Quintals per Hectare)

Year	Region I	Region II	Region II	Region IV	Region V	Region VI
1950	24.62	17.83	6.55	12.27	17.32	10.91
1951	39.55	26.84	16.11	19.96	19.60	15.29
1952	35.30	17.93	11.82	13.67	12.64	14.93
1953	39.82	30.16	27.04	20.80	23.38	17.80
1954	38.91	29.46	27.99	22.60	25.18	19.86
1955	40.69	35.62	23.60	22.39	31.10	23.96
1956	36.23	35.28	28.78	25.05	29.92	23.36
1957	38.83	32.95	29.60	24.04	26.32	15.73
1958	40.50	30.74	31.22	27.81	31.91	24.19
1959	23.67	27.74	20.83	27.83	26.77	24.19
1960	26.78	35.03	37.80	32.04	36.91	25.52
1961	25.99	33.07	27.17	24.69	30.24	20.13
1962	37.15	26.75	19.73	17.60	23.93	17.73
1963	53.25	37.19	39.67	37.90	38.14	31.61
1964	31.36	21.96	19.79	22.04	22.40	22.40
1965	51.39	31.74	43.71	34.28	37.62	26.73

Table 22. Projections of Grain Yields Based on the 1957-1965 Linear Trend, by Region. (Quintals per Hectare)

	Wheat		Barley		Corn	
Region	1970	1975	1970	1975	1970	1975
North	43.3	49.0	41.7	46.7	44.6	47.4
Northeast	29.4	32.4	29.2	32.4	35.2	37.6
West	32.2	37.2	31.2	37.3	40.7	46.7
Southwest	29.7	35.2	26.9	31.8	36.3	41.2
Mountains	28.4	32.7	24.1	26.0	39.7	44.7
Southeast	21.6	23.4	16.4	16.4	30.6	34.5

it is there that cultural practices are the most progressive and that new technology is adopted the most rapidly. Therefore, it may be assumed that past trends will continue in the Northern Region because new technology will become available, and in the other regions because a backlog of better technology is already available and progressively adopted. As can be seen in

Table 23. Projections to 1970 and 1975 of Wheat Surfaces, Yields, and Production, by Region and for France, Comparisons with PRATS' and ONIC's 1970 Projections.

	Production (thousand quintals)	Yields (quintals per hectare)	Surface (thousand hectares)	Production (thousand quintals)	Yields (quintals per hectare)	Surface (thousand hectares)
	1970			1975		
Region I	76,208	43.30	1,760	85,750	49.00	1,750
Region II	7,350	29.40	250	8,100	32.40	250
Region III	28,980	32.20	900	30,690	37.20	825
Region IV	14,256	29.70	480	15,136	35.20	430
Region V	14,484	28.40	510	14,290	32.70	437
Region VI	3,197	21.60	148	3,978	23.40	170
Total France	144,475	35.69	4,048	157,944	40.90	3,862
PRATS Projection	145,475	33.02	4,406	-------	-----	-----
ONIC Projection	146,538	32.23	4,546	-------	-----	-----

*1000 quintals = 100 tons

Table 24. Projections to 1970 and 1975 of Barley Surfaces, Yields, and Production, by Region and for France, Comparisons With PRATS' and ONIC's 1970 Projections.

	Production (thousand quintals)	Yields (quintals per hectare)	Surface (thousand hectares)	Production (thousand quintals)	Yields (quintals per hectare)	Surface (thousand hectares)
	1970			1975		
Region I	54,210	41.70	1,300	65,380	46.70	1,400
Region II	7,563	29.20	259	9,752	32.40	301
Region III	20,810	31.20	667	29,430	37.30	789
Region IV	4,304	26.90	160	5,724	31.80	180
Region V	9,495	24.10	394	11,830	26.00	455
Region VI	705	16.40	43	689	16.40	42
Total France	97,087	34.28	2,823	122,805	38.78	3,167
PRATS Projection	86,934	31.94	2,722	-------	-----	-----
ONIC Projection	79,603	31.81	2,502	-------	-----	-----

Tables 19, 20, and 21, the year to year yield variations are wide, particularly for corn. These are due to weather conditions (frosts, fall rains, cold springs, dry summers). It is impossible to predict what the weather

Table 25. Projections to 1970 and 1975 of Corn Surfaces, Yields, and Production, by Region and for France, Comparisons with PRATS' and AGPM's Projections. (1000 quintals = 100 tons)

	Production (thousand quintals)	Yields (quintals per hectare)	Surface (thousand hectares)	Production (thousand quintals	Yields (quintals per hectare)	Surface (thousand hectares)
	1970			1975		
Region I	11,150	44.60	250	15,168	47.40	320
Region II	528	35.20	15	602	37.60	16
Region III	4,192	40.70	103	5,931	46.70	127
Region IV	24,321	36.30	670	28,840	41.20	700
Region V	4,804	39.70	121	6,571	44.70	147
Region VI	979	30.60	32	1,207	34.50	35
Total France	45,974	38.60	1,191	58,319	43.36	1,345
PRATS Projection	32,743	31.22	1,048	------	-----	-----
AGPM Projection	40,000	38.00	1,050	------	-----	-----

will be in 1970 and 1975. The projections which can be made imply "normal" weather conditions. Thus the weather effect will be eliminated, even though the adoption of new technology may alter the yield variability due to weather (e.g., use of varieties more resistant to diseases favored by dampness but more sensitive to droughts). Projections of yields are based on past linear trends. They are given in Table 22.

Projections of Production

The projections of grain production resulting from the surface and yield projections are given in Tables 23, 24, and 25 for wheat, barley and corn respectively. They are compared in the same table within projections to 1970 of Prats and ONIC (the National Agency controlling grain marketing) or AGPM[6] (Association Generale des Producteurs de Mais) the corn producers' association.

For wheat, the three production projections are very close to each other. However, they result from different surfaces and yields. We feel that Prats and ONIC have underestimated both the potential increase in yields resulting from technical progress and the reduction in wheat surface. The latter divergence results from what we consider an exaggerated estimate of the impact of expected higher prices for wheat.

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[6] J. Prats: Situation, Progression et Perspectives de la Production des cereales, *B.T.I.*, 208, April 1966, pp. 275-301.

Table 26. Surface, Average Yield and Production of Oats and Rye, France, 1955-1965

Year	Oats			Rye		
	Surface (thousand hectares)	Yield (quintals per hectare)	Production (thousand metric tons)	Surface (thousand hectares)	Yield (quintals per hectare)	Production (thousand metric tons)
1955	2077	17.6	3640	388	11.4	440
1956	2277	20.2	4604	371	12.7	471
1957	1608	16.0	2579	364	13.2	481
1958	1487	17.7	2638	347	12.4	439
1959	1504	18.7	2815	328	14.3	470
1960	1427	19.2	2735	299	14.0	418
1961	1442	18.0	2591	261	13.3	347
1962	1356	19.4	2628	243	14.6	355
1963	1287	22.3	2876	232	15.4	357
1964	1094	21.1	2310	220	17.7	389
1965	1052	23.2	2439	221	17.0	375

Table 27. Projections to 1970 and 1975 of Oats and Rye Production in France.

	Oats			Rye		
	Surface (thousand hectares)	Yield (quintals per hectare)	Production (thousand metric tons)	Surface (thousand hectares)	Yield (quintals per hectare)	Production (thousand metric tons)
1970	600	24.2	1452	107	19.5	210
1975	300	26.6	798	50	22.0	110

For barley, our projections are higher for both yield and surface. The divergence for surfaces results from our forecast concerning the regression in wheat surface. As far as projected yields are concerned, the difference (around 2 quintals per hectare) is not enough to be of concern.

For corn, we project a 46 million quintal production, whereas AGPM projects 40 and Prats only 32.7 million quintals. We feel that Prats' yield projection is definitely pessimistic. Ours is close to AGPM's (38.6 quintals per hectare versus 38 quintals per hectare). The divergence is greater in the case of surfaces. It may be that our projection is too large since we predict 140,000 hectares more than Prats or AGPM, but we feel reasonably sure that they underestimated the future increase in corn surface.

Table 28. Distribution of Farmland Between Major Groups of Crops, France, 1956-1965. (1000 Hectares)

Years	Permanent Pasture	Arable Land				
		Total	Grains	Hoed Crops	Forage Crops	Others
1956	13,330.7	18,613.4	8,600.3	2,810.6	5,574.5	1,628.0
1957	13,242.4	18,735.6	9,036.7	2,640.1	5,657.8	1,401.0
1958	13,177.6	18,861.7	9,045.7	2,616.1	5,826.0	1,373.9
1959	13,122.0	18,937.9	9,173.2	2,574.0	5,906.8	1,283.9
1960	13,062.7	19,006.8	9,195.5	2,630.7	5,944.9	1,235.7
1961	13,133.9	19,022.6	9,033.7	2,559.7	6,017.9	1,411.3
1962	13,065.7	19,098.4	9,267.1	2,450.0	5,997.2	1,384.1
1963	13,113.2	18,910.1	9,028.8	2,432.7	5,989.3	1,459.3
1964	13,280.7	18,543.7	9,093.7	2,219.4	5,825.7	1,404.9
1965	13,326.6	18,544.8	9,213.2	2,139.0	5,834.0	1,358.6

Other Grains

Oats and rye are other grains of significance in French agriculture. But their importance has steadily declined as human consumption of rye dwindled and as the number of horses decreased. Because of yield differences, other feed grains, particularly barley, have replaced oats and rye. Surface, average yield, and production are given in Table 26. For projection purposes, it is assumed that yield will continue to increase on the same trend as between 1955 and 1965. As for surfaces, it is projected that they will continue to decrease but the decline will slow down. In the case of oats, all horses will not disappear. Some will remain for riding purposes and some as meat animals. France already imports horses for slaughter but it would not be reasonable to expect that all horses will be imported. Given the existing substitutability of horse meat for beef, and the likely future shortage of beef in the EEC, horse meat prices will increase, which will induce an increase in domestic production. Hence it is projected that the oats surface will not decrease below 300,000 hectares by 1975.

Similarly it is expected that the rye surface will decline but not disappear because of its use in some specialty baked products. Besides, a little rye will continue to be fed on farms in remote mountainous areas. The projections resulting from these assumptions are given in Table 27.

No projections have been made here for sorghum grain production. As already mentioned, this crop could well develop in France, particularly in the dryer parts of the Southwest. But it is expected that the increase in sorghum production would take place at the expense of the projected increase in corn. Thus, the total feed grain estimate would not be significantly affected.

Table 29. Distribution of Grain Surfaces, France, 1950-1965, and Projections To 1970 and 1975. (1000 Hectares)

Year	Total	Wheat	Barley	Oats	Corn	Others
1950	8,724.4	4,318.8	962.1	2,353.5	325.3	764.7
1951	8,628.4	4,250.4	1,019.2	2,272.0	349.3	737.5
1952	8,694.4	4,296.5	1,074.9	2,275.3	349.0	698.7
1953	8,740.7	4,219.4	1,203.3	2,269.6	375.2	673.2
1954	8,936.4	4,491.3	1,230.8	2,153.7	410.5	650.1
1955	9,016.6	4,553.7	1,313.4	2,076.7	453.4	619.4
1956	8,600.3	2,745.1	2,282.6	2,276.8	653.2	642.6
1957	9,036.7	4,667.6	1,642.6	1,607.8	543.9	574.8
1958	9,045.7	4,615.0	1,782.0	1,487.2	589.7	571.8
1959	9,173.2	4,439.3	1,988.8	1,503.6	704.1	537.4
1960	9,195.5	4,358.2	2,088.6	1,427.0	824.3	497.4
1961	9,033.7	3,997.3	2,259.1	1,441.7	975.3	360.3
1962	9,267.1	4,570.5	2,176.5	1,356.2	865.8	298.1
1963	9,028.8	3,849.5	2,538.5	1,286.9	952.3	401.6
1964	9,093.7	4,388.2	2,360.1	1,094.2	892.7	358.5
1965	9,213.2	4,504.4	2,398.7	1,051.8	872.9	385.4
1970	-------	4,048.0	2,823.0	600.0	1,191.0	-----
1975	-------	3,062.0	3,167.0	300.0	1,345.0	-----

Conclusions

In summary, an important increase in grain production is expected since total production is projected to increase from 27.4 million tons in 1964 to 30.6 and 34.9 million tons in 1970 and 1975 respectively. The increase can be attributed to a change in the average yield since the area planted to grains will remain around 9.1 million hectares. The increase in yield will result from technological improvements which will raise the average yield for every grain crop and shift within the grains; barley, corn and possibly sorghum will replace oats and rye. (Tables 28 and 29)

The expected changes in grain prices will not be very instrumental in bringing about changes in grain production. A very unlikely magnitude would be required to play such a role. In particular, the often-mentioned plowing of grassland into surfaces planted to grains appears very unlikely because of the very small size of farms in regions where land presently in permanent pasture is tillable.

Chapter 4

Projections of Pork Production

Data on pork production in France were not good until recently. Every year the Ministry of Agriculture publishes estimates of hog numbers by various categories and by *departement*. These estimates are based on the best judgment of agricultural civil servants of the *departement* who could only use knowingly false statements made by farmers. Yet it is believed that year to year variations in hog inventories are more or less reflected in the series. In particular, they show very clearly the existence of a hog cycle. Data on hog slaughter also are uncertain. Hogs killed in the controlled slaughter houses are recorded, but a significant portion of total production comes from hogs slaughtered on farms and from hogs slaughtered in small private slaughter houses whose fiscal records provide a very large underestimation of slaughter numbers. The very limited data available on production by region are very poor.[1] This situation is changing now. Considerable effort is presently being made to improve knowledge on pork production. A Ministry service has been set up to collect data on hog production and to forecast pork meat supply.[2] This service has progressively set up a permanent survey of the number of sows bred. Monthly reports are made. In addition, a survey on the structure of the hog herd on April 1, 1966 was made in the spring of 1966. Questionnaires were filled in by 22,100 randomly selected farmers and they provide the best information which has ever been available.[3] Unfortunately, this provides information on only one point in time and past trends cannot be inferred from it.

Hog production takes place on many farm units scattered throughout France. Out of a total 1.8 million farms on April 1, 1966, 1.025 million (i.e., 56.7%) had at least one hog. There is, however, some regional specialization since in planning regions[4] such as Brittany (West) and Midi Pyrenees (Southwest) the proportions of farms having at least one hog were 82.2% and 76.2% respectively. Farms are somewhat specialized between piglet producers (piglets are produced on 308,000 farms; 237,000 of which did not feed all their piglets) and feeders (413,400 farms). The production units are small (3.5 adult sows per farm having sows and 6.8 hogs per farm having hogs). The number of large producers is considered to have been underestimated yet it is very small (only 35 breeders were found to have more than 100 sows and only 706 farms had more than 200 hogs being fed on April 1, 1966).

[1] In particular the sum of regional slaughter estimates is significantly inferior to the national estimate.

[2] Their survey program is described in *Statistique Agricole--Supplement, "Serie Etudes"* no. 10, January, 1966.

[3] Etude sur la Structure du Cheptel Porcin, April 1966 - *Statistique Agricole, Supplement "Serie Etudes,"* no. 21, February 1967.

[4] There are 21 planning regions in France.

Contrary to what is often reported, dairy by-products make up only a minor portion of the total feed consumed by hogs (5.3%). The bulk of the feed comes from grains and high protein meals (over 80%). Purchases of feed are less important than feed produced on the farms where it is fed, but purchased feed makes up 40.8% of total feed. It is likely that this proportion has increased with vertical integration of pork production and will continue to do so.

Programming results in Choletais and Pays de Caux, Combrailles and Coteaux de Gascogne have shown that the situation is presently very favorable to vertical integration. Pork Production seems to be very profitable and restricted only by uncertainty and credit (capital) limitations, precisely those which can be lifted through vertical integration. However, technical uncertainties seem to slow down vertical integration.

Another important result of the survey is related to the technical level reached by hog producers. It was found that in a one-year period 2.7 million piglets died before weaning. Out of this total, 2 million died either of septicemia or of accidents due to the sows. These losses could be considerably reduced by systematic vaccination of piglets at birth and by better management (housing arrangements and better feeding programs to reduce the voracity of the sows). Of the accidents during the post-weaning feeding period (439,000 in the year covered by the survey), a large proportion could be avoided by better feeding hygiene. Thus, it appears that there is a fairly wide margin left for technical progress in hog production in France. It is likely that genetic improvements will take place between now and 1975. These will have to be taken into account when projecting hog production.

Projection Method

In order to project pork production, it is necessary to base the analysis on the available data concerning past trends. As mentioned, it is believed that year to year variations in hog numbers and hogs slaughtered are correctly reflected by the time series. As should be clear now, a regional analysis of French agriculture is essential. The only data available on a regional basis is the number of hogs on farms as of October 1 each year. These data are used to make regional projections of hog numbers which, in turn, are aggregated into a national figure. From these national figures on hog numbers, a projection of pork production is derived.

A simultaneous equation model built for U.S. pork production[5] showed that the number of sows farrowing was the most crucial factor in the determination of hog output, the latter including pork production plus increases or decreases in hog inventories. Unfortunately, there are no data in France on

[5] M. Petit, *Econometric Analysis of the Feed Grain Livestock Economy*, unpublished Ph.D. thesis, Michigan State University, 1964.

Table 30. Total Pork Production and Average Pork Production per Sow, Annual Figures and Three-Year Moving Averages, France, 1950-1965.

Year	Total Pork Production (1000 tons)		Pork Production per Sow (Kilograms per Sow)	
	Annual Data	Three-Year Moving Average	Annual Data	Three-Year Moving Average
1950	790	----	904	----
1951	745	828	873	948
1952	950	872	1067	997
1953	920	943	1053	1032
1954	960	943	978	1017
1955	950	995	1022	1049
1956	1075	1040	1147	1093
1957	1095	1088	1111	1109
1958	1095	1130	1071	1123
1959	1200	1152	1186	1124
1960	1160	1176	1116	1122
1961	1167	1205	1066	1134
1962	1286	1223	1220	1144
1963	1216	1235	1147	1171
1964	1203	----	1148	----

sow farrowings and hog output. However, sows farrowing in a given year and sows present on farms on October 1 of that year are two variables which probably are closely related. Accordingly the simple correlation coefficient between pork production in one year and number of sows present on farms on October 1 of the same year was computed on the basis of time series data for the period 1950-1964. A .95 value was found which indicates a close link between the two variables. From a purely economic point of view (i.e., expressing economic behavior of farmers), the relationship between pork production and sow numbers is not direct. It depends on many variables and particularly the proportion of young sows kept for breeding, the number of pigs raised per litter, and the average weight of fed hogs.

For production purposes, it was deemed preferable to project both the number of sows and the ratio of pork production per sow present on farms in October of each year. As seen in Table 30, the year to year variations in this ratio follow the hog cycle as more sows are kept for breeding when prices are high. The trend in this ratio observed on a 3-year moving average (to eliminate the effect of a rough 3-year cycle)[6] is steadily upward as

[6]For a description of the hog cycle in France, see J. LePere de Gravern, *Le Marche de la Viande en France--Etude Retrospective de 1950 a 1964, Etudes d'Economie Rurale*, no. 49-50, September-December, 1965.

Figure 2. Average Pork Production Per Sow, France, 1950-1964.

shown in Figure 2. This reflects the impact of technical progress in pork production since no less sows than before are required for the same hog output.

In summary, data availability and knowledge on hog output formation led to the following projection procedure: 1) Sow numbers were projected by region on the basis of past trends and available information on the relative profitability of hog enterprises in the farms of the region. Programming studies help in providing this information. 2.) The national average pork

production per sow was projected on the basis of past trends and judgment on the margin for technical progress in hog breeding and feeding. 3.) The projected national pork production was computed and compared with past production figures. Such a procedure has the advantage of avoiding the difficulties associated to movements of weaned piglets from one region to another.[7]

Projection of Number of Sows by Region

Data on numbers of sows and other hogs by region for the 1950-1965 period are given in Tables 31, 32, and 33.

Region I (North)

In order to eliminate the effect of the hog cycle, 3-year moving averages are used to judge past trends. As can be seen in Figure 3, the number of sows in the Northern Region increased rapidly from 1954 to 1961 but has decreased since 1962. In view of the relative importance of large farms with less and less labor in that area, such a phenomenon is not surprising. Large farms employing hired labor cannot compete with small family farms where the reservation price for family labor is very low and it should not be expected that the number of sows will increase in the region. On the other hand, it would be unreasonable to expect a large decrease because Region I includes areas where farms are small and piglet production is important, in particular the extreme North of France (*departements du Nord and Pas de Calais*). The final projection then is 205,000 sows in 1970 and 200,000 in 1975.

Region II (Northeast)

In this area, the number of sows has remained very stationary since 1960. There is no reason to expect that the balance between upward and downward forces will be upset there. The relative profitability of hog enterprises on small farms will probably be offset by the considerable reduction in the number of farms. Thus, we project a constant number of sows (55,000) for 1970 and 1975.

Region III (Western)

Past data and programming results in Choletais show the rapid growth and potential for further growth of the number of sows in the Western Region. As seen in Figure 3, the 3-year moving average of the number of sows has followed an almost perfect linear trend. Available family labor, cooperative concentration, development of hog producers' groups helped by the government are factors which indicate that the past growth will at least continue at the same rate. The final projection figures proposed are 450,000 and 500,000

[7]International trade of piglets is very limited at the present time. It could develop but probably not to such an extent that production projections would have to be significantly revised.

Table 31. Number of Hogs on Farms, October 1, by Type in the North and Northeast Regions. (Thousand Head)

	North			Northeast		
Year	Total	Sows	Other Hogs	Total	Sows	Other Hogs
1950	1107.57	164.45	943.12	551.17	49.51	501.66
1951	1134.60	161.97	972.63	575.16	51.23	523.93
1952	1195.51	169.34	1026.17	569.65	53.50	516.15
1953	1220.72	165.26	1055.46	578.78	53.53	525.25
1954	1266.17	171.14	1095.03	601.38	54.70	546.68
1955	1312.56	173.00	1139.56	617.70	56.25	561.45
1956	1476.70	199.00	1277.70	625.60	56.40	569.20
1957	1537.50	210.80	1326.70	637.60	54.40	583.20
1958	1666.45	221.90	1444.55	629.05	50.55	578.50
1959	1644.20	223.70	1420.50	639.80	49.60	590.20
1960	1668.00	224.00	1444.00	663.00	52.00	611.00
1961	1901.00	236.20	1664.80	714.00	56.80	657.20
1962	1863.40	231.60	1631.80	692.90	56.50	636.40
1963	1838.30	225.00	1613.30	639.80	55.20	584.60
1964	1866.90	223.10	1643.80	631.10	55.70	575.40
1965[1]	-------	212.20	-------	------	56.50	------

[1]Provisional data

Table 32. Number of Hogs on Farms, October 1, by Type in the South and Southwest Regions. (Thousand Head)

	South			Southwest		
Year	Total	Sows	Other Hogs	Total	Sows	Other Hogs
1950	1902.05	286.21	1615.84	1110.62	123.84	986.78
1951	2126.81	299.62	1827.19	1140.03	125.50	1014.53
1952	2086.90	307.37	1779.53	1177.97	130.44	1047.53
1953	2215.99	306.00	1909.99	1141.42	121.99	1019.43
1954	2338.19	323.80	2014.39	1206.50	134.15	1072.35
1955	2383.75	324.30	2059.45	1207.53	137.60	1069.93
1956	2379.00	327.90	2051.10	1137.70	123.90	1013.80
1957	2448.80	337.50	2111.30	1290.70	148.10	1142.60
1958	2540.00	351.70	2188.30	1391.70	156.50	1235.20
1959	2437.90	338.70	2099.20	1505.60	171.10	1334.50
1960	2588.00	355.00	2233.00	1526.00	178.00	1348.00
1961	2907.00	384.00	2523.00	1557.00	184.50	1372.50
1962	2807.00	376.20	2430.80	1525.60	176.00	1349.60
1963	3016.10	405.70	2610.40	1456.50	175.00	1281.50
1964	3081.30	398.50	2682.80	1473.60	181.10	1292.50
1965[1]	-------	397.40	-------	-------	175.20	-------

[1]Provisional data

Table 33. Number of Hogs on Farms, October 1, by Type in the Mountain and Southeast Regions. (Thousand Head)

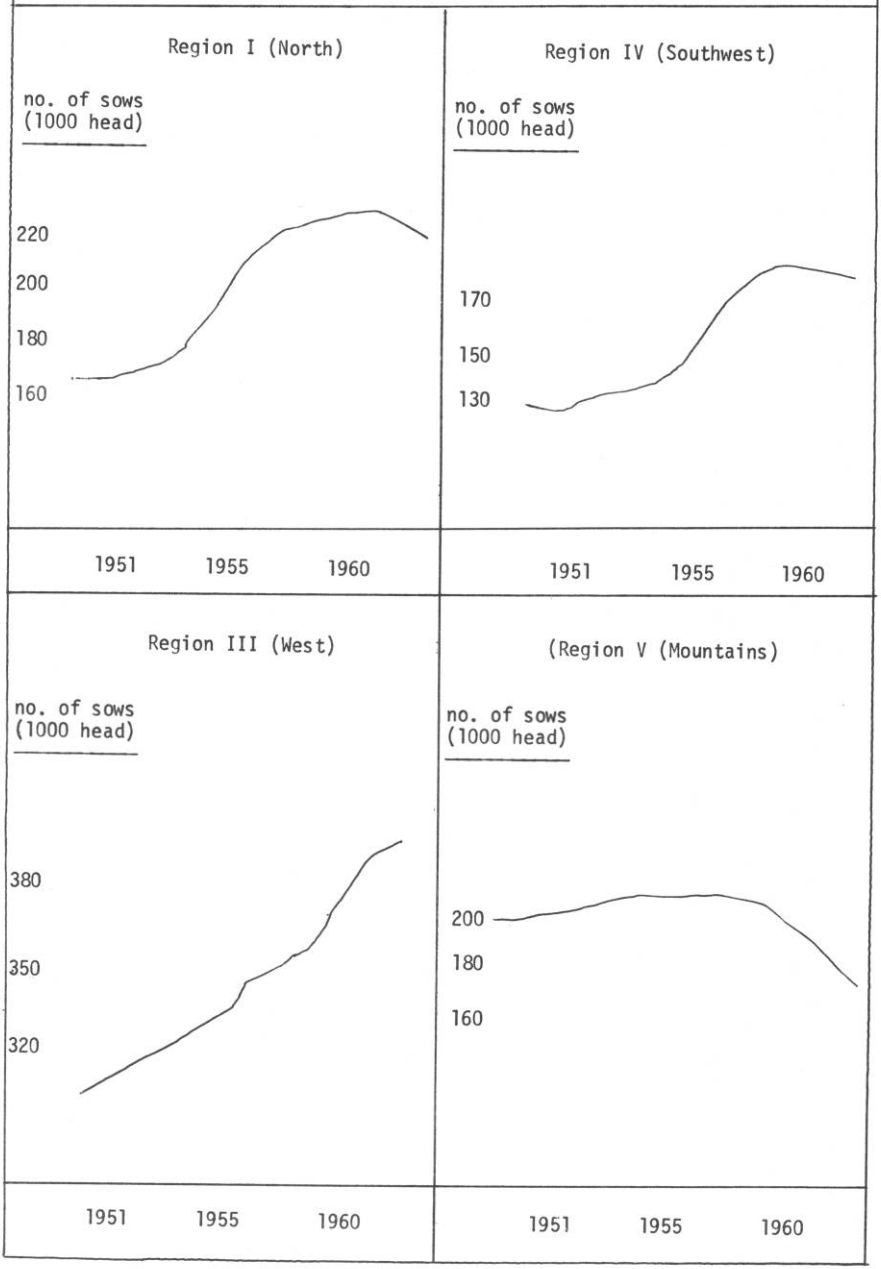
	Mountains			Southeast		
Year	Total	Sows	Other Hogs	Total	Sows	Other Hogs
1950	1811.51	200.26	1611.25	341.31	29.70	311.61
1951	1870.34	205.27	1665.07	375.10	30.63	344.47
1952	1790.31	199.41	1590.90	358.72	30.08	328.34
1953	1818.94	201.76	1617.18	310.74	25.07	285.67
1954	1831.24	207.82	1623.42	326.19	28.12	298.07
1955	1895.00	211.57	1683.43	313.67	27.27	286.40
1956	1852.20	203.40	1648.80	288.00	25.80	262.20
1957	1909.60	207.60	1702.00	306.70	27.00	279.70
1958	1928.90	214.60	1714.30	313.18	26.88	286.30
1959	1827.70	205.10	1622.60	302.00	23.30	278.70
1960	1852.00	206.00	1646.00	306.00	23.00	283.00
1961	1841.00	209.60	1631.40	297.00	23.10	273.90
1962	1876.60	192.20	1684.40	314.90	21.40	293.50
1963	1760.90	180.90	1580.00	255.40	18.70	236.70
1964	1727.30	173.10	1554.20	262.50	16.60	245.90
1965[1]	-------	167.50	-------	------	15.60	------

[1]Provisional data

Table 34. Number of Hogs on Farms, October 1, by Type in France 1950-1965 and National Projections of the Pork Production 1970 and 1975. (thousand head)

	France		
Year	Total	Sows	Other Hogs
1950	6824.20	854.00	5970.20
1951	7222.00	874.20	6347.80
1952	7179.00	890.20	6288.80
1953	7286.60	873.60	6413.00
1954	7569.70	919.70	6650.00
1955	7729.20	930.00	6799.20
1956	7759.20	936.40	6822.80
1957	8130.90	985.40	7145.50
1958	8469.30	1022.10	7447.20
1959	8357.20	1011.50	7345.70
1960	8603.00	1038.00	7565.00
1961	9217.00	1094.20	8122.80
1962	9080.40	1053.90	8026.50
1963	8967.00	1060.50	7906.50
1964	9042.70	1048.10	7994.60
1965	9149.40	1024.40	8125.00
1970	1078.00	1309.00	1400.00
1975	1113.00	1390.00	1550.00

Figure 3. 3-Year Moving Average Number Of Sows in Selected Regions, 1950-1964.



sows, as compared with the figures -- 443,000 and 482,000 -- given by the least square linear trend.

Region IV (Southwest)

The situation in the Southwest resembles that of the Western Region but the rate of increase has slowed since 1961, as seen in Figure 3. Contrary to the Northern Region where the number of sows has not increased either for the last few years, it is believed that, because of the great difference in farm structure and of the relatively slow increase in farm size which should be expected in that area, the number of sows will resume its growth. This assumption is supported by recent, and as yet unpublished, programming results in Coteaux de Gascogne. Accordingly, the figures obtained from computing the linear trend will probably be reached and the final projection is 215,000 sows in 1970 and 240,000 sows in 1975.

Region V (Mountains)

In this region, the number of sows remained fairly stable from 1950 to 1958. Since that date, it has decreased at a rapid rate as shown in Figure 3 giving the 3-year moving average number of sows. The expected decrease in the number of farms leads to the belief that the decrease in the number of sows will continue. Another indication is provided by the first programming results of Combrailles which show that hog enterprises are generally profitable but less than in the Western Region.

With this information in mind, the final projection proposed is 140,000 sows in 1970 and 130,000 sows in 1975.

Region VI (Southeast)

This region has very minor importance in French hog production. The number of sows is declining and projected to follow the linear trend which leads to projections of 13,000 and 8,000 sows respectively in 1970 and 1975.

National Projections

The addition of the regional projections result at the national level in a projected 1,078,000 sows in 1970 and 1,113,000 in 1975.

Projection of National Pork Production

As mentioned above, the projection of pork production is obtained by multiplying the projected number of sows by the projected average pork production per sow. The latter ratio must then be projected. Its values are given in Table 30 for the 1950-1964 period. Because of the cyclical influence, the 3-year moving average has been computed and is given in the same table. This average has steadily increased except in the period 1958-1960 when it remained stable. The simple correlation coefficient between this

average and time is high (.82) and therefore justifies projecting an increase in the average pork production per sow inasmuch as the brief description of French pork production has shown that there still is a wide margin for technical progress. The projected values for this average are thus 1309 kilograms per sow for 1970 and 1390 kilograms per sow for 1975.

These figures give a projected pork production of 1,400,000 tons in 1970 and 1,550,000 tons in 1975. (Table 34) Such projections appear coherent with past trend since as shown in Table 30, pork production increased from 828,000 tons in 1951 to 1,235,000 tons in 1963. They imply that the slowdown in the growth observed by LePere[8] from 1962 to 1965 will only be temporary.

Conclusion

In summary, a fairly important increase in pork production is projected despite the observed slowdown from 1962 to 1965. This projection is justified by the regional analysis and the programming results which show that the relative profitability of hog enterprises is generally very high. The figure obtained here for 1970, i.e., 1,400,000 tons, should be compared with the Fifth Plan prediction of 1,500,000 tons in 1970. It should be remembered, however, that demand conditions have not been taken into account here. In the final analysis consumption projections must play an important role becuase they will probably bring a downward pressure on production through a decline in the real price for pork.[9] Similarly the full enforcement of the Common Agricultural Policy will bring outside supplies to bear on the French market. This combined with the fact that the Common Policy does not provide a rigid support mechanism for pork prices suggests that profitability of pork production will decline somewhat in future years. In this respect, it is significant that imports of pork into France did not stop in 1965, at the top of the production cycle. Given these reservations, the proposed projections should only be taken as indicators of forces underlying pork production in France. In the last chapter of this report, the production projection will be compared with projected demands.

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[8] J. LePere, *op. cit.*, p. 39.

[9] D.J. Epp, *Changes in Regional Grain and Livestock Prices Under the European Economic Community Policies*, Number 4 in this series, Institute of International Agriculture, Michigan State University, June, 1968.

Chapter 5

Cattle Projections

Cattle production is widespread, nonspecialized and not concentrated in France. The number of breeds is very high and cattle productivity is low. Statistical data on cattle are very poor and studies at the national level very hazardous. A brief description of cattle production will first be given here, then statistical data limitations will be reviewed before making tentative projections of milk, beef, and veal production.

Brief Description of Cattle Production in France

Published results for the most recent survey sample on cattle production give data on cattle numbers on farms on October 1, 1964.[1] Table 35 gives the distribution of farms having cattle according to the surface and the number of cattle, and Table 36 gives the distribution of cattle according to the surface and the number of cattle per farm. At that date, 1,343,100 farms had 20,022,400 head of cattle, (i.e., an average 15.4 head per farm). It can be seen that, as would normally be expected, larger farms have larger herds. More surprisingly, it can be noted that 64 percent of the cattle are found on farms larger than 20 hectares and 52 percent of cattle on these farms larger than 20 hectares, have a herd of more than 20 head of cattle. Comparing these tables with 1955 census data given by Rottier,[2] it appears that substantial growth in the average size of herds has taken place. The number of herds having between 1 and 9 head of cattle declined from 1.1 million to 603 thousand while the number of herds having more than 20 head of

Table 35. Distribution of Farms Having Cattle on October 1, 1964 According to the Surface and the Number of Cattle.

Farm Surface (Hectares)	Total	Farms Classified According to No. of Cattle		
		1-9	10-19	20 & over
		(1000 farms)		
0 to 4.9	162.5	161.4	1.1	0
5 to 9.9	272.0	223.2	47.8	1.0
10 to 19.9	420.3	158.5	220.4	41.4
20 to 29.9	221.3	37.0	85.0	99.3
30 and over	267.0	22.8	54.1	190.1
Total	1343.1	602.9	408.4	331.8

[1] Ministere de l'Agriculture, "Resultats de l'enquete sur la structure du Cheptel bovin au 1er Octobre 1964," *Statistique Agricole*, Supplement "Series Etudes" No. 13, June, 1966.

[2] CREDOC, *op. cit.*

Table 36. Distribution of Cattle on Farms on October 1, 1964 According to Size of Farms and Number of Cattle per Farm.

Farm Surface (Hectares)	Classified according to number of cattle (1000 cattle)			
	Total	1-9	10-19	20 & over
0 to 9.9	2,248	1,653	572	23
10 to 19.9	4,910	974	2,950	985
20 & over	12,864	340	2,010	10,515
Total	20,022	2,967	5,532	11,523

cattle increased from 162 to 332 thousand. As Rottier points out, the 1955 census data on livestock are very poor -- great caution must be used when estimating change in concentration. However, the 1964 survey sample results can be reasonably trusted; they indicate that in spite of a definite concentration movement over the past ten years, the number of herds remains very large, the average size of herds small and the number of large herds very small (only 61,300 farms had more than 30 cows and heifers).

Cattle breeds are numerous in France, but the importance of major breeds is increasing. There are three major dairy breeds -- Frisian, Normande, and Pie Rough de l'Est -- which are really dual purpose breeds having been selected for both milk and beef production. The Frisian breed is typical in that respect. It is more beefy than the North American Holstein. Table 37 gives the number of cows and heifers of major breeds on farms on October 1, 1964 and on January 1, 1963.[3] These two points in time correspond to two survey samples for which data have been published. Cows and heifers are chosen as the best indicators of farmers' decisions concerning the choice of breeds. It can be seen in this table that the three major dairy breeds made up almost two-thirds of the total number of females in October 1964. The total beef breeds made up only 19 percent of the total number of females, and this percentage has very slightly declined from January 1963 to October 1964 even though the most famous beef breed, the Charolais, has increased from 992,000 to 1,113,000 females. These data indicate that local breeds, whether dairy or beef or work, are declining, the most important gains being achieved by the three major dairy breeds, particularly the Frisian.

As a result of the composition of cow inventories, beef appears mainly as a by-product of milk. This is somewhat less marked than in other coun-

[3]Results of this survey have been partly published in Supplement "Serie Etudes" No. 4 of *Statistique Agricole*, partly in No. 13 and partly in a forthcoming issue.

Table 37. Number of female cattle (cows and heifers) on farms by breeds on January 1, 1963 and October 1, 1964. (Thousand Head)

Breeds	January 1, 1963		October 1, 1964	
	number	percent	number	percent
Normande	4,380		4,647	
Frisian	3,414		3,689	
Pie Rouge de l'Est	1,667		1,766	
Total 3 major dairy breeds	9,461	61.8	10,102	64.7
Other dairy breeds	2,867		2,562	
Charollaise	992		1,113	
Limousine	408		429	
Other Beef Breeds	1,554.9		1,431	
Total Beef Breeds	2,955	19.3	2,973	19.0
TOTAL	15,283	100.0	15,637	100.0

tries of Western Europe because of the existence of specialized beef breeds, but it is clear that the latter are not of major importance in France.[4] It is often claimed that culled dairy cows make up more than 60 percent of total beef production even though there are really no data to support such a claim, as will be seen later.

Cattle are widespread in the various parts of France. But as seen in Figure 4, they are more numerous in the West and very few are found in the Southeast. Regional specialization is not very great but in the Northern, Western and Northeastern regions, almost all cows are of dairy breeds (over 95 percent), while beef breeds are of importance in the Southwest and the Central Mountains.

The two surveys mentioned above provide information on feeding practices in France. They confirm microeconomic information that shows the relatively small importance of concentrates in cattle rations. During the 1963-1964 crop year, all cattle were fed 9.6 million tons of sugar beet pulps and tops, and 31 million quintals of grains produced on the farms were consumed. These make up less than 10 percent of the total feed units received by cattle. French cattle are essentially grass fed. The forage crops occupied 15 million hectares on farms where cattle were found on October 1, 1964. As a result milk and beef productions are both very sensitive to weather conditions.

As will be seen later, veal production is very important in France. More than half of the calves born are killed as vealers. A major innovation occurred recently in calf feeding techniques with the development of milk

[4] It is so much more so because cows from beef breeds are sometimes used for dairy production as well.

Figure 4. Number of Female Cattle (all ages) by *departement* (January 1, 1963).

> 300,000
> 150,000–300,000
> 50,000–150,000
< 50,000

substitute powders.[5] There are no aggregate data available on the consumption of milk substitutes, but people familiar with the trade emphasize the very rapid growth of the milk substitute industry.[6] It is likely that this shift has increased milk deliveries by farmers and will continue to do so. The rapid increase in the number of 8-day old calves marketed may be partly due to this technical progress.

Statistical Problems

Both cattle number and cattle production data raise difficult statistical problems. These problems will be successively reviewed.

Cattle Numbers

Use has been made above of data from two survey samples conducted in 1963 and 1964. However, these two points in time are not far enough apart to provide an estimate of past trends. We must then resort to very inappropriate time series data. Rottier[7] has shown very well the major inconsistencies in these data. In particular, they imply that the number of calves born per 100 cows would in some years be greater than 100. Unfortunately, such a high fertility rate is a statistical illusion. In order to reduce these inconsistencies, Rottier revised the time series data. The above-mentioned survey sample results were not yet available when he made his revisions. Unfortunately, Rottier's revised estimates are less consistent with the 1963 survey results[8] than the unrevised estimates. Thus we cannot use Rottier's revised data and must build our own. However, previous experience shows that one cannot be confident of building a consistent set of data better than the Ministry of Agriculture's estimates. Therefore, we will be very cautious and propose new data only where absolutely necessary. Survey sample results have shown that the estimate of the total number of cows on farms was reasonably good if two-year-old heifers are included with the cows, whereas the number of other cattle were probably overestimated. Our projection will rely mainly on the time series data for the total number of cows.

Cattle Production

Meat

Beef cattle and calf slaughter are estimated on a global basis. A major

[5] J. LeBihan an expert on this topic, estimates that the production of milk substitutes increased from 65,000 metric tons in 1961 to 350,000 metric tons in 1966. However, these figures based on scanty evidence should only be taken as an order of magnitude.

[6] Survey results in all four regions (Choletais, Pays de Caux, Combrailles and Coteaux de Gascogne) show that a large proportion of farmers use milk substitute in their calf rations.

[7] CREDOC, *op. cit.*

[8] The 1964 survey cannot be taken as a check here since the sampling was made on the basis of 1963 results.

part of the slaughter takes place in slaughter houses where sanitary conditions are controlled by veterinarians. The number and weight of animals slaughtered in such houses are officially considered to be known with reasonable accuracy, even though the existence of an excise tax on meat is an incentive to fraud. But total slaughter can not be known exactly because some cattle and calves are slaughtered in "private slaughter houses" which are not under sanitary control. Every year the Ministry of Agriculture publishes estimates of total beef production and total veal production which are roughly 30 percent higher than "controlled slaughter" production.

The economic staff of a farm organization has questioned the total production estimates on the basis of the number of hides collected by the leather industry.[9] For beef, they give an estimate which is very close to the "controlled slaughter" production published by the Ministry of Agriculture. According to LePere, the actual production is probably between these two estimates, because very few beef cattle are now slaughtered in private slaughter houses. Rottier took the total estimate of the Ministry of Agriculture but argued that slaughter numbers were overestimated and weight underestimated. We feel that the first part of this argument is probably true as explained below but we are not able to judge the average carcass weight estimates.

Milk

Data on milk production is no better than on beef or veal production. Departmental estimates are tabulated in Paris and corrected upwards. A national production estimate is published by the Ministry of Agriculture; but, as Rottier explains, these data have long been questioned. They do not seem to be in accord with consumption study results. Experimental surveys on milk yields have been recently conducted. Unpublished results seem to indicate, however, that, after all, in the few areas where they have been conducted, the Departmental Agricultural Agencies' estimates may not be so bad. In the absence of any other data, we will depend on the Ministry of Agriculture estimates.

Average milk yields per cow play a crucial role in any milk projection. As is clear from the previous paragraphs, milk yields are very poorly known in France since both the number of dairy cows and milk production are subject to great uncertainty. Furthermore, an overall average yield may not be very meaningful because some cows which are milked are not really dairy cows. Some are beef cows and others are work cows. Unfortunately, it is very difficult to define homogeneous categories of cows, to estimate the number of each category, and to appraise milk production by category. As a result, very rough

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[9] APPCA *Bulletin d'information et de liaison*, May, 1964, quoted by J. LePere, *op. cit.*

approximations will be used.

Projections of Cattle Production

Given the extreme uncertainty surrounding cattle numbers and production estimates, cattle projections are very hazardous. Projections will only be useful as indicators of expected future trends, but great caution must be exercised in interpreting them since available time series data may even give biased estimates of past trends. To project cattle production, it seems reasonable to project cow numbers first, and then milk production on one hand and beef and veal output on the other hand. Such a procedure is justified inasmuch as three sets of relatively independent factors are responsible for variations in the number of cows, milk production per cow and meat production per cow respectively.

The number of cows depends mainly on the amount of feed available, (i.e., on the surface devoted to feed crops and thus on the relative profitability of cash crops versus livestock products as a whole). Given the number of cows, the number of calves born depends on technical progress. The proportion of calves which survive depends also on technical progress. All calves which survive accidents and diseases will be slaughtered sometime, either as veal or as beef. The importance of each depends on the relative prices of beef and of veal and on the price of milk or milk substitutes. It also depends on farm structure because small farms produce milk which they transform as veal, whereas larger farms may be prone to buy calves or to use their own for beef feeding stock. The average milk yield per cow depends on technical progress and on the proportion of dairy cows in the total number of cows. This proportion depends on the relative price of milk and beef, but also on farm structure -- smaller farms have dairy cows, larger farms may have beef cows.

Projections of Cow Numbers

As mentioned, the total number of cows and two-year-old heifers estimated at the national level was close to the figures obtained for the same year from the 1963 survey sample. Accordingly, they are considered to be fairly good. Projections are made by regions on the basis of past trends and information obtained at the microeconomic level.

Total cow numbers by region for the period 1950-1965 are given in Table 38. Table 39 gives two projections of the number of cows by region: first, the extrapolations of the linear trend and then the final projected figure taking into account expected changes in prices, structure, and technology.

Northern Region

Figure 5 gives the variations in the number of cows from 1950 to 1965. The influence of the beef cycle can be clearly seen. Actually this region is

Table 38. Total Number of Cattle on Farms, October 1, by Region. (Thousand Head)

Year	Paris Basin			East		
	All Cattle	Cows	Other Cattle	All Cattle	Cows	Other Cattle
1950	3047.34	1525.78	1521.56	1083.30	579.96	503.34
1951	3140.10	1574.32	1565.78	1145.10	622.96	522.14
1952	3183.75	1607.23	1576.52	1188.10	646.44	541.66
1953	3363.10	1708.76	1654.34	1235.16	670.72	564.44
1954	3487.35	1777.11	1710.24	1280.41	701.52	578.89
1955	3543.91	1812.83	1731.08	1300.92	711.60	589.32
1956	3493.10	1812.00	1681.10	1325.80	721.90	603.90
1957	3487.40	1821.50	1665.90	1368.70	740.70	628.00
1958	3623.20	1851.20	1772.00	1318.50	700.40	618.10
1959	3581.10	1821.80	1759.30	1390.90	712.20	678.70
1960	3828.00	1887.00	1941.00	1512.00	758.00	754.00
1961	4214.80	2023.00	2191.80	1718.50	830.00	888.50
1962	4294.60	2071.00	2223.50	1651.80	770.20	881.60
1963	4433.20	2244.70	2188.50	1574.70	837.20	737.50
1964	4271.30	2199.80	2071.50	1576.30	869.20	707.10
1965	4318.00	2205.90	2112.10	1612.20	889.50	722.70
	West			Southwest		
1950	5323.76	2624.31	2699.45	2061.78	1061.71	1000.10
1951	5464.30	2719.37	2744.93	2100.28	1091.67	1008.61
1952	5438.49	2762.20	2676.29	2097.44	1110.10	987.34
1953	5661.26	2901.21	2760.10	2156.29	1155.88	1000.41
1954	5825.00	3004.16	2820.84	2195.38	1186.23	1009.15
1955	5921.66	3064.21	2857.45	2204.26	1203.30	1000.96
1956	6058.30	3135.10	2923.20	2165.30	1212.10	953.20
1957	6183.90	3217.70	2966.20	2169.70	1247.10	922.60
1958	6432.00	3310.60	3121.40	2236.20	1290.90	945.30
1959	6538.30	3350.40	3187.90	2294.90	1320.70	974.20
1960	6780.00	3458.00	3322.00	2315.00	1355.00	960.00
1961	7065.80	3634.00	3431.80	2373.30	1375.00	998.00
1962	6956.10	3474.10	3482.00	2297.30	1363.00	934.30
1963	6904.20	3735.00	3169.20	2310.30	1495.76	814.60
1964	7048.00	3923.70	3124.30	2303.00	1503.70	799.30
1965	7127.60	3940.50	3187.10	2355.60	1515.10	840.50

continued.....

Table 38. (continued)

Year	Mountains			Southeast		
	All Cattle	Cows	Other Cattle	All Cattle	Cows	Other Cattle
1950	4029.00	2230.51	1798.49	255.38	141.91	113.47
1951	4129.46	2277.46	1852.00	256.10	144.84	111.26
1952	4130.44	2285.36	1845.10	242.38	141.59	100.79
1953	4266.36	2377.88	1888.48	229.10	131.80	97.30
1954	4299.73	2399.63	1900.10	234.59	134.87	99.72
1955	4367.99	2450.15	1917.84	232.82	133.49	99.33
1956	4419.30	2481.70	1937.60	230.90	134.40	96.50
1957	4480.20	2512.70	1967.50	234.50	134.90	99.60
1958	4613.00	2565.10	2047.90	242.80	139.40	103.40
1959	4676.30	2581.00	2096.30	253.60	142.70	110.90
1960	4800.00	2654.00	2146.00	266.00	150.00	116.00
1961	4944.30	2678.00	2266.30	266.50	155.00	111.50
1962	4823.00	2633.50	2189.50	263.20	142.00	121.20
1963	4813.60	2856.20	1957.40	244.00	152.00	92.00
1964	4806.60	2827.90	1978.70	238.70	147.70	91.00
1965	4861.60	2935.50	2026.10	240.40	149.20	91.20

	FRANCE		
	All Cattle	Cows	Other Cattle
1950	15,800.60	8,164.20	7,636.40
1951	16,236.00	8,431.00	7,805.00
1952	16,280.60	8,553.20	7,727.40
1953	16,911.20	8,946.20	7,965.00
1954	17,322.50	9,203.50	8,119.00
1955	17,571.60	9,375.60	8,196.00
1956	17,692.70	9,497.20	8,195.50
1957	17,924.40	9,674.60	8,249.80
1958	18,465.60	9,857.70	8,607.90
1959	18,735.10	9,928.80	8,806.30
1960	19,501.00	10,262.00	9,239.00
1961	20,583.20	10,695.00	9,888.20
1962	20,286.00	10,453.80	9,832.20
1963	20,040.60	11,321.00	8,719.60
1964	20,243.90	11,472.00	8,771.90
1965	20,515.90	11,535.70	8,980.20
1970	---------	12,585.00	--------
1975	---------	13,695.00	--------

not homogeneous with respect to cattle production. In the immediate Paris area the number of cows has declined while it increased in Haute Normandie and in the North. Budgeting results in Pays de Caux show that cash crop production in that area is limited by institutional and rotational restraints. Thus it seems normal to expect that the upward trend in the number of cows will continue as forage yields increase. A shift in relative prices of grain and beef may affect beef feeding practices, but it is unlikely that cow numbers will be significantly influenced. As a result, we project cow numbers to be slightly below the extrapolation of past trends but not very much.

Eastern Region

Figure 6 gives cow numbers each year for the Eastern Region during the 1950-1965 period. The variations must be interpreted with great care because successive and contradictory adjustments were made in the series. It can be roughly assumed that a general upward trend was followed. There are fairly

Table 39. Total Number of Cows Projected to 1970 and 1975 Linear Trend and Final Projections. (Thousand Head)

	1970	1970	1975	1975
Region	Linear Trend	Final Projection	Linear Trend	Final Projection
Region I	2,437	2,425	2,663	2,650
Region II	951	950	1,037	1,035
Region III	4,339	4,400	4,768	4,850
Region IV	1,661	1,600	1,813	1,750
Region V	3,058	3,060	3,264	3,260
Region VI	153	150	158	150
Total	12,599	12,585	13,703	13,695

good reasons to believe that the same trend will continue because this region, particularly Lorraine, seems to be in the process of a dairy specialization. Therefore, the extrapolated linear trend figures are used as final projections here.

Western Region

Figure 7, giving the number of cows in the Western Region each year for the period 1950-1965, indicates clearly that this number increased very steadily and at a fairly rapid rate. True, the regularity of the growth from 1950 to 1961 may have been somewhat exaggerated by the reporting system (best guesses of the Agricultural Administrations civil servants), but the irregularities afterwards are at least partly due to changes in the availability of statistical evidence -- here again the general trend will be considered as

Figure 5. Total Number of Cows and Milk Yield per Cow, Northern Region, 1950-65.

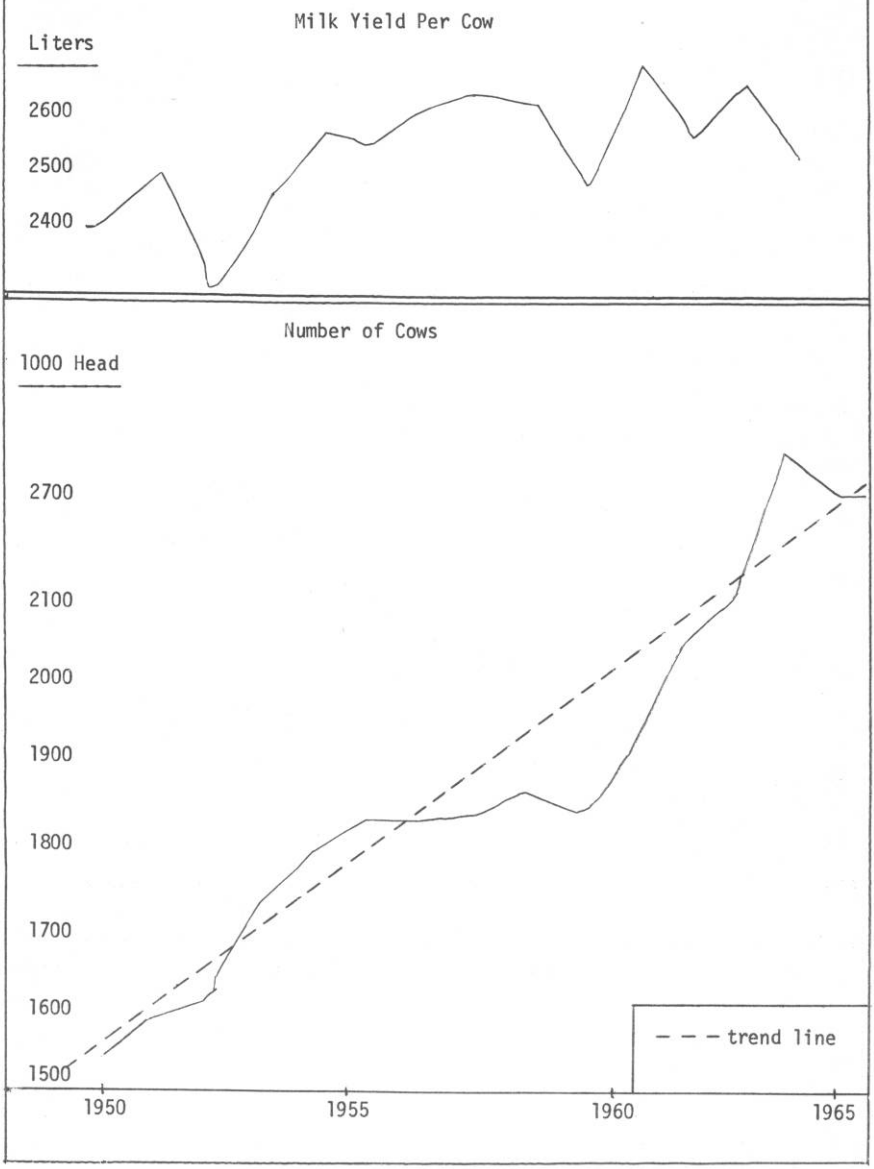


Figure 6. Number of Cows and Milk Yield Per Cow, Northeastern Region, 1950-1965.

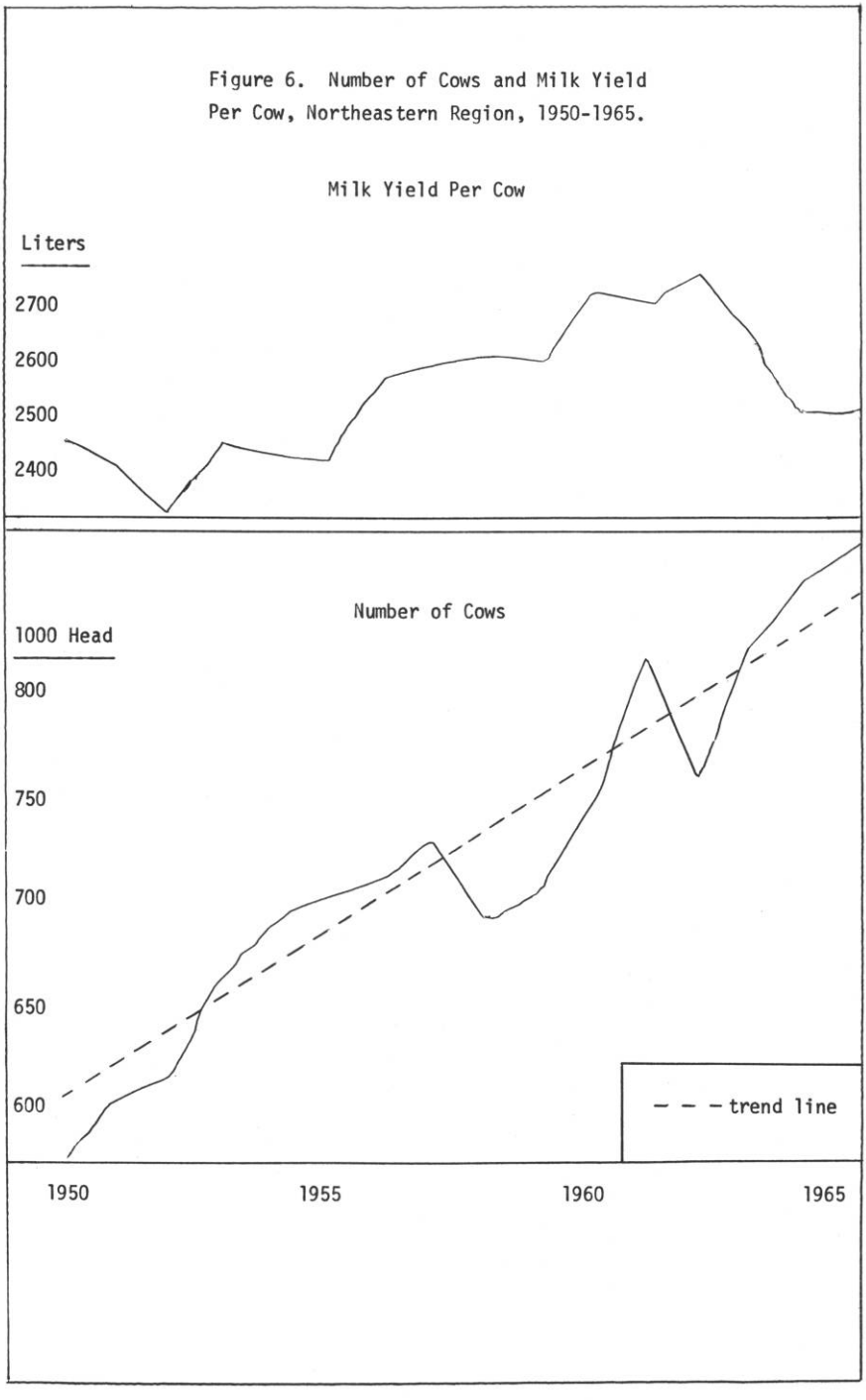


Figure 7. Number of Cows and Milk Yield Per Cow, Western Region, 1950-1965.

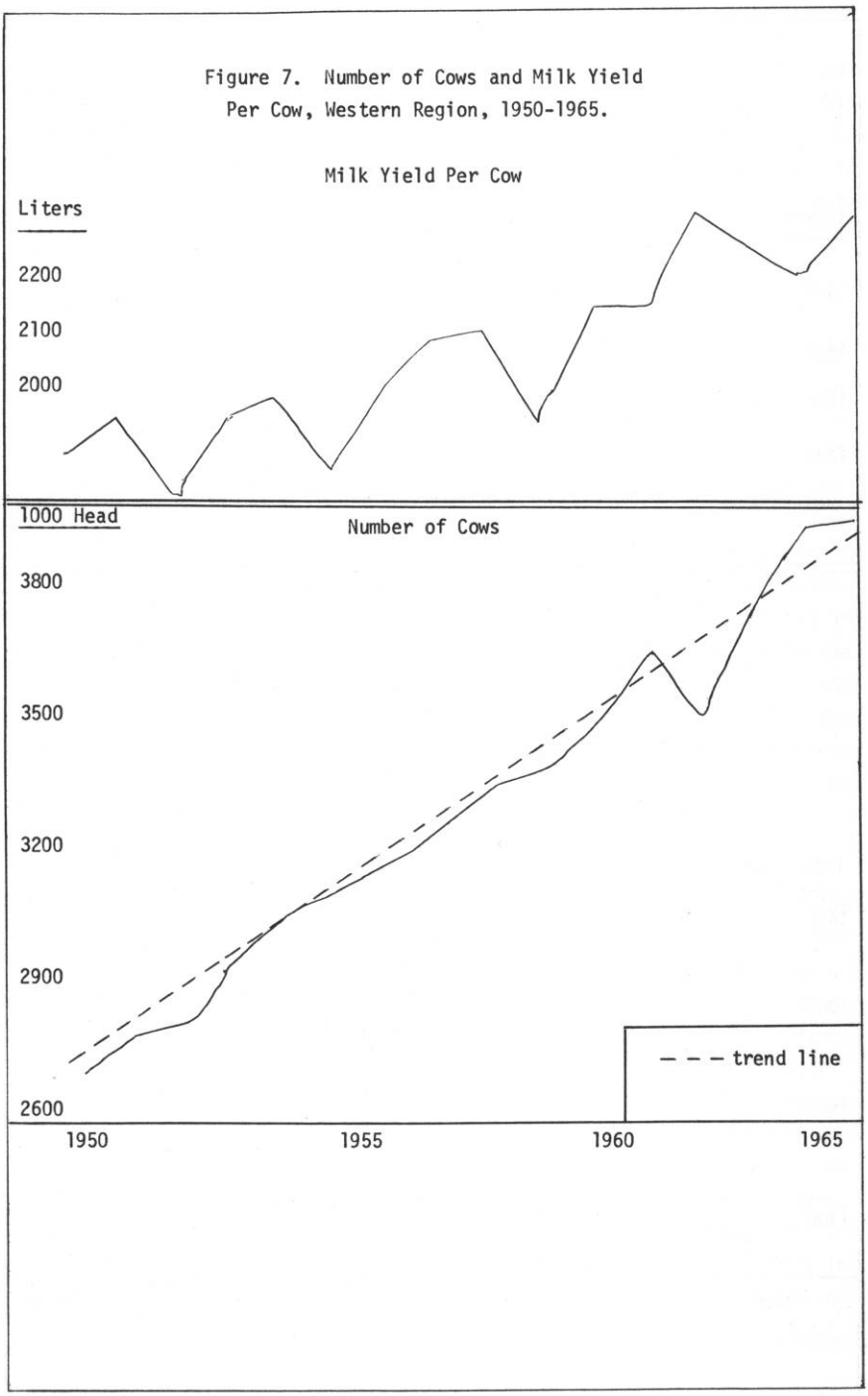
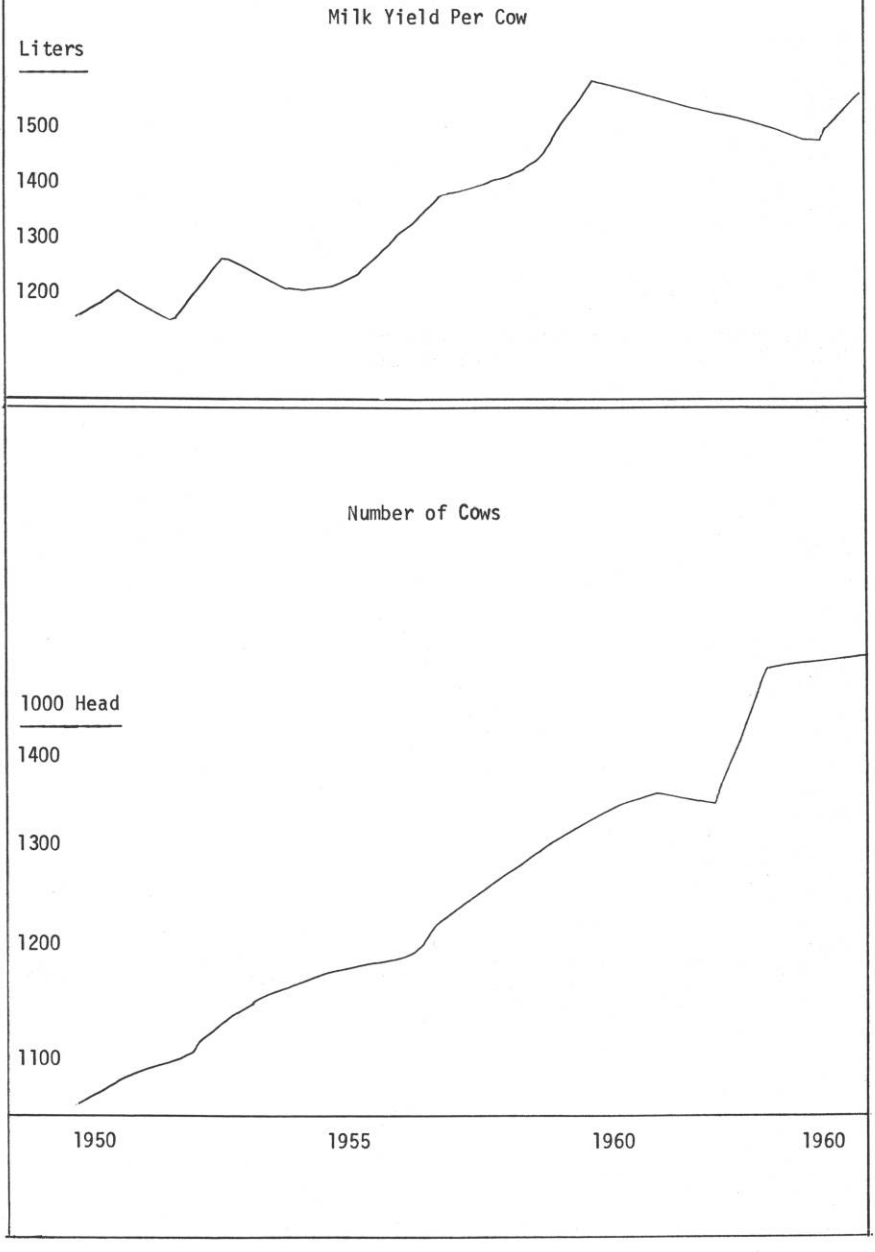


Figure 8. Number of Cows and Milk Yield Per Cow, Southwestern Region, 1950-1965.



well as estimated.

Budgeting results in Choletais and work by Hovelaque in Rennes show that cattle production will probably continue to develop fairly rapidly in this region where farms are small.[10] Feed requirements will be satisfied by increases in forage yields and thus it seems safe to assert that the growth in the cow herd will be even faster than indicated by past trends. We estimate as final projection figures 4.4 million cows in 1970 and 4.85 million in 1975.

Southwestern Region

Figure 8 gives the number of cows in the Southwestern Region for the 1950-1965 period. Apparently the growth was fairly regular until 1960 and then slowed down. The jump from 1962 to 1963 does not correspond to a year-to-year variation but to a readjustment of the time series after the 1963 survey sample. This interpretation of the data seems justified by the general knowledge of the region and our survey in Coteaux de Gascogne. Many cows were used as work animals in the early 50's. Now they have been largely replaced by tractors. In this region the valleys are very fertile, especially when they are irrigated, whereas the hills are poor and very backward in agricultural development. The development of irrigation in the valley has mainly favored fruits and vegetables. Thus, it is not surprising that the growth of the cow herd has slowed down; and it should be expected that the number of cows in 1970 and 1975 will be lower than the extrapolated linear trend. We estimate 1.6 million head for 1970 and 1.75 million for 1975 as final projection figures.

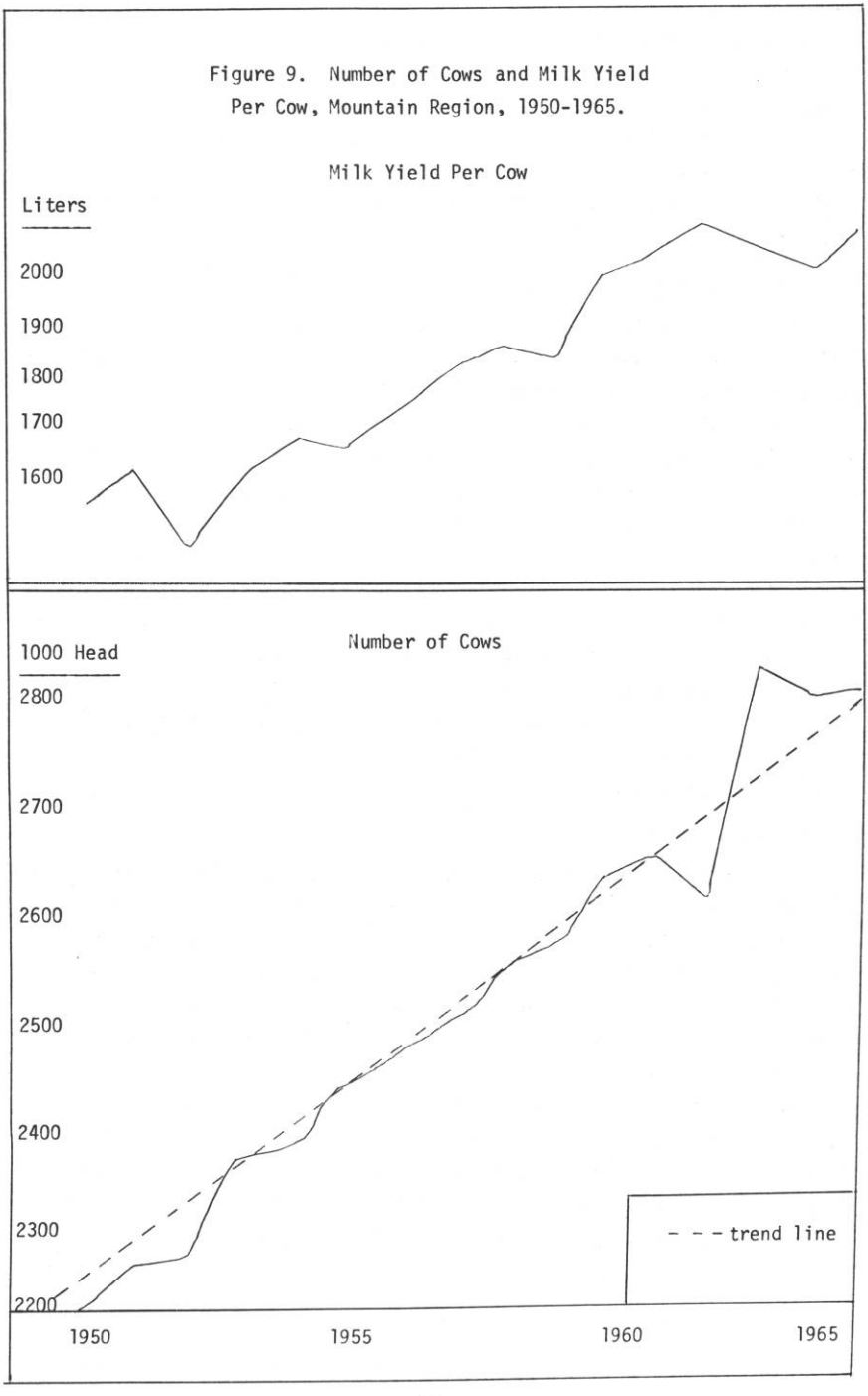
Mountain Region

Figure 9 gives cow numbers in the Mountain Region each year for the 1950-1965 period. As in the Southwestern Region, the jump from 1962 to 1963 corresponds to a readjustment of the time series and must not be taken as year-to-year variation. A general upward trend seems to have been followed. We feel that it will continue because the decrease in the number of farms which will take place should not lead to a relative decrease in the importance of cattle enterprises here. The Central Mountain area is almost the only place in France where an extensive use of grassland for beef cattle breeding could develop. A study made in Aubrac indicates that farms of 70 to 100 hectares could profitably be organized as specialized feeder stock breeders. Of course, important institutional obstacles will have to be overcome to create such "large farms"; but it seems as if the economic pressure will work in that direction.[11] Therefore, the number of cows given by the extrapolation

[10] R. Hovelaque, *Modeles de structures d'exploitations agricoles*, Rennes, INRA, April 1966.

[11] J.P. Cousse, *et. al.*, *Etude d'un Example de Production Bovine Extensive*, Paris, INRA and SEDIAC, 1966.

Figure 9. Number of Cows and Milk Yield Per Cow, Mountain Region, 1950-1965.



of past linear trends are used as final projection figures.

Southeastern Region

Given the limited importance of this region for cattle production--linear trend projection rounded to 150,000 head for both 1970 and 1975 are used as final projections.

The totals for France are given in Table 39. The final projections do not differ much from the linear trend. This partly results from the uncertainty surrounding the data. Changes in past trends can hardly be identified. Thus, there is no basis from analysis of the past to assume that trends will change in the future. But it also reflects our best expectations. As explained above, there are good reasons to believe that the number of cows will continue to increase in the various regions; accordingly, we project a fairly rapid growth.

Projection of Beef and Veal Production

Given the uncertainty surrounding meat production estimates, projections were based on a simple model inspired from Broussolle's work.[12] EEC projections rely on a similar approach, which has workability as its main advantage and which points out the key variables influencing meat production.

Theoretical Model

Given the number of cows in year t, C_t, the number of calves born V_{b_t} depends only on the fertility rate F.

$$V_{b_t} = F \times C_t$$

The number of calves slaughtered V_{s_t} during year t is some proportion K of the number of calves born.[13] $V_{s_t} = K \times V_{b_t}$

The production of veal is equal to the number of calves slaughtered multiplied by their average carcass weight, W_{v_t}.

$$V_t = V_{s_t} \times W_{v_t}$$

To project veal production, given the projected number of cows, it is then necessary to project the fertility rate F, the porportion of calves slaughtered K, and the average weight of calves W_v. As will be seen below, some information is available on these parameters and attempts will be made

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[12] C. Broussolle, Modele Econometrique de la Production Bovine in *L'augmentation de la Production de Viande Bovine dans les Pays de la CEE*, Brussels, 1951, Etudes, serie agriculture, No. 5.

[13] Neglecting for the moment, the calf feeding delay which generally varies from 2 to 4 months.

to project them.

For beef production, the problem is somewhat more complicated. Beef is made of culled cows and fattened steers and heifers. The number of culled cows depends on the culling rate which seems to vary with the beef cycle. But the essential purpose of making projections to 1970 and 1975 is to indicate the most likely future trends. The years 1970 and 1975 are not interesting in themselves and attempts to predict the phase of the beef cycle would be misleading. Thus, the cycle must be assumed away.

If the cattle population were stationary, the number of cattle slaughtered for beef would be equal to the number of calves raised, the difficulties of projecting this number would be the same as for calves slaughtered. But when the growth in the cow herd is taken into account, the problem becomes more difficult.

Let T be the number of years a cow is kept on farms. The number of culled cows in year t is equal to the number of heifers kept to become cows in year t - T. The number of steers and heifers slaughtered in year t is equal to the number of calves raised 2 or 3 years earlier[14] minus the number of heifer calves from the same generation which are kept to replace culled cows in year t and t + 1 (assuming that cows calve for the first time when they are 3 years old, which has been confirmed by the 1963 and 1964 survey sample results). Projecting beef production in year t requires then the knowledge of T, of the number of heifers raised in year t - T and the number of steers and heifers kept for beef in year t - 2 and t - 3. As fairly good data on livestock numbers are available for 1963 and 1964, the various figures required to make projections will be estimated on the basis of the 1963 and 1964 data and on the basis of the assumed rate of growth of the cow herd.

Parameter Estimations

The number of calves born and the proportion of calves slaughtered play a crucial role in meat production. Attempts were made to estimate these figures. As explained above, the number of calves slaughtered under sanitary control is published by the Ministry of Agriculture; similarly veal production under control and a total veal production estimate are published every year. In spite of available indications that such figures overestimate total veal production, all official documents use them. In a first step, they are also used here. Dividing the total veal production by the average carcass weight of calves slaughtered under control provides an estimate of the total number of calves slaughtered during one year. Calves raised must be added to calves slaughtered in order to obtain calves born. The number of calves

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[14] This assumes that steers and heifers are slaughtered at around 30 months of age on the average, which seems likely.

raised during one year is equal to the number of cattle under one year old at the date of inventory minus those among that number which will be slaughtered for veal. The inventory date being October 1, this last number is equal to the number of calves slaughtered between Ocotber 1 and December 31 if vealers are killed when they are 3 months old. Data on controlled slaughter being available on a monthly basis, the number of calves raised was computed under the above assumptions for each year of the 1953-1964 period. The figures are given in Tables 40 and 41. The last two columns of Table 41 provide estimates of the fertility rate F and the proportion of calves slaughtered K.

Before accepting these figures based on very weak data and assumptions, checking appears highly desirable. The 1963 and 1964 survey sample results permit some checking since they were not used in deriving these estimates, which were based only on time series data.

Comparisons of Table 41 with results of the survey samples indicate that the number of calves raised has probably been underestimated because the number of cattle under one year old on farms is underestimated and the proportion of vealers among that number is overestimated. On January 1, 1963 there were 4.496 million cattle under 1 year old on farms according to survey sample results, whereas the time series estimate on October 1, 1962 was 4.183 million. Of course, there are seasonal variations in that number but they are probably not large enough to explain such a difference. On October 1, 1964 there were 3.949 million head of cattle born in 1964 (i.e., less than 9 months old) on farms according to the survey sample. The time series figure 4.564 million for cattle under 1 year old at the same date then appears too small.

According to computations based on assumptions described above, the number of calves on farms October 1, which are slaughtered as vealers between October 1 and December 31, was 1.497 million in 1962 and 1.319 million in 1964. These figures appear much too high when they are compared with the number of vealers on farms January 1, 1963 and October 1, 1964 (864 and 851 thousand respectively). Finally the number of calves born computed as indicated above and given in Table 41 also appears underestimated. According to survey sample results, there were 9.6 million calves born in 1962, whereas the computed figure is 8.9 million. The 1964 survey sample gives only the number of calves born from cows which were on farms on October 1, 1964 (8.67 million). This number which does not include calves born from cows slaughtered or lost before October 1 should be compared with the computed figure for the total number of calves born between October 1, 1963 and October 1, 1964 (8.8 million). Here again it appears that calf births were underestimated.

As a result, the estimation of parameters K and F cannot be taken as such. K has been overestimated because calves born were underestimated. If,

Table 40. Veal Production, Controlled Slaughter, and Total Production

Year	Controlled Slaughter							Total Production (Thousand Tons)	Total Production (Thousand Head)	Total Production /Controlled Slaughter	Total No. of Calves Slaughtered Between Oct. 1/ Dec. 31
	By Month (Thousand Head)			Sum of 3 Months	Year (Thousand Head)	Year (Thousand Tons)	Average Carcass Weight				
1953	366	342	390	1098	4294	241.7	56.3	316.3	5618	1.31	1438
1954	363	377	386	1126	4793	271.9	56.7	356.9	6294	1.31	1475
1955	375	380	369	1124	4836	280.8	58.1	366.9	6315	1.31	1472
1956	383	340	338	1061	4640	276.2	59.5	357.5	6008	1.30	1379
1957	335	295	320	950	4187	260.2	62.1	339.8	5472	1.31	1244
1958	329	294	342	965	3933	251.5	63.9	328.0	5133	1.31	1264
1959	353	337	370	1060	4208	266.6	63.4	348.0	5489	1.30	1378
1960	354	362	348	1064	4473	287.1	64.2	383.0	5966	1.33	1415
1961	377	343	337	1057	4573	302.0	66.0	400.2	6064	1.33	1406
1962	412	368	363	1143	4764	316.5	66.4	413.4	6226	1.31	1497
1963	377	313	326	1016	4694	323.6	68.9	421.7	6120	1.30	1320
1964	344	317	346	1007	4253	306.4	72.0	401.7	5579	1.31	1319
1965	319	323	316	958	4174	309.1	74.0	-----	----	----	----

Table 41. Estimation of the Fertility Rate and the Proportion of Calves Slaughtered as Vealers

Year	Total No. of Cows (Thousand Head)	Cattle Less Than 1 Yr. Old on Farm Oct. 1 (Thousand Head)	Total No. of Calves Slaughtered Between Oct. 1 & Dec. 31 (Thousand Head)	Calves Raised (Thousand Head)	Calves Slaughtered (Thousand Head)	Calves Born (Thousand Head)	Fertility Rate (F)	Proportion of Calves Slaughtered (K) %
1953	8946.2	2903.0	1438	1465.0	5618	7083.0	0.83	79.3
1954	9203.5	2932.5	1475	1457.5	6294	7751.5	0.86	81.2
1955	9375.6	2987.3	1472	1515.3	6315	7830.3	0.85	80.6
1956	9497.2	3001.9	1379	1622.9	6008	7630.9	0.81	78.7
1957	9674.6	3118.8	1244	1874.8	5472	7346.8	0.77	74.4
1958	9857.7	3336.2	1264	2072.2	5133	7205.2	0.74	71.2
1959	9928.8	3442.9	1378	2064.9	5189	7553.9	0.77	72.6
1960	10262.0	3662.0	1415	2247.0	5966	8213.0	0.82	72.7
1961	10695.0	4134.0	1406	2728.0	6064	8792.0	0.85	69.0
1962	10453.8	4182.8	1497	2685.8	6226	8911.8	0.83	69.7
1963	11321.0	4287.1	1320	2967.1	6120	9087.1	0.87	67.5
1964	11472.0	4563.6	1319	3224.6	5579	8803.6	0.78	67.3
1965	11535.7	4630.4	----	------	----	------	----	----

besides, it is agreed that calf slaughter is overestimated, K appears even more overestimated. Similarly, F has been underestimated. But the estimation bias is probably systematic, thus it may be acceptable to judge general trends on the basis of time series data. Examination of Table 41 shows that the proportion of calves slaughtered declined steadily from 1953 to 1964. Actually their number varied from year to year, but the general trend seems to be roughly constant. The increase in veal production resulted from a change in the average carcass weight of calves, which increased from around 56 kilograms in 1953 to 72 kilograms in 1964.

It is more surprising to see that the fertility rate F varies from year to year. Some variations reflect only uncertainties in statistical data, but others may be explained as follows: The total number of cows on farms October 1 of year t includes culled cows and heifers which have not yet calved. Some years, depending in particular on the beef cycle, the number of culled cows before October 1 may vary as well as the growth of the cow herd. Figures of Table 41 do not permit, however, an assumption that the fertility rate has increased because of technical progress. Improvements may have taken place, but they are small enough to be hidden by statistical uncertainties and accidents in livestock numbers such as those caused by hoof and mouth disease or tuberculosis.

Some revisions of past estimates of production are absolutely necessary to make projections. The 1963 survey sample results provide a check for 1962. As mentioned, the number of calves born in 1962 is 9.6 million. The time series report a decrease in the inventory of all cattle of .3 million head between October 1, 1961 and October 1, 1962. Assuming no loss, 9.9 million head of cattle (veal and beef) would have been slaughtered between these two dates if we neglect the difference in calf births between the two periods October 1 and December 31, for the years 1961 and 1962.[15] Official Ministry of Agriculture estimates of total veal and beef production imply slaughter of 10.9 million head of cattle if average carcass weights are assumed to be correctly estimated. These figures strongly support the argument presented above that beef production is overestimated. There were 8.4 million head reported slaughtered "under control," thus the error would be 1.5 million head (i.e., 18 percent of controlled slaughters and not 30 percent as assumed by the Ministry of Agriculture). Now a difficult question arises: How to estimate the distribution of the error between beef cattle and calves? Since there are no strong reasons to assume that the error is more important on one type than on the other, we will assume that it is the same. As a result, official production data must be reduced by about 10 percent to be consistent

[15]The approximation error is less than 100,000 and thus can be neglected here.

with the previous argument.[16]

Projections

To project veal production, we assume that the number of calves slaughtered will remain fairly constant, around 5.1 million head (5.7 minus around 10 percent), while the average carcass weight will continue to increase. Assuming that this weight will follow the past linear trend estimated by least squares, it will reach 78.6 kilograms in 1970 and 85.2 kilograms in 1975. Veal production would then be 400,000 metric tons in 1970 and 435,000 tons in 1975.[17]

Actually these assumptions are quite questionable, because farmers as a whole can easily modify the proportion, K, of calves slaughtered. The number of calves raised will vary with the relative price of beef and veal and with the profitability of feeding calves. Developments in the Southwestern and Central Mountain Regions will play a crucial role in determining veal and beef production in France. In these regions many small farms produce veal as shown by surveys in Haute Garonne and Combrailles. A large increase in the supply of beef in future years could occur if a significant number of farms shift from veal to feeder stock production. Such a development is very unlikely in the next few years, but may take place in the 1970's if a sufficient number of farms become fairly large (e.g. 70 hectares and above). Another assumption used to project veal production can be questioned. It has been assumed that the average carcass weight of calves will continue to increase. We believe that such is the most likely possibility, but it may very well be that substitution of "industrial" calf production for traditional methods will put a downward pressure on the average carcass weight of calves, unless a major increase in veal prices takes place. In summary, the figures given above can be considered as the most likely ones on the basis of economic forces on the supply side; but it is particularly clear that the relative importance of veal and beef will depend on demand conditions.

Beef production comes from culled cows and fattened steers and heifers. The number of culled cows in 1970 will be roughly equal to the number of heifers joining the cow herd in 1965. Survey sample results gave a figure of 1.6 million culled cows in 1962. Given the growth of the herd, there must have been around 1.715 million cows culled in 1965. To insure the continued growth of the herd, 1.95 million heifers must be kept in 1965; they will be culled in 1970. The fattened steers and heifers slaughtered in 1970 will

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[16] As mentioned earlier, the overestimation of total production may be less than 10 percent because average carcass weight may be underestimated in controlled slaughter houses.

[17] When comparing these figures with present production data, it must be remembered that the latter are overestimated by around 10 percent.

have been born in 1968. The number of calves born between October 1, 1967 and October 1, 1968 is projected equal to the projected number of cows on October 1, 1968 (i.e., 12.15 million) multiplied by the fertility rate F (taken here as .90 because of the underestimation of calf births in Table 41). The number of calves born will then be 10.935 million. We assumed that 5.1 million would be slaughtered as calves -- Given the death loss, Lenco has shown that between 20 and 25 percent of calves must be kept to become cows in order to insure a 2 percent growth of the cow herd.[18] Since the regional projections of cow numbers amount to roughly a 2% national growth rate for the cow herd, it can be assumed that 2.5 million calves of the 1968 generation will be kept as breeding stock. As a result, it is projected that 3.3 million steers and heifers will be slaughtered in 1970. The total number of beef cattle slaughtered in 1970 would then be around 5.3 million head. As can be seen in Table 42, the average carcass weight of beef cattle slaughtered varies with the beef cycle; but it follows a general upward trend. Projection of the linear trend seems warranted by the increase in the carcass weight of dairy cows and in the proportion of fattened steers and heifers (even though they may become lighter on the average) in the total beef cattle slaughters. The projected average carcass weight is then 290 kilograms for 1970 and 296 for 1975. Accordingly, beef production would be 1.54 million tons in 1970. A similar computation provides the projected production figure for 1975. The cows culled in 1975 will have been incorporated in the herd in 1970. We computed that 2.5 million heifers would become cows in 1970; assuming a 400,000 death loss on that generation, 2.1 million will be slaughtered in 1975. The number of calves born in 1973 is projected equal to the number of cows on October 1, 1973 (i.e., 13.25 million) multiplied by the fertility rate (.9) this would give 11.925 million calves, and 2.98 million must be kept as breeding stock to insure the continued growth of the cow herd, 5.1 million will be slaughtered as vealers. There remain 3.644 steers and heifers slaughtered in 1975, which added to the 2.1 million culled cows make up 5.74 million head of beef cattle slaughtered in 1975. The average carcass weight having been projected to 296 kilograms, the projected beef production in 1975 is 1.7 million tons.

Conclusion

The uncertainty surrounding statistical data has been emphasized. It is such that the figures given as projection must be taken with extreme caution and only considered as order of magnitude. The projected figures 1.54 and 1.7 million tons should be compared with a revised estimate of around 1.1 million tons for the 1963-1965 yearly average beef production. Hence the in-

[18] Ministere de l'Agriculture, "Fe condite et Evolution du Troupeau Bovin," *Statistique Agricoles*, Supplement "Series Etudes", No. 4, May 1965.

Table 42. Average Carcass Weight of Beef Cattle Slaughtered "Under Control".									
Year	1949	1950	1951	1952	1953	1954	1955	1956	1957
Average Weight	250.5	257.2	265.2	270.2	267.2	269.2	271.2	270.3	281.2
Year	1958	1959	1960	1961	1962	1963	1964	1965	
Average Weight	282.0	275.3	273.0	277.3	272.4	275.9	283.9	286.9	

crease in production is projected to be quite significant. These projections are contingent upon the realization of several key assumptions based on present information but which may prove to be mistaken. The two most crucial assumptions are first, that the number of cows will continue to increase at a fairly rapid rate and, second, that the number of calves slaughtered as vealers will not exceed 5.1 million head. There are good reasons to believe that the increase in total cow numbers is the most likely possibility; but, as explained above, the proportion of calves between beef and veal production will mainly depend on the relative profitability of each product.

Projection of Milk Production

After unsuccessful attempts to use the available data on numbers of dairy cows and of other cows as the basis for projection, we decided to resort to a rougher method. The average milk yield of all cows was estimated by region and projected to 1970 and 1975. Multiplication of this average yield by the total number of cows provided the projected regional productions of milk. As already mentioned, *departemental* data are tabulated in Paris; and the total is corrected upwards to give total French production. In the absence of better information, the same correction factor was used to derive regional estimates of production. These are given in Table 43. Table 44 gives by region and by year, total milk production, total number of cows, and average milk yield per cow. The year-to-year variations in milk yields are represented for the various regions in Figures 5 to 9. For region I (Northern), Figure 5 indicates that the average milk yield varies from year to year; in particular, the impact of droughts in 1959 and 1964 is very visible. The linear trend computed by least squares and extrapolated to 1970 and 1975 gives projected yields of 2840 liters and 2945 liters respectively. It may appear surprising that yields are not higher and do not increase faster than they do in this region where agriculture is technically advanced. Actually the limited data available on the subject indicate that beef cows, although representing only 7 or 8 percent of the total, are increasing faster than dairy cows. The figures extrapolated from the linear trend will be used as projected yields. (See Table 45)

Table 43. Milk Production by Region, Departmental Estimates and Revisions, 1950-65. (1000 hectaliters)

Year	Departmental Estimates						
	Region I	Region II	Region III	Region IV	Region V	Region VI	Total
1950	32,911.4	12,684.0	43,800.5	10,773.1	31,084.8	2,021.7	133,273.6
1951	36,436.5	14,030.7	49,204.3	12,219.2	34,851.7	2,201.7	148,944.1
1952	34,627.8	14,230.6	46,967.3	11,983.4	32,124.2	2,132.0	142,065.3
1953	39,546.9	15,617.6	53,004.1	13,757.7	36,235.5	2,187.2	160,349.0
1954	44,669.8	16,737.6	58,214.7	14,570.7	39,365.5	2,317.1	175,875.1
1955	45,457.5	17,037.3	55,719.7	14,345.7	40,216.2	2,320.3	175,096.7
1956	44,972.0	17,729.0	59,157.5	14,575.9	40,960.3	2,271.8	179,666.5
1957	45,662.9	18,475.7	63,760.3	16,166.0	43,143.9	2,360.2	189,569.0
1958	46,381.0	17,686.6	66,496.7	17,210.1	45,359.5	2,403.2	195,537.1
1959	43,011.9	18,063.0	61,875.3	18,430.5	45,348.4	2,462.2	189,191,3
1960	48,848.0	20,195.0	70,992.0	20,696.0	50,516.0	2,532.0	213,779.0
1961	50,865.0	22,454.0	76,364.0	21,142.0	52,942.0	2,515.0	226,282.0
1962	52,179.0	20,516.0	76,526.0	19,720.0	51,783.0	2,423.0	223,147.0
1963	52,491.5	21,048.8	78,425.0	21,123.3	53,899.4	2,426.6	229,414.6
1964	51,560.9	20,215.7	79,046.7	20,277.3	51,484.8	2,278.5	224,863.9
1965	53,414.7	21,097.6	84,432.1	21,919.1	54,209.4	2,284.6	237,354.5

Table 43. (continued)

Year	Revised Estimates							
	Total	Region I	Region II	Region III	Region IV	Region V	Region VI	Correction Coefficient
1950	150,000	37,042	14,276	49,299	12,125	34,983	2,275	1.1255
1951	160,000	39,142	15,072	52,857	13,126	37,438	2,365	1.0742
1952	150,000	36,562	15,025	49,591	12,653	33,918	2,251	1.0558
1953	170,000	41,927	16,558	56,194	14,586	38,416	2,319	1.0602
1954	180,000	45,718	17,130	59,580	14,192	40,289	2,371	1.0234
1955	178,000	46,211	17,320	56,644	14,583	40,883	2,359	1.0166
1956	190,000	47,560	18,748	62,560	15,414	43,316	2,402	1.0572
1957	200,000	48,176	18,492	67,269	17,055	45,518	2,490	1.0550
1958	205,000	48,627	18,542	69,715	18,043	47,554	2,519	1.0484
1959	197,000	44,787	18,809	64,429	19,191	47,220	2,564	1.0413
1960	223,000	50,956	21,066	74,054	21,588	52,695	2,641	1.0431
1961	231,000	51,927	22,878	77,957	21,456	54,047	2,535	1.0208
1962	236,000	55,185	21,698	80,933	20,856	54,756	2,563	1.0576
1963	246,000	56,287	22,570	84,095	22,650	57,796	2,602	1.0723
1964	245,000	56,178	22,026	86,125	22,093	56,095	2,483	1.0895
1965	256,000	57,610	22,755	91,064	23,640	58,467	2,464	1.0786

Table 44. Number of Cows, Milk Production, and Average Milk Yield, By Region.

Year	Region I			Region II			Region III		
	No. Cows 1000 Head	Production 1000 hl	Yield in Liters	No. Cows 1000 Head	Production 1000 hl	Yield in Liters	No. Cows 1000 Head	Production 1000 hl	Yield in Liters
1950	1,525.8	37,042	2,427	580.0	14,276	2,461	2,624.3	49,299	1,878
1951	1,574.3	39,142	2,503	623.0	15,072	2,419	2,719.4	52,857	1,944
1952	1,607.2	36,562	2,275	646.4	15,025	2,324	2,762.2	49,591	1,795
1953	1,708.8	41,927	2,453	670.7	16,558	2,469	2,901.2	56,194	1,937
1954	1,777.1	45,718	2,573	701.5	17,130	2,442	3,004.2	59,580	1,983
1955	1,812.8	46,211	2,550	711.6	17,320	2,434	3,064.2	56,644	1,848
1956	1,812.0	47,560	2,625	721.9	18,748	2,597	3,135.1	62,560	1,995
1957	1,821.5	48,176	2,645	740.7	19,492	2,631	3,217.7	67,269	2,090
1958	1,851.2	48,627	2,627	700.4	18,542	2,647	3,310.6	69,715	2,106
1959	1,821.8	44,787	2,458	712.2	18,809	2,641	3,350.4	64,429	1,923
1960	1,887.0	50,956	2,700	758.0	21,066	2,779	3,458.0	74,054	2,141
1961	2,023.0	51,927	2,567	830.0	22,878	2,756	3,634.0	77,957	2,145
1962	2,271.0	55,185	2,665	770.2	21,698	2,817	3,474.1	80,933	2,329
1963	2,244.7	56,287	2,507	837.2	22,570	2,696	3,735.0	84,095	2,251
1964	2,199.8	56,178	2,554	869.2	22,026	2,542	3,923.7	86,125	2,195
1965	2,205.9	57,610	2,612	889.5	22,755	2,558	3,940.5	91,064	2,311

Table 44. (continued)

Year	Region IV			Region V			Region VI		
	No. Cows 1000 Head	Production 1000 hl	Yield in Liters	No. Cows 1000 Head	Production 1000 hl	Yield in Liters	No. Cows 1000 Head	Production 1000 hl	Yield in Liters
1950	1,061.7	12,125	1,142	2,230.5	34,983	1,568	141.9	2,275	1,603
1951	1,091.7	13,126	1,202	2,277.5	37,438	1,644	144.8	2,365	1,633
1952	1,110.1	12,653	1,140	2,285.4	33,918	1,484	141.6	2,251	1,590
1953	1,155.9	14,586	1,262	2,377.9	38,416	1,615	131.8	2,319	1,759
1954	1,186.2	14,192	1,196	2,399.6	40,289	1,679	134.9	2,371	1,758
1955	1,203.3	14,583	1,212	2,450.2	40,883	1,669	133.5	2,359	1,767
1956	1,212.1	15,414	1,272	2,481.7	43,316	1,745	134.4	2,402	1,787
1957	1,247.1	17,055	1,367	2,512.7	45,518	1,812	134.9	2,490	1,846
1958	1,290.9	18,043	1,398	2,565.1	47,554	1,854	139.4	2,519	1,807
1959	1,320.7	19,191	1,453	2,581.0	47,220	1,830	142.7	2,564	1,797
1960	1,355.0	21,588	1,593	2,654.0	52,695	1,985	150.0	2,641	1,761
1961	1,375.0	21,456	1,560	2,678.0	54,047	2,018	155.0	2,535	1,635
1962	1,363.0	20,856	1,530	2,633.5	54,756	2,079	142.0	2,563	1,805
1963	1,495.8	22,650	1,514	2,856.2	57,796	2,024	152.0	2,602	1,712
1964	1,503.7	22,093	1,469	2,827.9	56,095	1,984	147.7	2,483	1,681
1965	1,515.1	23,640	1,560	2,835.5	58,467	2,062	149.2	2,464	1,645

yields and the increase in the average yields can be explained by the great importance of work cows in the past and their rapid decline in that region in recent years. Nondairy cows still make up half of the total number of cows. Productive dairy breeds, particularly Frisian, have made important inroads and it is likely that they will continue to do so. Programming results in Coteaux de Gascogne show that dairy production is very profitable as compared to other products. It is presently limited by the low development of dairy plants collecting channels and by the delay implied by any change from a local breed formerly used for a triple purpose (milk, beef, and draft) to a more productive dairy breed. Thus, it seems realistic to project a continuous growth in average milk yields in spite of the uncertainties surrounding the choice between beef and dairy breeds. In the absence of better information, we use as projected yields the extrapolation of the past upward linear trend. (See Table 45)

As indicated by Figure 9, the average milk yield increased rapidly in the Mountain Region from 1950 to 1962. The influence of droughts in 1955, 1959 and 1964 is visible but not very important. Milk yields are not very high (2062 liters in 1965) because nondairy cows still make up a significant share of total cows (over 40 percent). Here as in the Southwestern Region, the crucial question is whether local beef breeds will be replaced by dairy breeds or crossed with beef breeds such as Charolais and Limousine to produce feeder stock. Given the importance of small farms, the first alternative seems to be more likely as programming results in Combrailles have shown. Accordingly, we project an increase in average milk yields along the extrapolated past linear trend. (See Table 45) Cow numbers and average milk yields projected as indicated above are summarized in Table 45. The resulting milk production projections are also given in Table 45. The total milk production for France is thus projected to be 300 million hectaliters in 1970 and 346 million hectaliters in 1975. These figures can be compared with the production figures for the period 1950-1965 given in Table 43. It appears that the projected rate of growth is similar to what has occurred in the past (a little less than a 40 percent increase in 10 years), but the projection is higher than the extrapolation of the linear trend.

Chapter 6

Poultry and Egg Production
Total Derived Demand for Feed Grain

Poultry and egg production in France can be characterized by the existence of two types of production units. First, the traditional farms which have a small flock of hens, ducks, geese, etc. These provide only a small share of the total gross receipts of the farm. In the second type, the farms use modern production techniques, adequate buildings, feeding techniques, and high genetic quality birds. For these farms, the gross receipts from poultry production make up generally a large share of the total gross receipts.

Available data on these two types of poultry production are very poor, and they don't permit to assert the respective importance of each type in total production. Available information shows that traditional production is declining, whereas modern production is increasing. Most of the latter is integrated by feed industries, and also farmers' cooperatives. The integration has been very widespread in Brittany, where it started, and this development can be compared to that of vertical integration in areas of the southeastern United States where farms are small, farmers are generally poor and labor is in excess.

As can be seen in Table 46, the data on production of poultry and eggs are fairly uncertain; thus the analysis of past trends from time series data is delicate. However, it appears that egg production has increased while the number of hens has remained fairly stable. Hence, the average egg production per hen grew progressively to reach 126 in 1964, which is still a small figure. Poultry meat production has increased rapidly from 300,000 tons in 1955 to 394,000 tons in 1960, and to 550,000 tons in 1964.

In order to project to 1970 and 1975, the following assumptions were made: French poultry producers, given their low average productivity and their fairly poor market organization, will be on the defensive in the competition with German and Dutch producers. Thus, the expected production is linked essentially to an improvement of production techniques. The traditional sector of production will decline, and the modern one increase. For eggs, we assume that the number of hens will remain stable, but that the number of eggs per hen will increase quickly to reach 150 in 1970 and 175 in 1975. For poultry meat, we assume that the yearly rate of increase will remain about the same from 1959 to 1970 (i.e., 30,000 tons per year), and will slow down between 1970 and 1975 to 25,000 tons per year because the Common Market will be realized beginning July 1968 and its impact will be quickly felt.

These assumptions and the results which they lead to are summarized in Table 47. When compared with the projected consumption figures derived by

Table 46. Poultry Numbers, Eggs and Poultry Meat Production, France, 1955-1964.

Year	Chickens (1000 head)	Hens (1000 head)	Eggs per hen	Egg production (million units)	Poultry production (1000 metric tons)
1955	90,000	75,000	91	6,800	300
1956	97,000	75,000	93	7,000	320
1957	99,000	72,000	106	7,600	330
1958	102,000	73,000	109	7,950	350
1959	103,000	76,000	112	8,500	370
1960	103,000	73,300	116	8,500	394
1961	105,000	74,600	120	8,950	420
1962	105,000	74,600	124	9,230	460
1963	105,000	74,600	125	9,356	500
1964	108,000	75,000	126	9,478	550

Source: OSCE, *Statistiques Agricoles*.

Table 47. Poultry and Egg Projections, 1970 and 1975

Year	Eggs per hen	Total eggs (million units)	Total poultry (1000 metric tons)
1964	126	9,478	550
1970	150	11,250	730
1975	175	13,125	855

Sorenson and Hathaway[1], one sees that the balance leads to a slight deficit for poultry meats in 1970 and 1975. This result is likely because considerable French export is very unlikely and some imports are possible but only in small quantities.

Derived Demand for Feed Grains

Demand for feed grain in France is not well known. Very little statistical data is available on the subject. Aggregate statistics are published for each grain giving the various uses: food, seeds, industrial uses, and animal feed. These data are published yearly by the Ministry of Agriculture. But there is no data on the utilization of grain by each animal species. Thus, it is only possible to know the total feed grain consumption of livestock, but not by kind. Other data must then be used. As seen in Chapter 4 on pork projection, the recent survey by the Ministry of Agriculture on hog production provides some information on the feed consumed by hogs. These

[1] Sorenson and Hathaway, *op. cit.*

data will be extremely useful in making these projections. Other data of a microeconomic nature will also be used. Conversion ratios for hogs and poultry are fairly well known on some farms. The composition of commercial feed will also be taken into account. This brief summary of the available statistical data on the use of feed grains justifies the methodology used to project feed grain disappearance in France in 1970 and 1975.

Methodology

In the absence of data on feed grains used by each kind of livestock, it appears that the only feasible approach is to estimate the consumption of feed grains by the various kinds of livestock on the basis of microeconomic data, and then to insure that they are consistent with the total disappearance figures published for the last few years. Hence, the first step of the analysis will be to reconstitute the feed grain balance for 1964. The next step will be to project the consumption of feed grains by the various kinds of livestock to 1970 and 1975 on the basis of our knowledge of present relationships and on the best judgment of what the future will be concerning feeding techniques. For each species, the consumption of feed grains by livestock unit will be projected and then multiplication by the number of the particular kind of livestock will provide an estimate of the total consumption of feed grains by each kind of livestock. The principal animal species using feed grains are hogs, poultry, cattle, horses and sheep. Goats will not be taken into account because of their very small importance.

Hogs -- Estimate of 1964 feed grain consumption

The hog survey already mentioned, gives data on feed consumption between April 1, 1965 and March 31, 1966. These data are not completely satisfactory; first, because the feed considered did not include all feed (rye, for instance, was excluded from this survey) and, second, because the use of many kinds of feed was underestimated. Thus, the global conversion ratio expressed in feed units has been underestimated.

We made some corrections on the basis of information collected at the microeconomic level from linear programming analysis. During these studies, local experts, mainly extension workers, gave advice concerning the actual feed grain rations of hogs. These led to a global conversion ratio higher than what the previously mentioned survey indicated.

We have made a further assumption, (i.e., the estimation errors on quantities of feed consumed by hogs were more important on such feeds as roots, potatoes, and milk by-products than on grains). Besides, we have assumed that the commercial feed consumption, generally well known by farmers since it must be bought, was estimated without error. Grains are often fed on farms, so the quantities used are not so well known as that of commercial feed; but they are probably better known than roots and potatoes because far-

mers have a pretty good idea of the weight of a given volume of grain.

After corrections, it was estimated that the total consumption of feed units by hogs was 7.6 billion as compared to 6 billion estimated by the survey. The global feed conversion appeared then as 6.3 feed units[2] per kilogram of carcass weight of pork compared to 4.8 in the survey. The correction was thus rather large, and it is felt that it is justified because the 4.8 conversion ratio was not at all in accord with microeconomic data.

Given the above assumptions on the distribution of the errors, the various feeds accounted for the following percentage in the total number of feed units consumed: commercial feed, 18.1%; grain, 48.8%; other feed, 25.2%; high protein feed, 7.9%. This corresponds to a total consumption of feed grains by hogs in 1964 of 4.86 million metric tons, including the feed grains incorporated in commercial feeds.

Projections to 1970 and 1975

Given the conversion ratios and the distribution of the various feeds in 1964, it is possible to make assumptions on what the consumption of feed grains by hogs will be in 1970 and 1975. For that, it is necessary to know how the feeding techniques will change. Two sets of assumptions have been used. First, with slow technical progress and little vertical integration, the conversion ratio will decrease only slightly. This corresponds to a small development in the use of commercial feed and to a small decline in the use of milk by-products and of roughage feed, such as potatoes and roots.

Second, technical progress will develop quickly. The global conversion ratios will decrease rather quickly because of the development of commercial feed and the fast decline of feed such as roots and potatoes. It has been assumed that the latter feeds will not be used in 1975 anymore, but dairy by-products will be.

These two sets of assumptions are summarized in Table 48, where three main types of rations are distinguished: 1) The commercial feed, containing 80% of grain is that which provides the best conversion ratio. 2) Rations based on grain (80%), mixed on the farm with commercial complementary feed rich in protein, for which the conversion ratio generally is higher than for pure commercial feed,3) Rations made of other feed, milk by-products, potatoes and roots (50%) and of complementary feed rich in high protein.

Somewhat surprisingly, computations indicate that approximately the same feed grain consumption will result from either set of hypotheses for 1970 and 1975: 5.7 million tons and 6.2 million tons respectively. These results can be fairly well explained. Two counteracting forces cause this. When technical progress is fast, grain is substituted for other feed in the form of commercial feed; but the conversion ratio decreases. On the other hand, when

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[2] One feed unit is the energy equivalent of one kilogram of barley.

Table 48. Hog Feeding Rations, 1964 Estimate, 1970 and 1975 Projections

1) Share of the type of feeding ration as percent of total feed units (slow modernization)

	1964	1970	1975
Commercial rations	18.6	22.0	25.0
Grain rations	32.6	36.0	40.0
Other rations	48.8	42.0	35.0

2) Conversion ratios (Feed unit/kg.[1] of live weight)

	1964	1970	1975
Commercial feed	3.60	3.50	3.40
Grain rations	4.25	4.00	3.80
Other rations	5.05	5.00	5.00
Aggregate conversion ratios	4.44	4.21	4.02

3) Share of the type of feeding ration as percent of total feed units (fast modernization)

	1964	1970	1975
Commercial feed	18.60	34.00	50.00
Grain rations	32.60	31.00	30.00
Other rations	48.80	35.00	20.00
Aggregate conversion ratios	4.44	4.10	3.80

[1]One feed unit is the energy equivalent of 1 kg. of barley.

technical progress is slow, other feeds remain important; but the conversion ratio does not decrease so fast and thus the consumption of feed grains by the hogs is about the same. In summary, the estimates of the derived demand of feed grains by hogs are summarized as follows: 1964, 4.8 million tons; 1970, 5.7 million tons; 1975, 6.2 million tons. Apparently, there will be a slowdown in the increase of feed grain consumption by hogs after 1970. This result appears normal since it is logical to expect a decline in the conversion ratio and at the same time a smaller proportion of feed other than grain remains to be substituted.

Poultry and Eggs -- 1964 balance

The balance has been established on the basis of the statistical data concerning production, plus general information concerning conversion ratios

for eggs and broilers. Poultry production is not well known in France at the aggregate level, and the figures used here must be taken with great care because of the uncertainty surrounding them. The data are given in Table 49. Consumption of grain for egg production appears to be 1.9 million tons and grain necessary for poultry meat production 1.1 million tons, or a total of 3 million tons. This figure may be underestimated, but available information is not sufficient to propose a reasonable modification.

Table 49. Feed Grain Demand for Poultry and Eggs 1964 Estimates, 1970 and 1975 Projections.

	1964	1970	1975
Feed-grain units per kilogram egg	3.50	3.30	3.10
Feed-grain demand for eggs (1000 metric tons)	1.90	2.15	2.30
Feed-grain units per kilogram poultry	2.20	2.05	1.85
Feed-grain demand for poultry (1000 metric tons)	1.10	1.30	1.40
Total feed-grain demand (1000 metric tons)	3.00	3.45	3.70

Projection to 1970 and 1975

On the basis of the production projections and of the assumption that the conversion ratio in grains will decrease, one reaches a total consumption of grains of 3.45 million tons in 1970 and 3.7 million tons in 1975. The basis for this computation is shown in Table 49.

Horses, Sheep and Other -- 1964 Balance

Available statistical data on the number of horses on farms and the number of sheep on farms permit an estimate of the consumption of feed grains by these types of animals. However, it would have been better to know also the number of ewes. Yet, very little information is available on the use of grain by these animals. On the basis of our knowledge concerning feeding practices for these animals, we have made the assumption that horses consume .6 tons of feed grain, largely oats, and that the ewes and their brood consume around 40 kilograms of feed grains per year. These data are the best available, but should not be taken as precise estimates. However, only a small amount of feed grain is consumed by these livestock. The total consumption of feed grains resulting from this assumption is then for 1964, 1.15 million tons.

Projection to 1970 and 1975

To know the consumption of grain by horses and sheep by 1975, it is nec-

essary to make a projection of the number of these animals over the next ten years. As can be seen in Table 50, the number of sheep on farms has remained fairly stable since 1955. We have assumed that this number will continue to remain stable until 1975. There are counteracting forces. The demand for mutton is increasing, which should induce an increase in sheep production; but on the other hand, structural conditions, in particular the disappearance of labor, have inhibited expansion of this production. Thus, it appears that the number of sheep on farms will remain about stable. On the other hand, we have assumed that the consumption of feed grains per head will increase and that it will reach 50 kilograms per ewe in 1970 and 60 kilograms in 1975.

Table 50. Total Number of Sheep and Horses from 1955 to 1964.

Year	Sheep (1000 head)	Horses (1000 head)
1955	8246	2161
1956	8403	2064
1957	8573	1982
1958	8749	1903
1959	8942	1825
1960	9063	1729
1961	8886	1617
1962	8345	1526
1963	8626	1356
1964	8824	1228

Since 1955, the average weight of carcasses has increased and it is believed that this increase in carcass weight is due to the use of better feeding techniques, and in particular to the use of more concentrates in the rations. These assumptions lead to a projection of 280,000 tons of feed grains for sheep in 1970 and 340,000 tons in 1975. For horses, it can be seen in Table 50, that their number has decreased very much since 1955. They were used as draft animals, and their importance for this purpose has declined. But if one extends the trend, the number of horses would be 700,000 by 1970 and only 260,000 in 1975. It is felt that this rate of decline is unlikely to continue until 1975. Consumption of horse meat is fairly important in France. It has increased since 1955. The present production of horse meat in France, including that which resulted from the decrease in horse inventory, is not sufficient to cover the needs of domestic consumption; and France imports horses for slaughter.

Given the likely increase in the real price of red meats, it seems that the number of horses will not decrease below 500,000 by 1975. The slowdown in the rate of decrease will probably be progressive, and we assume that

there will be 750,000 head in 1970. The consumption by head is difficult to project. In Germany, available data shows that it has declined. The limited available information for France leads to the assumption that the present consumption of .6 tons will probably not decrease. The resulting total grain consumption by horses, would then be 450,000 tons in 1970 and 300,000 in 1975. The total from horses, sheep and other livestock would then appear as follows: 1964, 1.5 million tons; 1970, .85 million tons; 1975, .7 million tons.

Consumption of feed grains by cattle -- 1964 Balance

The total consumption of feed grains by cattle is not known; the only available data are of a microeconomic nature. The previous estimates for the other kinds of livestock are subtracted from the total feed consumption, estimated at 12.5 million tons in 1964. This gives an estimated consumption of feed grains by cattle of 3.6 million tons in 1964. This aggregate figure obtained in the manner just described above, is very uncertain because errors made in the previous estimates can be compounded in these last figures. Thus, it is essential to ascertain that the global figure is consistent with microeconomic knowledge on feeding practices in French cattle production.

Available information has been collected when establishing linear programming models in the same manner as it was for hog rations. These data are very sketchy, but they indicate that most of the grains consumed by cattle are consumed by dairy cows. The total number of cows in 1964 is estimated by the Ministry of Agriculture; and the average yield has also been estimated, as seen in Chapter 5 on cattle production. The quantity of grains received on the average by one cow during a year has been estimated. The computation takes into account the fact that roughly 20% of the cows are not dairy cows and that among the dairy cows, there is a dispersion of the milk yield. Account is also taken of the fact that the national data overestimates the number of cows really producing milk.

On the basis of the preceding consideration, it can then be estimated that the average quantity of grain received by a cow is 275 kilograms. Similar estimates have been made for the other kinds of livestock. The young heifers receive an estimated 50 kilograms of grain from the time of their birth to their first calving. For beef cattle, it was estimated that they receive an average of 50 kilograms between birth and the age of one year (weaning time), and 80 kilograms when they are fattened. The latter figure for fattening purposes may be overestimated given the importance of grass fattening. But this overestimate may be offset by the fact that we have assumed that culled cows do not receive any grain.

With these rations, the 1964 grain consumption by cattle is 3.6 million tons, the aggregate estimate above. Actually, it is very difficult to judge the quality of this estimate; but we will use the above figures because they

are consistent with available information at both the aggregate and the microeconomic level.

Projections to 1970 and 1975

To derive the demand for feed grains for cattle in 1970 and 1975, the projections for the number of cattle and for milk yields will be used. The changes in rations between 1964 and 1970 and between 1964 and 1975 are estimated and the set of assumptions which have been made is summarized in Table 51. It has been assumed that the proportion of dairy cows in the total number of cows would remain stable (around 80%). The increase in the average yield of dairy cows will be obtained through an increase in grain consumption. Similarly, the feeding techniques for beef production will improve,

Table 51. Feed Grain Consumption by Cattle 1964 Estimates, 1970 and 1975 Projections.

	1964		1970		1975	
	(million head)	Feed grain kilogram /head	(million head)	Feed grain kilogram /head	(million head)	Feed grain kilogram /head
Cows	11.50	275	12.6	310	13.70	330
Calves for veal	5.10	00	5.1	00	5.10	00
0-1 yr. heifers	2.40	50	2.7	125	3.20	175
1-2 yr. heifers	2.30	00	2.6	00	3.10	00
2-3 yr. heifers	2.00	00	2.5	40	3.00	70
0-1 yr. cattle for beef	2.80	50	3.5	125	4.00	175
1-2 yr. cattle for beef	2.65	00	3.4	00	3.80	00
2-3 yr. cattle for beef	2.20	80	3.3	150	3.65	200
Culled cows	1.70	00	2.0	20	2.10	40
Total feed grains (million metric tons)	3.60	--	5.2	--	6.80	--

which will imply an increased consumption of grain particularly at weaning time. The fattening of beef cattle will also require more grain. The use of 150 kilograms of feed grain per steer fattened represents the best estimate of the feeding in 1970: The corresponding figure is 200 kilograms for 1975. This, it should be noted, is less than what would happen if feedlot operations were developed in the Paris Basin Region where steers would be fattened on grains.

The future expansion of such feedlots does not seem likely, given the uncertainty surrounding the marketing of grain fed animals, the difficulty of supplying feeders to these feedlots, and the prospective changes in the beef-

grain price ratio. It has been assumed that steers will continue to be fattened, mainly in other areas; some will also be fattened in the Paris Basin Region on rations containing a large share of industrial by-products, such as sugar beet pulps. However, it is likely that on all those farms, the consumption of grains for fattening steers will increase because of the likely reduction in the age of slaughtering.

Under the previously discussed assumption, the consumption of feed grain by cattle is projected to increase from 3.6 million tons in 1964 to 5.2 million tons in 1970 and to 6.8 million tons in 1975. This represents a sizable increase in less than 12 years.

Summary

The total feed grain consumption resulting from the projections by species would then be 15.2 million tons in 1970 and 17.4 in 1975, as compared to 12.5 in 1964. These figures, therefore, show a significant increase in feed grain consumption over the next ten years.

If one looks at Table 52, where the projections are summarized, it appears that the most important increase comes from cattle consumption, whereas the consumption by hogs increases, but at a slower rate. Poultry consumption will increase slowly as a result of two counteracting factors: the increase

Table 52. Derived Demand for Grains as Feed 1964 Estimates, 1970 and 1975 Projections

	1964	1970	1975
		(1000 metric tons)	
Total Demand	12.50	15.20	17.4
- Cattle	3.60	5.20	6.8
- Hogs	4.80	5.70	6.2
- Poultry	3.00	3.45	3.7
- Others (horses, sheep)	1.15	0.85	0.7

in production and the decrease in conversion ratios. The projected increase in the demand for feed grain is much less than that which was projected by Rottier, since he projected the consumption of 21.8 million tons of feed grains by 1975. We feel that he overestimated the increase in feed grain demand by hogs and by cattle. For hogs, it seems likely that France will be less than fully competitive which means that conversion ratios will be low and total production less important than the CREDOC projections. For cattle, new available evidence at the microeconomic level indicates that the increase in concentrate feeding will not take place as rapidly as Rottier assumed.

Chapter 7

Summary and Conclusions

French production of the major grain and livestock products has been projected to 1970 and 1975. The method used to derive these projections was determined on the basis of the availability of data. In general, trends have been inferred from time series data published by the French Ministry of Agriculture. The projections result from the study of trends of appropriate variables (such as grain surfaces, grain yields, number of cows, number of sows, average carcass weights, etc.) and the incorporation of information gathered at the microeconomic level. Most of such information was gathered by the authors within their INRA research program which included surveys in five small areas and programming studies of typical farms in these areas. The essential results of this research are summarized below.

Because of the uncertainty of the aggregate data and of the impossibility of inferring aggregate relationships from studies in only five small areas, the procedure used to derive projections included a large amount of judgment on the part of the authors. As a result, the figures given here must be interpreted with caution. Some important features, however, emerge from the analysis.

Results from the microeconomic studies relative to the influences of the variables influencing agricultural supply are presented first. Then projection results are given commodity by commodity. Finally overall appraisal of these results gives an idea of their limitations.

Variables Influencing Agricultural Supply

Static production theory permits us to classify the variables influencing agricultural supply in three groups: farm structure, technical level of farmers, and prices. Obviously these variables are not independent from each other. It is, however, permitted to study their influence one by one if there are good reasons to believe that variations in one group will be largely independent of variations in another. Such is the assumption made implicitly in this study. Its most severe limitation relates to the influence of agricultural price level on changes in farm structure.

It is likely that higher farm prices, other things remaining equal, lead to slower labor migration off farm, higher farm income, higher savings by farmers and greater capital accumulation on farms. However, very little quantitative evidence is available on these secondary influences. They have been neglected in this study. It is felt that the limitations implied by such simplification are not serious for projecting 1970 and it is hoped that they are not too severe for 1975.

Microeconomic analysis clearly shows that farm structure plays the most important role in determining production decisions by farmers. By farm

structure, we mean here the mix of resources which a farmer can use: land, family labor, equipment, amount of working capital. Most of these resources are somewhat fixed; lack of mobility of many inputs prevents farmers from adjusting to various changes, particularly price changes. Thus, small farm family labor which has a low opportunity cost is abundant relative to other inputs. As a result the farmer is led to choose enterprises bringing a high income per acre since land is the most limiting factor, even if this is achieved with low returns to labor. Dairy cows and hogs are then the most profitable enterprises. However, the expansion of hog production is often limited by the lack of the necessary working capital and by the extreme price uncertainty. On larger farms the choice of the best enterprise combination can vary more than on small farms. It is generally more labor extensive, includes less cows per acre of farmland but often more cash crops and beef cattle fattening.

After farm structure, and sometimes before, the technical level of farmers plays an important role in the choice of enterprises. Results of studies made in Combrailles and Coteaux de Gascogne clearly indicate that farmers in these regions would become specialized dairy producers if they had cows with higher milk yields than now. It was computed that a yield of only 2500 liters of milk per year would bring an increase of over 50% in the income of a 20 hectare farmer. Such a microeconomic result is substantiated by the present shift from local breeds to more productive dairy breeds taking place at the present time in the Southwestern and the Central Mountain areas of France.

Considering the extreme rigidity of production decisions enforced by farm structure and the outstanding technical changes occurring in grain and milk production, it is not surprising that the relatively minor changes in prices for grain and livestock which are expected to occur will only play a minor role in bringing about changes in production. This is not to say that price supply elasticities are zero for all products but it seems very clear that the influence of price changes on future productions will be very small compared to that of other variables at hand. This conviction justifies not giving considerable attention to the various fine aspects of the Common Agricultural Policy (beef/milk price ratio, relative price changes, regionalization of the derived intervention prices) since it was felt that the other variables were more crucial.

Commodity Projections

The products for which projections were made are wheat, corn, barley, and other feed grains, pork, poultry, eggs, milk, beef, and veal.

Grain Production

To project grain production, first, surfaces planted to grain and then

average yields were projected. A crucial question has been raised when it was expected that real prices for grains would significantly increase in France under the EEC Common Agricultural Policy. Would French farmers shift large acreages of grassland into grain production? Programming results in five regions show that such a development is very unlikely. In regions where grassland is abundant, farms are generally small. Grain cannot compete for land with livestock products which give a much higher gross income per acre than grains. In the Paris Basin, where farms are large, grain production is close to the maximum permitted by rotational constraints. Two offsetting forces will influence grain acreage: the apparition of larger farms in areas where grassland is abundant and the shift of some farmland to forests and other nonfarm uses in areas where the farm population density is declining. As a result, it was projected that the surface planted to grains would not change much.

By contrast, yields will continue to increase under the influence of technical progress and of the shifts from oats and rye to corn and barley which are more productive. Programming results have shown that the composition of the mix of grains was very sensitive to change in relative profitability of the various grains (price and yield effects).

As a result, total grain production is projected to increase from 27.4 million tons in 1964 to 34.9 million tons in 1975. When these estimates are confronted with demand projection for food[1] and for feed grains, (Table 53) it appears that the net surplus of grains in France will grow from 7.2 million tons to 9.9 million tons. France will have to export wheat, but also barley and corn, since the deficit in feed grains, which appears in Table 53, does not take into account the use of wheat as animal feed which amounted to 3.6 million tons in 1964. While there is a good probability that the French surplus of feed grains will find an easy outlet in other EEC countries, it will be more difficult to export wheat, since the French soft wheat does not have the milling qualities required by the trade in other EEC countries.

Livestock Production

Two classes must be made within the livestock products. On one side, hog and poultry products can be studied together. They do not depend much on roughage and thus are fairly independent of land constraints. On the other hand, milk, beef, and veal are joint products of the cattle enterprise. Roughage makes up a major input in their production and as such, they are very dependent on land.

Hogs and Poultry

The basic assumption underlying the projections is that French producers

[1] Sorenson and Hathaway, *op. cit.*

Table 53. Supply-Demand Balance for Grain and Livestock Products 1964 and Projections to 1970 and 1975. (Thousand Metric Tons)

Grain or Livestock Product	Production	Consumption	+ or -
		1964	
Total Cereals	27,364.0	20,172.0	+7,192.0
Feed Grains	13,384.0	14,197.0	- 813.0
Food Grains	13,980.0	5,975.0	+8,005.0
Dairy Products	24,500.0	18,553.0	+5,947.0
Beef and Veal	1,587.0	1,550.4	+ 36.6
Pork	1,203.1	1,177.3	+ 25.8
Poultry Meat	550.0	512.0	- 22.0
Eggs	560.0	557.0	+ 3.0
		1970	
Total Cereals	30,646.0	23,078.0	+7,628.0
Feed Grains	16,198.0	17,200.0	-1,002.0
Food Grains	14,448.0	5,818.0	+8,630.0
Dairy Products	30,052.6	22,737.7	+1,314.9
Beef and Veal	1,940.0	1,780.1	+ 179.8
Pork	1,440.2	1,419.0	+ 20.2
Poultry Meat	730.0	748.0	- 18.0
Eggs	650.0	666.0	+ 16.0
		1975	
Total Cereals	34,945.0	25,018.0	+9,927.0
Feed Grains	19,150.0	19,400.0	- 250.0
Food Grains	15,795.0	5,618.0	+10,177.0
Dairy Products	34,607.3	24,985.1	+9,622.2
Beef and Veal	2,135.0	1,955.2	+ 179.8
Pork	1,550.0	1,543.1	+ 6.9
Poultry Meat	855.0	846.0	+ 9.0
Eggs	750.0	756.0	- 6.0

will be on the defensive in the EEC markets for pork and poultry products. Programming results in the four regions for which they are available, show that hog production is very profitable on small farms. It is only limited by technical and financial constraints and by marketing uncertainties. Thus, much hog production is ready for vertical integration. However, the available evidence shows that integration is not developing very fast. Technical and marketing constraints prevent its expansion. Thus, it seems logical to assume that French production will increase but not as much as microeconomic

data would suggest. It can be seen in Table 53 that the projected supplies and demands just about balance out even though they were derived independently. The previous considerations imply that such a balance is likely. It would mean a definite increase in hog output from 1.2 to 1.44 and 1.55 million tons in 1964, 1970, and 1975 respectively.

Integration has taken place much more extensively in poultry production; most broilers and a large share of the egg output comes from integrated units. Yet their distance from consumption centers and the inadequate structural organization of the industry warrant the assumption that the French poultry industry will be on the defensive and will not be strong enough to compete with the efficient Dutch and German producers outside of France. The approximate balance between supplies and demands appearing in Table 53 for both poultry meat and eggs appears consistent with the previous considerations. However, it represents a sizable increase in poultry production.

Cattle Products

The key variable in projecting milk, beef, and veal output is the number of cows on farms. Programming results in all regions indicate that the number of cows will increase on most farms with technical progress in forage production and utilization. Even though the number of farms will decline markedly in France during the next decade, they will remain small enough to keep livestock production more profitable than grains.

At the same time, milk yields will continue to increase under the impact of the shift toward more productive dairy breeds. This shift is well supported by programming results particularly in Combrailles and Coteaux de Gascogne where the number of cows from local breeds is still large. Improvements in sanitary conditions, feeding techniques, and hereditary potential through selection, will also push milk yields upward. The resulting projected productions compared with demand estimates (Table 53) show that the surplus of dairy products in France will increase greatly, passing from 5.9 million tons in 1964 to 7.3 and 9.7 million tons in 1970 and 1975 respectively.

Beef and veal production will increase too. The main features of the present veal projection is that the increased production will result only from a rising average carcass weight, while the number of vealers will remain stable. The increased number of calves available will then be devoted to beef production which, thus, will significantly increase. The resulting beef and veal production will be sufficient to satisfy the projected demand and leave a little surplus to export. However, these exports will fall far short from meeting EEC total demand, especially for beef. In spite of this very large potential outlet, it is unlikely that beef production will increase more than what has been projected here. Farm structure obstacles will limit feeder production in the southwest and the mountains where it could de-

Table 54. Projected Changes in Grain and Livestock Products from the 1963 Three-Year Average to 1970 and 1975, by Product and Aggregate.

Item	Production (thousand metric tons)			Production Index[2]	
	1963	1970	1975	1970	1975
Wheat	12,713	16,448.0	15,795	113.6	124.0
Feed Grains	12,500	16,198.0	19,150	129.6	153.0
Total Cereals	25,213	30.646.0	34,945	121.5	132.5
Pork	1,235	1,440.2	1,550	116.5	126.0
Poultry Meat	503	730.0	855	145.0	170.0
Eggs	553	650.0	750	117.5	135.6
Dairy Products	24,960	30,052.0	34,607	120.6	138.6
Beef and Veal	1,476	1,940.0	2,135	131.6	144.6
Production[1]	7.0	8.66	9.65		
Index	100.0	123.70	137.90		

[1] in billion U.A. [2] 1963 = 100

velop otherwise. Grain/beef ratios and marketing difficulties will probably prevent the Paris Basin farmers from becoming important beef feeders.

General Appraisal

The results of this study indicate that French agricultural production will grow rapidly. Table 54 gives the relative increase in production for the various products studied here. The year 1963 has been chosen as a reference date because it was deemed preferable to eliminate the influence of weather and livestock cycles. So the most recent 3-year average for which complete data are available has been chosen as the base for the indices. It can be seen in Table 54 that all production will increase. The fastest increases will be for poultry meat (1975 index: 170) and feed grains (153), and the slowest for pork and other red meat (126 and 124).

In order to judge the total growth of the grain livestock production, the aggregate production of the sector has been estimated for 1963, 1970 and 1975 at constant prices.[2] The average compounded rate of growth between 1963 and 1975 will then be around 2.7%. Such a rate is large for agricultural production. The French total agricultural production increased at a rate of 2.6% per year between 1959 and 1964. True, livestock and grain are only a part of total agriculture, but they make up a sector which can be fairly well isolated from the rest of agriculture. A growth of close to 3% per year during 12 years appears high.

[2] The prices used were those projected for 1975 by Donald Epp, Number 4 in this series.

Even so, it seems to be feasible. The average technological level of French farmers is low. There is evidence that the gap between the present and the potential level can be reduced. Economic forces will push in the proper direction. First, the achievement of a Common Market will provide an outlet for several French products and generally put French agriculture in a market where prices will be high.[3] Second, improvements in the structure of French farms will be significant. Brun's study[4] shows that the average size of farms will increase from 17.7 to 32 hectares between 1963 and 1978. In deed, most French farms will still be small, but the impact of the increase in size will be very significant, as suggested by programming results. Finally, a key factor in the adoption of better technology will be the extent to which farmers will be able to accumulate capital. The present financial strength of the farmers' mutual bank (Credit Agricole) and the prospects for higher agricultural incomes are such that internal and external sources of financing will be sufficient to support a 3% rate of growth. The major limiting factor to the achievement of French agriculture's production potential will be the marketing situation. Generally speaking, the market organization is well suited to serve as an intermediary between a large number of small farms and a large number of small street corner food stores. The productivity of labor is low in such a system and cannot be improved very easily. Besides, a more serious disadvantage is that the French marketing system is not well geared to export large quantities of livestock products on a regular basis. Obviously, there is here an interaction between marketing and production conditions. The marketing system is not very well suited to export livestock products because there is little of such products to export. Similarly, there will not be any large increase in livestock exports unless efficient marketing channels can be found.

As a result of the present situation, French grain and livestock production appear to be oriented toward producing surpluses of wheat and milk, while the potential EEC beef market will not be completely exploited. The disposal of the wheat and milk surpluses will be difficult and raise conflicts both within France between farm groups and government agencies and outside of France between the EEC member countires since the European Agricultural Guidance and Guarantee Fund must finance the disposal of surplus commodities on the world markets.

Despite the conflicts and the efforts which will probably be made to solve them, the present study shows that forces in the production sector will

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[3]For a discussion of the impact of the Common Market on French agriculture, see B. Courtois, *Le Marche' Caumun et les Echanges de Products Agricoles entre les Etats Unis et la Caumunaute' Economique Europe' eme* Paris, INRA, 1967. Actually Courtois' work encompasses many issues tackled in this study.

[4]A. Brun. *Perspectives de Remplacement des Chefs d'Exploitation Agricole*, Paris, INRA, April 1967.

be strong enough to lead to a surplus of wheat and milk, but will prevent France from taking a dominant position as supplier of meat in the EEC. The orientation will not be changed unless major and very unlikely policy changes occur. The Common Agricultural Policy, in its present stage, does not seem to be effective in bringing about a more desirable orientation of French agricultural production.

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APPENDIXES

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APPENDIX A

Appendix Table A-1. Farm Number Projections to 1978[1]. (A demographic analysis of the farm population observed in the 1963 survey sample on farm structure provides the following projections.)

Regions	1963		1978		
	Number Of Farms	Average Size of Farms	Number Of Farms	Average Size of Farms	Reduction in Number of Farms as % of 1963 no.
	(thousands)	(hectares)	(thousands)	(hectares)	(percent)
Paris Basin	292	28.4	170	47.0	41.5
Northeast	120	20.0	633	37.0	47.0
West	538	14.9	318	25.2	41.0
Southwest	304	15.2	170	27.0	44.3
Central Mountains	425	17.4	229	32.3	46.2
Southeast	220	13.6	103	29.1	53.3
Total	1900	17.7	1053	32.0	44.5

[1]Computed from A. Brum, *Perspectives de Remplacement des Chefs d'Exploitation Agricole*, Paris, INRA, April 1967.

APPENDIX B

Appendix Table B-1. Summary of Beef Projections.

V_b = number of calves born

V_s = number of calves slaughtered as vealers

F = fertility rate

C = number of cows

V_R = number of heifer calves kept to become cows

S + H = number of steers and heifers slaughtered

C_c = number of culled cows

1970

$S + H_{1970} = V_{b_{1968}} - V_{s_{1968}} - V_{R_{1968}} - \text{mortality}$

$V_{b_{1968}} = C_{1968} \times F = 12.15 \times .9 = 10.935$ million

$V_{s_{1968}} = 5.1$ million

$V_{R_{1968}} = 2.5$ million (to insure the 2% growth rate of the cow herd implied by the projection of the number of cows)

$S + H_{1970} = 3.3$ million

$C_{c_{1970}} = 1.95$ million (assumed equal to the number of heifers joining the cow herd in 1965)

Beef Production = $(S + H + C_c) \times$ Average carcass weight 1970

Beef Production = 5.3 million head x 290 kg

Beef Production = 1.54 million tons

1975

$C_{c_{1975}} = 2.1$ million

$V_{b_{1973}} = C_{1973} \times F = 13.25 \times .3 = 11.925$ million

$V_{R_{1973}} = 2.98$ million $\quad V_{s_{1973}} = 5.1$ million $\quad S + H_{1975} = 3.64$ mill

Beef Production = $(S + H + C_c)_{1975} \times$ Average carcass weight 1975

Beef Production = 5.74 million head x 296 kg

Beef Production = 1.7 million tons

APPENDIX C

Table C-1. Weights, Measures and Conversion Table.

1 Acre	= .4047 Hectares
1 Dollar	= 4.937 Francs
1 Gallon	= 3.785 Liters
1 Hectare	= 2.471 Acres
1 Hectoliter	= 100 Liters
1 Hundredweight	= .508 Quintals
1 Kilogram	= 1,000 Grams
1 Kilogram	= 2.2046 Pounds
100 Kilograms	= 1 Quintal
1000 Kilograms	= 1 Metric Ton
1 Kilometer	= .6214 Mile
1 Kilometer, Square	= 100 Hectares
1 Liter	= 1.057 Quarts (liquid)
1 Pound	= .4536 Kilograms
1 Pound	= 453.6 Grams
1 Meter	= 1.094 Yards
1 Meter	= 3.281 Feet
1 Metric Ton	= 2,204 Pounds
1 Mile	= 1.609 Kilometers
1 Quintal	= 100 Kilograms
1 Quintal	= 1.97 Hundredweight
10 Quintals	= 1 Metric Ton